

OJĀRS SPĀRĪTIS,
EUGENE ETERIS

Modern European science policy: challenges and opportunities for Latvian perspective growth

„In choosing priorities in the national development, Latvia has to rely on European-wide strategic goals: among them are the commonly adopted priorities for the member states, such as green growth and smart growth. Together with sustainability, these are the focal points of Latvian growth perspectives in which science and innovations play a decisive.”

Andris Bērziņš,
President of Latvia (2011-2015)

„We would like to see scientific findings translated into products and their commercialization expanding that in its turn allows widening the fiscal space and ensuring long-term growth of economy, Latvia's prestige enhanced on international scale and budget increase. Investing in science and research today is thinking in long-term categories. It is essential for scientists to be aware that for receiving public and private financing they have to justify the significance of their research. It is responsibility of each and every one of the vision we have when building the future of our country.”

Ilga Šuplinska,
Minister of Education and Science of Latvia

Latvia in Europe and the World

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Modern European science policy:
challenges and opportunities
for Latvian perspective growth

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Latvia in Europe and the World

Modern European science policy:
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for Latvian perspective growth

Latvian Academy of Sciences' publication series:

Latvia in Europe and the world

**Modern European science policy: challenges and opportunities for
Latvian perspective growth**

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CONTENTS

Science policy — basis of Latvian national development	5
1. EUROPEAN SCIENCE POLICY AND LATVIA: A SHARED COMPETENCE	9
1.1 EU science policy: administration and management	9
1.2 European future and emerging technologies: perspectives for Latvia	15
1.3 Integrating European science activities	20
1.4 European Semester in science and research	22
1.5 Perspectives in research and innovation of the Baltic States . . .	23
1.6 Case study. Research in transport mobility: reducing air pollution in the Baltic States	25
2. PROMOTING INNOVATIONS: MAIN ASPECTS IN EUROPEAN SCIENCE AND RESEARCH	33
2.1 Changes in approaches to science and research in Europe	33
2.2 Active role of science and technology	34
2.3 Mobilizing public and private investment: EU and the Baltic States	36
2.4 Promoting innovation policy: EU education strategy and research activities	39
2.5 European education area: confronting modern challenges . .	39
2.6 Innovative start-ups: opportunities for increasing capital	44
2.7 Case study. Strategic European science and research: innovation policy platform	47
2.8 New innovation initiatives in Latvia	48
3. SCIENCE IN ACTION: DEVELOPMENT OF SMART SPECIALIZATION IN LATVIA	55
3.1 Science and research for national smart specialization issues	55
3.2 Research directions for Latvian industrial development and manufacturing	68

3.3 Cooperation of Europe and the Baltic States in industrial development	75
3.4 Digital single market and new skills	79
3.5 Case study. Science policy in Latvian national growth strategy	82
4. SCIENCE AND RESEARCH FOR LATVIAN GROWTH STRATEGY	91
4.1 Perspectives in national growth: science policy implications in Latvia	91
4.2 SDGs and innovative research	94
4.3 Towards clean energy strategy in Latvia and the other Baltic States	101
4.4 Researchers' impetus to waste management	103
4.5 Science and research for Latvian agro-sector: options for growth	105
4.6 Coastal fisheries: a window of opportunities for researchers	117
4.7 Turning research into innovative SMEs.....	118

SCIENCE POLICY — BASIS OF LATVIAN NATIONAL DEVELOPMENT

A state has no other more momentous obligation than to ensure its sustainable growth by using all possible means at its disposal. This perception lies at the basis of recommendations Eižens Eteris, Ph.d. Economics, and Ojārs Spārītis, President of the Latvian Academy of Sciences, offer to the science policy and strategy makers in Latvia. The book focuses on solving topical issues and themes by an approach that is integrated in science ecosystem not only at regional, but also at the level of the Baltic States and the European Union.

When modelling the theses of science policy, it is essential to be aware of the place science of one's country takes in the science ecosystem of the Baltics and EU and to see it integrated in the system of collaboration projects. The European economic structure is heterogeneous and as varied is its science ecosystem. However, differences is not a barrier if the members of the system are open to changes and are flexible in training of specialists and researchers, and scientific institutions are able to adapt to new challenges. To do it, public and private resources are needed alongside with cooperation with businessmen motivating them for innovations, developing new smart specializations and fostering among politicians, representatives of education, science and business the development of environment that is beneficial for growth. Latvia is a country of limited human resources, small and medium-sized enterprises; in this environment smart specialization is the only real way of developing economy and creating new products in the traditional sectors of production and fields of science. Such understanding urges to look actively for a special niche for Latvian products on European and global markets at the same time bearing in mind that the partners who are most familiar with the specificities of Latvia are in the Baltic Sea Region, Nordic and Eastern Europe countries. We all have similar mindset and the system of traditional values, we have mutually coordinated research infrastructure and research themes that are developed in joint research and economic cooperation projects.

To illustrate what makes smart specialization or 3S strategy to be effective, the authors of the book provide examples taken from the

experience the countries of the European Union have on industry collaboration with the rapidly developing engineering sciences. It is worth mentioning here the meetings held in spring 2019 in Vilnius, Helsinki and Palanga with the participation of education and research administrators, politicians and representatives of executive powers; the intense consultations underscore the internationally recognized necessity of a swift and efficient action. At all these meetings the key topics focused on the need for motivated cooperation of a regional alliance with the Baltic and Nordic countries on the administration of science, development of joint projects and creating joint financing for joint projects. However, each country has its own science ecosystem with its traditional or newly developed fields of scientific specialisation that evolved during the years of regained independence and is not on the list of the OECD recommendations.

Estonia is famous for its digital management systems and achievements in the field of information technologies that are well known in the whole world. Lithuania is proud of the great number of researchers in life sciences whose concern is the maintenance and renewal of human resources. Latvia has a much wider spectrum of scientific specialization that is recognized internationally, namely, it includes cosmic signals obtained due to radioastronomic observations and their deciphering for economic needs, digital translation and the authorship of infographics used by media all over the world, achievements of international significance in cardiac surgery and regenerative medicine as well as synthesis of effective pharmacological preparations and their ingredients. Latvia is one of the greatest exporters of timber and derived products; the chemical composition of wood is unique and the country has high potential for selecting species of trees suitable for the local climate. Considering the beneficial environmental situation of all the Baltic states, good climatic conditions, the coastline of several kilometres with excellent possibilities for recreation, tourism and balneotherapy, it is just Latvia that can most successfully integrate in the large international consortia in the fields of curative activities, traditional and eco-cultural tourism.

However, science policy planning is not free from contradictions and risks either. Our turbulent time of historic and political changes, the economic conditions as well as the fourth industrial revolution have

set a more rapid pace of development, but science administrators still speak about sustainable development. It cannot have any other recipe than the ability of swift adaptation comparable to sprinting where the first to come to the finish are those participants who have perfectly elaborated management skills and experience, alongside with greater human resources capacity and finances. The result of this science-running race will fully depend upon the investment volume and flexibility of the target, readiness of the state to stimulate the development of those trends by its supported cooperation between the industry and science the researchers of the Academy of Sciences and experts jointly have recognized as commercially beneficial and necessary.

Undoubtedly, all the Baltic States are interested in cooperation of research and development of common energy market in the search of alternative energy sources and energy independence. The same may apply to smart farming and manufacturers of eco-friendly products as the demand for eco-foodstuffs is growing and will definitely increase both on the local and international eco-market. Consequently, the traditional agricultural methods in a combination with smart selection and innovative methods in food production and processing might produce nutrient-dense quality products of Latvian and all Baltic agriculture.

Today heated discussions revolve around the benefits of territorial reform in Latvia. Thus, in this period it is vital to create principles for economically independent and developed administrative territorial unit taking into account considerations about effective use of the natural, financial and social resources for stimulating both the traditional and emerging, science based, entrepreneurship sectors. The tasks are as if simple — to think nationally, but act globally — it is the goal of science strategy. And it remains unchanged for both the development of science and economic growth of the country. It allows concluding this introduction with a kind of axiom in science policy: state care and investments in science are the basis for the growth of economic and social welfare of all society.

*Ojārs Spārītis,
President of the Latvian
Academy of Sciences*

PART I

EUROPEAN SCIENCE POLICY AND LATVIA: A SHARED COMPETENCE

- 1.1 EU science policy: administration and management
- 1.2 European future and emerging technologies: perspectives for Latvia
- 1.3 Integrating EU science activities
- 1.4 European Semester in science and research
- 1.5 Perspectives in research and innovation of the Baltic States
- 1.6 Case study. Research in transport mobility: reducing air pollution in the Baltic States

1.1 EU SCIENCE POLICY: ADMINISTRATION AND MANAGEMENT

There are numerous EU institutions and agencies dealing with various aspects of coordinated science, research and innovation issues. Due to Europe's efforts in integrative policy cooperative efforts in science were channeled through the following EU bodies:

- Main directions in sectoral innovation efforts are exercised through the European *Innovation and Networks Executive Agency* (INEA) as the successor of the Trans-European Transport Network Executive Agency (TEN-TEA), which was created by the European Commission in 2006 to manage the technical and financial implementation of TEN-T program in transport. However, it needed about seven years for INEA to start its present activities (actually, from January 2014); currently, it implements the following EU programs: *Connecting Europe Facility* (CEF), some *parts of Horizon 2020* (i.e. smart, green and integrated transport; secure, clean and efficient energy), and other *transportation programs from previous years*, such as TEN-T and Marco Polo, which was run from 2007 to 2013. INEA's main objective is to increase the management efficiency of the technical and financial aspects in the EU numerous transportation programs. (1)

The Commission's Directorate-General for Research (DG RTD) develops and carries out the Commission's policies on research and innovation as well as cross-cutting actions to promote innovation in the member states for the common EU future. (2, 8)

- *European Research Area*. One of the European Union's objectives is creating a European Research Area (ERA) in which researchers, scientific knowledge and technology circulate freely (Article 179 TFEU). The Commission's DG for Research and Innovation (DG R&I) supports efforts of the EU member states and research organizations to implement the policies and reforms needed for achieving this objective.

According to the European Council decisions of 2011–2014, the Commission intended to create all conditions necessary for the states and scientific organizations to achieve the ERA by 2018–2019. However, the completion of ERA, much like the EU single/internal market, is a gradual process and further implementation efforts are needed. Every year the Commission issues the ERA monitoring mechanism, which assesses progress of the EU states and research organizations in the implementation of the ERA actions as set by the Commission. Horizon 2020, together with the national public research funding available in the EU states, is an important financial pillar for delivering the ERA. The existence of recognized world-level research infrastructures allows European states remain at the forefront of top-class science-technology development and innovation.

In this regard, the Commission's DG R&I actively participates in the European Strategy Forum on Research Infrastructures (ESFRI), which supports the development of research facilities in the member states. In particular, the ESFRI Roadmap identifies new pan-European research infrastructures or major upgrades to the existing ones. The DG R&I supports the member states and associated countries in coordinating their efforts to identify new European research infrastructures to be included in the ESFRI Roadmap as well as to fully implement and ensure sustainability of infrastructure and operations.

As the core idea of the EU development and cooperation/integration in all spheres of sciences is to create an efficient European Research Area, a specific activity among member states in organizing a common research territory is outlined in the ERA program. Research and innovation contribute directly to the increasing level of prosperity and citi-

zen well-being in the member states. In fact, it was the present EU basic law — the Treaty of Lisbon (2010), which strengthened the EU actions in the field of research with the aim of creating a European Research Area.

Horizon 2020 with a budget of about € 80 billion is the EU research and innovation program for the period 2014–2020. It is designed to implement the European Innovation Union (see below), which is a European strategy for innovation and one of Europe 2020 Flagship Initiatives. Horizon 2020 aims to establish in the EU member states the globally-leading knowledge-based economies, producing world-class science and innovation to ensure the states' global competitiveness. (3)

- There is also the *European Research Council* (ERC) created under the previous Framework Program (FP7) in 2007 and extended by the current Horizon 2020 (H-2020) framework program as an EU-wide administrative instrument in research and innovation among the member states. The scientific community in EU states benefits from the ERC frontier research funding by providing top researchers with the means to conduct their research independently and by offering them attractive perspectives for a career in science. Such EU-funded research responds to the needs of improving Europe's attractiveness for the best researchers worldwide and strengthening the state capacity to generate new knowledge that feeds back into the economy and society. (4)

The ERC is funded exclusively by the EU budget: every year it selects and funds the very best creative researchers of any nationality and age to run projects based in Europe. Since 2007, some 9000 projects have been selected for funding through open competitions and over 110 000 articles acknowledging the ERC support have been published in international scientific journals. ERC grantees have won prestigious prizes, including 6 Nobel Prizes, 4 Fields Medals and 5 Wolf Prizes. The ERC has already enabled researchers to pursue promising avenues leading to scientific breakthroughs such as the first image of a black hole, important advances in cancer research or the early detection of security flaws in computer processors. The newly elected ERC President, Professor Mauro Ferrari (since May 2019) is the formal ERC representative and chairs the Scientific Council, the ERC's governing body. The Scientific Council, composed of eminent scientists and scholars, defines the scientific funding strategy and methodologies of the ERC. (5)

By supporting the best research and making Europe a magnet for world-class talent, the ERC backs the EU job creation, as well as long-term growth and investment, thereby also encouraging the establishment of new research teams in Europe and supporting young talents.

While implementing a *bottom-up funding approach* and focusing on excellence, the ERC contributes to the EU political priorities in other fields, pushing knowledge forward in a variety of areas: transport, energy, environment, climate, international cooperation, digital agenda, etc. The ERC efforts are designed to deliver smart, sustainable and inclusive growth through the strengthening of every link in the innovation chain, i.e. from theoretical research to very practical commercial outcomes. (6)

• *Other EU bodies for coordination research and innovation.* While the member states science and research activities are in the shared competence between the EU institutions and member states, the main EU activities in this sphere are concentrated in the hands of the Commissioner for Research, Science and Innovation. However, the shared nature of the EU science, research — and particularly, innovation — makes the whole European R&D system complicated, for example, there are numerous components/spheres in the EU science, research and innovation policies. (9)

The Research, Science and Innovation Commissioner's working arm is the DG RTD. It defines and implements European research and innovation (R&I) policy with a view to achieving the EU strategy goals and its key flagship initiative within the EU Innovation Union. The DG RTD develops and carries out the Commission's R&I; the new title reflects a change from the previous R&D, research and development, to research and innovation. The DG contributes to the European Semester by analyzing national R&I policies, by assessing their strengths and weaknesses, and by formulating country specific recommendations when necessary. The DG also monitors and contributes to the realization of newly established EU Innovation Union initiatives and the completion of the European Research Area; the DG also funds perspective research and innovation works in the member states. (10)

• *Innovation Union.* The creation of the EU-wide *innovation union* is one of the recent moves towards new scientific fields in the member states. The new Union is one of the 7 flagship initiatives of the Europe

2020 strategy for smart, sustainable and inclusive growth since 2014. The Innovation Union plan contains over 30 joint actions of the member states and is aimed at reaching three main goals: (a) to make European states the world-class science performers; (b) to remove obstacles to innovation activities by liquidating, for instance, expensive patenting fees, science-market fragmentation, slow standard-setting and skills shortages; and (c) revolutionizing the way public and private sectors work together, notably through the innovation partnerships among the European institutions, national, regional authorities and business community. (11)

In fact, the European Innovation Union has three main policy goals aimed at providing for greater openness in science and research:

- *open innovation*, i.e. opening up the innovation process to people from other fields than academia and science. By including more people in the innovation process, knowledge will circulate more freely; it will help to develop products and services for new markets;
- *open science*, i. e. an approach to the scientific process that focuses on spreading knowledge as soon as it is available using digital and collaborative technologies;
- *open to the world*, i.e. changing the standard practice of publishing results in scientific publications only at the end of the research process. Various platforms promoting international research cooperation would allow European science to access the latest knowledge worldwide, recruit the best talents, tackle global challenges and create business opportunities. (12)

Additionally, the Commission's *Research Executive Agency* (REA), helps to manage some parts of the European Horizon 2020 — the EU general research and innovation program — by the following means: — running research projects supported under the Horizon 2020 program; — providing support to the states' researchers through funding, coordination and independent experts; — keeping closer contact with the EU funds and their efficient usage; — managing the Research Enquiry Service, which answers questions from grant applicants, EU-funded researchers and the public; and — additional support by the EU independent experts to evaluate project proposals for the EU

research funds, and assisting with other legal and financial support. (13)

Among other EU agencies, councils and bodies in the science policy sphere the following must be mentioned:

- *The European Research Council Executive Agency* (ERCEA) coordinates and develops the activities of member states (with a general view to formulate the EU-wide policies and approaches) in transport, energy and the digital economy spheres. Besides, ERCEA manages the following EU programs: Connecting Europe Facility (CEF), some elements in the EU Horizon 2020 and Trans-European Transport Networks (TEN-T). (14)

- *The European Research Council* (ERC) has the mission of encouraging the highest quality research in the member states through competitive funding and supporting investigation-driven frontier research across all R&D spheres, on the basis of scientific excellence.

The ERC complements other EU funding activities, such as the national research funding agencies, some flagship components of the Horizon 2020 program and the EU Research Framework Program for 2014–2020.

Being investigator-driven and bottom-up in nature, the ERC approach allows researchers in the member states identify new opportunities and directions in any field of research, rather than being led by priorities set by politicians. This ensures that funds are channeled into new and promising areas of research with a greater degree of flexibility. (15)

- *The European Institute of Innovation and Technology* (EIT) was established in 2008 with the idea of bringing together leading education institutions in the member states, research labs, etc. to form a dynamic cross-border partnership, the so-called knowledge and innovation communities or KICs. (16)

One of the main added values of the EIT is to integrate the education dimension into the innovation web, as it has often been absent from the more traditional research-business partnerships. The EIT supports the creation of tomorrow's entrepreneurs and promotes a real change of mindset towards an entrepreneurial culture and attitude. By investing in the EIT, Europe invests in the talent of tomorrow who will not only create new start-ups but also contribute to innovation in existing companies, thus becoming a source for growth.

With this perspective, the KICs have developed their own education programs that have a very strong focus on the delivery of entrepreneurship and innovation skills, and that are more tailored to the needs of the European innovation system.

KICs' higher education partners focus on developing innovative curricula that provide students, entrepreneurs and business innovators with the knowledge and skills necessary for a knowledge and entrepreneurial society. These innovative programs are based on partnerships between different universities, companies and research centers that collaborate closely and offer double degrees, international and cross-sectorial mobility experiences, as well as applied innovation and entrepreneurship education. (17)

- Additional European R&I-sectoral approach is exercised through the Directorate-General for Communications Networks, Content and Technology (DG Connect), which conceives and implements the EU policies required to create a *digital single market* for more *growth and jobs*, including social spheres, civil society and businesses. This DG is the EU institutional mechanism under supervision of the Commission's Vice-President to assist member states in implementing digital transformation in the EU member state industry and public services through the use of innovative digital technology and support for the development of digital skills. Besides, the DG assists in developing a long-term vision investing in potential technology breakthroughs and flagships, which can improve peoples' lives and increase the competitiveness of the member state economies in key sectors. (18)

1.2 EUROPEAN FUTURE AND EMERGING TECHNOLOGIES: PERSPECTIVES FOR LATVIA

The European new trend in science/research/innovation policies (from the old "research and development", R&D, to modern "research and innovation-style", R&I) shows the importance of investment into most innovative science directions leading to practical results in the national growth. Particularly relevant EU recommendations are in *future and emerging technologies* (FET).

Two directions are especially vital in this approach:

(1) to fine-tune scientific community's approach to more mission-oriented and impact-focused research addressing European and global challenges. The EU idea is to correlate these challenges with the industrial and manufacturing trends in the states to tackle the global competitiveness while applying methods and technologies with major practical effect for the state welfare;

(2) to improve coordination among European and national R&I issues in order to add European value to scientific research and achievements conducted in the states; in short, a better coordination between the EU and national research programs will create additional value. These two trends in the European *future and emerging technologies* are of particular importance for Latvia.

The EU general science policy trend from R&D to R&I, with attention to invest in innovative science has another idea: to better apprehend the results of EU funding. European recommendations to Latvia are highly relevant concerning the above mentioned two FET directions. The European FET will provide insight into the changing traditional mindset of people and show how R&I is changing industries and wider society, i.e. how new science applications and devices are bringing major practical implications and benefits for citizens. This direction shall stimulate the member state approach to more mission-oriented and impact-focused research addressing national, European and global challenges.

Another FET direction is towards more active cooperation among the member states. The European and national R&I policies shall provide for additional European value to scientific achievements and projects conducted by several states, i.e. a better coordination between EU and national research programs is becoming important.

In the coming decade, the FET policies will have the Union's budget of about € 1 billion for each of the mentioned two directions, which will be some of the most ambitious EU-funded research projects. (19)

The EU *human brain project* deals with neuroscience: it is about understanding the human brain and its diseases. Thus, emulating some of the brain's computational capabilities should lead to major advances in robotics, artificial intelligence, big data analysis and new computing architectures. This FET direction is tackling one of the greatest modern

scientific challenges: understanding human brain's potentials as well as its diseases, the issues which actually revolutionize neuroscience. (20)

One more FET perspective direction is *quantum technologies*: the first quantum revolution expanded scientific horizons to lasers and transistors; the second quantum revolution is based on the ability to manipulate and sense quantum effects in customized systems and materials. This will lead to completely new concepts of devices with the following practical impact: ultra-precise synchronization in the sensitivity devices and guaranteed data privacy and communication security, as well as the high-end of computing technology, to name a few. In order to develop a strong quantum industry, the EU and the states should coordinate this work, which is one of the main objectives of the Quantum Flagship research.

The Quantum Technologies Flagship projects will provide funding under the coordination of the Commission for 20 projects during October 2018-September 2021; the funding will focus on four application areas: a) *quantum communication*, b) *quantum computing*, c) *quantum simulation*, and d) *quantum metrology and sensing* — as well as the *basic science research behind quantum technologies*. More than one third of participants are industrial companies from a wide range of sectors, with a large share of SMEs. Quantum research and development will be funded from the EU's multi-annual financial framework for 2021–2028.

The Quantum Technologies Flagship is supported by the Horizon Europe program for research and space applications, as well as the *Digital Europe* program: both will develop and reinforce Europe's strategic digital capacities, supporting the development of Europe's first quantum computers and their integration with classical supercomputers, and of a pan-European quantum communication infrastructure (on the mentioned programs see links below).

Since 1998, the EU FET program provided around € 550 million of funding for quantum research in Europe. The EU has also funded research on quantum technologies through the European Research Council (ERC). Since 2007, the ERC has funded more than 250 research projects related to quantum technologies, worth some 450 million euros.

The Quantum Technologies Flagship is currently supported by Horizon 2020 as part of the FET program, which currently runs two

other Flagships (the Graphene Flagship and the Human Brain Project Flagship). The interest of European industry in graphene properties is huge: it could be graphene-based sensors for collision detection systems, which combine visible and infrared light to avoid collisions even in fog; sensors in a band around the arm can detect electrical signals from muscles in order to move a robotic hand. (21)

FET is a perspective research direction in *quantum technologies*: the EU research support runs initially up to 2020.

There are numerous European high-class scientists in quantum theory; but the sphere lacks industrial take-up and commercial implementation. To develop a strong quantum industry, the EU member states have to better coordinate the Quantum Flagship research. There are already about two million researchers working in thousands of European universities and research centers; working together across borders, sectors and disciplines, the EU member states can push the boundaries of science towards developing practical applications for the benefit of people.

Thus, the main rationale of political and financial commitment to FET includes the following priorities: developing a dynamic environment for research and innovation, allowing ideas to progress smoothly from laboratories to market, attracting and retaining world-class talents and making sure that Europe remains a global science leader. (22)

Within the next 10 years, the performance enhancements resulting from quantum technologies will yield unprecedented computing power, guarantee secure communications, and provide ultra-high precision measurements. Examples include the measurement of the tiniest variations of magnetic or electric fields for medical imaging below the cell level for less invasive diagnosis and treatments, or for searching raw materials (petroleum, minerals, etc.), ultra-precise atomic clocks in smart grids allowing energy saving, or quantum key distribution technologies to prevent eavesdropping in finance, banking and defense by establishing secure communication links, and supercomputers outperforming existing or future classical supercomputers and at a fraction of their energy consumption. (23)

In the long term, quantum computing has the potential to solve computational problems that would take current supercomputers longer time. Numerous spheres of scientific computing could bring

about breakthroughs in, for example, chemical process design, energy efficient materials, and energy harvesting, as well as machine learning and big data analysis. (24)

To illustrate, the Graphene Flagship and the Human Brain Project are clear signs of being on the right track to identify and develop practical applications that will make a positive difference to people's lives and streamline social and economic progress. Scientists have been theorizing about graphene for years: it had been unintentionally produced in small quantities for centuries, through the use of pencils and other similar graphite applications. It was originally observed in electron microscopes in 1962, but it was fundamentally studied only when used on metal surfaces. Extensive research resulted in two Nobel Prizes in physics in 2010 for groundbreaking experiments regarding the two-dimensional material graphene. Graphene as a composite material is a transparent and flexible conductor that can be used in various material/device applications, including solar cells, light-emitting diodes (LED), touch panels and smart windows or phones, e.g. graphene-based touch panel modules produced in China have been sold in volumes to manufacturers of cell phones, home appliances and other devices. Commercial use of graphene includes also graphene-infused printer powder, graphene supercapacitors (which serve as energy storage alternative to traditional electrolytic batteries). Among advantages are fast charging, long life span and environmentally friendly production. Graphene supercapacitors have been commercially available since about 2015 and were first used in some specialized applications instead of traditional batteries. (25)

The EU funding in graphene made the development of a super battery for cars possible. An Estonian company produces an energy storage device called ultracapacitor, which is a 100 times more powerful than an ordinary battery and can withstand one million recharge cycles. Skeletons of ultracapacitors are based on graphene: a two dimensional form of carbon with remarkable properties. The company has raised € 13 million to build a manufacturing facility in Germany capable of producing millions of these new ultracapacitors a year.

Better science and research coordination among the EU and the Baltic States can stimulate the national progressive growth. In June 2017, the Commission's DG for Research, Science and Innovation

started a EU-wide discussion about the role of research and innovation for the perspective growth in member states in order to maximize the impact of European research and innovation programs. (26)

National authorities have confirmed the attractiveness of the Union's research program Horizon 2020 as a well-functioning investment instrument to stimulate innovation. European states have been for centuries at the forefront of leading ideas and top science centers with advanced research and technology achievements.

However, numerous challenges remain: tackling globalization issues, growing digitalization, rapidly evolving world innovation dynamics and increasing funding for innovative research. Besides, the role of science, research and innovation shall be reassessed in the European integration process. (27)

1.3 INTEGRATING EUROPEAN SCIENCE ACTIVITIES

The EU Science Hub brings together scientific knowledge produced by the EU Joint Research Centre (JRC), the science and knowledge service of the European Commission. It is the platform for information and exchange about all scientific activities carried out by the JRC in the member states and around the world. The JRC Science Hub aims to gradually integrate and aggregate all of the European science related activities, tools, laboratories, facilities, databases and networks. The Science Hub enhances the transparency and openness of the JRC and further enables the open access policy to the EU scientific research data. This is a living platform which will serve the information and exchange needs of the scientific community, policy and decision-makers. (28)

It has to be mentioned that the competences of the EU institutions in the area of research and technological development are shared with the member states. Specifically, the basic EU law (Article 4(3) TFEU) stipulates that "... in the areas of research, technological development and space, the Union has competence to carry out activities, in particular to define and implement programs; however, the exercise of that competence shall not result in the member states being prevented from exercising theirs".

As the R&D policy is a shared competence, the EU provides collective scientific knowledge to researchers with the help of the EU Joint Research Centre, which, as the European Commission's science and knowledge service, supports the research spheres of the member states with an independent scientific advice. It creates, manages and coordinates knowledge acquisition and develops innovative tools to make them available to national policy makers.

The JRC anticipates emerging issues that need to be addressed at EU level and understands policy environments, collaborates with over a thousand organizations worldwide whose scientists have access to many JRC facilities through various collaboration agreements. (29) The JRC activities have a direct impact on innovations in the states by contributing with its research outcomes to a healthy and safe environment, secure energy supplies, sustainable mobility and consumer health and safety. The Centre draws on over 50 years of scientific experience, has a world-wide expertise in knowledge production and knowledge management; besides, it hosts special laboratories and unique research facilities with thousands of scientists.

The JRC has six sub-regional centers in five EU countries; they are located in Brussels, Geel, Ispra, Karlsruhe, Petten and Seville. There is also a JRC focal point in Latvia. (30)

Quite spectacular is the research administration in Estonia — the Research and Development Council advises the government on matters related to R&D. (31) On the other hand, the Estonian Ministry of Education and Research implements national research policy, organizes financing and evaluation of the activities of R&D institutions and coordinates international research cooperation at the national level. The Ministry is also responsible for planning, coordination, execution and monitoring of research policy related to the activities of universities and research institutes; the Minister of Education and Research is advised by the Research Policy Committee. Additionally, the Estonian Ministry of Economic Affairs and Communications is responsible for planning, coordinating and executing research and development activities and innovation policy related to business; whereas the Estonian Academy of Sciences with about 60 top national scientists, organized into ten research associations/societies and six research institutions, provide a general background to achieve common national research

goals. (32) The Estonian Research Council is the main research funding agency for Estonian researchers and is responsible for institutional and personal research funding in Estonia to provide adequate support for participation in the EU Horizon-2020 programs. (33) There are also national research libraries with the task of collecting, storing and processing research information to make it accessible for research purposes. The Estonian Research Information System (ETIS) functions as a national register incorporating information on R&D institutions, researchers, projects and research results. At the same time, ETIS is also used as a medium for submission of applications and reports as well as the revision and approval thereof. (34) According to statistics, in Estonia 47.7% of Estonian enterprises were innovative in 2016; and industrial enterprises have been among the most active innovators. (35)

1.4 EUROPEAN SEMESTER IN SCIENCE AND RESEARCH

During 2011–2013 the Commission introduced the European Semester, a yearly-cycle mechanism aimed to facilitate, control and coordinate the governance of the economic policy of member states. There are many research spheres involved in the Semester process for all scientists in the Baltic States, Latvia including.

There are two main aspects in the Semester: Commission's analytical economic assessment (with the Country Report, analyzing the economic situation and possible reform agendas of the state) and the Commission's proposals with the country-specific recommendations for every EU state providing tailor-made policy advice in areas deemed as priorities for the next 12–18 months. In the Semester's context, there are important research and innovation aspects; economic policy tools in the states are not yet fully perceived by the national policy-makers. Thus, it is essential that the member states ensure an adequate integration of R&I aspects in the above mentioned two types of Semester documents.

The Commission's DG for Research and Innovation develops a comprehensive evidence-based approach targeting at: (a) identification for each EU state of its main R&I policy challenges, i.e. the key bottlenecks impeding the full contribution of R&I to smart, sustainable and

inclusive growth; and (b) the assessment of the adequacy of the policy response to the identified challenges.

In the R&I Thematic Fiche, three broad types of R&I policy challenges are considered: (1) fostering the quality of the public R&I system; (2) leveraging business R&I through public-private cooperation; (3) ensuring a business environment supportive of private R&I investments and the emergence of fast-growing innovative SMEs. (36)

1.5 PERSPECTIVES IN RESEARCH AND INNOVATION OF THE BALTIC STATES

The mentioned significant changes in approaches to science and research policy in European states from *research and development* (R&D) to *research and investment/innovation* (R&I) have already provided for the major shifts in science policies in Europe and the member states. However, in order for the research and innovation plans to be successful in the coming years the states need stable funding for it. The EU institutions have funding priorities in the multi-annual budget period, the so-called FP-9 financial programming, the successor of the Horizon 2020 (the latter will last as the EU research and innovation program up to 2020).

Some new directions have been mentioned above, e.g. the Human Brain Project, Graphene, Quantum and other FET Flagships. Sufficient funding will help to maintain European excellence in scientific research and convert scientific discoveries into large industrial applications. Several countries have already done it: China has already overtaken the EU in terms of R&D spending as a share of GDP; South Korea, Japan and the United States win top ranking.

Three main actions of EU institutions and member states must be mentioned addressing the situation in improving R&I conditions in the European strategic plan for research and innovation up to 2020; the concerted actions are aimed at achieving:

- *Open innovation*, i.e. helping member states to capitalize on the results of research and innovation reached at the European level and create shared economic and social value by bringing more actors into the innovation process. Open innovation can also boost investment,

maximize the impact of innovation and create the right innovation ecosystems.

- *Open science*, i.e. supporting new ways of doing research and diffusing knowledge among the member states by using digital technologies and new collaborative tools, to ensure excellent science and open access to data and results, so that EU states can benefit from digital technologies to drive innovation. The particular importance of *open science* can be seen in the member states circular economy policies (the EU Circular Economy Package includes an Action Plan and legislative proposals on waste recycling targets adopted in December 2015). Circular economy is a clear example of both *open science* and *open innovation*: for circular economy business models to be effective, there is a need for open data (for primary and secondary raw materials and for products on land and the sea), for collaboration among different stakeholders along the value chain, for use and combination of different knowledge bases, and for end-users as drivers of innovation. The Commission's DG for Research and Innovation has been supporting innovation as an essential element of the Circular Economy Package. Other actions in this area include ensuring effective Horizon 2020 investment, the use of financial instruments, and coordination with the EU states, awareness raising and reviewing of the Commission's 2012 Bio-economy Strategy.

- *Open to the world*, i.e. fostering international cooperation so that the EU's strengths in research and innovation help the member states tackle global societal challenges effectively, create business opportunities in new and emerging markets, and use science diplomacy as an influential instrument of external policy.

The EU and Latvian future depends on how efficiently policy-makers would use momentum for investing in research and innovation in progressive science and research ideas. National authorities in the EU states have already confirmed the attractiveness of the Union's research program Horizon 2020 as a well-performing agenda and a key investment instrument in safeguarding progressive future. For centuries the European continent has been a home to leading global companies, top universities with frontier research and technology centers. However, some questions still remain in order to mitigate perspective challenges and rapidly evolving innovation dynamics and see the ways research and innovation would shape the future of Europe. (37)

1.6 CASE STUDY. RESEARCH IN TRANSPORT MOBILITY: REDUCING AIR POLLUTION IN THE BALTIC STATES

By working together across borders, sectors and disciplines, researchers of the member states can push the boundaries of science towards developing practical applications that can make difference to people's lives. The European Commission underlines that the rationale of political and financial commitment to FET consists of the following general priorities: — developing a dynamic environment for research and innovation; — allowing ideas to progress smoothly from laboratories to market; — attracting and retaining world-class talents; and making sure that Europe remains a global science leader. European research in transport mobility is a perfect opportunity to get assistance to the Baltic States in reducing air pollution.

In February 2019, the EU legislative institutions (the Parliament and the Council) agreed on a stricter air pollution control in cities. For the first time in the EU history, the states are forced to reduce CO emissions by 30%, compared with the 2019 level. The EU states committed to improve city air quality banning polluting transport in cities by 2030.

Already in 2017, there were adopted several EU measures to reduce transport pollution, the so-called mobility packages — in line with the EU industrial policy strategy — to complete the process on the EU Strategy for Low-Emission Mobility which was initiated in 2016. (38)

In 2016, the EU states agreed to collectively reduce greenhouse gas (GHG) emissions by at least 40% by 2030 compared to the 1990 levels in all sectors contributing to climate change, including transport, construction, agriculture, waste disposal, land-use and forestry sectors, etc. (39) Main attention is devoted to modernizing mobility systems: numerous EU initiatives have formed a set of consistent policies addressing various interlinked aspects of the mobility systems in cities. The EU efforts and legislative packages consist of the following initiatives and proposals:

- The Commission has outlined a *new road safety policy* framework for 2020–2030, which is accompanied by two legislative initiatives: on *vehicle and pedestrian safety*, and on *infrastructure safety management*;

- In the Communication to the states, the Commission addressed automated mobility to make European states world leaders in *autonomous and safe mobility systems*;
- Several legislative initiatives were adopted, e.g. on CO standards for trucks, on their aerodynamic, on tyre labeling and on a common methodology for fuel price comparison. These initiatives were accompanied by a strategic action plan for car batteries. These measures reaffirmed the EU objective of *reducing GHG emissions from transport*;
- Besides, there were drafts for establishing a *digital environment for information exchange in transport*;
- Finally, a draft was adopted to streamline permitting procedures for projects on the core *trans-European transport network* (TEN-T).

These initiatives were supported by the Connecting Europe Facility (CEF) with € 450 million to finance the member state efforts for road safety, digitalization and multi-modality.

Especially critical situation regarding air quality has been noticed in Riga: already in 2014 the European Commission started an infringement procedure against Latvia over coarse particular matter PM-10 in air; it was one of the most serious infringement procedures launched against Latvia over noncompliance with environmental standards, underlined the Under Secretary of State for Environmental Protection at the Ministry of Environmental Protection and Regional Development of Latvia. Already in 2015, the European Commission warned to resolve the problem, otherwise Latvian government might face legal action and sizable fines in millions of euros for violating the EU air quality requirements. Although, the infringement procedure was put on hold in May 2019 (the European Commission will make another air quality assessments and air quality checks in Riga), the risk of legal action is quite high. The Latvian Ministry of Environmental Protection has prepared the air quality improvement plan, which has been put for public debate with further approval in the fall of 2019. However, experts do not believe that Riga can meet the EU air quality targets for 2020.

The Saeima subcommittee decided to send the Riga City Council an official letter urging to take necessary measures to safeguard air quality in the capital; legislators called also for concrete and ambitious targets in the air quality improvement program. (40)

Thus, safe mobility could be another perspective in Latvian research; besides, the Commission is taking measures to strongly contribute to safety on roads. Thus, due to the safe mobility initiative, since 2001 road fatalities in the member states have been reduced by more than half; however, still 25,300 people were killed on the EU roads in 2017 and another 135,000 were seriously injured.

The Commission's new models of vehicles are equipped with *advanced safety features*, such as advanced emergency braking and lane-keeping system for trucks to prevent fatalities for pedestrians and cyclists. The Commission is helping the states in systematic identification of dangerous road sections and advice on better-targeted investment: these measures could save up to 10,500 lives and avoid close to 60,000 injuries over a decade during 2020–2030, thereby contributing to the EU long-term goal of moving close to zero fatalities and serious injuries by 2050 (so-called Vision Zero program).

As to clean mobility issues and completing the agenda for a low-emission mobility system, the Commission has put forward the first ever CO emissions standards for heavy-duty vehicles. Producers of new truck vehicles from 2025 will have to reduce COemissions average by about 15 per cent and from 2030 — by at least 30 per cent.

These targets would allow transport companies and connected SMEs to make significant savings due to lower fuel consumption (€ 25,000 over five years). To allow for further COreductions, the Commission is making it easier to design *more aerodynamic trucks* while at the same time improving *labeling for tyres*. The Commission suggested an action plan for car-batteries that would create a competitive and sustainable battery ecosystem in Europe. (41)

One of the recent examples: in May 2018, the European Commission introduced a package of transport safety measures addressing automated and clean mobility. It included proposals for COemissions for lorries to reconcile the world-leading environmental standards with increasing European heavy duty vehicle manufacturing industry's competitiveness and secure jobs and growth. Most popular eco-bus brands in Europe are the German ones, e.g. Mercedes and MAN.

The European Joint Research Centre (JRC) has provided essential scientific support to the member states on many EU initiatives: in particular, on the emissions and technologies of present heavy-duty vehicles

(HDV) and on the socio-economic impacts of automated mobility. The JRC can also contribute to the preparation of the national action plans for competitive and sustainable battery-cell-manufacturing industries and assessing the demand for critical raw materials for batteries in the electric vehicles sector until 2030. (42)

The new European CO emission standards for cars and light vans in the EU for the period after 2020 is a further step to modernizing the European mobility sector and preparing it for climate neutrality in the second half of the century: emissions from new trucks will have to be by 30–40 % lower in 2030 compared to the 2019 emissions. The new standards will help the states to comply with the EU emission targets, promote innovation in clean mobility solutions, as well as to strengthen the competitiveness of EU industry, stimulate new employment, reduce fuel consumption costs for transport operators while contributing to better air quality. (43)

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PART II

PROMOTING INNOVATIONS: MAIN ASPECTS IN EUROPEAN SCIENCE AND RESEARCH

- 2.1 Changes in approaches to science and research in Europe
 - 2.2 Active role of science and technology
 - 2.3 Mobilizing public and private investment: EU and the Baltic States
 - 2.4 Promoting innovation policies: EU education strategy and research activities
 - 2.5. European education area: confronting modern challenges
 - 2.5.1 Smart growth and research universities
 - 2.6 Innovative start-ups: opportunities for increasing capital
 - 2.7 Case study. Strategic European science and research: innovation policy platform
 - 2.8 New innovation initiatives in Latvia
- Supplementary material
Optional reading
References and notes

2.1 CHANGES IN APPROACHES TO SCIENCE AND RESEARCH IN EUROPE

Significant changes have already occurred in approaches to science, technology and research policy in the European Union institutions and member states. The main shift in European science policy has been towards a new — and promising to be fruitful — combination of *research, innovation and investments* (R&I), rather than the previously dominating direction oriented to *research and development* (R&D). The latter was quite positive and delivering in the past decades, though not any more feasible in the modern period of globalization and ICT revolution. The EU leaders specifically have addressed the importance of these changes since the end of 2014; however, it took several years to

figure out the proper combination of needed financial resources and most promising directions of integrative approach to research activities in the member states.

The European approaches to transformation from R&D to R&I are in the direction from initiatives to new technologies and from innovations to solutions, focusing on the following four thematic fields:

- *new technologies and business models*, which should make digital economy/society more inclusive while reducing inequality and increasing growth;
- innovations that could empower people to *fully participate in digital agenda* and increase both employment and national competitiveness;
- initiatives to support perspective changes in the labor market and acquiring appropriate skills to shape *knowledge economy through creativity*;
- solutions to protect and support low wage/skilled workers in the *evolving labor market*.

No doubt, delivering on these new innovative approaches shall be among the main tasks when implementing Latvian science policy. Research activities in the Nordic countries are already subject to intensive cooperation: modern research activity is becoming so expensive that single countries cannot afford conducting full-scale research in the needed fields. For example, *New Opportunities for Research Funding Agency Co-operation in Europe* (Norface, launched in 2004) was a collaborative partnership of national research funding agencies from about 20 European countries in the area of social and behavioral sciences. It was a unique opportunity for the participating states in facilitating new networks of research cooperation in social sciences. (1)

2.2 ACTIVE ROLE OF SCIENCE AND TECHNOLOGY

Numerous combined and coordinated efforts among the EU institutions and member states exist in order to gain fore-front science and innovation positions in the world. Modern European science policies

are directed towards creating an optimal position of progressive and pioneering member states in global science and technologies. Main ideas in these political decisions are on the **future and emerging technologies** (FET) (see more below), which are supposed to represent elaboration of long-term research directions in the still uncharted areas in broad science and technology fields.

In the shared competences of EU-member states, more active role of science, research, technology and innovation development go to the member states. On the EU side, the investment in science is required to be 3% of national GDP; besides, national science policy directions have to correspond to both European-wide policy guidelines and the national growth strategies.

Although Horizon 2020 is Europe's largest single research and innovation programme, it accounts for only a very small portion of the public research and innovation efforts in Europe. The headline indicator of 3% R&I expenditure fixed in the Europe-2020 strategy for the member states is made up of 1% public expenditure (in which Horizon 2020 is a minor part), and 2% private expenditure.

To have any chance of progressing to this goal, efforts need to go well beyond effective implementation of the EU financial framework programme. This is also needed to address the challenges of ensuring a competitive industrial and technological base, and an effective coordination of the member states science policies. (2)

The EU institutions and member states are slowly changing the old pattern of the EU science policy from a previously dominating **research and development** approach (R&D, quickly translating science achievements into development) to a new one aimed at a fruitful combination of **research, innovation and investments** (R&I, with an additional accent on innovation and public-private investment).

In order for the EU-wide research and innovation policies to be successful in the coming years, the member states need funding. The EU financial investment priorities in the budget for the next seven years include new financial programming — the so-called FP9 — the successor to Horizon 2020, which is the EU research and innovation programme up to 2020. Commission's experts suggest that increasing R&I priorities at both the EU and national level in the next EU's post-2020 budget for research should be doubled. (3)

Historically, already in one of the first reports on the EU policy support facility, which emerged from the European Semester Annual Growth Survey-15, the Commission identified research and innovation (R&I) as one of the seven priorities for the structural reforms of member states in order to boost investment and growth. The survey highlighted the necessary reforms in the EU states to increase the impact of public funding through improved R&I strategies and reforms to ensure an investment-friendly environment to stimulate business innovation. (4)

The *Horizon 2020 Policy Support Facility* (RIO-PSF) was launched in March 2015 as a new instrument that gives the EU states associated to Horizon 2020 practical support to design and implement reforms that enhance the quality of their R&I investment policies. Such reforms included, for example, the stimulation of stronger and closer links between science and business as well as the introduction of performance-based funding of public research institutions. (5)

The RIO-PSF website provides the EU researchers with access to independent high-level expertise and analyses through a broad range of services such as peer reviews of the national R&I systems, support to specific reforms or project-based mutual learning exercises and access to the RIO-PSF Knowledge Center. (6)

2.3 MOBILIZING PUBLIC AND PRIVATE INVESTMENT: EU AND THE BALTIC STATES

The main problem in activating R&D investments in the Baltic States, Latvia including, is the lack of additional financial resources and, partly, inadequate selection of national development priorities. Currently they are included into the EU smart specialization strategies, the so-called 3S models.

Among the Baltic States only Estonia can afford to assign about 3% of GDP to R-D-I spheres; Lithuania and Latvia make only about 0.6–0.8% of GDP each; generally, the Baltic States rely upon the EU financial assistance and advice. However, the issue is a problem of the whole Union: infrastructure investment activities in the EU states has been lately at 1.8% of the European aggregate GDP, down from 2.2% in 2009,

which is the lowest in the last 20 years. The contraction in government investment continued in six EU periphery countries (Cyprus, Greece, Ireland, Italy, Portugal and Spain) — down to 2.1%; while 12 cohesion countries (Bulgaria, Croatia, the Czech Republic, **Estonia**, Hungary, **Latvia**, **Lithuania**, Malta, Poland, Romania, Slovakia and Slovenia) have seen a sharp decline in funding from the European Structural and Investment Funds (ESIF) since 2015.

Thus, a new EU Investment Fund, established in mid-January 2019, the so-called InvestEU Program, is aimed at bringing together under one roof all EU financial instruments for investment in the states, which should trigger considerably innovation investments in the coming years to boost jobs, innovation and skills. (7)

The new *InvestEU Program* and corresponding fund have five main priority directions:

- *Providing guarantees*: the Commission suggests collecting € 15.2 billion in the InvestEU Fund. This amount is composed of € 38 billion guarantee from the EU budget to support strategically important projects in the member states. Assembling private and public investments, the Commission expects the InvestEU Fund to trigger more than € 650 billion in additional investment across the EU states in the next 7 years.

- *Creating a diversified and flexible investment portfolio*: the Fund will support four policy areas: (a) sustainable infrastructure; (b) research, innovation and digitization; (c) small and medium-sized businesses; and (d) social investment and skills. Flexibility of InvestEU will rest on its ability to react to market changes and policy priorities that change over time.

- *Coherence and simplicity*: the InvestEU program will have a single, coherent governance structure and reporting requirements, avoiding overlaps. A single fund will integrate several different EU-level financial instruments and numerous regulations; the approach means a strengthened focus on research policy areas and objectives being linked to the EU priorities.

- *Capitalize on local, national and EU-wide expertise in financial partnership*: the European Investment Bank (EIB) Group will remain the Commission's main financial partner under the InvestEU program, given its role as the EU's public bank, with its capacity to operate in all

EU states and its experience in managing the EFSI. In addition, the national and regional promotional banks and other EU institutions would become financial partners by offering specific expertise and experience.

- *Help the member states leverage their EU funds more effectively:* the EU states will have the option to channel some of their allocated Cohesion Policy Funds into the InvestEU budget guarantee. Any funds channeled into the Fund will benefit from the EU guarantee and its high credit rating, giving more efficiency to national and regional investments. If the states choose to do this, the funds will be earmarked for that particular country. To facilitate deployment of the InvestEU Fund in the states, the Commission will also control the money channeled through InvestEU to member states and their use in state aid programs. (8)

The **European Fund for Strategic Investments** (EFSI) (established at the end of 2017), managed to mobilize in about a year over € 371 billion worth of investments, more than the initial target, with about two thirds coming from private investors. The European Court of Auditors (ECA) in the report on the EFSI, issued in January 2019, stated that the EFSI activity has already increased the European GDP by 0.6%, which is expected to reach 1.3% by 2020.

The biggest winners from the EFSI support are about ten EU states, including all three Baltic States (Estonia, Latvia and Lithuania) as well as Greece, Portugal, Spain, Bulgaria, Finland, Poland and Italy.

The EFSI helps finance strategic investments in key areas such as infrastructure, research and innovation, education, renewable energy and energy efficiency; it acts as an EU budgetary guarantee for the EIB Group. The EFSI enables the EIB and the Invest EU Fund to provide additional financial support to eligible projects in the EU and mobilize additional private and public investment for these projects. However, about a third of the infrastructure projects financed through the EFSI could have been financed from the public-private partnership without the Fund's assistance. (9)

2.4 PROMOTING INNOVATION POLICY: EU EDUCATION STRATEGY AND RESEARCH ACTIVITIES

Innovation is crucial for long-term economic growth in the EU states: it fosters competitiveness, creates jobs, helps to address environmental and health challenges, reduces inequality and contributes to sustained and inclusive growth. However, innovation-driven growth requires a right mix of multi-sector and multidisciplinary policy actions: in education, research, science and technology, in finances, public procurement, etc. Important is the decision-making process that combines growth priorities, innovations and budget incentives for policy solutions that work best in a given country.

The Innovation Policy Platform (IPP), developed by the World Bank Group and the Organisation for Economic Co-operation and Development (OECD), is a web-based interactive space that provides easy access to knowledge, learning resources, indicators and communities of practice on the design, implementation, and evaluation of innovation policies. The Platform helps users learn how innovation systems operate, identify good practices across different countries, conduct statistical benchmarking and devise and apply effective policy solutions. More broadly, it facilitates knowledge exchange and collaboration across countries and regions. (10)

2.5 EUROPEAN EDUCATION AREA: CONFRONTING MODERN CHALLENGES

Education policies in the member states are subject to serious changes facing modern European and global challenges. The new initiative suggests that the EU research and education funding will support the creation of twenty EU universities based on a network of consortia of about six universities from at least three member states.

Already at the end of 2017 during the Gothenburg summit, the EU states outlined a new vision for the European cooperation in education,

research, sciences as well as in culture. Since then, the EU institutions have taken a number of initiatives aimed at strengthening the EU-wide strategic partnerships among the higher education institutions of the member states. The idea is to create European-wide universities to deal with the global educational competitiveness. So far, only Estonian and Lithuanian universities — one from each state — have shown interest to participate.

2.5.1 Smart growth and research universities

In modern EU transition to smart growth, there is a vital triangle uniting the European education, research and innovation spheres. Although it is not that easy to materialize the triangle, some first steps towards the noble goal have been made: creating European education centers or a consortium of about twenty European Universities in the coming 5 years. The idea is to enable students to obtain knowledge (and degrees) combining studies in several EU countries, which will contribute to increasing international competitiveness among the existing EU universities. With this in mind, a promising idea to create by 2024 about twenty the so-called EU universities was coined by the French president. The initiative has been co-developed by the member states higher education institutions, student organisations and the Commission; the EU-wide universities initiative has become an integral part of the EU ambitious plan of creating an EU-wide *European Education Area* (EEA).

There are two directions within coordinating efforts among the European states:

- a) through the *Erasmus+ programs* in the Education, Audiovisual and Culture Executive Agency (EACEA); (11) and
- b) through the DG for Education and Culture (EAC) in improving the *quality and efficiency of education and training*, as well as in enhancing creativity and innovation (including entrepreneurship) at all levels of education and training. (12)

Although higher education, in principle, has been the domain of the member states (since the Lisbon Treaty in 2010), the research and innovation activities are within a shared competence involving efforts from both the EU institution and member states.

The EU-university network is regarded as the transnational alliances of European universities, as a reaction to the EU future challenges by promoting and revolutionizing quality and competitiveness of European higher education. As part of this quality-quantity step, the European Commission intends to test different cooperation models based on the following principles:

- an alliance of partners from all types of higher education institution covering a broad European territory;
- a co-envisioned long-term strategy focused on sustainability, circular economy and research excellence, being cognizant of European values;
- offering student-centered curricula jointly delivered across an inter-university cooperation with diverse student councils and their own programs;
- taking a challenge-based approach where students, academics and external partners can cooperate in cross-disciplinary teams to tackle the biggest issues facing European states.

The idea of cooperative models has another important aspect, i.e. to streamline the European research-innovation-investment alliances across languages, borders and scientific disciplines, to address modern global and European socio-economic challenges. (13)

In 2019, for the activities in the above-mentioned universities alliance about € 60 million of European funding is available to twelve experimental models to test the concept and its transformative potential. (14)

The European university cooperation initiative does not define a specific budget, but suggests that to reach the objectives each network should get about € 5–6 million over five years, i.e. at least € 100 million in total. A pilot project started at the end of 2018 with the aim of strengthening the ***triangle of innovation, research and education in Europe***, and to encourage more European integration in higher education and research (the networks are also open to the UK, US or other non-EU universities). (15)

The challenges addressed in the European Consortium of Innovative Universities (ECIU) are also related to the UN Sustainable Development Goals and will be worked out in international cross-scientific

teams with participants from academic communities in the member states, other interested bodies and student councils.

A specific network is the *Charm European University* (the so-called Charm-EU), launched in January 2019, which will focus, among other issues, on the United Nations Sustainable Development Goals and incorporates universities in five EU states: Trinity College Dublin, University of Barcelona, Utrecht University, University of Montpellier and Eötvös Loránd University in Budapest. (16)

In February 2019, the European Commission provided additional funding of € 30 million to the program, doubling the total to € 60 million, which enables 12 of the 54 networks to be selected for funding in the first stage of the project. With this, the Commission has called for “a shared, integrated, long-term joint strategy for education with links, when possible, to research and innovation to society”. The first pilot project of European Universities will test different “innovative and structural models for implementing and achieving long-term visions through a step-by-step approach”. (17)

The EU-university proposal addresses a long-term vision of linking higher education to research and innovation and to develop new innovative structural models that could work towards added European value, notably through its transnationality. European research dimension consists of several European universities, which would “enable students to obtain a degree by combining studies in several EU countries and contribute to the international competitiveness of universities”.

In this way, the ECIU is going to challenge the conventional thinking, including the existing activities by the European University Foundation (EUF) and the University of the Greater Region (UniGR) (see below), to name a few. The ECIU has already 13 partner-universities. (18)

There is another ECIU group uniting universities in four EU states, the so-called UniGR, which offers an opportunity to study and conduct research in 3 languages, in 5 sub-regions and in 6 universities. The Greater Region covers Saarland and Rhineland-Palatinate in Germany, the Grand Duchy of Luxembourg, the French region of Lorraine and the Belgian Wallonia with its French and German-speaking communities. (19)

The activity of the *Guild of European Research-Intensive Universities* (the Guild) should be specifically mentioned: it was founded in 2016 and currently comprises 19 Europe’s most distinguished research-intensive universities in fourteen countries (a member from the Baltic States is the University of Tartu, Estonia). The Guild is dedicated to enhancing the voice of academic institutions, their researchers and their students. The Guild is committed to the pursuit of excellence, the importance of truth-seeking and trust-building as the foundation of public life, and the creation of new knowledge for the benefit of society, culture, and economic growth. (20)

The European Commission expects some medium-term achievements in the EU member states in the following growth sectors:

- *Research and innovation, R&I*: around 130,000 firms will receive R&I support and almost 72,000 researchers will benefit from improved European Regional Development Fund (ERDF)-supported research facilities.

- *Supporting the growth of Europe’s SMEs*: under the ERDF alone, over 5% of all SMEs and 8% of all new enterprises will be supported. The ERDF will support over 1 million enterprises, of which about 130 thousand will increase their research and innovation capacity.

- *Protection of environment, circular economy and resource efficiency*: waste management will be supported by about € 5.5 billion from the ERDF in the most needed regions, leading to expected increased waste recycling capacity by 2.5 million tons.

- *Transport infrastructures*: 7,515 km railway lines, of which 5,200 km belonging to the TEN-T, will be built, reconstructed or upgraded. Over 3 thousand km of new roads will be built, of which about 2 thousand km will be TEN-T roads. Over 10 thousand km of roads will be reconstructed, of which 798 km will be TEN-T; about 3 thousand km of TEN-T road to be built or upgraded, which represents 5% of the TEN-T network. Besides, 748 km of tram or metro lines will be constructed or improved; and 977 km of new or improved inland waterways are projected.

- *Direct job creation*: interventions financed by the Commission’s DG for Regional and Urban Policy (DG Regio) will support the direct creation of 423,100 new jobs; about 30 thousand will be created with new researchers employed under the ERDF research measures and many more jobs will be created indirectly.

2.6 INNOVATIVE START-UPS: OPPORTUNITIES FOR INCREASING CAPITAL

There are numerous talented, top-class researchers and skilled entrepreneurs in the Baltic States, Latvia included. Generally, they lack only an incentive push in turning their good ideas into excellent and successful business achievements, which is often about access to capital. Innovations are better off in practice if supported by financial injections through venture capital.

The European Union institutions — mainly the Commission — play a key role: together with the European Investment Fund (EIF), the Commission created in April 2018 six venture capital funds to support innovative investments in the European states. These so-called pan-European venture capital Funds-of-Funds or *VentureEU* are expected to boost investment in innovative start-up and scale-up companies in the Baltic Sea Region. The innovative activity is already backed by EU funding in the amount of € 410 million; together with *VentureEU*, they will raise up to € 2.1 billion of public and private investment. In turn, this is expected to trigger an estimated € 6.5 billion of new investment in innovative start-up and scale-up companies across Europe, doubling the amount of venture capital currently available in Europe.

Among various investment support instruments for innovations, venture capital (VC) is most vital and operative in the business world; however, it remains underdeveloped in Europe. For example, in 2016, venture capitalists invested about € 6.5 billion in the EU states compared to € 39.4 billion in the US. Moreover, VC funds in Europe are too small — € 56 million on average compared to € 156 million in the US. As a result, VC companies move to states where they have better chances for fast growth. The number of VC companies with the so-called unicorn status, i.e. with more than \$1 billion market valuation are concentrated in the US (109 companies) and China (59 companies) compared to just 26 in the EU at the end of 2017. *VentureEU* is aimed at providing additional sources of financing, giving the European innovators the opportunity to grow into world-leading companies: about 1,500 start-ups and scale-ups are expected to gain access to financing across the whole EU. With *VentureEU*, innovative entrepreneurs will

get the investment they need to implement their success ideas as it will increase the amount and average size of venture capital funds. In European states, *VentureEU* will become a key element of the EU Open Innovation Strategy launched in 2015 and aimed at making European entrepreneurs to be global industrial leaders. *VentureEU* becomes an important addition to the existing European equity market for science and innovation: currently the EIF supports about 500 VC funds; this would make a difference. The structure of *VentureEU* is composed of the cornerstone investment in amount of € 410 million, including € 67 million of the EIF resources: € 200 million from the Horizon 2020 InnovFin Equity, € 105 million from COSME (Europe's program for SMEs) and € 105 million from the European Fund for Strategic Investments (EFSI). Other necessary financing will be raised by the selected fund managers primarily from independent investors.

Six *VentureEU* funds will join a number of smaller VC funds to finance cooperative projects from at least four European countries. These funds will help finance SMEs and mid-caps from a range of progressive sectors, e.g. in information and communication technologies (ICT), digital, life sciences, medical technologies, as well as in resource and energy efficiency.

History of venture capital is not long: the Commission announced the creation of a Pan-European Venture Capital Funds-of-Funds Program (*VentureEU*) under the Capital Markets Union and the Start-up and Scale-up Initiative in November 2016; initially these efforts were part of the EU Open Science, Open Innovation and Open to the World Strategy from 2015. (21)

In November 2016, the Commission and EIF launched a Call for Expression of Interest to the member states with the application submission deadline for two months and 17 were received. As a first step, the Commission assessed all investment proposals, conducted the pre-selection process while the EIF conducted its standard process of the pre-selected candidates, six of which were selected for funding and invited to enter into negotiations with the EIF late in 2017. Among them were *IsomerCapital* and *Axon Partners Group* (the first two); the other four were Aberdeen Standard Investments, LGT, Lombard Odier Asset Management and Schroder AdvEq; all selections were finished during 2018.

VentureEU is part of the wider ecosystem that the EU is putting in place to give Europe's many innovative entrepreneurs every opportunity to become the world's leading companies. In particular, as part of the EU's capital market action plan, the Commission presented a series of measures to improve access to finance for small and growing companies to create jobs and growth. The Commission's investment plan also aimed at improving business environment in the member states by making smarter use of financial resources and removing barriers to investment. (22)

In March 2018, new regulations on the European Venture Capital Fund (*EuVECA*) and European Social Entrepreneurship Fund (*EuSEF*) came into force in the member states, making it easier for all fund managers to run these funds and allowing a greater range of companies to benefit from their investments. The new regulations are going to make the cross-border marketing of the *EuVECA* and *EuSEF* funds less costly and will simplify registration processes. (23)

According to the EU renewed industrial policy from 2017, the Commission set up a complementary *European Scale-Up Action for Risk Capital* (*Escalar*) to enable venture capital funds to increase their investment capacity. (24)

In November 2016, the Commission proposed a Directive on business insolvency, e.g. possibilities for facilitating early restructuring and a second chance. For example, the new regulation would allow entrepreneurs to benefit from a second chance, as they will be fully discharged of their debt after a maximum period of 3 years; currently, half of Europeans say they would not start a business because of fear of failure. Besides, each year about 200,000 firms in the member states go bankrupt, which results in 1.7 million job losses; that could often be avoided with a more efficient insolvency and restructuring procedures. (25)

The Commission is also advancing efforts on a robust single EU VAT area, which includes proposals for targeted measures to help SMEs operating cross-border in the EU. The new rules have already been agreed by the member states, which should simplify VAT obligations for thousands of SMEs that sell goods online across the EU member states. (26)

2.7 CASE STUDY. STRATEGIC EUROPEAN SCIENCE AND RESEARCH: INNOVATION POLICY PLATFORM

In the discussion on future and emerging technologies, the Commission underlined that combined and coordinated efforts among the EU institutions and member states are needed towards gaining forefront positions in the world. Some new directions have been mentioned, e.g. the Human Brain Project, which provides additional understanding of the human brain and its diseases, as well as graphene and quantum research projects.

EU future and emerging technologies (FET) are directed towards European perspective and pioneering positions in global science and technologies. The FET Flagship projects represent challenging and long-term research directions into uncharted areas that stretch the boundaries of science and technology.

There is a fundamental shift from research and development (R&D) to research and investment (R&I) in the European science policy. In order for European research and innovation to be successful in the coming years, the member states need funding. The EU is now considering funding and priorities for its next budget period, including FP9, the successor to Horizon 2020, which is the current EU research and innovation program.

Some recommendations are particularly relevant:

- to fine-tune the approach of scientific community to more mission-oriented and impact-focused research addressing global challenges. Here, the EU Flagships provide the power to change how the world sees whole industries and wider society, e.g. applications and devices that are developed based on their results in bringing major practical implications and benefits for everyone.
- to improve how EU and national R&I issues can be combined in order to add European value to scientific achievements and projects conducted together with the EU states; thus, better coordination between EU and national research programmes is important.

2.8 NEW INNOVATION INITIATIVES IN LATVIA

Featuring a broad practical and educational program, the second international *Magnetic Latvia* technology conference *Deep Tech Atelier* organized by the Latvian Investment and Development Agency (LIAA) was held in Riga (April 2019), gathering more than 600 participants from 25 countries. During the Commercialization Reactor *Ignition Event* eight new science-based tech companies were created, *Deep Tech Atelier* participants received industry expert consultations about the commercialization of science, and there were more than 80 business meetings during the conference.

The *Deep Tech Atelier* gathered science-based startups, research organisations, entrepreneurs, industry and government representatives, and those interested in technology to acquire the necessary knowledge and skills for business development and science commercialization to create new science-based business teams and determine the startup competition winners.

Modern development is impossible without new technologies, specifically of social relevance; in this way SMEs can create new investment opportunities through connecting scientists and entrepreneurs in creating new teams and startups. Government support is crucial for deep technology development; and LIAA also offers a support program for scientists, science commercialization and innovative startups.

The *Deep Tech Atelier* serves as a place where brilliant ideas meet investors, and the ideas become commercialized. In 2019, all *Deep Tech Atelier* startup competition semi-finalists won awards from the main conference partners and supporters. The *Schaeffler AG* main prize went to two Latvian SMEs: the car monitoring system creator *SIZZAPP* and the label verification manufacturer *InLable*. The Commercialization Reactor main prize in pre-seed investment and participation in a 3-month acceleration program with the possibility of obtaining a further financial support in seed investment was won by two other Latvian SMEs: green industry innovator *AB Labs* and *Vigo*; the latter is developing software to help patients have more effective recovery after a stroke. The Innovation Network for Advanced Materials award went to the Latvian 3D printing materials producer *3D Strong*. The *EnergySpin* accelerator prize was won by *Empyrion* (Latvia), which provides a com-

pact autonomous sewage sludge mono-incinerator for waste containing over 80% moisture. The *Merck* accelerator main prize went to *COWOW* (Latvia), a developer of IoT system assisting farmers in detecting clinical and sub-clinical mastitis of cows on microbiological level. (27)

Supplementary material

Additional reading on European science, research and business:

- *Research and innovation as the only perspective for progressive growth*. 17.05.2018. In: http://www.baltic-course.com/eng/analytics/?doc=140061&ins_print;
- *Science & innovation will save Europe*. 17.05.2018. In: http://www.baltic-course.com/eng/editors_note/?doc=19425&ins_print;
- *Digital transformation in the EU: the Baltic States are catching up*. 21.05.2018. In: http://www.baltic-course.com/eng/good_for_business/?doc=140167&ins_print;
- *“Knowing entrepreneurship”: challenges for the Baltics’ authorities*. 16.03.2018. In: http://www.baltic-course.com/eng/editors_note/?doc=19200&ins_print;
- *Research and innovation activities in Europe: solid background for growth*. 25.06.2018. In: http://www.baltic-course.com/eng/modern_eu/?doc=140986&ins_print;
- *Innovations as a driving force for the Baltic States’ growth*. 25.06.2018. In: http://www.baltic-course.com/eng/editors_note/?doc=19597&ins_print; Growth in Europe and the Baltic States, 09.07.2018. In: http://www.baltic-course.com/eng/editors_note/?doc=19657&ins_print;
- *Promoting “creative business”: Commission’s proposal for the next budget*. 12.07.2018. In: http://www.baltic-course.com/eng/modern_eu/?doc=141464&ins_print;
- *EU and Altum in support for Latvian SMEs*. 06.09.2018. In: http://www.baltic-course.com/eng/modern_eu/?doc=143078&ins_print;
- *Commission’s “Education and Training Monitor” encourages reforms in the member states*. 18.10.2018. In: http://www.baltic-course.com/eng/modern_eu/?doc=144333&ins_print;
- *European development perspectives and growth strategy*. 27.11.2018. In: http://www.baltic-course.com/eng/modern_eu/?doc=145484&ins_print;
- *Perspective directions for Latvian science and research*. 08.01.2019. In: http://www.baltic-course.com/eng/modern_eu/?doc=146341&ins_print;

Optional reading on science and research spheres in EU and Latvia
(publications from 2017–2018 and partly in 2019):

a) On general EU development issues:

- Modern EU reforms: effect for Baltic States. 03.03.2017. In: http://www.baltic-course.com/eng/editors_note/?doc=17655&ins_print;
- Commission's vision on the EU's future by 2025. E. Eteris, RSU, 03.03.2017. In: http://www.baltic-course.com/eng/modern_eu/?doc=128015&ins_print;
- State of the Union-2017: charting direction for the EU's future. 14.09.2017. http://www.baltic-course.com/eng/modern_eu/?doc=133186&ins_print;

b) On sustainability, science and research:

- The EU's transition to a low-carbon era is taking shape. 11.05.2017. In: http://www.baltic-course.com/eng/modern_eu/?doc=129603&ins_print;
- End of fossil fuels: warning to the Baltic States. 23.08.2017. In: http://www.baltic-course.com/eng/analytics/?doc=132480&ins_print;
- Fuel-cell buses: solution for city air pollution. 19.09.2017. In: http://www.baltic-course.com/eng/baltic_states/?doc=133314&ins_print;
- Circular economy: opportunities for business. By Eugene Eteris, RSU, 04.08.2017. In: http://www.baltic-course.com/eng/good_for_business/?doc=131904&ins_print;
- Circular economy: new political economy guidelines. 04.08.2017. In: http://www.baltic-course.com/eng/editors_note/?doc=18227&ins_print;
- Delivering on European Circular Economy Action Plan: the EU's results for 2017. 12.09.2017. In: http://www.baltic-course.com/eng/good_for_business/?doc=133112&ins_print;

c) On financial issues and investments in research:

- Investment funds in euro area: supporting business. 01.06.2017. In: http://www.baltic-course.com/eng/modern_eu/?doc=130111;
- EU Budget after 2019: funding more with less. 04.07.2017. In: http://www.baltic-course.com/eng/modern_eu/?doc=130891&ins_print;
- European funds and cohesion policy after 2020. 09.08.2017. In: http://www.baltic-course.com/eng/good_for_business/?doc=132044&ins_print;

d) On smart specialization and the role of scientists:

- Smart specialisation and innovative-led growth in the EU states. 21.07.2017. In: http://www.baltic-course.com/eng/good_for_business/?doc=131478&ins_print;
- Facing globalisation: EU assists Baltic States in smart specialisation. 30.09.2017. In: http://www.baltic-course.com/eng/good_for_business/?doc=133683&ins_print;
- EU new industrial policy: investing in a smart, innovative and sustainable industry. 19.09.2017. In: http://www.baltic-course.com/eng/good_for_business/?doc=133328&ins_print;

References and notes

1. Note: the Norface network has developed two new research programs: *Dynamics of (In)equality during the Life Course* and *Transformations to Sustainability*, in which both Estonia and Lithuania participate; more on Nordic cooperation in: <https://www.norface.net/about-norface/>.
2. More on the EU Strategic Plan in: https://ec.europa.eu/info/sites/info/files/strategic-plan-2016-2020-dg-rtd_march2016_en.pdf (in particular page 4).
3. More on European science priorities in: <http://ec.europa.eu/research/index.cfm?pg=events&eventcode>
4. See more: Initial Annual Growth Survey on R&I in COM (2014) 902 of 28 November 2014.
5. More in: http://ec.europa.eu/europe2020/pdf/themes/2015/research_innovation_20151126.pdf
6. See more in: Research and Innovation Observatory (July 18, 2018); retrieved from <https://rio.jrc.ec.europa.eu/en>
7. See more in the Commission press release at: http://europa.eu/rapid/press-release_IP-19-444_en.htm?locale=en and the *InvestEU Program* in: https://ec.europa.eu/commission/publications/investeu-programme_en
8. More information on the *Invest EU Fund* in the following web-links: Press release: *InvestEU Programme to support jobs, growth and innovation in Europe*; Memo: *InvestEU Program — questions and answers*; *InvestEU policy package*; Factsheet: *What is InvestEU?*; Factsheet: *InvestEU — what will it finance?*; *Proposal for a Regulation establishing the InvestEU Program*; and *EU budget for the future*.
9. More in: <https://www.eca.europa.eu/en/Pages/DocItem.aspx?did={516972F3-71DA-461E-AEF7-625866BE8825}>

10. More in: Usable knowledge for policy practitioners; February 19, 2019, retrieved from: https://www.innovationpolicyplatform.org/sites/default/files/IPP_flyer_13_10_2015_0.pdf
11. More on Erasmus+ in: https://eacea.ec.europa.eu/erasmus-plus/selection-results/knowledge-alliances-2018_en.
12. More on DG EAC in: https://ec.europa.eu/info/topics/education-and-training_en
13. More on European university cooperation initiative in: https://ec.europa.eu/education/education-in-the-eu/european-education-area/european-universities-initiative_en
14. More on the Erasmus+ applications in the EACEA's website: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:C2018/384/04&from=EN>
15. More in: <https://www.universityworldnews.com/post.php?story=20171124150640414>
16. More in: <https://www.uu.nl/en/news/launch-of-charm-eu-a-new-university-alliance-focusing-on-interdisciplinary-challenge-based-education>
17. Source: <https://www.universityworldnews.com/post.php?story=20190307070330629>.
18. See additional information in the following web-links: — on consortium of 13 universities in: <https://www.eciu.org/> (from the Baltic States the Kaunas University of Technology is participating); — on European university foundation in: https://eurep.auth.gr/en/networks/campus_europae (the University of Latvia participates in the EUF network).
19. More in: https://www.en.uni.lu/international/university_of_the_greater_region_unigr.
20. More on research universities in: <https://www.the-guild.eu/about/>.
21. More on the Commission's start-up and scale-up initiative in the press release: http://europa.eu/rapid/press-release_IP-16-3882_en.htm. The book about EU's open science, open innovation and open to the world concept in: <https://publications.europa.eu/en/publication-detail/-/publication/3213b335-1cbc-11e6-ba9a-01aa75ed71a1>
22. See more on the Commission's investment plan in: https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/investment-plan-europe-juncker-plan_en
23. New rules on *EUVECA* see: https://ec.europa.eu/info/business-economy-euro/growth-and-investment/investment-funds_en
24. Communication on the renewed industrial policy in: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2017:479:FIN>
25. On a proposed Directive on European rules concerning business insolvency in: http://europa.eu/rapid/press-release_IP-16-3802_en.htm
26. The Commission's proposal on new tools to combat VAT fraud in: http://europa.eu/rapid/press-release_IP-17-4946_en.htm, November 2017
 - On proposed new rules to give the states more flexibility to set Value Added Tax (VAT) rates and to create a better tax environment to help SMEs flourish, see the Commission press release (January 2018) in: http://europa.eu/rapid/press-release_IP-18-185_en.htm
 - On simplified VAT see: http://europa.eu/rapid/press-release_IP-17-4404_en.htm; The new system will make it easier for consumers and businesses, in particular start-ups and SMEs, to buy and sell goods cross-border online. It will also help states to recoup the current estimated € 5 billion of VAT lost on online sales every year.
27. Note: *Deep Tech Atelier* is organised by the Investment and Development Agency of Latvia — LIAA and Magnetic Latvia in cooperation with the Commercialization Reactor. *Deep Tech Atelier 2020* will be held again in April 17-18.

PART III

SCIENCE IN ACTION: DEVELOPMENT OF SMART SPECIALIZATION IN LATVIA

- 3.1 Science and research for national smart specialization issues
 - 3.1.1 Baltic States initiatives in 3S
 - 3.1.2 Examples of other EU states
 - 3.1.3 Modern European 3S policy
 - 3.1.4 Case study. European 3S pilot projects
 - 3.1.5 Regional 3S activity
 - 3.1.6 Optional reading for 3S issues
 - 3.2 Research directions for Latvian industrial development and manufacturing
 - 3.2.1 Latvian industrial/manufacturing perspectives
 - 3.2.2 European approaches to manufacturing
 - 3.2.3 EU policy towards industrialization of states
 - 3.2.4 Start-ups and scale-ups in industrial growth
 - 3.3 Cooperation of Europe and the Baltic States in industrial development
 - 3.3.1 Industrial innovation
 - 3.4 Digital single market and new skills
 - 3.4.1 Estonian example
 - 3.4.2 Smart tourism
 - 3.5 Case study. Science policy in Latvian national growth strategy
- References and Notes

3.1 SCIENCE AND RESEARCH FOR NATIONAL SMART SPECIALIZATION ISSUES

Globalization has brought enormous benefits and numerous opportunities for European states and Latvia. However, the benefits are unevenly spread among the states; certain stumbling blocks increase the adoptive costs among the EU countries. Therefore, the European Commission highlighted the necessity to take up the challenges of economic modernization; at the same time, the EU member states need to

empower their regions and help them create additional and competitive values through smart specialization. Generally, it means embracing innovation, digitalization, decarbonization and developing perspective people's skills. To be competitive in the world, the Baltic States, Latvia including, have to develop their own so-called smart specialization strategies.

The EU general strategy regarding recommendations for the development of member states is to identify the specific spheres for growth and specialization that could provide additional competitive advantage in the global value chain. Hence, Latvian decision-makers have to figure out the possible specific spheres, taking into consideration the available resources (both natural and human), existing structural reforms in economy, as well as business culture, infrastructure, etc.

The EU message is as follows: Latvia has to find its smart specialization that would drive its growth in the years to come.

Moreover, the EU recommends the member states to increase their industrial base, including specific manufacturing sectors. The European Commission is certain that for the states to find out their competitive advantages they need to activate the role of science, research and innovations.

The process of finding Latvian specialization is closely connected with re-evaluating the advantages of the economic growth policy, which can be most optimally done considering the new narrative of economic policy.

The smart specialization approach in the EU originated in 2011, when the European Commission for the first time provided advice to the authorities of member states on developing national specialization platforms using the so-called smart specialization strategies, often referred to as 3S. Smart specialization is regarded as an innovative approach to boost growth and jobs by enabling each state (and even each region, if possible) to *identify and develop its own competitive advantages*. The 3S approach in the EU states intends to bring *smart specialization* into the local communities, science and academia, businesses and the civil society at large additional tools for the implementation of long-term growth strategies. The smart specialization concept is based on three approaches to modern economic governance:

- first, "**smart**" means prioritizing science and research components in growth supported by public-private innovation investment in competitive areas;
- second, "**specialization**" means identifying the unique growth opportunities and strengths of states and regions, with own resources providing for competitive advantages in Europe and the world;
- third, "**strategic**" means specifying socio-economic priorities in the national long-term development plans. (1)

National smart specialization strategy or N3S is seen, generally, as a strategic approach to economic development through targeted support for a specialized innovative approach to research. That was the main reason to include the new Innovation Union approach into the EU-2020 Strategy as the key action of the European cohesion policy. (2)

Development of *specific innovation activities* in the member states (mainly, in the form of research for smart specialization) is regarded as a vital *pre-condition* for the Baltic States, including Latvia, in receiving support from the European Regional Development Fund (ERDF) and European Agricultural Fund for Rural Development (EAFRD). Therefore Latvia, for example, has to rely upon new science and innovation aspects in applications for the EU funds in order to get financial support in the future. In this way, the 3S is aimed at ensuring more effective and efficient innovation policy strategies at national and regional level to maximize the impact of EU funds and investment. (3)

Initially, the Commission suggested two main 3S spheres and categories for the member state strategic planning: a) supporting **industrial transition**, i.e. strengthening the productivity growth through new industries and/or progressive manufacturing solutions, and b) supporting **inter-regional partnerships** (at least four EU member states have to participate in the cooperative projects to be supported by the EU funds) to develop competitive in Europe value chains in growth.

The S3 platform provides advice to the member states and regions in the design and implementation of their strategies, e.g. Latvia can receive advice and support in the following activities: preparing guidance material and examples of good practice; strategy formation and policy-making; facilitating peer-reviews and mutual learning; supporting

access to relevant data, and assisting in training policy-makers.(4) It would be feasible, in this regard, to create a national focal point for developing a perspective Latvian 3S strategy.

Already in 2012, the Commission presented an initial design of better national 3S policies for boosting innovation-driven growth among the EU states, first of all through the EU cohesion policy. Originally the Organization for Economic Co-operation and Development (OECD) compiled a special report and examined the development of 3S indicators and included 15 case studies of national experiences in 3S design and implementation. (5)

3.1.1 Baltic States initiatives in 3S

Below are some examples of 3S implementation in the Baltic States; the following are the strategic directions in Latvia:

- in *knowledge-intensive bio-economy*: — sustainable forestry with full-scale wood biomass chemical processing; — innovative plant and animal breeding technologies; — development of new agro-plant and animal/breeding products through by-products' use; — food safety;
- in *bio-medicine and technology*: — chemical and bio-technological methods and products in pharmaceutical and bio-active substances; — development of new human and veterinary medicinal products; — new molecular and individualized treatment and diagnostic methods and cell technology; — functional foods, therapeutic cosmetics and bio-active natural substances;
- in *smart materials, technology and engineering*: — developing implant materials, composite materials, thin layers and coatings; — new equipment and machinery for glass and fiber products as well as other smart glass-based materials;
- in *advanced ICT*: — innovative knowledge management, system modeling and software development methods and tools; — innovative sectoral ICT hardware and software application; — cyber-physics systems, language technologies and the semantic web; big-data and knowledge infrastructure; — information security and quantum computers; — PC testing methods;
- in *smart energy field*: — development of smart grids; — development of demand-supply energy systems in smart buildings and

residential automation systems; — development of next-generation technologies for renewable energy sources; — increasing energy efficiency in construction and in residential infrastructure elements; — sustainable energy for transport and public electric transportation. (6)

3S priorities in Estonia are as follows:

- in *e-health and bio-technology*: — healthy food and progressive drugs; medical diagnostics and therapeutic application; bio-banking;
- in *ICT and e-governance*: robotics and embedded systems, cyber security, big data science and data processing;
- in *material technologies*: — nano-technologies in new materials; — surface coating technologies; oil shale in the chemical industry;
- in *enhancement of existing resources*: — biomass (primarily timber and food); — oil shale exploration; — energy efficiency related to knowledge-based construction techniques. (7)

Lithuanian 3S priorities are the following:

- in *agro-innovations and food technologies*: — sustainable agro-biological resources and safer food; — functional food; — innovative development, improvement and processing of biological raw materials (bio-refinery);
- in *energy and sustainable environment sectors*: — smart systems for energy efficiency, diagnostic, monitoring, metering and management of generators, grids and customers; — energy and fuel production using biomass/waste and waste treatment, storage and disposal; — technology for the development and use of smart low-energy buildings and construction materials; — solar energy equipment and technologies for electricity production, for heating and cooling systems;
- in *new production processes, materials and technologies*: — photonic and laser technologies; — functional materials and coatings; — structural and composite materials; — flexible technological systems for product development;
- in *health and bio-technologies*: — molecular technologies for medicine and bio-pharmaceutics; advanced applied technologies

for individual and public health; advanced medical engineering for early diagnostic and treatment;

- in *transport, logistics and ICT*: — smart transport systems and information and communication technologies; technologies/models for the management of international transport corridors and integration of modes of transport; advanced electronic contents, content development technologies and information interoperability; information and communications technology infrastructure, cloud computing solutions and services;
- inclusive and creative society: — modern self-development and education technologies and processes; technologies and processes for the development and implementation of breakthrough innovations. (8)

3.1.2 Examples of other EU states

The regions of Catalonia in Spain, Skåne in South Sweden and Aquitaine in France have shown what 3S really mean in practice. The EU institutions invited these regions to present their strategies, as these regions were considered by the European Commission as providing positive examples for other EU states in the most optimal ways in 3S creation.

- *The Research and Innovation Strategies for Smart Specialization* (RIS3) in Spain is a strategic approach to economic development through targeted support for research and innovation. Before regional funds are invested in research and innovation, regions need to draw up so-called smart specialization strategies. Each region has to focus on a limited set of priority areas, in which it already has a competitive advantage. These strategies will help regions to build on their particular assets and strengths. It should result in new ways of exploiting knowledge and new ways of doing businesses. The success of Catalonia lies in the fruitful partnership between public and private actors. Though Catalonia has first-rate R&D centers and universities as well as a solid industrial tradition, it registered a lack of technology transfer.

Consequently, connecting its research and innovation system to the existing business and industrial fabric is identified as the strategic priority in their RIS3CAT — *Research and Innovation Strategy for the*

Smart Specialization of Catalonia. The resulting cooperation between companies and research institutes is identified as a driver for the economic transformation of the regional production system. This cooperation should ensure that investments in research and innovation are effectively translated into economic growth and job creation in the region.

- *In Aquitania (France)*, three main sectors have been identified for 3S: the agro-food sector as a “sleeping giant” in France, being a traditional sector of excellence with although a very little innovative application. The aeronautical subcontracting sector is regarded as a “hungry dwarf”; and the start-ups, which are considered as the “goblins” that should be better and more active supported.

The Smart Specialisation Strategy in the region focuses on boosting innovation by adopting a method based on objectivity, transparency and inclusion. In order to advance on the path of smart specialization, the Aquitaine region has set out selective rules and permanent mechanisms of supervision and control.

- The main aim of the so-called IISS in Sweden — *International Innovation Strategy in Skåne* is expected to become Europe’s most innovative region by 2020. To strengthen its innovation capacity, Skåne region focuses on the collaboration between universities, researchers and entrepreneurs. The process has identified three areas of innovation: smart materials, personal health, and smart and sustainable cities. The Skåne Research & Innovation Council serves as a long-term guarantee of this innovation process; the Council which is an advisory body provides a platform for discussion on increasing existing potentials for this small region. (9)

3.1.3 Modern European 3S policy

In July 2017, the Commission proposed a new set of actions to further help European regions invest in their niche areas of competitive strength (now generally recognized in the EU as *smart specialization strategies* or 3S) and a generator for innovation, resilience and growth needed so much. (10)

The Baltic States, including Latvia, can benefit from the new EU support structures if they quickly and creatively draft an optimal (resilient, in the EU jargon) 3S approach in economy with correspond-

ing industrial and/or manufacturing sectors, as well as other perspective and competitive services. Latvia and its regions, for example, can apply for the Commission programs and can benefit from financial and advisory support in transforming their economies and modernizing their industries (e.g. in September 2017, the European Commission made such programs to assist the states in uncovering their specific areas of competitive growth and strong sectors, as well as to design specific investment strategies. Latvia has good chances to get a sufficiently helping hand from the EU institutions in designing optimal strategic specialization. Being one of the instruments to ensure *effective EU Cohesion Policy funds* in research and innovation, 3S has required all regions to design investment strategies based on *their own competitive assets*, e.g. from agro-food specialties and tourism to nanotechnologies, etc.

Under these strategies, local businesses can receive EU financial support to develop innovative products and expand export; these strategies have also resulted in better links between science and business as well as improved coordination at all levels of national/local governance.

The Commission's regional policy (formulated in September 2017) underlined five steps which the EU states/regions should take into consideration in order to get a share in a value chain in a globalised economy. These steps are: *embracing innovation, increasing digitalization, reducing pollution (so-called decarbonization process), developing people's skills, and breaking down barriers to investment*.

This Commission's assisting instrument provides assistance in developing the member states' 3S specialization. The 3S approach in the EU states during last 5–6 years has already facilitated mutual learning, data gathering, analysis, and networking opportunities in about 170 EU regions and 18 national governments. Various EU regions joined forces and pooled resources on the basis of matching smart specialization priorities in high valued added sectors. For example, partnerships among EU states and/or regions have been developed in the fields of 3D printing, medical technology, smart grids, solar energy, sustainable buildings, high-tech farming, etc.

More active smart specialization approaches are already visible in all EU regional policy programs since 2014: these approaches improved

regional innovation strategies by closely connecting local businesses and researchers. Over 120 smart specialization strategies have been developed since; more than € 67 billion from the European Structural and Investment Funds (ESIF) and national/regional funding have been available to support such 3S initiatives.

The Commission predicts that the 3S achievements would bring 15 thousand new products to markets, create 140 thousand new start-ups and 350 thousand new jobs in the years to come. Attention to the 3S strategies of member states goes hand-in-hand with the EU-2020 growth strategy for a changing world, which aims at making the EU *a smart, sustainable and inclusive economy*. These three mutually reinforcing priorities shall provide additional help to the EU member states to deliver high levels of employment, productivity and social cohesion. These priorities have turned into five ambitious objectives: on employment, innovation, education, social inclusion and climate/energy, to be reached by 2020. Each EU state has adopted its own national targets in each of these areas.

National and regional authorities in Europe *shall also design smart specialization strategies in entrepreneurial activities* so that the ESIF can be used more efficiently with synergies between different EU, national and regional policies, as well as using public and private investments. (11)

In implementing 3S approach, the Baltic States, including Latvia, have to increase their science and technology potentials; much is going to be done by national governments, as the Baltic States are lagging behind in innovative capacities. Thus, according to the Commission assessment, Latvia belongs to a category of *moderate innovators*. Latvian research and development directions have been coordinated with the Commission and finally formulated in the following 3S priority areas: *1. Information & communication technologies; 2. Human health & social work activities; 3. Key enabling technologies; 4. Energy production and distribution, and 5. Manufacturing and industry*. (12)

However, without additional investments in R&D it would be almost impossible to activate Latvian 3S directions. Therefore, a big role is to be played by rational political decisions and subsequent economic implementation.

3.1.4 Case study: European 3S pilot projects

The European Commission has already suggested some 3S pilot projects that build on the previous positive experience and suggest the following two groups of activities in the member states/regions:

- *Group 1: Tailored support for regions facing industrial transition.* Some European regions have been bearing the costs of globalization without yet reaping its benefits. They have often suffered substantial job losses, lack of appropriate skills, high labor costs and de-industrialization. Latvian regions facing these specific challenges can have the following benefits provided from the Commission:

- a) *tailored assistance* from the Commission experts of regional teams, who will help regions in the states to compose regional economy transformation strategies; in some cases the expenses for the expert 3S work will be covered by the Commission. Such experts could be from the financial sector, including business consultants or/and researchers in advanced manufacturing processes, etc. The Commission sets aside up to € 200,000 per region to cover the costs of this external expertise; the money comes from the European Regional Development Fund (ERDF).
- b) *additional support* from the *European observatory for clusters and industrial change* to help regions build cluster policies and link better local firms, research centers and academia. (13)
- c) support for the *early implementation* of the regional economic transformation strategies (so-called regional 3S), with up to € 300,000 from the ERDF. This initiative is specifically targeted at regions in transition and more-developed regions; the Commission has designated five most needed regions. In order to get the EU funding, the transition regions must have GDP per capita between 75% and 90% of the EU average; in more-developed regions GDP per capita must be over 90% of the EU average; Latvia and the other Baltic States can qualify for these two categories.

- *Group 2: Inter-regional partnerships to develop competitive European value chains.* This project is to commercialize and scale-up *inter-regional activities* in priority sectors such as big data, bio-economy, resource efficiency, connected mobility, health and active aging

or/and cybersecurity, etc. Regional transnational partnerships from at least four different EU countries and involving universities, research centers, clusters and businesses can apply for Commission's support in developing their projects and accessing new markets. Commission's support is through *Inforegio* experts from thematic departments; about € 1 million from the ERDF will support the development of these partnerships. (14)

3.1.5 Regional 3S activity

The EU institutions provide specific attention to developing *regional smart specialization strategies* (R3S). These strategies aim at making innovations as the driving force for growth in all EU regions. As part of the EU-2020 strategy to create a smart, sustainable and inclusive economy, regional governments are designing economic transformation agendas that concentrate on existing strengths, competitive advantages and resources' potential. (15)

Another important sphere in 3S approach is *cultural and creative industries* (CCIs). It has to be noted that in the 21st century, CCIs have undergone considerable changes as a result of increased digital technologies, new economic development patterns (sustainability, circular economy, etc.) and considerable changes in the regulatory framework.

Support to CCIs has, likewise, evolved rapidly, witnessing core changes in intellectual property law, increased support through state aid, and a greater recognition of their potential contribution to economy. Despite the considerable potential of CCIs, estimated to be responsible for over 3% of the EU gross domestic product and jobs, they remain undervalued and unrecognized, especially in terms of their ability to access start-up capital and financing. The challenges facing CCIs are connected to a lack of clear evidence and information in the sector, which further limits the ability of financial backers to recognize their potential, as well as other legislative hurdles, such as intellectual property rights, varying tax regimes, and mobility issues. In line with the EU-2020 strategy for growth and jobs, the European Commission is trying to ensure that the culture sector is able to increasingly contribute to employment and growth in the member states; specifically, this involves the provision of direct financial and technical support in the form of grants or the establishment of networks and platforms. (16)

Latvia's efforts in CCIs shall follow the Commission's priorities in this field which include: a) attention to changing skills' needs by promoting innovation in education; b) coordinating member states reforms in regulatory and legal instruments, and c) developing policies and initiatives to promote market access for and investment in CCIs.

These priorities are complemented by a number of actions and initiatives through the EU Creative Europe program; besides, specific activities are also included, as well as projects on economic benefits from cultural diversity and publications on the state potentials in cultural and creative industries. The EU Open Method of Coordination assists in establishing different creative value chains in the digital agenda, e.g. in visual and performing arts, cultural heritage, artistic crafts, book publishing, music, films, TV, broadcasting and multimedia. (17)

Choosing smart specialization for Latvia, first of all, is an urgent political issue; although it has been inspired from the European Commission, it provides practical steps for the member states in reaching 3S aims. Second, 3S is an important issue of Latvian perspective economic growth: only finding its competitive edge Latvia can secure its progressive future. Third, Latvian 3S is based on creating more export-driven development, mainly through widely used manufacturing spheres (they are easy to structure and affiliate modern innovations). Finally, 3S in Latvia needs political and economic national investments in its future: to foster this process Latvia must adopt adequate political decisions concerning, for example, reduction of taxes (to make export competitive), reform public services (to reduce bureaucracy) and transform education system.

It seems that the next EU multi-annual financial budget will be slightly re-oriented, mainly in the cohesion funding: hence, priority for Latvian scientists to strive for additional financial support in cohesion funds for less developed regions. It means that the European regional development funds and, in particular the program for the Peripheral Maritime Regions (PMRs), allow for additional funding with about € 11 billion left in the next EU long-term budget. According to PMRs, which represent coastal regions and those areas on the periphery of the EU, several Latvian regions are currently classified as less developed regions under the Commission eligibility rules. These regions could

receive a significant share of the EU cohesion funds; some regions of Latvia would also be regarded as less developed regions for the period 2021–2027 (most of them could possibly receive EU support in excess of € 500 per capita for the seven-year period).

Smart specialization can be important in the development of Latvian energy sector. This sectoral move was underlined by the Commission in January 2018 and was aimed at facilitating partnership among European states, regions and universities in making common planning of investments in energy innovations and using more effectively the EU funds. This EU activity was called S3P-Energy with an active participation of the Commission, the European Committee of the Regions and the European Parliament. (18)

During 2018, there were created *five interregional partnerships* that brought *together sixty European regions* in closer partnership in such fields as bio-energy, solar energy, renewable marine energy, smart grids and sustainable buildings. The selected regions have already been moving to the practical phase: implementing pilot activities and defining business and funding plans. S3P-Energy will help to identify and combine EU funds to finance projects, in line with the EU Energy Union strategy and the EU Plan in strategic investments in jobs and growth.

Furthermore, two of the partnerships: in sustainable buildings and renewable marine energy — have been additionally selected to receive tailored support under a new EU-funded pilot action for interregional innovation. (19)

3.1.6 Optional reading on 3S issues:

- Smart specialization and innovative-led growth in the EU states. In: http://www.baltic-course.com/eng/good_for_business/?doc=131478&ins_print;
- EU new industrial policy: investing in a smart, innovative and sustainable industry. In: http://www.baltic-course.com/eng/good_for_business/?doc=133328&ins_print;
- Fuel-cell buses: solution for city air pollution. In: http://www.baltic-course.com/eng/baltic_states/?doc=133314&ins_print;
- Facing globalization: EU assists Baltic States in smart specialization. In: http://www.baltic-course.com/eng/good_for_business/?doc=133683&ins_print.

3.2 RESEARCH DIRECTIONS FOR LATVIAN INDUSTRIAL DEVELOPMENT AND MANUFACTURING

According to the EU requirement, the member states' GDP shall be composed of at least 20% by industrial and/or manufacturing production (in the EU context, a number of manufacturing sectors are included into industries as well). Therefore, Latvia, for example, with stringent conditions for development of industrial sectors may have opportunities to develop some manufacturing directions. However, industrial/manufacturing potentials greatly depend on the national development strategy, available resources and political will to design national industrial policy. In forming Latvian industrial policy, attention has to be given both to traditional development spheres (e.g. agro-sector, including eco-farming of still high importance for national growth), and some new ones, e.g. new clean transport means, artificial intelligence and sustainable smart manufacturing.

The industrial policy issues in the EU context are *the sole competence of the member states*; the EU institutions have only supplementing, supporting and coordinating means to “influence” the industrial development of states. Besides, the industrial sector includes the so-called second-level of production (manufacturing); and finally, the EU approach to industrial policy covers a whole spectrum of socio-economic development issues, combining the European internal market aspects to the EU basic four freedoms of movement of goods, services, people and capital, as well as in entrepreneurship and SMEs.

The current Fourth Industrial Revolution supports dynamic changes through new technologies and concepts including artificial intelligence (AI), circular- and bio-economies, etc. which would assist Latvian choice in manufacturing. (20)

However, opinions about AI in manufacturing differ, e.g. Stephen Hawking warned that “the development of full artificial intelligence could spell the end of the human race”; Microsoft founder Bill Gates argues that he did not understand “why some people were not concerned about artificial intelligence”. Elon Musk, *Tesla*, is very careful about artificial intelligence, saying that to prevent the biggest existen-

tial threats it would be necessary to introduce some national and international regulations to make sure “that we don't do something very foolish”. (21)

3.2.1 Latvian industrial/manufacturing perspectives

The role of science and innovative research in forming a progressive path for Latvian industrial/manufacturing future is extremely important; and in activating this role, the Commission provides sufficient support. For example, for several years the biggest ever EU research and innovation program Horizon 2020 is assisting the member states with industrial development: almost once a month the EU institutions arrange conferences analyzing perspective issues in modern manufacturing and its role by 2030. (22)

The best source for stimulating the Latvian industrial/manufacturing development is the EU Framework Program for Research and Innovation running until 2020 with a budget of nearly € 80 billion; it is the biggest multinational research program in the world funding research in all areas of science and innovation. The program is open to the world: researchers, universities, companies and institutes from all over the world can participate in research initiatives.

Due to difficulties in creating new industries or reviving the old ones in the Baltics, almost the only way to fulfill the EU requirement about 20% of GDP from industrial development is through the manufacturing sector with a strong innovative component!

There are multiple ways and programs to support transformation of the manufacturing industry. For example, the *collaborative robots* market is expected to be worth \$ 4.28 billion by 2023, growing at a rate of 56.94% between 2017 and 2023. European industrial potential in manufacturing is enormous, e.g. AI in manufacturing market is expected to grow from \$ 272.5 million in 2016 to about \$ 5 billion by 2023, at an immensely high growth rate! The growing usage of *big data technology*, *industrial internet of things (IoT)*, extensive usage of *robotics in manufacturing*, *computer vision technologies*, cross-industry partnerships and collaborations (with a significant increase in venture capital investments) would propel the growth of the AI in manufacturing market. (23)

AI in manufacturing could be both positive and negative: thus, a robot can protect a human being from any harm, but being programmed “inhuman” a robot can enter in conflict with the first presumption. However, AI suggests some other issues: ethical (pertaining to or dealing with morals or the principles of morality, pertaining to right and wrong in conduct, being in accordance with the rules or standards for right conduct or practice); anthropocentric (human beings are the central or most significant entities in the world), and democratic (in the interest of the whole community and not the singles).

3.2.2 European approaches to manufacturing

The EU is supporting transformation of manufacturing through several programs:

- *Factories of the Future*, so-called FoF partnership: it is € 1.15 billion program including over 250 projects with over 2,500 organizations participating and 60% of industrial companies; it provides over 30% of funding to SMEs in several national and regional FoFs.

- *European Factories of the Future Research Association* (EFFRA-project), which is uniting industry-led association representing private side in the *Factories of the Future* public-private partnership. EFFRA includes 170 large, small and medium industrial enterprises, research organizations, universities, industrial associations and clusters. Its aim is to connect SMEs with coordinating research agenda and the EU institutions. (24)

The EU manufacturing perspectives are great, e.g. by 2020 Germany and the UK will be among **ten global competitive countries**; the rest are from the US, China, Taiwan, India, Japan, South Korea, etc.

Box: Manufacturing role in Europe:

- It is a key sector transforming material and energy into high added value products;
- It is responsible for 80% of European exports with about 15–16% of aggregated GDP;
- It has huge potential to generate wealth and high-quality jobs;
- It provides thirty million direct jobs and sixty million indirect jobs in the EU-28. (25)

However, manufacturing ideas are not wide-spread among European SMEs: only 8% of 16–18 year olds would consider a job in manufacturing. The majority prefers to work in service-based industries: among them desk jobs are highly favored and 76% believed they are better paid and 84% think this job is more “glamorous”.

Less than ten young-people consider manufacturing career: young people and their parents consider manufacturing to be dirty, greasy and sweaty work aimed for people who didn’t do well academically in high school. They think that it is a dead-end career, low-paying and comprised of monotonous and brain-numbing tasks. Hence *teaching manufacturing* is important in schools and universities: it encourages youth to be future scientists, engineers, makers and inventors; it activates manufacturing hub for education uniting high schools, universities and research centers. Qualified workforce in technology needs to be trained in STEM system (science, technology, engineering and mathematics). Job market needs more technological based professionals capable to adapt to high-tech breakthroughs: automation, robotics, digital. Future graduates in science and technology are expected to be better considering rethinking education, investing in skills for better socio-economic outcomes.

The following directions of rethinking education at all levels for current industrial needs in Latvia might be considered: — master degrees/courses in combining Industry 4.0 and manufacturing; — STEM for qualified workforce; — cognitive and non-cognitive skills; — training elder workforce and immigrants, etc.

In order to ensure the competitiveness of European industry and manufacturing sector the following actions should be taken in the near future in order to attract people to manufacturing: manufacturing summer camps; manufacturing hub for education involving industry, research centers, universities and high schools; spreading information about manufacturing; adapting long-life learning to modern industrial/manufacturing needs, etc. (26)

3.2.3 EU policy towards industrialization of states

These activities include the following related topics: free movement of goods, free movement of services, industrial sectors and SMEs. Besides, the Commission’s DG GROW is responsible for the EU’s

general industrial sphere, which means that issues concerning either starting a new industrial/manufacturing sector or/and merging the existing one with a sector in another EU state are coordinated with the Commission. Such coordination creates most effective production forces in the member states with sufficient and qualified labor force and needed resources.

Therefore, the EU's industry, generally, is more than just a sum of the member states' industrial development: the idea is to make the so-called *unified regional industrial block*.

Therefore, the Commission's DG GROW responsibilities include:

- Renewing the strategy for completing the single market for goods and services, including extending the list of products to be recognized in all EU countries and eliminating remaining obstacles.
- Maintaining and reinforcing a strong and high-performing industrial base for the European internal market, by stimulating investment in new technologies, improving the business environment and easing access to markets and finance.
- Identifying new sources for high-value jobs and growth, in industry and services with a focus on start-ups. (27)

The EU states are active in industrial coordination, too: the Ministers of Economic of EU member states debate almost each month on issues of European *industrial policy* with a view of adopting common approaches to future industrial strategies. The regular, so-called competitiveness check-ups are integral parts of such sessions, focusing on common industrial policy objectives.

Research and innovation is another aspect in creating efficient and competitive industrial policy: generally it is the competence of different configurations in the EU Council of Ministers. For example, the Council considers ways to solve global challenges and industrial competitiveness in the EU multi-annual framework for research and innovation, the successor of the current Horizon-2020 program.

The overall objective of the strategy is to *eliminate the remaining economic barriers* from the single market. This would expand consumer choices and support new business models, thus boosting innovation and job creation. In October 2017, the European Council called for a *more integrated single market* able to deliver practical benefits for European citizens.

Box: EU single market for industrialization in numbers:

- Services account for more than **65%** of EU gross domestic product and **70%** of total employment;
- Public procurement represents around **19%** of the EU GDP, with over **€ 2.3 trillion** spent each year by public authorities and utilities; and
- Europe has over 5000 regulated professions, which equates to **50 million people** facing unnecessary regulatory obstacles to mobility. (28)

Persisting barriers to the free exchange of products and services, *insufficient enforcement* of existing EU rules and a low level of cross-border public procurement all limit opportunities for businesses and citizens. This results in fewer jobs and higher prices. At present, cross-border services account only for 5% of the EU's GDP, compared with 17% for goods. According to the European Commission, a more ambitious implementation of the existing services directive alone would yield a *1.8 % increase* in the EU's GDP.

3.2.4 Start-ups and scale-ups in industrial growth

The European Commission Communication the *Start-up and Scale-up Initiative* (2016) to Europe's next leaders provided the member states with the following set of perspective moves: a) *removing barriers* for start-ups and scale-ups in the single market, b) *facilitating partnerships* and access to commercial opportunities and skills, and c) ensuring a *better access to finance*. This initiative was an important step towards creating a favorable environment for start-ups and scale-ups in Europe; it would have a direct effect on *innovation, employment and economic growth*.

As to innovation, the opportunities are huge: a recent example from northern Africa shows that plastic waste can be used in a more productive way. After the Egyptian cotton crop witnessed difficult times, a few emerging recycling factories started to reuse plastic bottles to make fiber, which is then used to make polyester fabric. Cotton production in the country has slumped since 2011, a year of political upheaval that coincided with looser regulations that degraded the quality of local cotton. Less cotton is being planted, and it is starting to decrease globally,

too. Besides, government efforts to boost production ended up making cotton even more expensive. Thus, the recycling factories managed to fill the gap: cheaper fabric can be a good alternative to a declining cotton industry. The Pharaohs Polyester Staple Fiber Factory in Egypt is the one using an alternative to cotton. According to the manufacturers, polyester made from recycled fiber is increasingly in demand in the market and is being added to the once pure-cotton fabrics used in textile. (29)

The EU integration and industrialization processes (being freed from the traditional liberalism) gave place to the EU protectionist policies, e.g. at the beginning of 2019 Germany launched a new industrial policy which is more closely aligned with France with one general idea: to protect national champions against threats from China and the US. (30) German Economy Minister recently suggested to render a special support to some advanced industrial sectors of European importance, e.g. electric cars' batteries, chemicals, 3D-printing devices, machine engineering, medical devices, green technologies, defense, etc. The intention is so strong that even the EU competition rules shall be revised according to the EU's interests.

The two biggest EU industrial states are dissatisfied with the Commission's antitrust regulations that wanted to block merger between France's *Alstom* and Germany's *Siemens* in the rail sector.

One of the decisive elements in the EU-wide industrial policy is centrally planned economy (or more *dirigisme-type* policies, in the French manner) versus extensive liberalism. The topic is widely discussed among national councils of economic experts in the EU states, commonly called wise men, to secure economic and technological leadership of the biggest EU's economies. There are suggestions that instead of subsidizing industrial champions, the EU states should spend more on research, innovation and training the right skills.

However, in November 2018, the Council of the EU adopted a set of conclusions stressing the need for a future comprehensive and long-term EU strategy on industrial policy. (31)

3.3 COOPERATION OF EUROPE AND THE BALTIC STATES IN INDUSTRIAL DEVELOPMENT

The future of the industry of Europe and Baltic States depends on the ability to continuously adapt and innovate by investing in new technologies and embracing changes brought on by increased digitization and transition to low-carbon and circular economy. The EU's innovative measures to activate the industrial development of member states need to be assessed carefully by the Baltic States decision-makers.

European industrial development both in general terms and sectorally has been retaining strong and often leading positions in the global markets. Industry accounts for two thirds of the EU exports and provides jobs for 32 million people, with 1.5 million of these jobs created since 2013. But to maintain and reinforce its competitive advantage, some vital modernization efforts are required.

Industrial growth has been in the center of the European Commission's agenda since 2014 and almost all EU policies have been geared to empower industrial growth, to create jobs, boost European competitiveness, foster investment and innovation in clean and digital technologies, while defending European regions and workers affected by industrial change. (32)

3.3.1 Industrial innovation

New production technologies are changing Europe's industrial landscape and play an increasingly important role in determining the ability of states' businesses to compete globally, as technologies deliver higher productivity and benefit to national economies; besides, they also have a deeper impact on the nature and availability of work. At the same time, the global competition is becoming stronger; besides, the benefits of globalization and technological progress are unevenly spread across countries.

Commission's political guidelines have shown the importance of strong and high performing industries for the future of European economy in general and those of the member states. Hence, the creation of jobs and growth through innovation and investment has attracted attention both in the EU industrial policies and in the member states. For example, the EU's efforts towards closer capital markets union have

helped to mobilize resources to boost economic growth; the EU support for innovation helps industry and in particular SMEs in the states to gain strength. European industrial development is at the forefront of the global actions towards low-carbon and sustainable economies through bio- and circular-trends, clean energy, etc. (33)

There are several other EU initiatives that could be emulated in Latvia: for example, *key enabling technologies* (KET) which are already assisting the EU member states' industries compete globally. KETs inspire shifts to a greener economy, while modernizing member states' industrial base, and often creating entirely new industries; thus, KETS have become the key element of the member states' industrial policies. (34)

At the end of June 2019, the European Commission unveiled an initiative to support innovative researchers and SMEs in the EU states. A newly established European Innovation Council (EIC) will help researchers in the member states to turn their most radical ideas into innovative and revolutionary technologies. The EIC has three spheres of support: coaching, networking and funding. About € 3 billion is provided during 2018–2020 to fund most talented innovators and help SMEs to scale up and expand beyond European borders.

In June 2018, the European Council invited the Commission to launch a new initiative on increasing innovative research within the remaining period of Horizon 2020, the current EU research and innovation investment program, which runs until the end of 2020. In response to this invitation, in March 2019, the Commission announced an Enhanced EIC pilot for 2019–2020 to pave the way for a new European Innovation Council. The Center's activity is a part of the Horizon 2020 program, as well as the EU future and emerging technologies (FET) programs during 2019–2020; once the pilot phase is over, in 2021 the EIC will become a full-fledged program under Horizon Europe, a new research program for the next seven years. (35)

The EIC approach is to provide various kind of support to innovators, startups and companies with their ideas which are: first, radically different from existing products, services or business models; second, highly risky, and third, having the potential to scale up internationally. Thus, the EIC supports perspective ideas in any area of technology or business sector, including novel combinations of tech-

nologies and business models from feasibility to development and to the scale-up stages. (36)

The EIC is a key new initiative within the Innovative Europe pillar of Horizon Europe, the Commission's next research and innovation framework program for 2021–2027.

By incorporating FET Open and FET Proactive, the EIC will link ideas, results and participants from FET more directly with the innovators that can bring new technologies to the market. (37)

In the EIC program, the pathfinder scheme is particularly connected to the FET Open and FET Proactive pillars. For 30 years, the FET support program has been a key to the development of many of the digital technologies like artificial intelligence, quantum computing, and the Internet of Things (IoT) and to high-potential new concepts such as neuroprosthetics and artificial photosynthesis. FET research has also pioneered soft robotics, developed smart textiles that can monitor the wearer's body, and investigated energy storage at very high temperatures, to name a few. (38)

The EIC supports researchers and innovators developing high-risk, breakthrough innovations with the potential to create new markets while boosting jobs, growth and general prosperity in the European states. This support proceeds along two pilot-schemes: a) the EIC Pathfinder scheme (from April 2019 to the end of 2020) comprising FET-Open and FET-Proactive; and b) the EIC Accelerator building upon the SME Instrument. (39)

The EIC Pathfinder will support the development of future and emerging breakthrough innovations, including deep-tech innovations, while the Accelerator will aim to bridge financing gaps in the development, deployment and scaling-up of market-creating innovations, and leverage private capital and investment. The EIC Pathfinder is designed to help researchers bring radically new ideas to practical outcomes and demonstrate their commercial viability. The EIC Accelerator will fund high-risk and high-return innovative projects, and help SMEs and entrepreneurs to start up in the following spheres: Artificial Intelligence, implantable autonomous devices and materials, breakthrough zero-emissions energy generation for full decarbonization. (40)

The EIC's idea is to connect and co-design cooperation between the EIC Pathfinder scheme and the process of bringing innovations to mar-

ket, i.e. the cooperation that would boost EU's capacity to lead in the field of disruptive and deep tech innovation. There are also opportunities to preview some of the trail-blazing research carried out in the EU states into the technologies of the future, a number of which are already finding their way to users.

Building on thirty years of experience in the FET Program, the EIC Pathfinder has the potential to become a global landmark for breakthrough science and technology with its pilot scheme to test two main EIC's ideas in supporting advanced research in business and in creating new markets.

There are three spheres of support within the EIC: coaching, networking and funding:

- *Coaching and mentoring service* to SMEs is regarded as an important part of creating a growing and successful business. (41)
- *In networking*, the EIC offers business acceleration services to support SMEs. The networking opportunities exist through: a) match-making events with world-leading companies; b) access to trade fairs, and c) invitations to investor meetings. (42)
- As to *financial support and funding*, about € 360 million of the Pathfinder budget (up to the end of 2020) will go from the FET Open, supporting the early stages of research on radically new technological ideas.

During the same period, € 180 million will fund FET Proactive in targeting breakthrough technology in the following areas: human-centric artificial intelligence; implantable autonomous devices and materials; breakthrough zero-emissions energy generation for full decarbonization; future technologies for social experience; measuring the unmeasurable (the so-called sub-nanoscale science for nano-metrology); digital twins for the life-sciences; and environmental intelligence. (43)

The first EIC phase is financed from the Horizon 2020 and offers funding to innovative companies in support of market-creating innovations. This phase offers € 2.7 billion in funding for the period 2018–2020, as well as opportunities for networking, mentoring and coaching with a strategic advice to upgrade European innovative ecosystems.

3.4 DIGITAL SINGLE MARKET AND NEW SKILLS

The EU data economy is estimated at € 272 billion with the annual growth of 5.6%; the sector could employ 7.4 million people by 2020. Data can be used to improve almost every aspect of daily life, from business analysis to weather forecasting, from new era in medicine enabling personalized care, to safer roads and fewer traffic jams. The EU institutions have been constantly emphasizing the role of free flow of data among the member states. (44) The new initiative along with the digital single market as well as the accompanying digitization of industry also include new European proposals concerning the EU-5G action plan; both would help businesses in the member states to take advantage of new developments. (45)

Generally, the *European single market strategy* makes it possible for industrial sectors and SMEs to get access to the EU's markets composed of about 500 million consumers in the EU states and use connections in value chains free from customs or technical barriers. However, about 40% of European employers acknowledged that they could not find people with the right skills to grow and innovate. Finally, too few people have the entrepreneurial mindset and competences to start their own business and keep adapting to evolving requirements of the labor market.

The new European initiative on new skills (the actions approved during 2016–2017) includes about ten actions to be taken by the member states in the coming years.

The EU New Skills Initiative for the Baltic States is composed of the following actions:

- *A European/states' skills guarantee* to help low-skilled adults acquire a minimum level of literacy, numeracy and digital skills and progress towards an upper secondary qualification.
- *A review of the European qualifications framework* for a better understanding of qualifications and to make better use of all available skills in the European labor market.
- *The digital skills and jobs coalition* bringing together EU and states' education, employment and industry authorities to develop a

large European digital talent pool and ensure that individuals and the labor force in European states are equipped with adequate digital skills.

- *Sectoral cooperation on skills*, aimed to improve skills intelligence and address skills shortages in specific economic sectors.
 - *The skills profile tool for third country nationals* to support early identification and profiling of skills and qualifications of asylum seekers, refugees and other migrants.
 - A revision of the *Europass framework*, offering people better and easier-to-use tools to present their skills and get useful real-time information on skills needs and trends which can help with career and learning choices.
 - Activating *Vocational Education and Training (VET)* by enhancing opportunities for VET learners to undertake a work based learning experience and promoting greater VET's visibility of good labor market outcomes.
 - *Recommendation for the states on key competences* to help more people acquire the core set of skills necessary to work and live in the 21st century with a special focus on promoting entrepreneurial and innovation-oriented mind-sets and skills.
 - The member states' *graduate tracking* to improve information on how graduates progress in the labor market.
 - Exchange best practices on effective ways to address brain drain.
- (46)

3.4.1 Estonian example

The Swiss company *Business Investigation SA*, creator and developer of the GPS analytical platform for major applications based on artificial intelligence (AI) and machine learning (ML), has launched recently its sister company in Tallinn. The company is covering sales and service in the Baltic States, the Nordic countries and in Central Europe; besides, the Swiss company is moving its research and development centre to Tallinn, thus creating dozens of jobs for top AI and ML specialists over the coming years.

The Swiss company has found opportunities and the well-developed state ecosystem is the primary reason for moving to Estonia: because of the local know-how, expertise and infrastructures Tallinn is regarded as an important place to start expanding into the Baltic

Sea Region. In addition, the company is looking for future cooperation with Estonian government that is well known for the digitally advanced initiatives. The development of GPS application, based on AI and ML, integrated within the Estonian excellent platforms, would be mutually beneficial.

The *Business Investigation's* GPS platform development is a cooperative result between the Swiss Federal Institute of Technology in Lausanne and the School of Business and Engineering Vaud in Yverdon. To date, the *Business Investigation SA* has expanded to France, Germany, Italy, Chile, Egypt, Tunisia, India and China. Tallinn will be taking a central role in this network as the *Business Investigation's* IT development centre, where GPS, their core product, will be developed in the future.

GPS is an AI-based solution which uses machine learning for analysing work processes helping to optimise them and decrease a company's or government agency's costs as well as energy and time consumption. The function of GPS software lies in forecasting scenarios and identifying linearity in processes and flows, providing its users with information that supports more rational decision-making. However, the AI and ML market is still in its infancy: hence the company has been exploring research and technology that would help optimizing the processes for banks, insurance companies, industrial enterprises, medical facilities, the retail sector, airports, etc. (47)

3.4.2 Smart tourism

Latvia, as well as other EU states, is open to various types of traditional, innovative and sustainable tourism practices. Tourism in the EU is the third largest socio-economic activity, representing around 10% of the Union's GDP; the sector plays a crucial role in generating growth and jobs, while still holding untapped potentials.

The Commission has come with some initiatives for researchers aimed at achieving smart tourism in the EU states, so that both visitors and residents alike can benefit from new forms of tourism: educational, business, recreational, cultural, etc. These initiatives seek to strengthen tourism-generated innovative development in EU cities and their surroundings, increase their attractiveness while strengthening national growth and job creation. They also assist in establishing exchange of

best practices, creating opportunities for cooperation and new partnerships.

In order to compete for the title European Capital of Smart Tourism 2020, cities will demonstrate their innovative tourism practices in four areas: accessibility; sustainability; digitalization; cultural heritage and creativity. About ten European cities will present their city's smart activities and a jury will select two winners, i.e. European Capital of Smart Tourism in 2020, which will be announced at the end of 2019. Smart tourism responds to new challenges and demands in a fast-changing sector, including the expectation of digital information, products and services, equal opportunities and access for all visitors, sustainable development of the local area and support to creative industries and local talent. (48)

3.5 CASE STUDY. SCIENCE POLICY IN LATVIAN NATIONAL GROWTH STRATEGY

The focus of the book is to describe the role of science and research in Latvian perspective development; the research fields include both natural and social sciences (the latter also represent important sectors of research activities, particularly in politics and economics). Latvian socio-economic development has become a cornerstone of all spheres of national social science perspectives, including strategic aims, tactical solutions, chosen priorities, etc. Present and future politicians and economists will partly find answers to most pressing issues in the Latvian way forward in Europe and the world, formulating a new narrative for the country's political economy at the new stage in Latvian growth perspective.

Important messages to Latvian political economy from the EU institutions concern the national planning of socio-economic development for 5, 10 and 15-year periods in line with the European strategic guidelines. Important for the Latvian economic planning are recommendations from OECD experts: numerous OECD reports contain independent but quite important recommendations for Latvian political economy. So, the government budget priorities could be more specific, e.g. formulated around two main directions: a) *general*, which

includes long-standing public-private efforts, like increasing productivity and reducing income gaps between high-earning and low-earning population groups, facilitating export diversification while concentrating on high-value-added activities, reducing long-run unemployment and emigration, which contributes to skill shortage, etc. As to the quality of life in Latvia, life expectancy at birth is 74 years, six years below the OECD average; b) *specific*, which focuses on some specific priorities, e.g. like making more attractive vocational training/education, reducing problems in the health care system and housing market (as the availability of affordable quality housing is low), increasing trust in public institutions and law enforcement.

The EU-2020 strategy has shown already three main directions in Latvian perspective planning: *first*, the priority in Latvian development on research and innovation (the so-called smart growth); *second*, stimulating high level of employment, modernizing labor market with due respect for social protection (the so-called inclusive and high employment growth); *third*, Latvian political economy shall concentrate on a competitive, resource efficient and sustainable economy directions (the so-called green growth).

Thus, the role of scientists and researchers is to figure-out the most efficient ways to implement the EU recommendations for Latvian political economy. Besides, scientists can show the Latvian way with more fruitful and systematic integrative efforts with most positive effect for the strategic national interests.

Some extremely vital issues for Latvian economy include both universal European values and specifically national: the balance between the two is very important to sustain. For example, the development of such sectors (outlined in the Latvian National Development Plan) as national measures towards constant improvements of peoples' living and working conditions, strengthening the unity of Latvian economy with other member states and ensuring their harmonious development by reducing the existing differences among regions as well as providing for citizens' wide access to education and constantly updating methods of teaching.

Moreover, Latvian scientists have to find their place in modern development spheres (the so-called modern political economy), such as digital society, extensive innovations, energy security, etc. Social

scientists have to pay more attention to the changing role of the state, i.e. the state apparatus and other governing bodies in modern economic issues. The most progressive and reformative way is towards regulated market economy, where the state's instruments *would assist* the SMEs activities with the aim of increasing growth and peoples' wellbeing. These ideas correspond to the EU general direction of integration: creating *social market economies* in the member states, which would become important in stimulating employment and quality of life.

Besides, positive global growth development sends good signs to Latvian companies; with sufficient help from government they can reap sufficient benefits from digital aspects in corporate activities. Scientists in the world have already made valuable impetus in resolving modern national challenges, e.g. the United Nations suggested 17 Sustainable Development Goals (SDGs) that since 2016 have become an integral part of decision-making process in all EU states, including Latvia. Thus, theoretically, some of the Latvian present problems can be resolved by implementing global and European recommendations by following the most optimal and progressive growth paths; scientists have to make some nationally-adequate solutions stemming from both the global (SDGs) and the European solutions (the EU-2030 Agenda). The latter includes: a) making the SDGs part of the Latvian political economy framework, and b) practical implementation of the European longer term vision for the member states' sectoral policies. Latvian scientists and researchers must thoughtfully analyze the 17 Sustainable Development Goals and 169 associated targets in order to balance the three dimensions in national sustainable development: environmental, economic and social. It means, for example, to accommodate environmental protection and economic growth in a way that the new clean technologies assist in creating high quality life in Latvia; fuel cell buses in Riga is a good example.

On the other hand, the European Consensus on Development (ECD) reflects a paradigm shift in developmental policies through the 2030 Agenda, responding to the more complex and interconnected challenges Latvia is currently facing. The ECD shows that the EU's shared vision in most of the European integration policies concentrates on the cross-cutting drivers in development, such as equality, youth initiatives, entrepreneurship, sustainable energy, climate action, invest-

ment and mobility. The ECD is to increase the credibility, effectiveness and impact of the EU integration policies in Latvia based on shared analysis, common strategies, joint programming and actions.

The role of the Latvian Academy of Sciences (LAS) has to be specifically mentioned as a qualified national intellectual and scientific advisory institution on national socio-economic development issues. The Academy staff is actively involved in promoting the smart development strategy in Latvia, initiated in the Europe 2020 Strategy and the National Development Plan of Latvia for 2014–2020 (NDP 2020). In order to activate this process, Latvian scientists and business community have to be aware of the recent EU policy trends and actions in development as about 70% of Latvian legislation originates in the EU institutions.

A proper information supply is important to determine the Latvian perspective in proper directions and advantages in European and global competitiveness. So far, in the present global competitiveness rating Estonia ranks 30th, Lithuania 35th and Latvia 49th among 138 states of the world. Latvian political elite should treat such estimates as a serious signal for urgent steps to be taken to increase competitiveness. However, the NDP 2020 sets a very modest task — to stand 45th in the global competitiveness ranking by 2020.

To facilitate the process of adjustment to modern development strategies, Latvian science community is to be supplied with the EU signals on prospective socio-economic development guidelines; the LAS can provide a substantial assistance. The LAS' publication "Modern EU Information Resources for Latvia" distributed electronically to its members is about recent steps on the most important issues for Latvian economic and social development suggested by the Commission's Directorate of Sectoral Policies. There are about 30 different policy directions administered by the European Commission. Such informative leaflets published quarterly are supplemented by analytical reviews about state-of-the art in most promising for Latvia spheres of EU policies, including agro-rural issues, digital and science policies as well as construction, energy, transport, environment, etc.

According to the EU rules, Latvian government submits Latvia's Stability Program for 2019–2022 to Parliament in spring 2019; the Ministry of Finance — the financial issues of the Stability Program to the

European Commission at the same time. Thus, Latvian public authorities have to include into the strategic planning the science, technology and innovation issues. Besides, the Ministry of Defence has to stick to NATO requirements of 2% defence budget during 2020–2022; and the forecasts for fiscal space by the year 2020 is about € 12 million; during 2021 — about € 81 million, and in the year 2022 it predictably shall be about € 176 million: is there room for additional spending in science policy?

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 35. More on future and emerging technologies, FET at: <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/future-and-emerging-technologies>.
 36. More about EIC at: <https://ec.europa.eu/research/eic/index.cfm?pg=about>; About the EIC wizard at: <http://ec.europa.eu/research/participants/portal/data/eic/screen/home>.
 37. More on Horizon Europe at: https://ec.europa.eu/info/designing-next-research-and-innovation-framework-programme/what-shapes-next-framework-programme_en#relatedlinks.
 38. More at: <https://ec.europa.eu/digital-single-market/en/news/great-science-thrilling-technology>

39. More at: <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/european-innovation-council-eic-pilot>
40. More at: <https://ec.europa.eu/research/eic/index.cfm?pg=funding>
41. See more at: <https://ec.europa.eu/research/eic/index.cfm?pg=coaching>.
42. See more at: <https://ec.europa.eu/research/eic/index.cfm?pg=networking>.
43. More on FET and its impact analysis at: <https://ec.europa.eu/digital-single-market/en/news/future-and-emerging-technologies-impact-analysis>
44. More on the creation of a properly functioning data economy in the member states in the Commission press release: http://europa.eu/rapid/press-release_IP-17-5_en.htm?locale=en
45. More on the EU digital agenda strategy can be seen in: https://ec.europa.eu/commission/priorities/digital-single-market_en; on the digitization of industry, there is a comprehensive Commission's website: <https://ec.europa.eu/digital-single-market/en/policies/digitising-european-industry>
46. More on the new skills in: http://europa.eu/rapid/press-release_IP-16-2039_en.htm Additional information on industrial policy actions is in the following web-links: [State of the Union 2017 web page](#); [The 10 political priorities of the European Commission](#); [Factsheet "A holistic strategy and a strong partnership in a new industrial age"](#); [Factsheet "Making Europe's industry stronger: Key Commission initiatives"](#); [Stockshots: A Renewed Industrial Policy Strategy for Europe](#); [Annex — Next steps on key actions](#); [2017 list of Critical Raw Materials for the EU](#). Latvian version at: http://europa.eu/rapid/press-release_IP-17-3185_lv.htm
47. More on the company's platform in: <http://www.corpore.ee/>
48. More on the smart tourism concept in: <https://smarttourismcapital.eu/>

PART IV SCIENCE AND RESEARCH FOR LATVIAN GROWTH STRATEGY

- 4.1 Perspectives in national growth: science policy's implications in Latvia
 - 4.2 SDGs and innovative research
 - 4.2.1 Financial mechanism to support sustainability
 - 4.2.2 Financing energy efficiency: research perspectives in Latvia
 - 4.3 Towards clean energy strategy in Latvia and the other Baltic States
 - 4.4 Researchers' impetus to waste management
 - 4.4.1 Waste management, renewables and circular economy in Latvian business
 - 4.5 Science and research for Latvian agro-sector: options for growth
 - 4.5.1 New aspects of the CAP for Latvia
 - 4.5.2 CAP's role in promoting rural prosperity
 - 4.5.3 Agro-investments and financial support for farmers
 - 4.5.4 Combining EU and Latvian efforts in agro-policy
 - 4.5.5. EU regional policy and Latvian agro-sector
 - 4.5.6 Regional and urban issues
 - 4.6 Coastal fisheries: a window of opportunities for researchers
 - 4.7 Turning research into innovative SMEs
- References and Notes

4.1 PERSPECTIVES IN NATIONAL GROWTH: SCIENCE POLICY IMPLICATIONS IN LATVIA

There are over 1.8 million researchers working in thousands of universities, research centers, industrial and manufacturing companies, etc. They actively participate in cooperative projects across borders, research sectors and scientific disciplines.

The European Commission's priorities to create in the member states a dynamic environment for research and innovation by free exchange of information (while attracting world-class talents) make the states striving for a global scientific leadership easier.

During recent debates on the future of Europe, the EU authorities underlined the necessity to stimulate research, innovation and investment (RI&I) in the member states. European research cooperation, generally, can serve to promote exchange of researchers and ideas among countries with a clear added-value for European progress. Several statements by the EU High Level Group on maximizing R&I impact of EU, acknowledged the necessity of increasing investments in research and innovation.

However, numerous EU states are still far from achieving the Union's 3% target on science and research investments that was set already at the end of 2014 in the EU-2020 strategy. The active involvement of member states in supporting RI&I will increase general socio-economic development opportunities in a post-2020 world; besides, the new EU multi-annual budget shall reaffirm R&I investment as a long-standing priority. The advantages are obvious: R&I make a remarkable contribution to job creation and boost economies of European states as every € 1 invested in science and research results in a GDP increase of about € 6–8.5; with a projected total benefit to the European growth by up to € 600 billion in 2030.

Some Baltic States (e.g. Estonia during its six-month presidency of the Council) advocated a significant increase in national and EU research for innovation funding. The Estonian academic community urged all EU states to take immediate key steps to increase public and political support of RI&I; it was underlined in the Tallinn Call for Action 2017 presented at the high-level conference "European Research Excellence — Impact and Value for Society", which was held under the Estonian Presidency of the Council. Among the priorities were included national actions to ensure broad political commitment for increasing research and innovation funding; the impact of these innovative investments and public trust could refer to the following spheres:

- R&I gives a real chance to build a better future; it is critical to achieving the European political vision and values, and leads to deeper

understanding of changes in societies, while increasing human ability to master uncertainty and to embrace change.

- Investing in research and innovation is a necessity for competitiveness: creativity has been always the main capacity to increase wealth. The member states would have to increase public R&I investments to a desired 3% of GDP in order to create new ideas and quickly apply the new knowledge.

- New and pioneering research forms the basis for an efficient education and good climate for innovation. There is often too much pressure for public funding in focusing on R&I to produce immediate and short-term outcomes, neglecting the many contributions of research to society and the economy, including equipping people with the skills they need to thrive in future jobs.

- Stronger efforts are needed to make the benefits of R&I visible and understandable by all and to achieve wide citizen involvement. Increased public trust in scientific knowledge, as well as engaging people in shaping common future, are the foundations for ensuring greater R&I impact.

- R&I is essential in uniting European research cooperation in forging stronger links across borders and helping in creating trust and tolerance among academic communities. (1)

Estonian government initiatives to increase innovative investment have set a good example: budget allocations for science research and development will increase to 3% of GDP in 2020, which is the EU's aim. The Estonian scientific community already actively participates in transforming the research achievements to businesses. Universities and research institutions promote research and innovation in ecosystems that support co-creation, interdisciplinary collaboration and knowledge exchange which encourages mobility and career development. Estonian government is of the opinion that increased and more stable funding should be guaranteed to universities and research institutions.

In April 2019, the European Parliament agreed on the *InvestEU*, a program to boost investment in the member states during the next long-term EU budget. The agreement brings *InvestEU* closer to its practical implementation: thus, *over the next decade, the program will unlock at least € 650 billion to be invested in the European future growth and peoples' well-being. InvestEU* will make EU funding for investment

projects simpler to access and more effective. The program will bring together under one roof and with a single brand the European Fund for Strategic Investments and 13 other EU financial instruments currently supporting investment in the EU. The European *investment plan will put member states' entrepreneurship back on an active path fulfilling the EU and the states' main priority: creating jobs and growth. By making smart use of the EU budget, the InvestEU would help the states to be among attractive investors worldwide along with businesses and entrepreneurs getting easier access to EU funding while turning their ideas into concrete projects. Thus, the program will keep the member states at the forefront of innovation and climate action, while creating jobs and ensuring a growth model that is socially, environmentally and economically sustainable.*

Increasing the member states' innovative potentials in investment shall be done by using public resources in the states (so far quite limited) with the EU budget guarantees to leverage substantial private and public funds. The € 38 billion guarantee will target investments in **four main areas**: sustainable infrastructure; research, innovation and digitalisation; small and medium businesses and social investment and skills. The program is expected to trigger at least € 650 billion additional investment in the EU states.

Latest figures from the European Investment Bank, the Commission's strategic partner, show that by April 2019, the European Fund for Strategic Investments (EFSI) had mobilized almost € 393 billion of investments. Operations approved under EFSI so far represent a total financing volume of € 72.8 billion in all EU-28 states. The EIB has approved 524 infrastructure projects supported by EFSI for € 53.8 billion, while the European Investment Fund has approved 554 financing agreements for small and medium businesses worth € 19 billion, which should benefit about a million companies. (2)

4.2 SDGS AND INNOVATIVE RESEARCH

The EU and the member states' policies followed the global community's objective of a more sustainable and circular economy, low-carbon development and preventing climate change. After the adoption of the

UN 2030 Agenda for Sustainable Development, the EU institutions have developed some vital initiatives for the member states, which at the same time served as an inspiration for a wide range of scientists and researchers to accelerate innovative efforts in sustainability. The EU initiatives include major socio-economic activities that should be taken into account in national science policy's guidelines, in academic and business communities. These initiatives are part of the EU energy and climate framework (incorporating the ideas of the EU Energy Union), the circular economy action plan, and the EU Agenda 2030 for Sustainable Development; all three initiatives are part of the Capital Markets Union's project.

- *The first initiative* is included into the European Council-2030 framework for *climate and energy*; several targets for the member states' researchers are included into the framework with the general idea of assisting states achieve a more competitive, secure and sustainable energy system and to meet its long-term 2050 greenhouse gas reductions targets. All these efforts are supposed to inspire scientists and researchers in following the European climate and energy targets for 2030, which include: the following directions: a) about 40% cut in greenhouse gas emissions compared to 1990 levels; b) at least a 27% share of renewable energy consumption; c) improving energy efficiency by at least 27% (with a view of further 30%); and d) the completion of the Union's internal energy market by achieving the existing electricity interconnection target of 10% by 2020, with a view to reaching 15% by 2030. (3)

- *The second initiative* for the member states' researchers (adopted in January 2018) is about the member states' *circular economy plans*, which will help to transform the states' economies along the sustainable direction. In this regard, the main targets include: a) recycling all plastic packaging by 2030; b) scientists in the states shall address the connections among the chemical industry, production sector and waste management to formulate the national strategies for waste, products and chemicals; c) monitoring progress in national circular economy along *ten key indicators* cover all phases of production, consumption, waste management, secondary raw materials, investments, jobs and innovation; d) researching efficient use of critical raw materials in the national circular economy. (4)

- Finally, the *third initiative* covers scientists and researchers' impetus into developing the *sustainable development strategies* in the member states; the latter are obliged to transpose the global and European-2030 Agendas into national growth patterns. Although the EU institutions continue to play a leading role in delivering on the implementation of these transformative and universal agendas in the states, the latter take the main burden in delivering the practical steps in national sustainable development policies. (5)

4.2.1 Financial mechanism to support sustainability

Current levels of investment are not sufficient to support an environmentally oriented and sustainable economic system that combats dangerous climate changes and resource depletion. More private capital flows are needed towards sustainable investments to close the existing € 180 billion gap of additional investments needed to meet the EU's 2030 climate and energy targets. The Commission's first step was the Action Plan on Financing Sustainable Growth (March 2018); the plan was initially reviewed by the High-Level Expert Group on Sustainable Finance (established already in 2016). The Commission also conducted public consultation on institutional investors and asset managers' duties regarding sustainability.

The Action Plan and the Expert Group underlined that sustainable finance is based on two urgent imperatives: a) improving the contribution of finance to sustainable and inclusive growth by funding society's long-term needs; b) strengthening financial stability by incorporating environmental, social and governance (ESG) factors into investment decision-making. (6)

During 2018, the Commission discussed with the states some practical aspects of sustainable finances; it confirmed the support for the member states' leaders and key private players for necessary changes in the sustainable financial system. Seeing the difficulties in providing support for low-carbon development and sustainability in the states, the Commission suggested some financial incentives (with some indication points) on financing sustainability research and development; now it is the member states' turn to endorse the new rules. (7) They are oriented on: (a) climate-transition indication points (in the Commission's papers they are called benchmarks), and (b) creating EU-national

specialized investment portfolio; both rules are in line with the Paris Climate Agreement (2015) on limiting global temperature increase to 1.5° above the pre-industrial levels.

The positive aspects of innovations have been recognized by the states; the new rules also support the Capital Market Union's ideas to connect financial market with the real economy and the states' agendas for sustainable development. (8) These new rules represent a new trend in financing circular economies, too, e.g. to scale up private investment towards better SDGs and the objectives of climate agreements; the Commission has already drafted some legislative measures to follow up the first ever EU Action Plan on financing sustainable growth. (9)

The proposed regulated benchmarks for low-carbon investment strategies also include: a) establishing a unified EU classification system (taxonomy) of sustainable economic activities; and b) measures to improve disclosure requirements related to sustainability risks and opportunities. Investors will benefit from two benchmarks to pursue their ambitious climate strategies; in this way the member states will activate the means to finance sustainable growth and re-orient capital flows towards sustainable investment.

Thus, it can be concluded that the EU has already taken new steps, which demonstrated that the states' sustainable finances and a stronger EU capital market can work together; in this way, the states could become more attractive for investors by setting high disclosure standards and paving the way for long-term sustainable investment policies.

Another vital incentive for researchers in the financial sector concerns the so-called voluntary labels. These benchmarks have an important impact on investment flows: many investors would rely on them in creating investment opportunities, in measuring the performance of investment products and in asset allocation strategies. The two new benchmark categories are voluntary labels designed to orient the choice of investors who wish to adopt a climate-conscious investment strategy. The climate-transition benchmark will offer a low-carbon alternative to the commonly used benchmarks.

The new label is designed to give additional assurances to avoid greenwashing, i.e. investors are deceived by a company's misleading or unsubstantiated claims about the environmental benefits of its activities. The EU institutions also agreed to grant providers of critical

benchmarks (e.g. interest rates such as Euribor or EONIA) two extra years until 31 December 2021 to comply with the new requirements of the EU benchmark regulation. Technical experts will advise the Commission on selecting companies eligible for inclusion in the new benchmarks; after that, the Commission will propose draft on rules covering the composition of both benchmarks in detail. Given the crucial importance of third-country benchmarks for EU companies, the extra two years for benchmarks produced outside the EU was also introduced to provide additional time for work with non-EU regulators on how these benchmarks can be recognized as equivalent or otherwise endorsed for use in the EU states. The new mechanism is in place: the European institutions have made steps to formulate the indication points on financing low-carbon economies; the member states just have to approve the new rules. (10)

4.2.2 Financing energy efficiency: research perspectives in Latvia

The construction sector is responsible for approximately 40% of energy consumption and 36% of CO emissions in the EU. Currently, about 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy *inefficient*, while only 0.4–1.2% (depending on the country) of the building stock is renovated each year. Therefore, more renovation of existing buildings has the potential to lead to significant energy savings — potentially reducing the EU's total energy consumption by 5–6% and lowering CO emissions by about 5%. Improving the energy efficiency of buildings can also generate other economic, social and environmental benefits. Better performing buildings provide higher levels of comfort and wellbeing for their occupants, and improve health by reducing illnesses caused by a poor indoor climate. It also has a major impact on the affordability of housing and on the concept of energy poverty. Improvement of the energy performance of the housing stock and the energy savings it brings would enable many households to escape energy poverty.

The European Investment Bank (EIB) approved in February 2018 the creation of a brand new financial instrument, the *smart finance for smart buildings initiative*, with the aim of making investments in energy efficiency projects in residential buildings more attractive to private investors, mainly through the use of EU grants as a guaran-

tee. This new instrument, together with other EU policy initiatives for smart buildings, aims to unlock a total of € 10 billion in public and private funds up to 2020 for energy efficiency projects. It is estimated that this could support up to 220,000 jobs, and help establish a renovation market for small businesses worth up to € 120 billion. In addition, up to 3.2 million European families could be taken out of energy poverty. (11)

The *Smart Finance for Smart Buildings* facility will improve the use of public EU funding and will multiply the financial investment's effect: it will help to de-risk investments in the buildings sector, giving investors and financiers a better understanding of the risks and benefits of energy efficiency investments. Moreover, it will offer assistance with project development, as many households lack the skills and capacity to set up, implement and finance ambitious energy efficiency projects. (12)

Investments in energy efficiency also stimulate the economy, in particular the construction industry, which generates about 9% of Europe's GDP and directly accounts for 18 million direct jobs. SMEs would particularly benefit from a boosted renovation market, as they contribute more than 70% of the value added in the EU building sector.

In July 2018, the revised Energy Performance of Buildings Directive (2018/844/EU) entered into force, amending Directive 2010/31/EU. The Directive is aimed at accelerating the cost-effective renovation of existing buildings, with the vision of a decarbonized building stock by 2050 and the mobilization of investments. The revision also supports electromobility infrastructure deployment in buildings' car parks and introduces new provisions to enhance smart technologies and technical building systems, including automation. Member states have to transpose its provisions into national law until 10 March 2020. (13) Under the current Energy Performance of Buildings Directive, the following measures shall be taken by the member states:

- All new buildings must be nearly zero-energy buildings by 31 December 2020 (public buildings by 31 December 2018); (14)
- *Energy performance certificates* must be issued when a building is sold or rented, and they must also be included in all advertisements for the sale or rental of buildings;
- EU countries must establish *inspection schemes* for heating and air conditioning systems or put in place measures with equivalent effect;

- EU countries must set *cost-optimal minimum energy performance requirements* for new buildings, for the major renovation of existing buildings, and for the replacement or retrofit of building elements (heating and cooling systems, roofs, walls and so on); and
- EU countries must draw up *lists of national financial measures* to improve the energy efficiency of buildings. (15)

The EU has increased the amount of public funds available for energy efficiency. However, to meet the objectives of the Energy Union and support the transition to a clean energy system, there is a need to further unlock private financing, in particular for energy efficiency investments. It is estimated that an additional € 177 billion per year will be necessary over the period 2021–2030 to reach the EU’s energy and climate objectives for 2030. (16)

However, there is a necessity to changing the risks for financiers and investors: there is growing evidence that the risks associated with energy efficiency investments are lower than the level perceived by the market and that the associated probability of default is lower than other types of investment. It is still difficult for banks and investors to assess the risks associated with energy efficiency investments. The Commission, in collaboration with the Energy Efficiency Financial Institutions Group (EEFIG), has developed *two products* that aim to inform financial institutions, investors and project promoters about the real benefits and risks of energy efficiency investments:

- a) The De-risking Energy Efficiency Platform (DEEP) is a pan-EU open-source database containing detailed information and analysis of over 10,000 industrial and buildings-related energy efficiency projects. It builds performance track records and helps project developers, financiers, and investors better assess the risks and benefits of energy efficiency investments across Europe. The Commission encourages all market players to support this initiative by sharing available data and performance track records. (17)
- b) The Energy Efficiency Financial Institutions Group (EEFIG) created an underwriting toolkit, a guide to value and risk appraisal for energy efficiency financing, which was launched in mid-2017. It aimed at helping financial institutions scale up

the deployment of capital into energy efficiency. It also helped promoting bankable projects, and can be used by public authorities to better assess energy efficiency projects that receive public funding. (18)

Aerogel-materials can serve as an example of combining research and effective investment. Aerogels are a class of advanced porous materials with huge potentials; however, despite being discovered back in the 1930s, this potential has never turned to a booming commercial reality. Since the turn of the century there has been significant growth, but the industry has once again stalled before greater growth. IDTechEx forecast that the market will return to a growth phase and overall exceed \$530 million for manufacturers by 2029 in the report “Aerogel 2019–2029: Technologies, Markets and Players”. (19) IDTechEx is a leading provider of market intelligence for advanced materials and other emerging technologies. This report provides granular technical analysis of the industry providing player profiles, market forecasts, manufacturing solutions, material bench-marking and more for both organic and inorganic variants. (20) The aerogel’s industry is dominated by silica aerogels and their use as composite blankets in energy and industrial insulation. The silica aerogel industry is expected to grow as a result of a resurgence of use in established industries, diversification into new markets, and new market entrants or technology enhancements enabling this progression. The IDTechEX outlined four key challenges facing the new industry and ways to tackle the problems. (21)

4.3 TOWARDS CLEAN ENERGY STRATEGY IN LATVIA AND THE OTHER BALTIC STATES

The EU institutions recommend the Baltic States to put an end to the fossil fuel consumption which would reduce these states’ dependence on imported energy sources. For example, the Lithuanian-American gas supply agreement to cover Lithuanian energy mix is regarded as a temporary solution and actually contradicts the energy strategy of the Nordic region. However, the gas supply contract between the

Lithuanian gas company *LDT* and a couple of the US energy companies is regarded commercially feasible; besides, Lithuania also receives liquefied natural gas (LNG) from the Norwegian Statoil company.

It seems that gas shipment facilities to the Baltic States will go on: the market situation and its development, according to Lithuanian officials, shows an expected increase in the amount of these shipments and more LNG shipments from the US are expected to follow after the first LNG cargo delivered to Klaipeda in August 2017. Lithuanian energy experts acknowledged that US LNG was cheaper than the gas from Russia; though they do see that Russian gas would be forced out of the market. At the same time, there is a visual increase for Russian gas supply in Central and Western European states: export has increased by over 16% in Germany, by about 75% in Austria, by about 27% in Slovakia and the Czech Republic. As to the Baltic States, the demand for gas increased, correspondingly, by 90% in Estonia, 75% in Latvia and 125% in Lithuania. (22)

Some experts regard it as an alarming issue due to the so-called over-contracting situation in the European gas supply, i.e. there are more supply offers than the real consumers. For example, before the crisis in 2008, gas consumption in the EU exceeded the available supply offers; hence energy futures contracts have been in line with the expected growth. However, currently most EU states are re-assessing their gas supply models along the changes in structural energy mix and opportunities offered by renewables. (23)

It has to be noted that the oil prices are going up and down constantly, e.g. strengthening the profit of major oil producers opened the door to more mergers in the sector. Big global energy companies witnessed sharp fluctuations in oil prices (e.g. during 2018 the decline in oil prices for a barrel of crude oil was about \$52, which was less than half its peak in early 2014). Recent downward changes in global oil demand coincided with the global economy's gradual shifts to lower gear. According to the European Commission's predictions, average oil price would be about 14% lower in 2019 compared to 2018; for the European economy, the expected decline in oil prices could do more good, as oil prices are going to be about 20% lower in both 2019 and 2020. (24)

Some states in the Nordic region have decided to cut oil/gas consumption, e.g. the Danish energy company sold its oil and gas business in the North Sea to the French energy giant *Total* for about \$5 billion

with the idea of turning the Danish energy policy towards renewables: by 2050 the country will end up using any fossil fuels. (25)

A package of measures to keep the Baltic States competitive at the time when clean energy has been changing the global energy markets was included into a special EU program for transition to *clean energy*, adopted in November 2016. The EU institutions suggested the states to cut CO₂ emissions by at least 40% by 2030 while modernizing their economies along three main goals: energy efficiency, renewables and providing cheaper solutions for consumers. (26)

4.4 RESEARCHERS' IMPETUS TO WASTE MANAGEMENT

The EU revised legislation on waste management entered into force in July 2018. It sets clear targets for reduction of waste and establishes an ambitious and credible long-term path for waste management and recycling.

Key elements of the revised waste proposal include:

- a) common European targets for recycling 65% of municipal waste by 2035 and for recycling 70% of packaging waste by 2030;
- b) recycling targets for recycling of specific packaging materials: paper and cardboard by 85%; ferrous metals by 80%; aluminum by 60%; glass by 75%; and wooden products by 30%.

By 2030, all plastic packaging should be recyclable; to achieve its ambitious vision, the EU strategy foresees actions to improve the economy and quality of plastic recycling, such as: reducing plastic waste and littering, activating investments and innovation, as well as taking measures in line with reducing negative effect on climate change.

Important among these targets is a binding landfill target: to reduce landfill to maximum of 10% of municipal waste by 2035.

Besides, separate collection obligations in the member states are aimed at strengthening and extending recycling processes for hazardous household waste by 2022, bio-waste by 2023 and textiles by 2025. (27)

4.4.1 Waste management, renewables and circular economy in Latvian business

The data of the Latvian Central Statistical Bureau (CSB) show that gross consumption of renewable energy resources in Latvia (2016) constituted 68.7 petajoules (PJ), of which about 50 PJ is to fuel-wood. Compared to 2015, the consumption of renewables has risen by about 6%, whereas over the past ten years — by over 14%.

As the gross consumption of renewable resources (mainly formed by domestic energy resources) increased, Latvia's dependence upon imported energy resources reduced from 66.7% in 2006 to 51.2% in 2015. (28)

A significant increase was recorded in consumption of biogas (land-fill gas, sewage sludge gas, other biogas) — 12.7 times during the decade, reaching 3.8 PJ in 2016. Over the decade, the gross consumption of fuel-wood has increased by 9.3%, reaching 54.3 PJ in 2016, whereas compared to 2015 it has gone up by 3.2%. In 2016, the share of fuel-wood in the gross energy consumption accounted for 29.4%, which is by 0.8 % higher than in 2015. During the same time, the exports of fuel-wood rose: in 2016, Latvia exported 37.9 PJ of fuel-wood, which was by 12.6% more than in 2015. Wood pellets constituted 29.3 PJ of the total volume of fuel-wood exported in 2016, which is by 4.7% more than in 2015, whereas the volume of wood chips exported rose by 79.4%. The highest consumption of fuel-wood was recorded in the household sector; however, it has declined by 41.6% during the decade, constituting 34.6% of the gross consumption of fuel-wood in 2016. Compared to 2006, the volume of fuel-wood consumed in industry and construction has risen 2.7 times: in 2017, fuel-wood consumption in the sectors constituted 25.4% of the gross fuel-wood consumption.

During the last decade, the share of renewable resources consumed for the production of electricity and heat in the energy transformation sector has grown by 18.6 percentage points, in 2016 reaching 33.1% of the gross consumption in this sector. Compared to 2015, the consumption of fuel-wood in the energy transformation sector has gone up by 22.0%. From 2006 to 2016, fuel-wood consumption in this sector has risen 2.5 times, reaching 18.0 PJ last year. The largest share (88.2%) of the consumed fuel-wood is taken by wood chips that reached 15.9 PJ in 2016. It may be explained by the growing number of *combined heat and*

power (CHP) plants and the share of renewable sources in the energy transformation sector and reduction of the share of natural gas.

In 2016, electricity that was produced from renewable sources was 3 482 GWh; compared to 2015, the volume has risen by 25.4%. In 2016, due to the higher inflow to rivers the volume of electricity produced in hydropower plants constituted 2 530 GWh — by 36.0% more than in 2015. Over the decade, the volume of electricity produced in wind power plants has increased from 46 to 128 GWh or by 178.3%, the volume produced in biomass electrical power plants and CHP plants has risen from 7 to 427 GWh, and the volume produced in biogas CHP plants — from 36 to 397 GWh.

The EU Directive 2009/28/EC on promotion of the use of energy from renewable sources stipulated that the share of renewable sources in gross energy consumption in 2020 should comprise 40%. Latvia has the third highest share of renewables in the energy consumption in the European Union (the highest share was recorded in Sweden (53.9%) and the second largest in Finland (39.3%)); in 2015, the Latvian indicator constituted 37.6% (EU average is 16.7%). Moreover, by 2020, each European state shall ensure that the share of energy from renewable sources (biofuel, biogas, electricity produced from renewable sources and consumed in transport) would comprise at least 10% of the final energy consumption in transport; in 2015–2016 the Latvian renewables' share reached 4%. (29)

4.5 SCIENCE AND RESEARCH FOR LATVIAN AGRO-SECTOR: OPTIONS FOR GROWTH

The food and farming sectors become an important field when taking political decisions concerning Latvian industry and manufacturing. In this direction, the EU support is becoming vital: the Commission's ideas of supporting farmers through *sustainable agriculture* with simpler and more flexible rules are paving the way to the member states' more modern food and farming sectors. Following the principle of subsidiarity, new agricultural policies shall be re-assessed by the states in developing national food and farming sectors with sufficient control from the Commission. The Common Agricultural Policy

(CAP) is the oldest EU common policy (adopted in 1962). Almost each new Commissioner tried to “revolutionize” the European agro-sector; hence, the sector went through about half a dozen CAP reforms. However, the member states agricultural production is still far from being perfect and efficient; besides, new global challenges require adoption of accommodation efforts. Such new efforts cannot be done just by the policies from above: they need active and effective steps through political-economic decisions in the member states (the so-called subsidiarity approach); and again, with a proper coordination from the Commission.

Since February 2017, the European Commission conducted consultations with the member states on the CAP’s future in order to better understand the ways the current policy could be simplified and modernized. During the first three months of the consultation period, the European Commission received more than 320 000 replies, mostly from individual farmers, with the general outcome that the European agro-sector wants a strong common agricultural policy at the EU level. However, the farmers underlined as well the need for: a) simpler, more flexible agro-rules focused on meeting key challenges; b) fair standard of living for farmers, and c) preserving the environment and tackling climate change.

4.5.1 New aspects of the CAP for Latvia

Generally, the new policy’s goal is to allow the EU states greater freedom in agricultural investment with only restrictions concerning the ambitious EU common goals on environment, climate change and sustainability. However, as soon as agricultural policy is a shared competence between the EU institutions and the member states, the active policy directions and delimitations must be approved by both sides. According to the Commission, the EU should strive for such CAP that would keep delivering healthy and tasty food for consumers with jobs and growth in rural areas. Hence, the EU new proposals to modernise and simplify CAP, to follow the Commission’s new delivery model providing for greater subsidiarity to the states, i.e. making agriculture an important part of member states’ national political economy guidelines. Thus, the states are supposed to prepare their strategic agro-plans which will enable simplification, better coherence and monitoring. (30)

The Commission’s DG for Agriculture and Rural Development underlined urgent actions aimed at fostering smart and resilient agricultural sector while strengthening rural areas. The new CAP implementation clearly stresses national and regional efforts, i.e. a much greater degree of subsidiarity for states and regions with less EU prescriptive instruments to the states. However, the CAP’s traditional *two main pillars* remain intact: a) direct payments/market measures, and b) rural development. The *first pillar* supports farmers on an annual basis in the form of *direct payments* and market measures which are subject to compliance with basic rules and environmental objectives. The *second pillar* is a multi-annual and flexible investment tool, more adapted to the local realities of each EU state, in particular to help support *longer term agro-projects*. These two pillars prescribe that the states’ detailed agro-plans will be agreed by the EU institutions: thus, each state could develop their own strategic plans (though approved by the Commission) but setting out the ways to meet the new CAP objectives. The Commission’s DG will monitor state’s progress and ensure that funding is focused on concrete results. Moving from a one-size-fits-all to a tailor-made approach means the policy and its real-life implications will be closer to the farmers.

The future CAP reflects high sustainable development ambition regarding resource efficiency, environmental care and climate action; thus, among others, the new CAP includes:

- Encouraging the use of modern technologies to support farmers with market transparency and certainty;
- Greater attention to encourage young people to take up farming, to be coordinated with the states’ actions in such areas as land taxation, planning and skills development;
- Addressing farmers’ concerns regarding sustainable agricultural production, including health, nutrition, food waste and animal welfare;
- Seeking coherent action among agro-policies in line with the global dimension, notably on trade, migration and sustainable development; and
- Creating an EU-level platform on risk management and assisting farmers to cope with the uncertainty of climate, market volatility and other risks.

The new CAP has a common for all states objective, i.e. moving from a common set of measures (either at national or regional level) to states' preferred agro-policies in achieving the CAP goals. The actual farmers' needs will be assessed and included into the CAP strategic plan; in this way, the Commission would establish a "pact of trust" with the EU states' rural areas and individual farmers.

4.5.2 CAP's role in promoting rural prosperity

The CAP is acting not only on the productivity of the farming sector; it helps boosting local rural economies and enhancing rural prosperity. The EU rural development funds support creating agro-business and increasing growth potential in rural areas through support of new rural value chains, e.g. clean energy, emerging bio-economy, the circular economy and eco-tourism, investments in infrastructure, natural and human capital, including vocational training, programs to develop new skills, quality education and connectivity.

For example, the Commission's proposal about smart villages is to help local communities to address complicated and critical infrastructure and employment situations. (31)

In this regard, CAP efforts are aimed at supporting fairer approaches to agro-SMEs: during the first year (2015) about 20% of small farmers in the EU received around 80% of *direct payments*. Thus, the CAP concerns for economic efficiency and social equity reflected an urgent issue of land concentration versus supporting small farmers. As soon as more than half of the direct support beneficiaries were small farms, most of the payments (72% in 2015) went to medium-sized professionals (generally, family farms from 5 to 250 ha) who manage most of the EU agricultural land (over 70%); these medium-sized agro-firms have been mainly responsible for the delivery of public goods and environmental benefits in the agro-sector.

The Commission is committed to explore ways to further target direct payments more effectively and ensure a fair and better targeted support of farmers' income across the EU; the following list of possibilities should be further explored in Latvia:

- A compulsory capping of direct payments with managing negative effect on agro-jobs;
- Possible introduction of digressive payments as a way of reducing support for larger farms;

- Enhanced focus on a redistributive payments in order to provide support in e.g. small- and medium-sized farms;
- Ensuring support to genuine farmers, focusing on those who are actively farming in order to earn a living (and not a part-time job).

Modern CAP also supports farmers' efforts to protect environment. In this regard, Latvian farmers receiving income support from the CAP will have to apply various environment- and climate-friendly practices. The DG for Environment will determine the details, in line with the need to meet the EU objectives, but also taking into account national, regional and local circumstances; the system will involve fewer and less complex legislation.

Eco-friendly action which goes beyond this foundational level of good practice will be supported through schemes which are voluntary for farmers — at a relatively basic level, and above that more advanced schemes. It is important that Latvian government is responsible for designing the schemes in a way as to meet the EU objectives translated into national, regional and local terms. The CAP will also place strong emphasis on unlocking the potential of research, innovation, training and the use of advice to improve care for the environment and climate, including through greater resource efficiency.

Generational renewal should become a priority in the new Latvian agro-policy framework; here the EU is stimulating generational renewal using their powers on land regulation, taxation, inheritance law and/or territorial planning.

The CAP gives flexibility to Latvian farmers in developing tailor made schemes that reflect the specific needs of the country's young farmers. The CAP strategic plans could include support for skills development, knowledge, innovation, business development and investment support for Latvian farmers, as well as helping mitigate risk in the first years after launching a farming business by providing an EU-wide system of support.

Access to financial instruments to support farm investments and working capital in Latvia should be facilitated and better adapted to the investment needs and higher risk profiles of new entrants. Support to the new generation of farmers could be combined with the appropriate

incentives to facilitate the exit of the older generation and the transfer of knowledge among generations as well as to increase land mobility and facilitate succession planning.

4.5.3 Agro-investments and financial support for farmers

The CAP has a flexible investment tool to support competitiveness, innovation, climate change adaptation and, ultimately, the sustainability of Latvian agriculture and rural areas. Modernising a farm, setting up new technologies, renovating irrigation systems — these actions require a lot of substantial financial efforts that farmers do not have on their own.

However, the available public funds for grants from the EU are not sufficient to address the growing investment needs of the agro-sector. Rough estimations show that the market gap for financing agriculture in the EU-27 (without the UK) is between € 1.6 and € 4.1 billion for short-term loans, and between € 5.5 and € 14.8 billion for long-term loans.

Financial instruments, such as loans, guarantees and equity funds, can ease access to finance for those small farmers and agro-food producers who find it difficult to obtain the necessary funds. By bringing together EU and the states' private funding, it shall have a multiplier effect in increasing investment volumes and leverage.

During 2018, discussions took place on concrete objectives and the design of a future CAP policy in closer cooperation with the next multi-annual EU budget (Multiannual Financial Framework (MFF)). It will undergo some forms of impact assessments exploring different options by making use of the states and farmers' potentials (e.g. using the results of public consultations carried out in 2017). Following the Commission proposal for the next MFF, some legislative proposals on the future CAP have been revealed in the summer of 2018. (32)

Strengthening of farm advisory services for farmers and full implementation of geo-spatial aid applications will also support the simplification of EU aid applications and the implementation of investment measures.

The EU-CAP also provides assistance to Latvia in helping agro-companies innovate and grow internationally, e.g. supporting business innovation through the *Enterprise Europe Network* (EEN) by bringing

innovative ideas to commercial success on European and global markets. Innovation support services are open to all kinds of businesses and the EU experts can assess which services in Latvia are best suited to specific business development phases.

At an entry level, EEN services include: information on innovation-related policies, legislation and support programs, links with local innovation stakeholders, information about access to local sources of funding/support and innovation capacity building. (33) EEN experts also provide one-to-one services, including: innovation audits and strategy advice, consultancy on intellectual property rights, technology and innovation brokerage services, advice on technology marketing and on access to financial support for innovation, and supporting access to the EU funding programs, including Horizon 2020. EEN experts can advise Latvian agro-firms which have potentials to successfully apply for the EU Horizon 2020 "SME Instrument Program" and help present a competitive proposal.

Providing innovation management for entrepreneurs in the member states, the Commission's network services support potentially innovative businesses with innovation management solution. These services help update business plans and manage Latvian innovation activities as well as align their innovation strategy with other business processes. In practice, EEN experts perform innovation management assessment and help to develop an action plan to tackle the identified gaps, as well as finally assist agro-firms to carry out the action plan and indicate paths for further development. (34)

4.5.4 Combining EU and Latvian efforts in agro-policy

Latvian farming sector and rural areas are major players in terms of the country's well-being and its future. So far Latvian agricultural sector has not been at its optimum in the European competition; it used to be at the beginning of the last century (under Ulmanis' government) one of European leading producers of agro-food, e.g. bacon, cheese and other milk products.

Latvian farmers have to be "the guarantees" of national food security. Besides, farmers are also the first stewards of natural environment as they care for Latvian natural resources of soil, water, air and biodiversity. About half of Latvia's territory is covered by forests (in the

EU about 36%); forests provide essential natural CO filter for citizens, renewable resources for industry and energy sectors, being at the same time a big source of export revenues.

A large number of jobs in Latvia depend on farming, either within the sector itself (which provides regular work for thousands of people) or within the wider food manufacturing sector, i.e. food processing, related retail and other agro-sector's services.

The same picture is in the EU where the agro-sector provides jobs for about 44 million people or over 10% of Europe's total population. The EU's rural areas as a whole are home to 55% of its citizens, while serving as a major base for employment, recreation and tourism. However, the EU CAP is currently under stress over the existing differences between western and eastern European farmers; the tension increased in view of the new multi-annual budget talks among EU member states. As it was mentioned above, in November 2017, the Commission issued the framing paper "Future of Food and Farming" suggesting that the EU funding should be cut to large farms through the direct-payment-subsidy-ceiling and limit direct payments to the largest farms.

Nevertheless, small farmers want just and fair direct payment distribution with adequate management, as generally the family-style farming in Eastern Europe is mostly in danger. The choice is actually simple: either supporting small and medium farms or developing industrialized agro-business, though definitely small farms are more dynamic and better for protecting environment and for better employment. But at the end of the line, it is about the political choice in any country: which kind of agriculture to develop.

However, large farmers in the EU are furious over the planned cuts: meanwhile, the EU idea is to stop "landlords", agro-aristocrats and huge multinationals, from getting additional subsidies from the CAP. Moreover, these cuts (the expected reduction for the CAP in the next 7-year budget) might damage the economic conditions of small farmers in Eastern Europe as western farms are nine times larger in size (about 133 hectares per farm) than the EU average, with about 16 ha on average. (35)

Latvia's agro-policy has to follow the EU environmental and climate-related goals; the EU suggested re-evaluation of direct payments in order to ensure that a large portion of Latvian farmed area is man-

aged with environmentally-safe practices. Current area-based rural development payments (partly due to the CAP supported organic farming) expanded significantly, to cover about 6% of EU agro-land compared to 2% five years earlier.

The Union's *REFIT Platform* focuses on additional control over current eco-farms' measures with a control and audit system. Though there is a need to reduce the CAP's regulatory burden, there is a need to improve value for agro-support, while ensuring the achievement of CAP objectives and increase the agro-sector integration with other policy areas. The EU future agro-support through the CAP is going to be smaller by about € 60 billion a year. In response to cost-cutting measures, Latvian largest farmers would get a ceiling on hectare-support. Western farmers are getting more generous pay outs (sometimes 3–5 times more than in the East) which fueled the Eastern campaign to stop Western food producers selling inferior quality foods in the East. Thus, some agro-producers in Germany are getting about a billion euros in direct payments just growing potatoes and other vegetables... As soon as agriculture is in the EU-member states shared competence, greater subsidiarity (that is decision-making being closer to farmers) would make it possible to better take into account local conditions and needs.

Hence, Latvian agro-policy, if current governance structures continue, must ensure effective monitoring and enforcement of the attainment of the EU policy objectives and have a greater say in designing the compliance and control framework applicable to beneficiaries (including controls and penalties). The CAP focuses mostly on the European single market objectives while Latvian agro-policy would address national/regional specifics. The dichotomy means that the EU funding is aimed at results: that Latvian perspective agro-system should be more locally oriented while boosting subsidiarity, i.e. giving Latvian farmers a greater role in implementing the CAP's schemes and reducing administrative burden. Through this approach, simplified solutions and modern technologies would offer better opportunities for both farmers and citizens. The present structure of European agro-sector shows options for possible changes: farm sizes on average in the Baltic Sea Region (BSR) per holding are extremely diverse: thus, Latvian average utilized agro-areas per holding are much smaller than, e.g. in Denmark, Germany or even in Estonia.

Box: Farm sizes in some Baltic Sea Region's states

(average utilized agro-areas per holding, in ha.):

Denmark — 67,5; Germany — 58,6; **Estonia — 49,9**

Sweden — 45,2; Finland — 42,0; **Latvia — 23,0**;

Lithuania — 16,7; Poland — 10,1, EU's average — 16,1

Smallest: in Malta — 1,2 ha, Cyprus — 3,1 ha and Romania — 3,6 ha.

(36)

Latvian agro-sector has shown good growth during the first years of the new century: in the seven years from 2007 to 2013, the country's agro-output increased from € 600 million to about € 1 billion, while labor force in the sector reduced from 105 thousand to 82 thousand; livestock remained the same during the period at about 490 thousand. In Estonia and Lithuania, agro-output was growing, too: from € 491 to € 676 million in Estonia and from € 1.3 to € 1.9 billion in Lithuania.

However, farmers' income in the Baltic States has been far lower than in the EU average: thus, in Latvia and Lithuania it was at the level of € 3–4 thousand (EU average is about € 17 thousand) with the highest in the Nordic countries at the level of € 30 thousand. The CAP financial support in Latvia covers $\frac{3}{4}$ of farmers' income while in Lithuania — about $\frac{1}{3}$ and is fifty-fifty in Estonia.

The EU agro-sector now competes at global market prices; however, it managed to lead in terms of food product diversity and quality while achieving the world's highest agro-food exports (it has been worth € 131 billion in 2016). During 2016–2017, the value of EU agro-food exports increased by € 1 billion to € 12.7 billion; with EU monthly agro-food imports of around € 10 billion, the monthly trade balance in agro-food products remains around € 2.7 billion. Wine has seen the highest year-on-year export growth at the end of 2017, increasing by € 125 million; sugar exports grew by € 79 million compared to the end of 2016 while exports of spirits and liqueurs rose by € 71 million.

In contrast, EU wheat and other cereal exports experienced the biggest drop over the year, falling by 29% (or € 1.7 billion) and 15% (or € 0.3 billion) respectively; pork exports also saw a dramatic annual decline of 9% or € 47 million. In this regard, the CAP's message to Latvia is to continue coherent policy with the EU development policy guidelines, which recognise sustainable agriculture's vital role in growth

while promoting agricultural markets, inclusive value chains, encouraging agro-industry and generating jobs. With good quality agro-food, Latvian farmers can rely on the CAP and have additional financial support for farmers. For example, some Latvian farmers are already quite active in selling their agro-produce to North African states.

4.5.5 EU regional policy and Latvian agro-sector

Several EU funds assist structural reforms and progressive regional development in the Baltic States, Latvia including. The EU strategy aims at making European regions actively participating in nation growth. However, historic administrative and territorial divisions often do not cope with the modern digital societies and smart specialization trends. Hence, political decisions concerning regional policies have to be both optimal and progressive.

There are several sectoral Commissioners in the EU executive institution dealing with the complex regional issues; among most important for the Baltic States are: a) the regional and urban policy sector, and b) agriculture and rural development. Besides, there should be taken into account such directions in the European integration as energy, transport, health issues, etc.

The structure and functions of the EU regional policy are quite complicated: the Commission's DG Regio is responsible for the European policy on regions and cities, within it there is a special implementation unit D.5 dealing with the policy coordination for Estonia, Finland, Latvia and Lithuania. (37)

European policy objectives are numerous: from research, technological development and innovation, to ICT, to competitive small business, to shift towards a circular and low-carbon economy, to environmental protection and resource efficiency, to sustainable transport and better transport infrastructures, to sustainable and quality employment and labour mobility, to promoting social inclusion and combating poverty, to investments in education, training and lifelong learning. No wonder about 700 civil servants work for the DG Regio. (38)

Perspective research of the agro-rural development are the following: from helping farmers to produce sufficient quantities of safe food (with the producers respecting EU norms on sustainability,

environmental rules, animal welfare, etc.), to providing farm businesses with support systems to help stabilize their incomes in the face of less predictable production conditions, to facilitating investment in a sustainable, modern farming sector; to maintaining viable rural communities, with diverse economies; and to creating and maintaining jobs throughout the food chain. (39)

Thus, the rural development in Estonia, Latvia and/or Lithuania is managed nationally through the Rural Development Program (RDP), funded under the European Agricultural Fund for Rural Development (EAFRD), and national contributions. The RDP sets out priority approaches and actions to meet the needs of the specific geographical area it covers. See more on the EAFRD-supported projects in the Baltic States, as well as on the activities of the local action groups (LAGs). Rural development funding through the EAFRD in these countries is part of a broader framework of the European Structural and Investment Funds (currently, ESI Funds), including also the European Regional Development Fund, European Social Fund, Cohesion Fund, and European Maritime and Fisheries Fund. These are managed nationally, by each Baltic State, on the basis of Partnership Agreements, i.e. strategic plans outlining these countries' goals and investment priorities in the rural development as part of the general national growth strategy. (40)

4.5.6 Regional and urban issues

With the Commission's financial support for member states' regional and urban policies during 2016–2020 (in the amount of about € 40 billion in yearly financing), the following five main multiannual priorities have been identified: these priorities are going to be transposed into Latvian growth strategies:

- *new investments into boosting jobs and growth in regional spheres;*
- *connected digital single market in Latvian regions;* for example, by access to high capacity ICT networks as a key factor of competitiveness and economic growth; (41)
- *energy efficiency and resilient energy policy;* (42)
- *forward-looking climate change policy;* (43) and
- *strengthening the industrial/manufacturing development in the regions.* (44)

4.6 COASTAL FISHERIES: A WINDOW OF OPPORTUNITIES FOR RESEARCHERS

In February 2019, the World Bank and the European Commission launched the Blue Economy Development Framework (BEDF), which is a novelty in the area of international ocean governance. It aims to assist the coastal states transition to diverse and sustainable blue economy while building resilience to climate change.

This transition starts with data and knowledge collection about the marine environment and ocean sectors. The first output of the BEDF will therefore be a comprehensive diagnostic analysis of the conditions that could enable or restrict blue growth. This can be ecological, economic or social factors, but it also relates to the policy and regulatory environment.

The outcome of this diagnostic process will lead to a roadmap that assists governments to make the following strategies: prepare policy, fiscal, and administrative reforms; identify value creation opportunities from blue economy sectors; and identify strategic financial investments.

In short, the BEDF will help coastal countries and regions to develop evidence-based investment and policy reform plans for its coastal and ocean resources.

Although the main attention in the BEDF's actions is oriented towards coastal countries in the developing world (at least in the first years), the pilot studies will generate important lessons for the growing community of blue-growth policies in the EU states as well. (45)

Latvian researchers have a lot of opportunities to take part in the EU-sub-regional blue-growth development. For example, in September 2016, the Commission initiated a dialogue among the states of the Baltic Sea Region to identify the implementation of the Baltic Blue Growth Agenda. The thematic areas included: shipping, blue bio-economy (incl. aquaculture), coastal and marine tourism, environmental and monitoring technology, etc. The final report was published at the end of 2017. (46)

4.7 TURNING RESEARCH INTO INNOVATIVE SMES

The renewed EU Industrial Policy Strategy brings together all horizontal and sector-specific initiatives into a comprehensive industrial strategy. Thus, the strategy clarifies the tasks ahead for all actors in the states involved. For a better coordination, the EU created annual *Industry Days*, the first took place in February 2017, as well as a *High Level Industrial Roundtable* to allow in particular industry and civil society to steer industrial policy actions in the future. By embracing technological change, converting research investments into innovative business ideas, and continuing to pioneer the low-carbon and circular economy, Latvian government can pave the way for developing smart, innovative and sustainable industrial sectors.

The main elements of the new EU industrial policy strategy include:

- A comprehensive package to reinforce *industry's cybersecurity*: the efforts include the creation of a *European Cybersecurity Research and Competence Center* to support the development of technology and industrial capabilities in cybersecurity, as well as an EU-wide certification scheme for products and services, recognised in all EU states (adopted in 2017).
- A proposal for a regulation on the *free flow of non-personal data* to enable data circulate freely helping to modernise industry and create a truly common European data space.
- A series of actions on circular economy, including a strategy on plastics and measures to improve the production of *renewable biological resources* and their conversion into bio-based products and bio-energy.
- Initiatives to modernise the *intellectual property framework*, including the enforcement of intellectual property rights and providing a balanced, clear and predictable European licensing framework for *Standard Essential Patents*.
- Improving *public procurement* processes, including a voluntary mechanism to provide clarity and guidance to applicants in small and large infrastructure projects.

- Extension of the *Skills Agenda* to new key industry sectors, such as construction, steel, paper, green technologies and renewable energies, manufacturing and maritime shipping.
- A strategy on *sustainable finance* to better orient private capital flows to more sustainable investments.
- Initiatives for a *balanced and progressive trade policy* and a European framework for the screening of foreign direct investments that may pose a threat to security. (47)
- Revision of the list of *critical raw materials* to ensure a secure, sustainable and affordable supply for Latvian industrial and manufacturing sectors.
- Proposals for *clean, competitive and connected mobility*, including reduction of CO2 emissions for cars and vans, an Alternative Fuels Infrastructure Action Plan to support the deployment of battery's charging infrastructure, as well as some actions to foster autonomous driving.

These industrial policy actions have formed a shared responsibility between the EU institutions and the member states/Latvia through industrial policy development within the Union's supporting and supplementing competence. No doubt, the success of new industrial policy in Latvia depends on exploring a new vision and closer cooperation among the Latvian institutions, central and regional authorities, as well as academic and business community.

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 33. More in “Enterprise Europe Network”: <http://een.ec.europa.eu/>
 34. The EEN helps SMEs bring innovative ideas to commercial success; more in the Commission website: “Support for business”, in: <http://een.ec.europa.eu/content/support-business-innovation>
 35. Source: “Farm structure statistics”, Eurostat publication at: https://ec.europa.eu/eurostat/statistics-explained/index.php/Farm_structure_statistics accessed on 25.05.2019.
 36. Source: “Eurostat: Agriculture, forestry and fishery statistics” at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agriculture,_forestry_and_fishery_statistics
 37. See additional information in the Commission’s regional policy’s review in: https://ec.europa.eu/regional_policy/sources/dgs/organigramme_en.pdf
 38. Note: European regional policy is developing through 3 *main funds*: the European Regional Development Fund (ERDF), Cohesion Fund (CF) and European Social Fund (ESF); these funds work in close cooperation with two other funds: the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF), which have joined recently into the European Structural and Investment Funds (ESIF). General reference: https://ec.europa.eu/info/departments/regional-and-urban-policy_en; more in: https://ec.europa.eu/info/topics/regional-policy_en
 39. More in: https://ec.europa.eu/info/topics/agriculture_en
 40. See, for example priorities for Latvia in: https://enrd.ec.europa.eu/country/latvia_en/ and for Estonia in: https://enrd.ec.europa.eu/country/estonia_en Source: https://ec.europa.eu/info/departments/agriculture-and-rural-development_en More on the development of European agricultural sector see: Eteris E. European agriculture: policy’s effect for the Baltic States and Latvia in: http://www.baltic-course.com/eng/modern_eu/?doc=145322
 41. Note: Due to ERDF investment, particularly in less developed regions, the extent of broadband coverage will increase: more than 14 million additional households will be covered by broadband access as a result of ERDF support in 2014–2020. Besides, 77 500 companies will receive ERDF support to boost the use of quality ICT services and to develop ICT products. Over 3,600 enterprises will be supported to introduce new to the market or new to the firm ICT innovations.
 42. Note: the following financial support is envisaged for the EU states (in €): 4.9 billion for renewable energy production; 3.4 billion to support energy efficiency in SMEs; 13.3 billion for energy efficiency in public and residential buildings; 1.7 million for supporting high-efficiency co-generation; 1.1 billion for investments in smart distribution grids; and 2.3 billion is allocated for infrastructure for smart electricity and gas storage and transmission systems.
 43. Note: for example, € 6.4 billion is allocated to prevent climate change-related risks, in addition to € 1.1 billion for disaster resilience and the management of non-climate related risks. This will support flood prevention and ecosystem-based measures such as green infrastructure. These investments aim at protecting 13.3 million people from floods and 11.8 million from forest fires while making a positive impact on jobs and growth. Risk assessments, which take climate change adaptation strategies into account, are a precondition for funding in this area.
 44. Reference: DG Regional and Urban policy: Strategic plan 2016–2020. Electronic version for 1.04.2016, in: https://ec.europa.eu/info/sites/info/files/strategic-plan-2016-2020-dg-regio_april2016_en.pdf
 45. On European marine affairs and blue economy in: https://ec.europa.eu/maritimeaffairs/press/world-bank-and-european-commission-promote-blue-economy-through-new-tool_en
 46. Reference to: “Towards an implementation strategy for the sustainable blue growth agenda in the Baltic Sea region”. Publications

Office of the EU, September 2017. In: <https://publications.europa.eu/en/publication-detail/-/publication/60adf799-4f19-11e7-a5ca-01aa75ed71a1>

47. Note: on trade policy see the Commission press release in: http://europa.eu/rapid/press-release_IP-17-3182_en.htm; on FDI see: http://europa.eu/rapid/press-release_IP-17-3183_en.htm

