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NOTE

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FOREWORD

Innovation is a pillar of the United Nations 2030 Agenda for Sustainable Development and of approaches to economic development across the world. This is particularly prominent in Belarus, with its legacy of world-class scientific research and industrial production, where the Government has reformed its national innovation system in line with UNECE's recommendations in its first UNECE *Innovation Performance Review,* launched in 2011.

Central reforms include passing legislation to encourage commercialization of intellectual property, centralizing and improving transparency of innovation funds, and including innovation in the overall national strategy for sustainable development. However, important challenges remain. Priorities include increasing risk assessment and tolerance in funding innovative projects, improving project screening and evaluation, and strengthening the capacity for technology absorption and innovation in the private sector. Overall, setting up more dynamic inter-ministerial coordination, as well as fostering multi-stakeholder consultations to design, operate, and evaluate innovation policy, would significantly contribute to the sustainable development goals.

The *Innovation for Sustainable Development Review* shows both continuity and change with respect to previous publications in this series (i.e. *Innovation Performance Review*). On the one hand, the new format presents a general review of the national legal and institutional framework for innovation, in line with the structure of previous studies of Kazakhstan, Ukraine, Armenia and Tajikistan, as well as Belarus' first review. On the other hand, the new format includes specific chapters that highlight main findings with regard to the sustainable development goals. In the case of Belarus, these cover an assessment of the country's national development strategies in light of ongoing international initiatives and a review of recent eco-innovation projects in Government programmes and development strategies.

Innovation is a complex process that requires multi-stakeholder involvement in policymaking. UNECE advisory work in this area draws on longstanding engagement across the region. The Innovation Performance *Review* series takes a comprehensive approach, with strong country involvement and peer review of preliminary findings. I would like to thank the Government of Belarus and other stakeholders for the excellent support provided throughout this project and hope for continued joint working to assist in the implementation of the policy recommendations of the *Review* and to promote innovation for sustainable development.

[insert signature]

Olga Algayerova
Executive Secretary
United Nations Economic Commission for Europe

PREFACE

The practical work on the *Innovation for Sustainable Development Review of Belarus* began in December 2015 with a preparatory mission to Minsk by representatives of the UNECE secretariat to establish contact and discuss the structure and content of the *Review* with the national Government institutions and other stakeholders. The main project mission took place from 14 to 18 March 2016 with the participation of a team that included representatives of the UNECE secretariat as well as international and national experts.

This *Review* reflects the outcome of a series of consultations and discussions between the *Review* team and policymakers, Government officials, representatives of academic institutions and the business community, and other innovation stakeholders of Belarus.

The draft text of the *Review* was submitted for comments to the authorities of Belarus and to a group of independent international experts who had not participated in the field mission. The key findings of the study, including its main conclusions and recommendations, were presented and discussed during a national workshop held in Minsk on 6 October 2016, hosted by the State Committee on Science and Technology of Belarus. Participants included members of the *Review* team, external reviewers and high-level representatives of the Government of Belarus, as well as participants from civil society institutions, universities and international organizations based in Minsk.

The final text of the *Review* was prepared for publication by the UNECE secretariat reflecting the outcome of these discussions as well as other comments and suggestions from various stakeholders.

ACKNOWLEDGEMENTS

The Innovation for Sustainable Development Review of Belarus was prepared by a group of international and national experts as well as by staff of the UNECE secretariat. The Review was the result of a collective effort in which the lead authors for each chapter were: Mr. Ariel Ivanier, Mr. Ralph Heinrich and Mr. Igor Severine (Chapter 1), Mr. Rumen Dobrinsky and Mr. Thomas Stahlecker (Chapter 2), Mr. Slavo Radosevic (Chapter 3), Ms. Annamaria Inzelt and Ms. Natalja Apanasovich (Chapter 4), Mr. Ariel Ivanier and Mr. Ralph Heinrich (Chapter 5). Ms. Julia Djarova, Mr. Bart Verspagen, Mr. Manfred Spiesberger and Mr. Dietrich Hesse reviewed the first draft of the Review and provided relevant suggestions. Mr. Ralph Heinrich, Mr. Christopher Athey and Mr. Ariel Ivanier led on the development of the conceptual framework of the Review and overall editing of the publication, with Ms. Ludmila Boichuk providing technical assistance.

During the discussions at a peer review national workshop held in Minsk (October 2016), the following speakers presented significant comments and suggestions on behalf of the Government of Belarus: Mr. Andrei Kosovski (First Deputy Chairman, State Committee on Science and Technology), Mr. Yevgeny Malchevsky (Head of the Department of Innovation Policy, State Committee on Science and Technology), and Mr. Alexander Snetkov (Head of the Department General for Statistics of Enterprises, National Statistical Committee). Representatives of other national innovation stakeholders also provided substantive input to the workshop, including from the following institutions: the Ministry of Economy, the Ministry of Education, the Ministry of Industry, the Ministry of Natural Resources and Environmental Protection, the Belarusian State Economic University, the Academy of Public Administration, the Republication Union of Employers and the UNDP Office in Belarus.

The smooth work throughout the project was largely facilitated by the helpful support and cooperation of the State Committee on Science and Technology of Belarus, which was the lead national partner of UNECE in implementing this project. In particular, the efforts of Ms. Olga Meerovskaya (Head, Unit of International S&T Cooperation, Belarusian Institute of System Analysis and Information Support of S&T Sphere) in support of this project were very much appreciated.

UNECE would like to express its deep gratitude to the Government of the Russian Federation for its generous financial contribution, which made possible the implementation of the project *Innovation for Sustainable Development Review of Belarus.*

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ABBREVIATIONS

AAAA	Addis Ababa Action Agenda
BAVIN	Business Angels & Venture Investors Network
BD	Business Demography
BEEPS	Business Environment and Enterprise Performance Survey
BelInFund	Belarusian Innovation Foundation
BelISA	Belarusian Institute of System Analysis & Information Support (S&T sphere)
BIF	Belarusian Innovation Fund
BNTU	Belarusian National Technical University
BSU	Belarus State University
CEE	Central and Eastern Europe
CIS	Commonwealth of Independent States
CPA	Classification of Products
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
DUI	Doing, Using & Interacting (in new technology sphere)
EAEU	Eurasian Economic Union
EAPO	Eurasian Patent Organization
EBRD	European Bank for Reconstruction and Development
EECA	Eastern Europe and Central Asia
EEN	Enterprise Europe Network
EPR	Environmental Performance Review
ETAP	Environment & Technology Action Plan
ETER	European Tertiary Education Register (EC data)
FATS	Foreign Affiliate Trade Statistics
FDI	Foreign Direct Investment
FEZ	Free Economic Zone
FIT	Feed-In Tariff (energy sector)
GBOARD	Government Budget Outlays or Appropriations for R&D
GCI	Global Competitiveness Index (World Economic Forum)
GCR	Global Competitiveness Report (World Economic Forum)
GDP	Gross Domestic Product
GEF	Global Environment Facility
GERD	Gross Expenditures on Research and Development
GHG	Greenhouse Gas
GII	Global Innovation Index
GVC	Global Value Chain
HDI	Human Development Index (UNDP)
HEI	Higher Education Institution
HTP	Belarus Hi-Tech Park
IAEA	International Atomic Energy Agency
ICT	Information and Communication Technologies
IDI	ICT Development Index
IFI	International Financial Institutions
IFRS	International Financial Reporting Standards
IP	Intellectual Property
IPR	Intellectual Property Rights
ISCED	International Standard Classification of Education
ISL	Industry-Science Linkages

ISO	International Organization for Standardization
IUS	Institute for Statistics, UNESCO
MNC	Multinational Corporation
MNE	Multinational Enterprise
MNREP	Ministry of Natural Resources and Environmental Protection
MNIPI	Minsk Research Instrument Institute
NAS	National Academy of Sciences
NCIP	National Center for Intellectual Property
NIS	National Innovation System
NNIC	National Nuclear Innovation Consortium
NPP	Nuclear Power Plant
NSSSED	National Strategy for Sustainable Socio-Economic Development
NTBF	New Technology-Based Firm
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
OSCE	Organization for Security and Co-operation in Europe
PCT	Patent Co-operation Treaty
PDLRES	Programme for the Development of Local and Renewable Energy Sources
PPP	Public-Private Partnership
RCA	Revealed Competitive Advantage
R&D	Research and Development
R&D&I	Research and Development and Innovation
RCTT	Republican Center for Technology Transfer
RDI	Research, Development & Innovation
RES	Renewable Energy Source
RSTL	Republican Scientific and Technology Library
SBS	Structural Business Statistics
SCO	Shanghai Cooperation Organization
SCST	State Committee for Science and Technology
SDG	Sustainable Development Goals
SEIS	Shared Environmental Information System
SEMI	Semiconductor Equipment and Materials International
S&T	Science and Technology
SITC	Standard International Trade Classification
SME	Small-or Medium-sized Enterprise
SPID	State Programme for Innovative Development
SPIE	International Society of Optical Instruments Engineering
SPSR	State Programmes for Scientific Research
SSTP	State Science and Technology Programmes
STI	Science, Technology and Innovation
TEC	Trade by Enterprise Characteristics
TEMPUS	EU programme for modernization of higher education
TFM	Technology Facilitator Mechanism
TFP	Total Factor Productivity
UEID	Unit for Economic Innovation Development
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

UNIDO	United Nations Industrial Development Organization
UNSIF	United Nations Social Impact Fund
USAID	United States Agency for International Development
VOC	Volatile Organic Compounds
WBDI	World Bank Development Indicators
WBG	World Bank Group
WDI	World Development Indicators
WEF	World Economic Forum
WIPO	World Intellectual Property Organization
WPFI	Wind Private Finance Initiative
WTO	World Trade Organization

EXECUTIVE SUMMARY

The *Innovation for Sustainable Development Review of Belarus* presents an independent evaluation of the National Innovation System (NIS) of Belarus. Since 2011, the Government of Belarus has made significant efforts to upgrade this system in line with recommendations contained in the first UNECE Innovation Performance Review, which was undertaken in 2010-2011. The Review recommends a broader understanding of innovation, to include non-technological aspects. Innovation includes not only new products and services, but also innovative processes. Emphasis is placed on not only cutting-edge technological innovation but also on the introduction of technologies that may exist elsewhere but are new to the domestic market. Furthermore, this Review has a specific focus on the role of innovation policies to foster sustainable development. It analyses the institutional framework of innovation policy and the various mechanisms and instruments of related public support infrastructure. Policy options and recommendations are offered to improve and enhance the innovation capacities of stakeholders and thus help achieve the sustainable development goals.

Innovation Policies for Sustainable Development

In 2015, significant international developments took place that will shape innovation policies in the future. The first one was the adoption of the United Nations Agenda 2030 for Sustainable Development, an ambitious action plan with the objective to align economic prosperity with environmental sustainability and social inclusion. Amongst its 17 Sustainable Development Goals (SDGs) and 169 related targets, Goal 9 calls for member States to work together to "build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation". Moreover, innovation is recognized as one of the means of implementation for the entire 2030 Agenda.

Furthermore, the Addis Ababa Action Agenda (AAAA) was adopted at the Third International Conference on Financing for Development, which took place in Addis Ababa in July 2015. The AAAA provides a new global financing framework to mobilize and deliver the resources, technology and partnerships needed for sustainable development. One full chapter of the AAAA is devoted in particular to topics related to science, technology, innovation and capacity building.

One outcome of the adoption of the 2030 Agenda was the launching of a Technology Facilitation Mechanism, with the objective to bolster policies for sustainable development. It is based on a multi-stakeholder collaboration between Member States, international organizations, the private sector and other stakeholders. Its goal is to promote coordination, coherence and cooperation within the UN System on STI-related matters in order to enhance synergies and efficiency (UNECE is a member of this Interagency Task Team).

Belarus has supported these initiatives and will align Government structures and policy towards their fulfilment. With the goal to integrate existing strategies into a longer term policy framework, Belarus prepared a Concept for a National Strategy for Sustainable Socio-Economic Development until 2030 (NSSSED-2030) and related five-year National Socio-Economic Programmes for their implementation.

The NSSSED-2030 tackles sustainable development challenges around three components: social, with a focus on health, population ageing and migration, education and social inequalities; economic, with a focus on competitiveness, technological development, access to international markets, know-how, financial resources and energy security; and ecological, with a focus on challenges to climate change, the trans-border transfer of dangerous and harmful substances, the risk of new diseases and exhaustion of natural resources.

One key objective of the innovation policies described in the NSSSED-2030 is to facilitate the transition of Belarus towards a knowledge-based economy. Measures envisaged include the following: the modernization of the scientific sphere; the creation of new research schools and the implementation of strategic programmes of R&D; improving international connectivity; and ensuring the replacement of the currently well-educated scientific and technical personnel.

With regards to financing of innovation, the NSSSED acknowledges the need to attract investment from private sources (including venture capital funds and PPPs for the establishment of research infrastructure). It is also contemplated to promote cluster structures oriented to high technology final products; and to ensure the transformation of the intellectual property rights (IPR) framework to encourage the commercialization of R&D results.

Policy frameworks, programming and initiatives

Promoting a more creative economy features prominently in the long-term policy agenda. The State Programme for Innovative Development (SPID) 2016-2020 is envisaged as the programmatic means of operationalizing public innovation strategy and policy. It contains a range of ambitious objectives and targets for modernizing the economy of Belarus and increasing its international competitiveness. The programme contains seven chapters devoted to different aspects of planning and managing the innovation process and it lists innovative projects that are hoped will help create a competitive advantage for Belarus internationally.

The list includes a small number of projects for the implementation of cutting-edge technologies in areas where Belarus is a technological leader; and a large group of modernization projects, in areas where the country is an innovation-follower. All the projects target the development and commercialization of technological innovation in areas of proven expertise that are defined as priority S&T areas in high-level policy documents.

Further development of the innovation-support infrastructure is also a pillar of SPID 2016-2020. The programme envisages concrete plans for public investment in the development and modernization of nine technoparks in Belarus. In a similar vein, the programme places special emphasis on the objective of raising the export activity of Belarusian firms and increase its high value-added components, although measures are not specifically defined to pursue such an objective.

In addition to SPID, science and R&D activities are governed via two types of funding programmes: 1) State programmes for scientific research (in the past also referred to as “fundamental research”) and 2) State science and technology programmes (formerly referred to as “applied research”). Both types of programmes provide non-repayable funding to R&D projects for the period 2016-2020. The design of the actual programmes is preceded by a complex, multi-stage foresight process with the participation of institutions such as the National Academy of Sciences, other R&D centres and the Government.

Important legislative and regulatory developments have affected innovation activity and performance in recent years. Notably, two Presidential edicts in 2013 introduced regulations aimed at stimulating innovation activity and the commercialization of research results. For the first time, the access to public grant funding instruments (innovation vouchers and grants), was approved. The other reform concerns the process of commercializing the results of research undertaken with the support of public funding. In addition, a policy aimed at stimulating cluster development was initiated. With regard to changes in the tax regime, over the past five-year period a system of tax incentives for scientific-technological development was adopted, providing tax benefits for high-tech products and manufacturing.

Concerning *innovation finance*, Belarus relies on a banking sector dominated by State-owned institutions, with most decisions on financing innovation in Belarus taken by public authorities - with the private sector remaining underdeveloped. However, since the time of the last Innovation Performance Review in 2010, actions have been taken to bolster the R&D and innovation-financing system of Belarus. Firstly, a Development Bank was established with the goal of becoming the single channel to finance projects under all Government programmes, including possible innovative investment projects. With regard to SME financing, credit facilities are provided to 11 partner banks to fund SMEs and a new product to support start-ups was launched at the end of 2015 in the form of a loan or credit, typically for up to five to seven years. Regarding the Belarusian Innovation Fund (BIF), recent developments relate to a set of new presidential decrees aimed at improving finance for the final stages of the innovation process (i.e. commercialization, market entry) as well as new instruments to support the initial innovation phase (i.e. grants and vouchers), which are granted on a non-repayable basis. One major reform was the decision to centralize sector funds into a new Republican centralized innovation fund (2017). The fund will be implemented and managed by the State Committee on Science and Technology. It will have four operating areas: financing innovation projects from the SPID; financing R&D aimed at production of new products, services and technologies; funding the development of innovation infrastructure; and funding the development of sectoral laboratories.

As regards *NIS public institutions and innovation governance*, Belarus has a relatively well-developed system supporting innovation activities concerning public institutions. Public bodies in the NIS have well-defined functional responsibilities and roles in innovation governance. In addition, the information brokerage functions performed by these institutions (such as support to R&D and technology-oriented forums, exhibitions, fairs, etc.), facilitate linkages and match-making. However, unlike the practice of many countries, where various horizontal councils are in place tasked with policy coordination, governance in Belarus is largely performed hierarchically in the form of a top-down decision-making process, which is then communicated along vertical reporting lines to the parties involved. More often than not, such decision-making is preceded by a lengthy and cumbersome preparatory administrative processing by the institutions involved.

On the topic of *international cooperation*, to facilitate further engagement with foreign entities, SCST and the Belarusian Institute of System Analysis and Information Support of S&T Sphere (BelISA) recently launched a National S&T Portal, which provides comprehensive information on the existing international cooperation agreements to which Belarus is party. Another significant recent development was the establishment of the Eurasian Economic Union. In addition, Belarus participates in the CIS intergovernmental programme of cooperation in the

area of innovation until the year 2020. Belarus also has a range of bilateral S&T cooperation agreements with a number of countries and organizations.

With regards to *industry-science linkages, FDI and internationalization*, quantitative indicators show Belarus went through a phase of stagnation in recent years, partly due to external shocks, but also due to weaknesses in the Belarusian business sector and R&D activities. A lack of export-orientation is a hindrance, as it could act as a complement to importing, adapting and adopting foreign technologies. It is likely that innovations will be more successful when Belarus integrates itself into global supply chains, and when it invests more at the higher end of world technologies and increases independence from imports needed to produce at a world level of quality/excellence. In Belarus, the spill-over effects linked to cluster activities are hampered by the dominance of large companies within the R&D and innovation process and the fragmentation of the country`s industries (cf. chapter 4). In addition, FDI flows have not been significant. Between sectors, the largest inflows are geared to categories of low-tech activities like food, wood, coke and refined petroleum products. At present, the main investors in Belarus are Russia, United Kingdom, Netherlands, Cyprus, Austria, Germany and China. With regard to the export of high-tech products, statistics show that Belarus has improved in recent years. However, its performance in absolute and relative values is lagging behind.

Concerning *universities, research centres and intellectual property rights*, the Government considers them essential drivers for innovation and knowledge generation. A milestone in recent legislation is that universities are allowed to establish small companies to transfer technologies to the market. Belarusian universities and research centres have recently diversified ways of promoting innovation by setting-up new organizational units, both internally (e.g. National Academy of Sciences with institutions and enterprises subordinated to the NAS), and through improving linkages to external organizations to establish new support infrastructures like technoparks, incubators or start-up centres. Within the context of a gradual change of NAS from being a purely scientific organization to a more applied institution, 72 innovation centres/clusters have been set-up. Many of the NAS research institutes have initiated the formation of their own “clusters” with the participation of businesses. NAS was also involved in the establishment of the new innovation and technology park “BelBiograd”.

On aspects of *the intermediary system of support institutions*, Belarus has over the last five to ten years established a complementary infrastructure to promote innovation and technology transfer. From 2012 to 2015, the number of jobs and the production volume of innovation products in organizations that are residents of industrial parks has nearly doubled. The main directions of activity of residents of technoparks are instrumentation, mechanical engineering, electronics, information technology, software development, medicine, pharmaceuticals, medical equipment, optics, laser technology, energy, energy saving and bio-and nano-technology. One key success story concerns the development of the hi-tech industry. The High Tech Park in Minsk was established with the main goal to foster the ICT industry. It receives strong governmental support and its activities are considered crucial for export growth. Its first residents were registered in 2006. Currently, there are 164 companies registered as HTP residents. More than half of these are foreign companies and joint ventures.

Overall, the approach with regards to intermediary institutions is promising and can be a role model for other industries or technological fields. Remarkably, however, all techno- and science parks are organized in a way that no distinction between young companies (often unable to pay rents), and successful international companies is made. The same applies to the support services

offered by the centres to all of their residents. International experience indicates that a differentiation between profit-orientation and public services is commonly made to discriminate among the needs of residents and with the goal that subsidies be lifted over time as financial capabilities improve.

Measuring innovation performance

When compared to 1981, Belarus' real GDP had increased almost 2.5-fold by 2015. However, the economic growth of Belarus has significantly slowed since 2010, and it is not clear that it will be able to replicate past performance, as the trend may be strongly impacted by the overall slowdown in the EU and Russian Federation. Furthermore, the growth determinants of the Belarusian economy in the future remain uncertain. Whereas growth in Belarus during the late 1990s and early 2000s was driven by so-called total factor productivity enabled by organizational changes and efficiencies, future sources of growth should be sought in new factors related to technology, innovation and investments. In the long run, new sources of total factor productivity (TFP) gains will need to be grounded in improved knowledge generation and diffusion.

Regarding the *benchmarking* of Belarus' NIS, an improved international ranking is an explicit policy aim of the Government. The NSSSED-2030 has targeted improved positions in several indexes and ratings by 2030. A motivation behind the policy target is a genuine wish to improve performance by taking easily understood benchmarks. Benchmarking is useful for policy purposes as it provides an international perspective on the position of the country. If used in a smart way, it can provide a critical and unbiased view of a country's strengths and weaknesses. However, comparisons at face value or without understanding of the underlying conceptual approach and country differences in terms of levels of income and institutional practices may result in misleading or irrelevant policy conclusions.

The overall conclusion of the comparative analysis of Belarus' performance in international rankings, as well as indicators that are relevant for technology upgrading, is three-fold. First, the potential for the technological upgrading of Belarus is very firmly rooted in the CIS growth model and thus shares several structural features with countries in this region (e.g. Russian Federation, Ukraine and Kazakhstan). Second, when compared to more advanced peers, Belarus performs relatively well with regard to basic innovation inputs (human capital) and infrastructural capabilities (physical capital), but lags behind in the intensity of technology upgrading, R&D and technological capability, and firm-level capabilities. Third, similar to its CIS peers, Belarus lags behind regarding intensity of interaction and knowledge exchange with the global economy. The country also remains loosely connected to value chains and has a low share of FDI.

Still, some positive developments have occurred in recent years that could help reverse this deficit. The country has undertaken successful innovations in the development of space industry, nanotechnology, optics and information technology. It is encouraging that its share of ICT is growing and may become a major driver of macro growth if this sector continues to expand. Indeed, some companies of the High Tech Park have managed to become world leaders in their fields. Scientists of Belarus participated in the EU 7th Framework Programme and continue their engagement in Horizon 2020 (cf. chapter 4)

Another characteristic of the National Innovation System of Belarus is that it is very much oriented towards production capability or supporting problem-solving in the business enterprise sector. There is extensive support for new technology-based firms (NTBFs), but their impact has not yet been reflected in any comparative indicators except in the export of ICT services. Still, NTBFs are crucial as knowledge brokers and specialized suppliers. Their growth is also dependent on the growth of large firms, especially given that the "gazelle" type of NTBFs are still in the early stages of internationalization, with only a few high-profile exceptions (cf. chapter 4 for an analysis of a dual path of technology upgrading in Belarus).

The production orientation of public R&D is visible in the high share of applied R&D at universities as well as through a very low proportion of blue-sky basic research and close links between companies and universities (e.g. through commercialization activities of universities), (cf. chapter 2).

Furthermore, the business sector does not have developed in-house R&D and in that respect, the extramural R&D (in academies and universities) plays the role of a knowledge-intensive services sector while branch R&D is *de facto* insufficiently developed. The production-oriented R&D system is further reinforced by the low-risk approach to public funding of R&D with guaranteed return on budgetary funds.

Since the time of the first Innovation Performance Review, there has been further strengthening of the NTBF path of technology upgrading of Belarus, which deserves praise. This is visible through the strengthening of two major technology parks and through successful operation of NTBFs and their solid export performance. However, a remaining challenge is to enhance the other path (large enterprises) and to promote complementarities between the two paths (cf. chapter 4).

The first innovation policy review of Belarus recommended the Government to update its methodology for the collection of innovation statistics with the goal to follow internationally-agreed standards in similar areas of statistical practice. Such reform would improve the benchmarking of national innovation performance levels across a broad range of EU and non-EU countries based on a common methodology. During the period 2011-2016, the National Statistics Office (Belstat) made significant progress to better align national systems with international practice in line with the recommendations of the report. Important reforms were undertaken, including the adoption of indicators consistent with the EU Innovation Scoreboard and regular innovation surveys at the firm level.

In particular, guidance from the Organisation for Economic Cooperation and Development (OECD), Eurostat, as well as the UNESCO Institute for Statistics was used for this purpose. Accordingly, new definitions for the gathering of statistics were adopted including the following: definitions of what is innovation (with examples of product, process, organizational and marketing innovation); explanations of the components and range of innovation; and harmonization of existing questionnaires with international best practice.

With regards to international comparisons, work was undertaken to produce indicators that allow for the comparative evaluation of Belarus with the other countries covered by the EU Innovation Union Scoreboard (IUS). Statistics are developed annually and published for 16 of the total 25 indicators.

Finally, methodological harmonization was undertaken to update forms used for statistical reporting by institutions carrying out research and development. Other reforms were also adopted in innovation-related statistics and on the nomenclature of economic activities and products. For example, since 1 January 2016, national classifications were harmonized with the latest relevant international versions: by activity (NACE 2008), and by product (CPA 2008).

However, in spite of all the positive efforts to upgrade methodologies and mechanisms for collecting statistics, it should also be noted that some important constraints remain in place. For instance, the enterprise survey of innovation activities carried out by Belstat focuses only on firms' R&D expenditure and innovation output (i.e., sales of innovative products), but it does not cover some of the most critical aspects of modern firms' innovation activity according to international best practice. Another challenge concerns the population of the national innovation survey in Belarus, which has yet to cover a representative sample of firms from all sectors.

Innovation in the enterprise sector

In Belarus, many large firms are facing the challenge of inadequate modernization of equipment. According to government assessments, the majority of organizations that belong to the large public sector use mid-20th century technologies. One of the main reasons for this reluctance to innovate is the generally low level of market competition.

The economic management of large enterprises is hierarchical and characterized by predominantly vertical linkages between ministries and economic entities and enterprises. Reorganization has not significantly changed the traditional high degree of market concentration. In this context, small- and medium-sized businesses are developing only slowly, which limits the pressure on incumbent companies and enables them to survive even without innovating (many large firms have a monopoly position in the Belarusian market).

On the other hand, some firms undertaking research-intensive activities have presented a different path to innovation. Most of these were spin-offs created by university faculties or scientific institutes. Some of these firms are working in university/academy-linked technology parks; and often have undertaken commercialization activities in these venues. Among all these firms, some small firms are valuable as knowledge-producers, and are often spin-offs, knowledge-based, high-tech, innovative firms. They are important actors in the commercialization of knowledge and exploit the inherited knowledge-producing capabilities of the Soviet era, combined with new ideas from more recent university graduates (cf. section 4.4 in this chapter for a discussion of Belarus' *dual path*).

Overall, the cases studies included in this report provide insight into existing challenges to innovation in the enterprise sector and point to priority areas for policy reform. The selected firms were established either privately or by several State-owned entities on special conditions. At the time of their establishment, they obtained the most significant equipment and instruments from research institutes. Furthermore, their workforces were well educated, well trained and had substantial experience in scientific collaboration - typically with innately talented managers with good scientific records.

However, some of these conditions have changed significantly during recent years; and new challenges have emerged that call for policy reforms in order to sustain their innovative edge.

These include the consequences of macro-economic recession, the impact of the progressive reduction in R&D spending and finance, and problems securing qualified personnel. This information is confirmed by analysis of the survey data.

Two statistical surveys are used to provide information on innovation activities in the Belarusian industrial sector. These are respectively the innovation survey of Belstat (the National Statistical Office of Belarus) and the EBRD-World Bank Business Environment and Enterprise (EBRD BEEPS V) section on innovation.

Statistics show that the percentage of firms that undertook expenditures on technological innovation was higher in the private sector both in 2010 and in 2015. While public firms had a higher share of sales of innovative products to total sales in 2010, this drastically decreased by 2015. In addition, foreign-owned companies represent a small but increasing share, which goes largely into low- and medium-tech industry.

Innovation performance can also vary by economic sectors and activities. If a firm introduces more than one type of innovation, it can also create synergistic effects. According to Belstat statistics, 92.7 per cent of manufacturing organisations made expenditures on technological innovation, 11.7 per cent on organizational innovation and 16.5 per cent on marketing innovation in 2015. The various types of innovation can support each other and improve the firm’s chances of market success.

Concerning innovation in specific economic sectors of firms, high-tech and other emerging activities are usually more innovative than traditional sectors. For Belarus, ICT activities are the "innovation driver" and activities in nuclear sciences are also good performers in novel innovation. Notably, among selected manufacturing industries, the number of innovative firms seems stable over time and across sectors, with some slight increases in certain activities (i.e., manufacturing of electrical and optical equipment, chemical production and manufacture of pharmaceutical products).

A recent analysis by BelISA helps explain the survey findings. It concludes that Belarusian companies do not have sufficient own funds to finance RDI (Research, Development and Innovation), or are hesitant to invest in risky projects. At the same time, the State could not provide them with sufficient financial support, which is also due to the crisis and a tight budgetary policy. This situation resulted in a decline in innovation development and, therefore, the number of innovation-active enterprises decreased.

It should be highlighted that there are several obstacles that are more important for small companies than for medium and large ones. Access to land, access to electricity, political instability as well as customs and trade regulations appear to be a priority for smaller firms. In addition, some other factors hamper more the non-innovative medium companies, such as tax rates, the practice of competitors and access to finance.

The role of eco-innovations fostering sustainable development

In Belarus, government policies for the promotion of eco-innovation are embedded in the country's broader sustainable development agenda. A look at the national statistics of Belarus shows that some success has occurred with regards to environmental policy during recent years, for instance on reducing the incidence of ozone-depleting substances. On the other hand, waste management, which has significant implications for disease control, remains a priority area in the field of environmental protection. A specific issue that has attracted Government attention is the management of radioactive pollution from the Chernobyl accident in 1986.

With regards to policy instruments that promote the green economy, Belarus applies a range of measures aimed at increasing incentives for sustainable practices in industry and other sectors. These include environmental taxes on air pollution and waste, compensation for damages, and specific charges for pollutants. Taxation is integrated with a system of annual emission limits. Several reforms have taken place since 2011, including the approval of legislation obliging producers and importers of harmful products to assume the responsibility for collecting, neutralizing and/or recycling them. Priorities on the need for mainstreaming green economy principles in education have been formulated in the National Action Plan for the Implementation of the UN Economic Commission for Europe (UNECE) Strategy on Education for Sustainable Development in the Republic of Belarus for 2010–2014 and other programmes.

Overall, both *supply*- and *demand-side* measures contributed to a number of achievements to improve environmental performance, such as a decrease in air pollution from mobile sources, progress in integrating environmental education and education for sustainable development in formal, non-formal and informal education.

The Ministry of Natural Resources and Economic Protection (MNREP) has been implementing significant innovation projects that were included in the State Programme of Innovation Development for the period 2011-2015. Seven projects involved innovation activities on environmentally significant areas. Among these, five were in the field of geology and two in the field of hydrometeorology, although their impact on sustainability is not always clear. So-called *green public procurement* policies have also been initiated, but remain at the very early stage of implementation. In addition, funds allocated to the various R&D activities included innovative technologies for the efficient use of natural resources; sustainable forest management; new technologies for water supply, wastewater treatment and processing of secondary municipal waste; and improvements in energy efficiency.

Regarding international cooperation, MNREP enjoys the support of the European Union and initiatives have been held to obtain expert advice on eco-innovation. The goal has been to set up a plan for the development of the green economy and to develop sustainable patterns of consumption and production through the use of incentives. However, whereas MNREP has the research capacity to assist in the development of innovative products, its knowledge of aspects of the commercial viability of green products is limited. Because greening the economy is a multi-faceted sphere, there is a need for coordinated policy action involving delegates from other ministries not linked directly to the environment (e.g. social protection, trade).

The Department of Energy Efficiency of the State Committee for Standardization is the main Government agency implementing policies to promote energy efficiency. In 2009, Belarus became a member of the International Renewable Energy Agency; and since that time has

already adopted a Law on Renewable Energy (2010). In 2010, a National Energy Saving Programme for 2011 - 2015 was approved by the 2010 Resolution of the Council of Ministers (No. 1882) with the very ambitious goal to reduce the energy intensity of GDP in 2015 by half, taking into account environmental requirements, social standards and provisions of energy security indicators. Another programme was also adopted with a focus on renewable sources of energy; namely, the National Programme for the Development of Local and Renewable Energy Sources for 2011-2015 (PDLRES).

Although PLDRES has succeeded in significantly reducing the energy intensity of GDP, it has not had a transformative impact yet on the composition of energy sources. The share of renewable sources of energy still amounts to only a marginal amount of total supply of energy resources in Belarus, fluctuating between four and five per cent in recent years. Further, most standards have not been embraced by private firms. Although the legal framework for private firm certification and eco-labelling is broadly based on modern international standards (i.e., ISO 14024 and EU requirements), the practical implementation of product eco-labelling has lagged and no independent body for environmental certification of products is in place. However, voluntary approaches to standard setting are emerging as a result of competitive pressures on enterprises that work on markets with stricter environmental management regulations.

Since 2012, private firms can generate and re-sell electricity using existing electricity grids, provided it is from renewable sources. Legislation also allows foreign investors to build up and operate power installations based on renewable energy sources. Indeed, the renewables sector - together with the pharmaceuticals, automotive and food industries - is one of the four priority areas for FDI attraction highlighted by the National Agency for Investment and Privatization. Overall, domestic private sector involvement in the renewable energy sector remains limited, even if some national enterprises have been active as intermediaries. In particular, SMEs are involved in such areas as consulting and representing big energy brands, as well as the production of local fuels, with a focus on wood and agricultural waste fuels. Although innovation could make a significant contribution to the expansion of renewable energy and thus energy sustainability in Belarus, significant constraints remain due to a lack of demand from households, whose energy bills remain significantly subsidized, and a resulting lack of profitability and access to investment finance on the part of utilities.

Going forward, the development of energy efficient technologies and production of alternative fuels will be an essential feature of a successful strategy for sustainable development. Although it is not envisaged that Belarus will have a specific programme on “green” innovations, there are several projects that imply incremental improvements in the use of existing technologies. For instance, in recent times, the MNREP - in cooperation with other interested parties - developed a national action plan on the introduction of green economic principles in the national industries of Belarus to 2020. Also, amongst key R&D programmes, the State research programme on “Energy Systems, Processes and Technologies for 2016–2020,” under the auspices of the National Academy of Sciences and the Ministry of Education, supports a basic research project implemented by the Heat and Mass Transfer Institute of the NAS, the Belarusian National Technical University and other R&D players. The project includes the following priority areas - energy and energy efficiency, nuclear energy; environmental management and deep processing of natural resources. The SPID 2016-2020 also contains modernization and innovation projects to be undertaken by companies and research organizations with regards to energy efficiency.

However, the actual share of public funding for research activities in eco-innovations remains very limited, with an average of only five per cent in recent years. As is the norm in Belarus, research programmes have been developed in such a way that they are intended to cover the whole innovation cycle from ideas to their embodiment in a particular product or service. But the strict compliance requirements with State-funded projects contribute to the shrinking of completion frameworks and goals, reducing the attractiveness for long-term private investments.

Policy recommendations

Each of the chapters of this Innovation for Sustainable Development Review contains a list of recommendations, which cover multifaceted areas for policy action with distinct time horizons and sequencing. Because the recommendations are addressed to different Government agencies and institutions, coordination amongst ministries will be crucial for successful implementation. Table 1 presents a summary list of recommendations with related policy actions.

Table 1. Summary of Recommendations

Chapter 1: Innovation Policies for Sustainable Development		
	Recommendations	*Related policy actions*
1.	Improve the policy framework for implementation of SDG agendas	Establish an effective mechanism of inter-ministerial coordination based on an understanding of interdependency of various problems and factors, synergy of goals and efforts to address crosscutting issues.
2.	Adopt indicators, targets and monitoring mechanisms with regards to fostering eco-innovation.	a) Future revisions of the NSSSED 2030 and other programmes should identify specific objectives, indicators and monitoring mechanisms for benchmarking eco-innovations; b) Relevant ministries should work with the National Statistical Committee to set up indicators for specific variables (e.g., R&D expenditures on renewable sources, use of innovative environmental technologies, etc.)
Chapter 2: Policy frameworks, programming and initiatives		
	Recommendations	*Related policy actions*
1.	Ensure conceptual consistency in the typology of innovation policy targets and align these targets with matching policy instruments.	The SCST and other institutions could consider: a) Further transform SPID into an overarching document incorporating objectives and targets of the State R&D programmes; b) Consider identifying under the State S & T programmes a separate category of high-risk "science, technology and innovation" projects; c) Amend legislation to provide for the risk of innovation in acts regulating the issues of implementation of the various programmes and innovative projects; d) Develop practical guidelines for the assessment and sharing of risk.
2.	Initiate a gradual transition from predominantly vertical to predominantly horizontal policy mechanisms and instruments in the innovation policy mix.	The SCST and other institutions should: a) Increase the share of funding earmarked for high-risk "S&T innovation projects" and early-stage financing and reduce the share of low-risk investment projects; b) Within public early-stage financing, increase substantially the share of grant financing and reduce the share of loans; c) Align policy instruments and mechanisms and design new ones for the implementation of horizontal-type innovation policy.
3.	Ensure a better match between the strategic	The SCST and other institutions should:

	objectives of innovative development and the available policy instruments and public funding to pursue such objectives.	a) Ensure proper matching of available policy instruments and funding in the implementation of SPID 2016-2020; b) Consider introducing open horizontal competitive calls for collaborative innovative projects; instruments supporting international linkages, increased grants for innovative university startups or spinoffs; setting up new instruments and innovation programmes catering to the specificity of non-technological innovation; c) Specify in public-funded programmes in research and innovation which policy instruments will fund what programmatic activities.
4.	Streamline innovation governance with a view to rationalizing public sector decision-making related to innovation policy implementation.	a) SCST should prepare, in consultations with the public bodies concerned, proposals for optimizing the screening and evaluation process of innovation and R&D projects; b) The Government should consider the establishment of a joint Inter-agency Funding Committee to take the final decision on the release of public funds for all R&D and innovation projects. Alternatively, an Innovation Council could be established; c) The Government should consider measures for better aligning the implementation of S&T Programmes with the objectives of SPID.
5.	Initiate measures for the further development and strengthening of the NIS and the enhancement of weak components.	SCST in cooperation with other bodies should: a) Set up a system of monitoring linkages and collaboration in undertaking innovation activity; b) Strengthen international linkages leading to global technology-centred value chains as a strategic objective of innovation policy and set up monitoring instruments; c) Set up non-financial coordination instruments to support connectivity and linkages (e.g. mentoring for start-ups); d) Strengthen the systemic role of intellectual property rights (IPR); e) Design targeted tax incentives to encourage private sector engagement in the early stages of innovation financing; f) Develop additional tax incentives comparable to those existing for residents at the Hi-Tech Park and the Chinese-Belarusian industrial park “Great Stone”; g) Adopt measures to improve the fragmented business structure, the shortage of R&D centres, the lack of engineering and other innovation service firms, and a weak tradition in open innovation; h) Launch programmes and supporting schemes to nurture competitive supplier firms around leading innovative companies.
6.	Set up a system of measures to strengthen innovation-related competition and spur bottom-up entrepreneurial initiatives.	SCST in cooperation with the Ministry of Antimonopoly Regulation and Commerce should; a) Consider possibly aligning competitive calls with the Law on Public Procurement; b) Define incentives for the participation of foreign applicants of a desired type (e.g. linked to global technological value chains); c) Define the significant increase of innovative entrepreneurship (in particular, private/individual innovative entrepreneurs and SMEs) as a strategic objective and set concrete targets, in particular, for the support of technology-based start-ups and spin-offs.

7.	Improve innovation finance mechanisms.	a) Implement the support of early-stage, or the initial R&D phase, with vouchers and grants as well as venture funding; b) Shift from financing low-risk (infrastructure) projects to (early-stage) high-risk projects; c) Consider further foreign partnerships within the context of venture financing; in addition, seek ways to actively attract further foreign investors; the "good practice" example of the incubator at the Hi-Tech Park, should be extended to other industries/areas.
8.	Innovation-related loans, particularly regarding the financing of SMEs and start-ups should be intensified.	Strengthen the capacities of the new Development Bank.
9	Improve both the innovation potential inherent to foreign direct investment inflows and cross-border technology transfer.	a) Evaluate the mechanisms of the National Agency of Investment and Privatization concerning innovation-related and technological issues or science-intensive investments; b) Improve international cooperation in technology-transfer activities; c) Identify and further promote "good practice" examples of Belarusian companies in global value chains or regarding the establishment of strategic partnerships.
Chapter 3: Measuring innovation performance		
1	Fully adopt best international standards in the collection of innovation statistics as reflected in Eurostat's CIS Harmonized Survey questionnaire.	The National Statistical Committee should take into account the expert advice of the UNESCO Institute for Statistics on the proposals of the SCST on the improvement of statistical reporting forms 1-NT (innovation).[1]
2	Improve training of statisticians gathering innovation-related data and indicators.	The National Statistical Committee should consider seeking technical cooperation support, including through training activities with UNECE Statistical Division, Eurostat, OECD and/or UNESCO statistical office as well as with the participation of international experts with knowledge of CIS economies.
3	Increase the number of trainees on innovation-related statistics.	Consider extending the training activities beyond the National Statistical Committee to include surveyed organizations and potential users to understand better the logic of the innovation survey and its indicators.
4	Widen the scope and coverage of the innovation surveys in line with international best practice.	The National Statistical Committee should: a) Consider a broader population of enterprises in future surveys, which should also focus on non-technological innovations; b) Include more small firms in the targeted population of the innovation survey; c) Consider a more intensive use of the available data; d) Consider involving other stakeholders from civil society.
5	Indicators should inform policy, but only rarely should they become a policy target.	At the time of designing national strategies and programmes, Government bodies should not individually target specific indicators with only the narrow aim to improve the overall ranking on a specific international index

[1] Форма 1-нт (инновация) статистического комитета Республики Беларусь.

Chapter 4: Innovation in the enterprise sector		
1	Improve risk sharing between firms and Government.	a) The SCST and other bodies should be supporting large scale, risky innovation initiatives from public funds, including through co-financing; b) For establishing and nurturing financial actors (venture capital, business angels), the BIF should consider options providing seed capital and introduction of tax breaks; c) Pre-determined competition should be eliminated to make competition conditions equal for State-owned and private firms, including foreign entities operating in Belarus.
2	Consider increasing State financial support to approach better the critical mass of financial resources for RDI.	Government agencies should: a) Ensure that allocation of public funds for innovation meets development objectives; b) Seek changes in the allocation of State support from slowly growing low- and medium-tech sectors to the promising medium-high and high-tech sectors; c) Include more non-reimbursable financial support for risky projects; d) Set up programmes for nurturing innovative start-ups and further developing innovative SMEs; e) Consider tax exemptions and tax credits on intramural R&D activities; f) Discuss strategies for providing assistance for international patents and incentives for patenting abroad; g) Government should reduce significantly bureaucratic effort for public R&D and innovation support.
3	Improve labour and skills development policies.	SCST, in cooperation with the NAS and the Ministry of Education, should: a) Provide training for manager-practitioners in the field of R&D, innovation, knowledge management, technology transfer; b) Provide educational, training and consulting services for innovative enterprises and scientific-research organizations involving practitioners and researchers; c) Attract international experts with complementary knowledge, support on-the-job training and coaching; d) Continue successful initiatives on improving the business environment; e) Support job placements of PhD students, graduates and researchers.
4	Undertake measures to strenghten the Belarusian knowledge triangle.	Undertake measures with the goal to remove barriers affecting legislation, organizational matters, staffing, and access to finance, in line with the recommendations of findings of the Government Working Group under the TEMPUS project on “Fostering the knowledge triangle in Belarus, Ukraine and Republic of Moldova”.
Chapter 5: The role of eco-innovations fostering sustainable development		
1	Enhance R&D capacities on green technologies.	The authorities should target spending in green and eco-innovation projects. In particular, research on energy efficient technologies should be encouraged by competitive allocation of resources.
2	Seek engagement on international initiatives.	Additional financing could be obtained from international climate funds. Cooperation between national and foreign R&D institutes should be further encouraged.
3	Further deepen awareness campaigns.	Build on existing initiatives with UNDP to improve further education on climate change and the sustainable development goals in education institutions and to address the public.

4	Stimulate demand for eco-innovation.	Green public procurement mechanisms have been considered and could be further developed with the goal to disseminate green products and eco-innovation. In the long run, public procurement processes should be simplified in order to enable SMEs to compete for State contracts on a level playing field.
5	Introduce modern energy-efficiency and fuel-efficiency standards as well as building codes and infrastructure resilience parameters in order to improve sustainability.	Move towards the cost-reflective pricing of energy and water services with adequate social protection for the poor in order to enhance incentives for the adoption of progressive adaptation technologies and the sustainable use of natural resources.
6	Improve policies for the generation of knowledge, absorptive capacity of the economy, the diffusion of innovation and demand for innovation.	Better and more efficient policy coordination, both in design and implementation, in this area, including capacity building. In addition, the authorities should consider introducing specific mechanisms and instruments that encourage and facilitate linkages among stakeholders.
7	Enhance financial instruments supporting eco-innovation.	Firstly, consider introducing grant schemes to support R&D on eco-innovation. Also, establish project-based eco-innovation financing instruments that encourage the development of industry-science cooperation and inter-firm linkages, including by promoting climate-resilient infrastructure through public-private partnerships.

Chapter 1

INNOVATION POLICIES FOR SUSTAINABLE DEVELOPMENT

In September 2015, the General Assembly of the United Nations adopted the 2030 Sustainable Development Agenda to promote inclusive and sustainable economic development. Innovation can make an important contribution towards advancing this objective, as it drives productivity growth, conserves scarce resources and enables sustainable production and consumption patterns.[2] Beyond that, achieving most, if not all, of the sustainable development goals will require massive investments in innovation.

The original Innovation Performance Review of Belarus[3] discussed innovation policy as a general horizontal priority critical for long-term economic growth. The 2030 Agenda calls for economic growth to be aligned with ecological sustainability and social inclusion. Therefore, in addition to undertaking a general assessment of changes in the national innovation system over the last five years, the present study looks at areas where specific additional policy attention is needed to steer innovation efforts and investments into areas critical for sustainable development.

In Belarus, government policies for the promotion of innovation are embedded in the country's broader sustainable development agenda, which among other goals aims to reduce major negative anthropogenic effects on the environment and promote social inclusion. This chapter firstly describes the United Nations 2030 Agenda for Sustainable Development and the Addis Ababa Action Agenda and the role envisaged for innovation in achieving them. It then presents an assessment of the role of innovation policies in Government strategies and policies for achieving such objectives. It considers the country's national strategy for sustainable development till 2030, with a particular focus on innovation policies therein. Finally, the last section provides a conceptual discussion of the policy issues arising when trying to harness the power of innovation for sustainable development and some key policy tools that can be used to achieve this. Overall, markets for green economies and the "sharing" economy are only incipient in Belarus. However; in some areas important experiences have occurred with the help of international partners that could inform policymaking in the longer-run (cf. section 1.4 and chapter 5).

1.1 International initiatives promoting innovation for sustainable development.

The 2030 Agenda for Sustainable Development

At the United Nations Sustainable Development Summit on 25 September 2015, world leaders adopted the 2030 Agenda for Sustainable Development. This plan includes a series of actions to align economic prosperity with environmental sustainability and social inclusion by 2030.

[2] United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. A/RES/70/1
[3] UNECE (2011). *Innovation Performance Review: Belarus*. United Nations: New York and Geneva.

The 2030 Agenda for Sustainable Development covers 17 Sustainable Development Goals (SDGs) and 169 related targets that United Nations member States agreed to in September 2015. Goal 9 calls for member States to work together to "build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation". Innovation policies are also implicit in Goal 11 on sustainable urban development, and in the targets specified for Goal 8, including Target 8.2 "Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high value-added and labour-intensive sectors", and Target 8.3 "Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation (…)";[4] and in achieving Goal 12 on sustainable consumption and production.[5] Moreover, innovation is recognized as one of the means of implementation for the entire 2030 Agenda.

Means of implementation and the Global Partnership

The 2030 Agenda acknowledges that "private business activity, investment and innovation are major drivers of productivity, inclusive economic growth and job creation", and calls "on all businesses to apply their creativity and innovation to solving sustainable development challenges." The Agenda will also "encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships" (SDG 17, target 17.17) and "enhance North-South, South-South and triangular regional and international cooperation on, and access to, science, technology and innovation" (17.6).

The Addis Ababa Action Agenda

The Addis Ababa Action Agenda (AAAA) was adopted at the Third International Conference on Financing for Development, which took place in Addis Ababa in July 2015. The Declaration adopted by the Conference provides a new global financing framework to mobilize and deliver the resources, technology and partnerships needed for sustainable development. The AAAA was endorsed and referenced in the 2030 Agenda for Sustainable Development. The agenda contains seven thematic areas that cover different aspects of the financing of sustainable development. One full chapter of the AAAA concerns in particular the area of science, technology, innovation and capacity-building.

The Conference openly acknowledged that the creation, development and diffusion of new innovations and technologies and associated know-how - including the transfer of technology on mutually agreed terms between parties - are powerful drivers of economic growth and sustainable development. It also stressed that uneven innovative capacity, connectivity and access to technology within and between countries are each a key barrier to be overcome in the next years. Capacity development will be an integral aspect of this task, and the Conference called for enhanced international support through the establishment of multi-stakeholder partnerships. Effective and targeted capacity-building - which must be country-specific and country driven – will need to focus on addressing national strategies and priorities, set to support national plans. Among these, the importance of strengthening institutional capacity and human resource development was emphasized, including planning and management for both climate change adaptation and mitigation purposes, and water and sanitation-related activities and programmes.

[4] Ibid para. 34
[5] Ibid para. 28

In the declaration adopted at the end of the conference, the following decisions were taken, among others, which imply a commitment of Governments towards the fostering of innovation policies for the achievement of sustainable development goals:[6]

- To set-up policies that incentivize the creation of new technologies, research and innovation, acknowledging that enabling regulatory environment and governance frameworks are key;
- To promote social innovation for social well-being and sustainable livelihoods;
- To encourage knowledge-sharing through partnerships between stakeholders in sectors contributing to the achievement of the sustainable development goals;
- To promote entrepreneurship, including through supporting business incubators;
- To acknowledge roles of public finance and policies in research and technological development;
- To consider setting up innovation funds where appropriate, on an open, competitive basis to support innovative enterprises, particularly during early research and demonstration phases;
- To adopt science, technology and innovation strategies as integral elements of national sustainable development strategies;
- To increase investments in education in the fields of science, technology, engineering and mathematics and to enhance vocational and technical education and training, ensuring equal access for women;
- To encourage the development, dissemination and diffusion and transfer of environmentally sound technologies, including by setting up international cooperation and collaboration in science, research, technology and innovation, focusing on sustainable development goals;
- To support governments to strengthen their capacities towards more sustainable patterns of consumption and production;
- To commit further investments to achieve food security, including through international cooperation in the areas of earth observation, rural infrastructure, agricultural research and extension services.

Following a proposal in the Addis Ababa Action Agenda, the 2030 Agenda for Sustainable Development launched a Technology Facilitation Mechanism in order to support the sustainable development goals. The Technology Facilitation Mechanism will be based on a multi-stakeholder collaboration between Member States, civil society, private sector, scientific community, United Nations entities and other stakeholders and will be composed of: a United Nations Interagency Task Team on Science, Technology and Innovation for the SDGs, a collaborative Multi-stakeholder Forum on Science, Technology and Innovation for the SDGs and an on-line platform. The United Nations Interagency Task Team on Science, Technology and Innovation for the SDGs will promote coordination, coherence, and cooperation within the UN System on STI related matters, enhancing synergy and efficiency, in particular to enhance capacity-building initiatives. UNECE is a member of this Interagency Task Team. The first Forum on Science, Technology and Innovation for the SDGs was held in New York on 6-7 June 2016.

[6] See United Nations, Report of the third International Conference on Financing for Development Addis Ababa 13 - 16 July 2015 A/CONF.227/20 (paras. 114-122).

Some key principles underlying the 2030 Agenda for Sustainable Development and the Addis Ababa Action Agenda:

Universality

The UN 2030 Agenda for Sustainable Development is universal in that all countries and all stakeholders will implement it in a collective partnership. The Addis Ababa Action Agenda (AAAA) addresses the challenge of financing and creating an enabling environment at all levels for sustainable development. All UN Member States, including Belarus, have committed to implementing these agendas.

National Ownership and Responsibility

Not all 17 goals set in the 2030 Agenda are equally relevant for all countries. Each country will identify its own priorities within the Global Agenda and will take a commitment to develop a national strategy to achieve the priorities it sets for itself. Belarus is well advanced in the process of identifying priorities (Section 1.3). Thus, the present chapter can be seen as a contribution to identifying additional options on how to harness the power of innovation for achieving these priorities.

Follow-up and Review

The 2030 Agenda calls for a dedicated process at the national, regional and global levels for monitoring progress, and for facilitating implementation through policy learning. At the High-Level Forum for Sustainable Development in New York in July 2016, a first batch of Member States presented their initial reports on the priorities they have set and the strategies they are putting in place for achieving them. The follow-up and review processes are expected to draw, as far as possible, on initiatives and activities that already exist. They are expected to be based on evidence at the country level. It is hoped that the analysis presented in this Review will be useful as an input in this process.

1.2 Innovation and sustainable development – specific policy issues

To fully realize the potential of innovation for sustainable development, it is necessary to encourage and steer innovation efforts and investments into areas critical for sustainable development, and to encourage the rapid and broad-based adoption and diffusion of innovations in such fields. Cases in point include energy efficiency in buildings and transport, the move towards renewable energy, sustainable cities and the move to the circular economy, to name but a few. Without policy interventions which actively steer innovation efforts into areas critical for sustainable development, progress may not occur because innovation in sustainable technologies and products may not advance more rapidly than innovation in conventional technologies and products.[7]

[7] For instance, the historical record shows that the pace of innovation in exploration and drilling techniques has been rapid enough to keep increasing the level of proven fossil fuel reserves relative to demand, and to also keep the costs of exploitation from rising and the success rates of exploration from falling. Therefore, there is no evidence to suggest that supply will be outstripped by demand, and that prices will be pushed up "naturally", thereby encouraging a shift towards renewables/alternative fuels. Similarly, innovation in electric vehicles will not automatically lead to a market breakthrough. A breakthrough will happen only if innovation in electric vehicles is

There are barriers that may impede the innovations which can have a sizeable positive impact on sustainability. It is important to identify these barriers in order to design effective policies to overcome them. These barriers fall into the following categories:

- Externalities which distort market prices;
- Lack of salience of sustainability advantages (inattention);
- Credit constraints and other financial market imperfections;
- Information asymmetries between parties who must share costs and benefits of technology adoption; and
- Coordination failures ("chicken and egg" problems).

Distortions in market prices can negatively affect not only choices to invest in acquiring new technologies, but also choices on how to use them, as well as decisions to invest in innovation in the first place. These distortions arise from externalities, i.e. situations where decision makers (consumers or companies) do not bear the full costs or do not reap the full benefits of their choices, and where their choices therefore lead to excessively high costs or inefficiently low benefits for society as a whole. A classic example is a fuel price which reflects the costs of mining, refining and distributing the fuel, but not the cost of environmental pollution caused by burning it. In this situation, a consumer buying a car with a new more fuel efficient engine would bear the full cost of this investment, and would benefit from lower expenditures on fuel. However, if the price of fuel does not capture the cost of pollution, the owner of the more fuel efficient car will not reap the benefit of lower pollution. As a result, the demand for new cars may remain too low.

Even if externalities have been internalized and market prices are not distorted, innovations may still not be undertaken for lack of demand for the resulting products. One reason is that information on the sustainability properties of different products may be less salient to customers than other product features which then guide their purchase choices.
For instance the purchase prices of two alternative products can be compared easily, and will typically have a significant influence on the purchase decision. By contrast, whether an innovative product has lower usage costs may be much more difficult to assess, given that this depends on the technical properties of the product in conjunction with individual usage patterns. Future usage costs may thus receive less attention in purchase decisions.

Relatedly, adopting innovative sustainable technologies or products may require significant upfront investments. This is true for durable consumer goods, and even more so for innovative solutions in reducing the ecological impact of housing, or for investments in innovative sustainable production processes. The costs of adopting such innovations have to be incurred immediately, whereas the benefits in terms of reduced usage costs, lower environmental impact or higher revenues will materialize only over time. Such investments may therefore depend on the ability of consumers or companies to obtain credit.

There is ample evidence that consumers and companies, particularly small and medium-sized enterprises, are often constrained in their access to credit by a lack of collateral and by

more rapid than innovation in internal combustion engine vehicles (Thomas Covert, Michael Greenstone and Christopher R. Knittel. 2016. "Will We Ever Stop Using Fossil Fuels?." *Journal of Economic Perspectives*, 30(1): 117-38).

information asymmetries which discourage banks from lending. Such information asymmetries may be particularly relevant in the case of investments in innovative technologies where the return depends on product characteristics and future usage patterns that are difficult for creditors to verify.

Another possible barrier to the efficient adoption of innovations are information asymmetries between parties that must share the costs and benefits of the investment. An example is the decision by a landlord whether or not to use innovative materials to improve the insulation of a block of rental apartments. The landlord would do so if he could recover the costs through higher rents. The tenants would benefit through lower heating bills. However, it may be difficult for the two parties to agree on the appropriate size of a possible rent increase because the benefits will depend on the properties of the materials which the landlord installs, which the tenants do not control, and the heating habits of the tenants, which the landlord has no control over.

A fifth possible barrier can arise from coordination failures between the adoption of innovations and the development of complementary infrastructure (a.k.a. “chicken and egg problems”). For instance, consumers may be reluctant to purchase electrical cars or cars running on alternative fuels if there is a lack of charging stations, while the energy industry may be reluctant to build charging stations if there are few vehicles to be charged.

Policy options to promote innovation for sustainable development

There are a range of policy options available to address the above barriers to the adoption of critical innovations, such as the following:

- taxes and markets to internalize externalities;
- standards;
- regulations;
- product labelling;
- awareness-raising campaigns;
- subsidies;
- tax incentives; and
- public procurement.

These policies may be used individually to address specific barriers, or they may be used in combination to address barriers arising from the inter-connectedness of investment decisions in different areas.

Pigouvian taxes and, in the case of pollution externalities, markets for tradable permits, are generally considered the preferred policy instruments for internalizing negative externalities and correcting price distortions. The advantage of these instruments is that they are cost-effective because they do not discriminate between alternative technological solutions to sustainability problems and because they are generally well-targeted, i.e. they provide incentives for behavioural change primarily to those whose decisions are most distorted by market failures.

Where these options meet with political resistance, alternative policies that may be considered include subsidies for buyers or investors and mandatory quality or performance standards.

These policies are generally considered second-best because they are less well targeted (subsidies) and may be subject to regulatory capture (standards).

Awareness-raising campaigns, the introduction of product labelling and standards are examples of policies that can overcome the problem of lack of salience. Good practices include for instance, offering free-of-charge energy audits which inform consumers of the specific usage patterns and costs of consumer durables and homes.

In this regard, information has a key role to play, and advances in information and communication technologies, such as the move towards the Internet of Things, hold a lot of promise. This move will generate large quantities of data, for instance about how household appliances are being used, and these data can in turn be used to inform consumers about the true costs of their consumption choices, and to create pricing schedules which provide incentives for a more efficient use of resources.

Awareness-raising campaigns can also affect positive change in consumption patterns by changing behaviours through changing perceptions and aspirations. A case in point is the move to a "sharing economy" where people aspire less to owning durable consumption goods, such as cars, and focus more on being able to use them when they need them. This provides examples of innovations which, although often enabled by technology, are essentially new business models enabling new modes of consumption.

Credit constraints and other financial market imperfections can be addressed through investment tax incentives and different forms of investment subsidies. But minimising the risk of inefficient public spending requires detailed understanding of technologies and markets.[8]

It also requires careful targeting. There is evidence that some subsidies, while intended to encourage investments of poorer, more credit-constrained households, have instead been taken up mostly by wealthier, less constrained households. "Tagging", i.e. restricting eligibility for subsidies based on observable characteristics such as income level can improve outcomes significantly.[9]

Financial incentives can also be combined with product labelling or standards, as when subsidized mortgages are made available to home owners who build to certain minimum energy efficiency standards. There is also scope for providing additional incentives in areas such as green financing through changes in the regulatory environment for institutional investors.[10]

Information asymmetries between parties sharing the costs and benefits of adopting an innovation, and coordination failures between entities that need to make complementary investments can be mitigated through regulations and standards.

[8] Karol Kempa and Ulf Moslener (2015) *Climate Policy with the Chequebook – An Economic Analysis of Climate Investment Support.* Frankfurt School of Finance and Management, Working Paper Series no. 219.
[9] Hunt Allcott, Christopher Knittel and Dmitry Taubinsky (2015) *Tagging and Targeting of Energy Efficiency Subsidies.* American Economic Review, 105(5): 187-91.
[10] European Commission (EC), *Shifting Private Finance towards Climate Friendly Investments - Policy options for mobilizing institutional investors' capital for climate-friendly investment*, Brussels, 2015.

Barriers to the adoption of innovations often constrain the demand for innovation, even though, as indicated above, a lack of demand will also negatively affect supply. To address innovation adoption gaps, therefore, requires complementing supply-side policies with appropriate demand-side policies. In addition to the policies discussed above, the State can be an important source of demand for innovation for sustainable development, notably through public procurement. For example, in the EU market, procurement accounts for about 19 per cent of GDP. More generally, demand for innovation in areas critical for sustainability can be boosted by increasing the innovative capacity of the public sector to meet societal challenges.[11]

Public Procurement of Innovation (PPI) occurs when public authorities act as an "early user" customer for innovative goods or services. These are typically not yet available on a large-scale commercial basis and may include conformance testing. The procurer may be the user or catalysing/aggregating demand of others.

1.3 Belarus' National Strategy for Sustainable Socio-Economic Development 2030

In Belarus, innovation policies are embedded in the Government's national development strategy, the National Strategy for Sustainable Socio-Economic Development in the Republic of Belarus until 2030 (NSSSED-2030). This national strategy, which is the main policy document that sets the framework for sustainable development in the country, was launched in parallel to the development of the United Nations 2030 Agenda for Sustainable Development at the global level. The+ timing calls for a cross-examination to shed light on common priorities and links, especially with regards to the new global mandate on sustainable development and the role of innovation policies therein.

NSSSED-2030 was prepared based on previous policy documents and programmes, including the National Strategy on Socio-Economic Development for Belarus 2016-2020 (NSSD-2020), which was structured around three areas or pillars: economic, social and the environment.

The NSSD-2020 was adopted by the National Sustainable Development Commission and the Presidium of the Council of Ministers as the supreme planning and forecasting document within the system of national and regional government structures. It overviews the existing global development tendencies and the place of Belarus within the international system, outlines main conditions and principles, and considers social, economic and ecological components of sustainable development. It also identifies internal and external risks to policy implementation.

The NSSD-2020 defines the main strategic goal of sustainable development of the Republic of Belarus and presents three main sub-goals: an increase in the level and quality of living and poverty reduction; fostering economic production of goods and services; and a more rational management and preservation of nature and the environment for future generations. The NSSD-2020 further elaborates on the main directions and means of achieving these goals, and it stipulates the creation of a monitoring system.

As a rule, other national strategies and sector development plans have been aligned with the NSSD-2020. These include such initiatives as the Socio-Economic Development Programme of the Republic of Belarus 2011-2015 and the Industrial Complex Development Programme of the Republic of Belarus until 2020, among others.

[11] See the Committee's document on good practices and policy recommendations on Innovation in the Public Sector ECE/CECI/2015/5 and OECD (2011), *Demand-side Innovation Policies*.OECD: Paris.

With the goal to integrate existing strategies into a longer term policy framework, Belarus, with the support of UNDP, other resident and non-resident UN agencies and the World Bank, prepared a Concept for National Sustainable Socio-Economic Development Strategy till 2030 (NSSSED-2030) and related five-year National Socio-Economic Programmes for their implementation.

NSSSED-2030 is divided into two phases and contains six main development areas:

- Phase I: 2016-2020 – with goals of ensuring the transition to sustainable and balanced economic growth based on structural reforms and institutional transformation and the focus on development of hi-tech and eco-efficient industries; and
- Phase II: 2021-2030 – with goals of ensuring the achievement of a high level of human capital development based on the formation of the green economy, global informatization, accelerated development of hi-tech enterprises and services.

The six components are as follows: human capital development and an increase in the quality of life; scientific, technical and economic potential of sustainable development; preservation of the environmental potential for future generations and improvement of the environment; major instruments for ensuring sustainable development; sustainable spatial development strategy; development of democracy and mature civil society.

The NSSSED-2030 also addresses challenges to sustainable development of Belarus around three components: social, with a focus on health, population ageing and migrations, education and social inequalities; economic, with a focus on competitiveness, technological development, access to international markets, know-how and financial resources and energy security; and ecological, with a focus on challenges to climate change, trans-border transfer of dangerous and harmful substances, the risk of new diseases, and the exhaustion of natural resources.

The adoption of a longer-term agenda such as NSSSED-2030 reflects an impulse by the authorities to consolidate the multiplicity of programmes into more comprehensive, integrated initiatives. Importantly, the NSSSED-2030 includes a section dealing specifically with the promotion of science and innovation (Chapter. 5.2). In this regard, the Government has spelled out certain actions for the development of the scientific sphere, which are aimed at strengthening collaboration with academic institutions, industries and scientific universities with the goal to increase the country's competitiveness and achieve conditions for the undertaking of R&D and innovation activities that are equivalent to those obtained by advanced industrialised European countries.

One key objective of innovation policies described in NSSSED-2030 is to facilitate the transition of Belarus towards a knowledge economy. According to the strategy, this will require the modernization and restructuring of the scientific sphere in order to better integrate it into the real economy; the creation of new schools and the implementation of strategic programmes of R&D to achieve technological breakthroughs; ensuring the integration of the NIS into the world as well as to European and Eurasian innovation networks; and ensuring the adequate replacement of relevantly educated scientific and technical personnel in the long run.

Measures are envisaged for the expansion of international scientific and technical cooperation, strengthening the integration of science and production, commercialization and encouraging

technology transfer and diffusion. With regards to financing of innovation, the NSSSED acknowledges the need to attract investment in the financing of scientific research through the development of funding from private sources (including venture capital funds and PPPs for the establishment of research infrastructure).

It is also envisaged that promoting the transformation of research institutions through cluster structures oriented to high technology final products will help in this process. Also, it is expected that the transformation of the intellectual property rights (IPR) framework will be completed through the formation of a market for intellectual property and the commercialization of R&D results through a complete network of entities operating within a modern innovation infrastructure that allows for proper transfer of technology.

The strategy also stresses the need to establish effective mechanisms to create economic incentives for advancing priorities in fundamental research, as well as the key applied research projects (e.g. in the field of ICTs; nano-technologies and bio-technologies; genetic engineering; medicine and pharmaceuticals; laser and optical technologies; robotics; environmental management and resource conservation; energy saving systems, and others). These include mechanisms to encourage the creation of small innovative firms as well as a system of economic, social and legal measures to support researchers (e.g. including incentives for education and continued learning as well as school infrastructure). Box 1 summarizes the main directions of measures to be undertaken by year 2030.

Box 1. Main Directions of Development of Scientific and Technical Capacities in the NSSSED 2030

- Focus on developing the potential for the creation of high-tech specialized innovative industries (photonics, microelectronics, laser and space technology, nano-and biotechnologies and others);
- Development of scientific and technological innovation and industrial clusters, aimed at creating new technologies and scaling them up;
- The establishment of national research laboratories and centres capable of carrying out world-class basic and applied research and provide a rationale for scientific breakthroughs and technological development;
- The promotion of small forms of innovative entrepreneurship through the formation of clusters of practically-oriented organizations around major laboratories and research centres;
- Extending the use of innovation vouchers and grants to individuals and small businesses to implement innovative projects aimed at the commercialization of patents and trademarks;
- Optimization of State budget support for research development based on the criteria of priority, relevance and effectiveness;
- The creation and development of a unified State review system in the areas of scientific, technical and innovation activities with the use of information and communication technologies; and improving the system of organization and conduct of the State scientific and technical review;
- Improving the quality of training of highly qualified scientific personnel and specialists in high-tech industries within the chain linking "school - university - research institution - production", including through the development of training of young scientists in leading scientific institutions and their participation in academic exchanges;
- Stimulating the introduction of incentive mechanisms for research and innovation activities, including receiving the guaranteed income from the use of intellectual property;
- Foster the development of standardization as an important tool to stimulate innovation development by eliminating outdated State standards and technical regulations, harmonization with international standards; and development of technical regulations on priority directions of scientific and technical innovation; and
- Integration into the global system of research and further development of advanced forms of regional and global research cooperation.

Assessment of the National Agenda for Sustainable Development

In general, the NSSSED-2030 shows that a comprehensive and ambitious national development strategy exists, which is further supported by specific strategies and sector development plans. Indeed, many of the objectives for scientific development of the NSSSED-2030 have already been included in specific policy documents by the SCST (cf. chapter 2).

However, the NSSSED-2030 lacks quantitative targets and indicators of achievement to measure and account for progress made in many of the measures envisioned. As it was the case with other policy initiatives referred in Chapter 2 of this Review, the mechanisms for implementing such aspiring transformations are not spelled out in the NSSSED. Exceptions include the share of domestic expenditures on research and development, which is expected to increase from 0.7 per cent in 2015 to 2.5 per cent in 2030; and the share of non-State funded sources, which is expected to increase from 55 to 70 per cent.[12]

Moreover, the strategic priority sectors for innovation policies included in the NSSSED have a bias towards sectors where Belarus already has a significant capacity (i.e. software, bio-technology, nuclear energy). While it can make sense to build on existing strengths, economic activities in other areas could also be prioritised for innovation, especially in sectors that are not capital intensive and could result in high social impact from the point of view of sustainable development through increased job creation (e.g. tourism, agro-industries, industrial manufacturing).

1.4 International cooperation for sustainable development

The UN system, under the leadership of UNDP, will support countries in developing their national SDG objectives, including through regular country programmes within the United Nations Development Assistance Framework (UNDAF). The priority areas of work of the current Belarus UNDAF programme have been aligned to the priorities included in the NSSSED-2030 and the NSSD-2020. In spirit, they are also closely linked to the new Agenda 2030 development agenda. It should be noted that the strategic areas that have been chosen will set the main direction and scope of action of the UN systems assistance to the Government in Belarus over the next five years. They include the following areas: inclusive, responsive and accountable governance; sustainable economic development; environmental protection and sustainable environmental management based on the principles of the green economy; sustainable development of human capital, health and education; social inclusion and protection; and comprehensive development in the Chernobyl affected regions.

As part of its outreach activities, UNDP developed a programme during October 2015 to increase the visibility of the SDG agenda. The 'UN-70 Express' train with around 200 people on board departed from Minsk Railway Station in October 2015 with the goal to disseminate information about the SDGs in Belarus. The train got its name in commemoration of the 70th anniversary of the end of World War II and the foundation of the United Nations. The UN-70 Express visited the regions of Grodno, Baranovichi, Brest, Gomel, Mogilev and Vitebsk. Its mission was to bring people together and to give them a chance to talk to and hear each other. During its eight-day journey, it visited cities of Belarus and undertook outreach activities with various stakeholders.[13]

Overall, during the tour meetings were held in cooperation with 20 government agencies, 33 embassies and representatives of over 45 countries, 19 UN agencies - including UNECE-and 246 UN staff and partners, 150 non-governmental organizations, 25 private sector partners, 15 universities and nine schools. Attendance at the sponsored events reached over 150,000 people.

[12] Other targets include: the volume of new industrial products is expected to increase from 19 to 25 per cent; and the percentage of innovatively-active companies is expected to increase from 24 to 30 per cent in the same period.
[13] Key among them were the OSCE, the EU, the Global Fund, the Maria Sharapova Foundation, the US Agency for International Development and a number of media partners.

One of the key objectives was to enable the integration of the SDGs in policymaking at the local level in Belarus. Thus, in each city that was visited, the focus was on different SDGs. Good health in Grodno; quality education and gender equality in Brest; reduced inequalities in Gomel; no poverty, zero hunger, decent work, economic growth and sustainable cities in Mogilev; affordable and clean energy, responsible consumption and production, climate action in Vitebsk.

In cooperation with UNDP, some projects have been successfully performed to facilitate the implementation of green initiatives in Belarus, including specific ones promoting innovation. With regards to promoting energy efficiency a range of projects have been launched which are aimed at the improvement of energy-savings in the country.

In September 2013 the project called *"Developing an Integrated Approach to a Stepped-Up Energy Saving Programme"* was initiated. The objective of the project is to enhance efficient use of energy resources at the local level in Belarus through application of energy-saving technologies and measures in educational buildings. Pilot sites will be set to demonstrate the application of innovative energy-efficiency technologies in school buildings, with the goal to build capacities and raise awareness of local authorities, specialists and local populations to carry out energy saving measures at the local level. The project also aims at increasing the involvement of local peoplefor the further replication of best practices.

Since that time, the project organized a series of workshops to train 27 teachers from target regions to teach energy efficiency issues in educational institutions. Also, memorandums of Understanding between UNDP and Vitebsk, Grodno and Minsk Regional Executive Committee for the implementation of project activities were signed. Public Advisory Boards have been created in four target districts of Vitebsk, Grodno and Minsk regions to maximize the local communities' involvement in project activities.

Another project supported by UNDP and the European Union aims to promote "green growth" concepts and environmentally sustainable production and consumption patterns through support of local "green" initiatives (Box 2).

Box 2. EU/UNDP Project on supporting transition to a Green Economy in Belarus

The Project is part of the EU Annual Action Programme 2012 for Belarus and contributes to the delivery of its overall goals and objectives laid down in the financial agreement on the Annual Action Plan implementation between the Government of the Republic of Belarus and the European Union

The project includes the following objectives:

- Expanding public knowledge of the principles and ideas of green economy. Implementation occurs through a broad-based information campaign and diverse outreach strategies to promote the principles and ideas of the green economy. Actions included the development of a special interactive video reel explaining green economy concepts, which was broadcasted on the main TV channels of Belarus as social advertising. The target audience of the focused information campaign includes general public, the NGO sector, as well as public authorities, local business community, and mass media.
- Developing green economy in the regions through implementation of pilot initiatives and the creation of eco-info centres. The project supports local pilot initiatives aimed at the economic empowerment of local entities based on green growth principles in the areas of waste management, water management, biodiversity conservation, and ecotourism. A mobile phone game application for different platforms was also developed, focusing on different areas of the green economy (green energy, ecotourism, waste management, green transport, green lottery). In addition, special trainings were organized in March and April 2016 on the following topics: marketing of touristic destinations; development of touristic cluster; and the quality of tourists servicing. On 2 June 2016, and Eco-Forum was organized in Minsk to showcase greening experiences. In addition to the plenary sessions, a special exhibition demonstrating green technologies was organized, including pilot projects on the production of office paper from waste paper, processing of sapropel and organic agriculture. These initiatives seek to showcase the key principles of a green economy and related benefits in terms of reducing risks to the environment and preserving natural resources.
- Creating effective partnership and joint action mechanisms for NGOs, local administrations and businesses to implement commercially viable projects based on green growth ideas. A contest of green initiatives was undertaken between 1 July and 31 August 2015, with participation open to any officially registered NGO in Belarus. At the end, 16 applications were selected to support the initiation of measures on priority areas, including by innovative associations. Green initiatives that will receive financing include the following areas: waste management, eco-tourism, water-resources management, conservation of biodiversity, renewable energy, eco-innovations, organic agriculture. All initiatives are implemented by NGOs in partnership with local government and business organizations.

Source: http://www.by.undp.org/content/belarus/en/home/operations/projects/environment_and_energy/00081657.html (accessed 15 October 2016)

With regards to promoting energy efficiency in housing, a UNDP project "*On Improving Energy Efficiency in Residential Buildings in the Republic of Belarus"* is aimed at the reduction

of energy consumption in housing and related GHG emissions with the focus on new residential buildings. The project supports the introduction of new energy efficient building design and construction standards with related energy certification scheme(s) and seeks their effective implementation and enforcement. The goal is to reduce the energy consumption of new buildings by at least 70 per cent compared to the existing building stock constructed before 1993 and by 40 per cent compared to the buildings erected in accordance with current construction norms and thermal standards.

Within the frameworks of the Project, a detailed comparative analysis of existing gaps between the energy efficiency housing standards in Belarus and the European Union has been completed. This research provides a basis for a roadmap that includes a list of technical regulatory acts for further development and adoption. Many of these documents have been added to the Events Action Plans on standardization and regulation in the field of energy efficiency and energy saving in the construction sector for 2014-2017.[14] The project has already completed the preliminary stage for building three pilot energy efficient multi-apartments in Minsk, Hrodna and Mahilou (i.e. the construction sites have been identified, and the design as well as the specifications for technical installations, machines and tools necessary to improve the energy efficiency have been already developed). Procedures have also been launched to procure the energy efficient engineering equipment.

Finally, regarding the promotion of alternative fuels, a major project, launched by the Global Environmental Facility (GEF) and UNDP in Belarus will contribute to increase generation of wind energy. The project on *"Removing Barriers to Wind Power Development in Belarus"* proposes to establish a financially-viable private company funded by an investment grant to facilitate investment into wind energy in Belarus by providing equity capital and establishing market-based instruments (Box 3).

[14] The project, together with RUE 'Stroytekhnorm', has initiated the development and has prepared the first variant of the technical regulations 'Energy Efficiency for Buildings' - the most important legislative regulatory document in this field

Box 3. Removing Barriers to wind power development in Belarus

The main problem that the project seeks to address is that wind energy in Belarus is not commercially attractive to private developers of wind farms due to a number of barriers. For instance, the Law on Renewable Energy of 2010 defines the right to receive a "certification of origin" that is required in order to receive the renewable energy premium, but it did not provide the necessary details to implement this certificate of origin. Also, the feed-in premium model established by the law attempts to reflect a similar system practiced in many EU countries, such as Germany, but unlike in other EU States, it does not mitigate currency risk (resulting from the need to import equipment or to repay foreign loans), or commodity price risks, which reduces the likelihood of private finance for such projects.

The GEF-UNDP project, to be implemented between 2014 and 2019, seeks to address some of these hindrances through establishment of a Wind Private Finance Initiative (WPFI) that will support development of at least five project sites of renewable energy over their 20-year lifespan. This fund will be self-sustaining in the short to medium term as it uses the premiums that it collects to fund its ongoing operations. Its goal is to set realistic tariff rates that will generate a premium for sale of the better projects. A series of actions are contemplated in the initiative, including the following:

- Assist enacting secondary legislation in place to support wind energy (including technical norms and standards in line with EU practice, including provisions to establish the fixed lower limit for the one-part tariff and methodology for its determination; to establish fair transmission tariffs, infrastructure charges, loss compensation costs and many other cost components that enable the viability for wind farm projects;
- Work to increase confidence among investors in the profitability of wind power projects;
- Augment the perception of the benefits of wind energy and other RE for power generation by stakeholders and general public; and
- Provide an Investment Grant by the GEF project in order to ensure the successful construction and operation of a pilot wind farm in Belarus. Further Investment Grants will be made by the WPFI in case of availability of co-financing from the Government or private investors.

The goal of the project is that at least three wind farm projects will be successfully financed, constructed, and operated in Belarus with assistance from the WPFI. Also, WPFI will continue to operate and provide assistance to wind energy projects in Belarus beyond the lifetime of the project. By the end of its implementation, it is expected that the project will enable the development of sound Feed-in-Tariff and procedures to directly foster over 25 MW of installed wind capacity during a five year period and the generation of over one million MWh of renewable energy.

With regards to policies fostering social inclusion, UNDP assisted the government in the establishment of a United Nations Social Impact Fund (UNSIF) facility. UNSIF is the first organization of its kind, representing the UN's commitment to grow the Impact Ecosystem. This is a global platform, providing support in the form of grant capital, impact oversight and

expertise to subsidiary social impact funds. UNSIF will target seven priority Sustainable Development Goals, through partnership with Social Enterprises, Impact Investors, Venture Philanthropists and Policymakers.The social impact investment facility will provide seed money and investment in social enterprises and social investment products with a proven potential to generate social and financial returns. The amount of project funding for the Social Impact Fund will be matched by an equivalent amount from the Belarusian Development Bank.

Another initiative supporting economic development and local entrepreneurship is the Project on Support to Local Development in the Republic of Belarus, jointly funded by UNDP and the Government. This Project is aimed at assisting government authorities and organizations with improvement of good governance standards through a participatory approach and strengthened dialogue between authorities, businesses, not-for-profit organizations and citizens. It aims at finding strategic solutions to the problems of local development in conjunction with regional processes and supporting grassroots initiatives. The goal of regional development is defined as sustainable and dynamic development of all regions within the country in accordance with the profile of each region in the domestic division of labour, overcoming of inter-regional disparities in the levels of socio-economic development to ensure enhancement of human wellbeing levels irrespective of place of residence. Project partners include Regional Executive Committees, as well as district administrations and self-governance bodies in the territory of these regions. The Project's target groups include Government and civil society stakeholders interested in designing and implementing area-based development initiatives. In May 2015 the Project organized two educational workshops on territorial and sustainable development management featuring international experts.

Also, from April to June 2015, the 15 regional coordinators of the project visited over 100 regions of the Republic of Belarus to provide technical and advisory support in the preparation of applications for the 1st Contest of Local Initiatives, open to more than 1,200 representatives of local communities. This proved to be the largest contest of initiatives in Belarus: with 722 applications, 594 of which were accepted for assessment and 87 awarded financial aid.[15] One key component of this project was the undertaking of a large-scale sociological survey –"*My district*"– with the goal to identify and analyse challenges and priorities of the Belarusian regions. Surveys were gathered between November 2015 and January 2016, covering all 118 districts of the country. The findings will inform a report that will be available for wide public review.

Finally, another area where innovation has recently emerged with the assistance of international partners concerns social innovation and crowdsourcing. A UNDP Social Innovation Lab has been set up with the goal to nurture and promote innovative and bright ideas. The latest event organized by the UNDP Social Innovation Lab was a Hackathon (i.e. *#Hack4Tourism*),aimed at bringing together creative young people to find innovative solutions for promotion of Belarusian tourism. Considering that at present the tourism industry is strongly influenced by the Internet; and that travellers are increasingly empowered with more flexible choices and opportunities, it has resulted in more competitive pressures for the industry. The integration of IT technologies would become a strong driver to promote tourism worldwide and the goal of the event was to inform local stakeholders on current trends. #Hack4Tourism lasted for 48 hours and provided an opportunity for participants, together with experts and mentors to develop prototypes of the projects focused on two main themes:

[15] In 2015, 66 initiatives were financially supported - with a total funding amount at €785,641. See UNDP, Interim Narrative Report. Project: "Support to Local Development in the Republic of Belarus", Minsk, 2016.

- Innovative solutions to make existing information about tourist destinations in Belarus easily accessible for the public; and
- Create innovative marketing tools to promote tourism in Belarus.

Concerning crowdsourcing, one of the major Belarusian partners of UNDP is the Internet platform Talaka.by. As was shown in Chapter 4, this Belarusian not-for-profit provides a venue for project implementation where anyone can gather a team, get support andfeedback, as well as receive funding. Talaka is a gathering point of impartial people who jointly create social and entrepreneurial innovations. Everyone can publish and test their ideas, receive feedback from target groups, transform an idea to a project and then carry it out by means of crowdsourcing and crowd-funding resources provided by the platform.

1.5 Recommendations

To improve the policy framework for implementation of SDG agendas, the Government may:

- Consider establishing an effective mechanism of inter-ministerial coordination based on an understanding of the interdependency of various problems and factors, and the synergy of goals and efforts to resolve effectively cross-cutting issues; and
- Adopt indicators, targets and monitoring mechanisms with regards to fostering eco-innovation. Future revisions of the NSSSED-2030 and other programmes should aim at identifying specific objectives, indicators and monitoring mechanisms with regards to benchmarking the development of eco-innovations. Relevant ministries should work with the National Statistical Committee to consider the development of indicators on such variables as R&D expenditures on renewable sources, use of innovative environmental technologies, environmental-related patents, energy productivity, energy intensity by sector and activities, among others.

Chapter 2

POLICY FRAMEWORKS, PROGRAMMING AND INITIATIVES

Chapter 2 introduces some key features of the methodological approach that is followed in the Innovation for Sustainable Development Review of Belarus, which is based on the National Innovation System (NIS) concept. It also considers the framework conditions for innovation, and they key innovation policies and instruments. The chapter proposes a number of conclusions and recommendations to complete the process of building Belarus' NIS, as well as to improve its effectiveness and governance.

2.1 Innovation policies and instruments

Recent legislative and regulatory developments

Innovation has traditionally been assigned high priority in the declared strategic policy orientation of Belarus. Promoting innovation and the knowledge economy feature prominently in the long-term programmatic documents adopted at high level public administration.[16] Innovative development is also highlighted as one of the five key priority medium-term development objectives in the Programme of Socio-Economic Development of Belarus in 2016-2020, which stipulates the integration of science, education and industry, further development of innovation infrastructure; and places a special emphasis on the development of science-industry clusters as key ingredients of the innovative economy.[17] Among the key objectives of the action plan of the Belarusian government for 2016-2020 is "restoring of competitiveness of Belarus's industry and a new strategy of innovative development based on the principles of the green economy".[18] The Action Plan contains a separate section on innovation policy and ICT development, which outlines the main priorities of the public administration in this area.

In the past decade or so, this declared policy priority was also matched by considerable efforts in developing and adopting of a legislative and regulatory framework operationalizing the directions of public policy in this area (Table 2). Nevertheless, until recently, there was no specific law dedicated to the specificities of the innovation process in Belarus and the role of public policy in this process. Thus, innovation policy and practice in Belarus was given a significant new impetus with the adoption in 2012 of the new Law on State Innovation Policy and Innovation Activity (LSIPIA).[19] Many laws and regulations concerning science and

[16] An important specificity of Belarusian policy-making is the top-down approach to policy initiatives, with a leading role of the public sector, which to some extent reflects also the structure of the economy, with a still significant share of State ownership.

[17] Основные положения Программы социально-экономического развития Беларуси на 2016-2020 годы (Main provisions of the Programme of Socio-Economic Development of Belarus in 2016-2020),

[18] Постановление Совета Министров Республики Беларусь № 274, 5 апреля 2016. Программа деятельности Правительства Республики Беларусь на 2016 – 2020 годы. (Government Decree No. 274, 4 April 2016, Action Plan of the Government of the Republic of Belarus in 2016-2020).

[19] Закон Республики Беларусь № 425-З "О государственной инновационной политике и инновационной деятельности в Республике Беларусь", 10 июля 2012 г. (Belarus, Law of the Republic of Belarus "On State Innovation Policy and Innovation Activity in the Republic of Belarus, 10 July 2012).

innovation (and these have been numerous in the last five - six years) have been streamlined into this LSIPIA.

Table 2. Recent legislative, programmatic and regulatory policy documents

Policy document	Implementing agency
Government Decree "State programme for innovative development of the Republic of Belarus in 2011-2015", 26 May 2011.	State Committee for Science and Technology (SCST); National Academy of Sciences (NAS)
Government Decree "Strategy of the Republic of Belarus in the Sphere of Intellectual Property in 2012 – 2020", 2 March 2012	SCST, National Centre of Intellectual Property (NCIP)
Presidential Edict No. 253 "On China-Belarus Industrial Park", June 5 2012.	Council of Ministers
Law of the Republic of Belarus "On State innovation policy and innovation activity", 10 July 2012.	SCST, Line Ministries
Law of the Republic of Belarus "On the public procurement of goods and services", 13 July 2012.	Line Ministries
Presidential Edict No. 357 "On the approach to the mobilization of innovation funds and their use", 7 August 2012.	Line Ministries; Regional Authorities
Government Decree "Programme of State support to SME entrepreneurship in the Republic of Belarus in 2013-2015", 29 December 2012.	Ministry of the Economy, Regional authorities
Presidential Edict No. 59 "On the commercialization of the results of R&D activity undertaken on the basis of public funding", 5 February 2013	SCST
Presidential Edict No. 229 "On some measures for stimulating the implementation of innovation projects", 20 May 2013.	SCST
Government Decree "On some measures for implementing Presidential Edict 229 of 2013", 4 October 2013.	SCST
Law of the Republic of Belarus "On the counteraction to monopolistic activities and the development of competition", 12 December 2013	Ministry of the Economy
Government Decree "On the approval of the concept of formation and development of innovation and industrial clusters in the Republic of Belarus", 16 January 2014	Ministry of the Economy
National Strategy for Sustainable Socio-Economic Development of the Republic of Belarus till 2030. Endorsed by the Council of Ministers, 10 February 2015	Ministry of the Economy
Presidential Edict No. 1 "On changes in the State management in the sphere of science", 16 February 2015.	Council of Ministers; SCST
Presidential Edict No. 166 "On the priority directions of scientific and technical activities in the Republic of Belarus in 2016-2020", 22 April 2015.	National Academy of Sciences (NAS), Line Ministries
Government Decree "On the functioning of the unified system of State scientific and State science and technology expertise", 22 May 2015.	SCST, National Academy of Sciences (NAS)
Government Decree "On the approval of the list of State programmes for scientific research in 2016-2020", 10 June 2015.	SCST, National Academy of Sciences (NAS)
Government Decree "On the approach to developing and implementing State programmes for scientific research", 12 August 2015.	SCST, National Academy of Sciences (NAS)
Government Decree "On the approach to developing and implementing State science and technology programmes", 31 August 2005, last amended 5 June 2017.	SCST, National Academy of Sciences (NAS)
Presidential Edict No. 26 "On changes in Presidential Directive No.3 – Main factors of economic security", 26 January 2016.	Council of Ministers

Table 2. Recent legislative, programmatic and regulatory policy documents *(continued)*

Policy document	Implementing agency
Government Decree "On the State programme 'SME entrepreneurship in the Republic of Belarus' in 2016-2020", 23 February 2016.	Ministry of the Economy, Regional authorities
Government Decree "On the approval of the list of State and regional science-and-technology programmes in 2016-2020", 25 February 2016.	SCST, Line Ministries
Government Decree "On the approval of the State programme for the development of the digital economy and information society in 2016-2020", 23 March 2016.	SCST, Line Ministries
Government Decree "On the approval of the State programme on education and youth policy in 2016-2020 years", 28 March 2016.	Ministry of Education
Government Decree "Action Plan of the Government of the Republic of Belarus in 2016-2020", 4 April 2016.	Ministry of the Economy, Regional authorities
Main provisions of the Programme of socio-economic development of Belarus in 2016-2020 , October 2016	Council of Ministers; Ministry of the Economy
National programme for export support in 2016-2020, 1 August 2016	Council of Ministers; Ministry of Foreign Affairs
State programme for innovative development of the Republic of Belarus in 2016-2020	SCST

LSIPIA defines its own scope first by giving a definition of innovation and innovation activity (which is aligned with internationally accepted definitions[20]) and delineating the specific new functional responsibilities of the State in the context of other legislation dealing with related issues (such as the legislation governing R&D). In accordance with the provisions of the new Law, the objective of State innovation policy is the establishment of a favourable socio-economic, organizational and legal environment for the innovative development of Belarus and to raise the competitiveness of the national economy. The formulation of this policy is a responsibility of the highest level of government, with the participation of all relevant public bodies and the National Academy of Sciences. The Law also defines an "authorized republican body of State governance in the sphere of public regulation of innovation activity"[21] and spells out some of its responsibilities.

LSIPIA instituted the concept of a National Innovation System (NIS) and defined the State Programme for Innovative Development as the main programmatic document supporting the implementation of the main directions of State innovation policy. For the first time, LSIPIA acknowledged risk as a key feature of innovation activity which needs to be taken into account when planning, managing and financing the innovation process. Respectively, the Law defines categories such as "innovation projects" and "innovative goods" which can be subject to specific treatment by legislation and regulation. LSIPIA also deals with innovation infrastructure and support institutions. It defines the categories of "techno-park", "technology transfer centre" and "venture organization" which can also be subject to specific regulatory measures.

[20] OECD (2005). *Guidelines for Collecting and Interpreting Innovation Data (Oslo Manual), 3rd edition*. Paris: Organisation for Economic Co-operation and Development.
[21] At present this is the State Committee for Science and Technology (SCST).

The State Programme for Innovative Development

As stipulated in LSIPIA, the State Programmes for Innovative Development (SPID) are envisaged as the programmatic means of operationalizing public innovation strategy and policy. SPID is a specific document and tool for planning and monitoring the innovation process in Belarus which is tailored to the national context as well as to the specificity of the administrative system and budgetary process in the country. It is the outcome of interagency coordination efforts and presents the aggregation of programmes and projects initiated by different stakeholders but focused on the innovative development of Belarus.

In accordance with the general five-year government planning cycle in Belarus, Belarus has already implemented two such programmes: SPID 2007-2010 (with a shorter timeline as it was introduced in the middle of the regular planning cycle), and SPID 2011-2015. At the moment of writing, the Belarusian authorities were still deliberating the draft SPID 2016-2020.[22] Compared to the previous two such programmes, SPID 2016-2020 is the first programme that is grounded on a specific legislative framework (LISPIA) and its content is aligned with legislative provisions that address specific aspects of innovation activity. SPID 2016-2020 is designed as a strategic planning document, and includes two components: one containing the main directions of the State innovation policy, (i.e. innovative development of economic activities and the mechanisms of development of the national innovation system). The second component is a list of large-scale projects to create new industries of national importance, and measures for the development of innovation infrastructure, requiring the approval of the President and the Government of the Republic of Belarus.[23]

SPID 2016-2020 contains a range of ambitious objectives and targets for modernizing the Belarusian economy and raising its international competitiveness. The programme is structured in seven chapters devoted to the different aspects of planning and managing the innovation process: including priority policy area; desired directions of innovative development; development of the NIS; programmatic resources and expected outcomes.

A new element in SPID 2016-2020 is the envisaged establishment of a new funding source, the centralized innovation fund (see below). This will allow the targeted (albeit partial) funding of at least some of the projects included in the SPID. Earlier programmes did not envisage such instruments of direct funding of projects.

One of the key components of SPID 2016-2020, which is also developed in the greatest detail, is the referencing of "the most important projects for establishing new enterprises and production facilities with foremost importance for innovative development". In this, at least as regards the declared objectives, SPID 2016-2020 is a step forward compared to previous

[22] Концепция Государственной программы инновационного развития Республики Беларусь на 2016–2020 годы (Concept of the State programme for innovative development of the Republic of Belarus in 2016-2020), available at: http://www.gknt.gov.by/opencms/opencms/ru/innovation/inn2/

[23] Aspects of these projects are also disclosed in other public programmes, including scientific and technical programmes. A specific legislation provides for specific financing mechanisms for each of these from the national budget in various fields of science, technology and innovation. For example, the specific activities and funding identified for 2016-2018 and upto 2020, including innovative development activities financed under the programme "Education and youth policy" have already been approved by legislation (Приказом Государственного комитета по науке и технологиям от 14.07.2016 №146.; Постановлением Совета Министров Республики Беларусь от 28 марта 2016 г. № 250).

programmes which also included categories such as “modernisation projects”. The Programme contains a list of 74 such prospective “innovative projects”. The listed innovative projects allegedly need to create a competitive advantage for Belarus internationally.[24] At the same time, they seem too many given the size of the Belarusian economy and its economic difficulties in recent times. As it will be shown, perhaps a smaller number and more focused projects could bring more effective results. The initial list is a somewhat eclectic mix of a small number of projects for the implementation of cutting edge technologies in areas where Belarus is among the technological leaders in the world and a large majority of modernization projects in areas where the country is an innovation follower. All the projects target the development and commercialization of technological innovation in areas of proven expertise that are defined as priority S&T areas in high-level policy documents.

In practical terms, SPID 2016-2020 involves both change and continuity with respect to previous programmes. Whereas the previous programmes included both innovation and modernization of existing enterprises, the new programme has shifted the focus towards innovation development. Also, the current programme significantly changed the procedure for the selection of innovative projects, which is now based according to pre-defined criteria.[25]

The programme as a whole is *de facto* a mix of some concrete policy measures supported by earmarked budgetary funding and a wider policy framework defining the general policy orientation and desired steps to operationalize these steps without, however, concrete budgetary commitments for their implementation. Hence there is a visible mismatch between programme objectives and targets and available policy instruments: some objectives and targets read more like desirable outcomes which, however, are not within the operational outreach of the Programme as it is not always clear which funding sources and other policy instruments can be used to pursue such objectives.[26]

The SPID section referring to “the most important projects for establishing new enterprises and production facilities with foremost importance for innovative development” is where the largest

[24] This list is considered as a living document: it contains both projects that started in the previous programmatic cycle (and whose implementation is still under way), and new projects that are due to be implemented in 2016-2020. Also, the list is considered as open and will be complemented and updated in the course of SPID implementation on the basis of annual calls open to all types of bidders (including R&D institutions and private companies).

[25] Projects with decisive importance for the innovative development of the Republic of Belarus to be included in programming are the following: 1. Projects corresponding to precise criteria: an average value added per employee similar to the level of the European Union on the relevant economic activity or exceeding this level; export orientation of the project (ie, excess of exports over imports); the novelty of the technology of the product to the world or to the Republic of Belarus. 2. Socially significant projects relevant for the priority of scientific and technical activities; 3. Projects and (or) actions involving financing by the Belarusian Innovation Fund and/or Republican and local funds on the basis of contracts concluded with those organizations implementing projects; and 4. Projects implemented by entities claiming State financial support in the manner established by Presidential Decree of May 20, 2013 № 229 "On some measures to stimulate innovative projects" (grants and vouchers).

[26] Within the framework of the SPID, there are flexible funding arrangements to finance projects. Such mechanisms could include the centralized Innovation Fund, local innovation funds, the Belarusian Innovation Fund, as well as the Russian-Belarusian Fund of venture capital investments. The listed tools assume annual funding on a competitive basis for innovative projects that are not included in the list of the SPID. However, due to the peculiarities of formation and functioning of the funds, exact funding sums for specific projects are not approved within the framework of the SPID.

share of public financial resources earmarked for innovation is concentrated.[27] It can also be noted that SPID 2016-2020 contains both projects that may be eligible for public support and such that will be implemented on the basis of own resources of the initiators. Public support (which is estimated to account for just 20 per cent of the total cost of the SPID 2016-2020 projects - see Figure 1) is to be allocated in the form of grants after an evaluation and selection procedure from within the applicant bids. Only projects that passed successfully the evaluation process (see below) are included in the list of publicly funded SPID projects.

In principle this part has clear objectives: putting into operation concrete, new-for-the-country technologies and production facilities. Judging from past experience, these policies have achieved some of their declared objectives.

Still, although data does not clearly distinguish investments in industrialization from innovation, given the nature of the projects it is clear that industrial modernization - labelled as innovation projects - takes many resources. In principle, industrial policy may be a valid strategy in the context of Belarus. Elsewhere, industrial policy has been more or less appropriate depending on the institutional and economic context in which it was implemented.[28] However, it must be emphasized that innovation strategies differ substantially from mere industrial development policies, if only because of the risk to the activities involved; and therefore should stand for themselves in the governmental efforts and dedicated resources.[29]

SPID contains a detailed list of such candidate projects for the period 2016-2020. In principle, inclusion is open to all types of institutions. Applications for inclusion in the programme are not limited to the size of the organization, organizational-legal form and other characteristics. In addition, the list of projects is repeatedly reviewed throughout the life of the programme.[30] Still, the evaluation and screening envisaged in the programme is not straightforward.

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[27] Among the projects included in the list is the Belarus Nuclear Power Station which is under construction. This project is a clear outlier in terms of its nature, size and sources of funding.

[28] For a discussion of advantages and disadvantages, see UNCTAD, *World Investment Report: Non-equity Modes of International Production and Development*. United Nations: Geneva and New York. 2011, chapter 3, pp. 105-111.

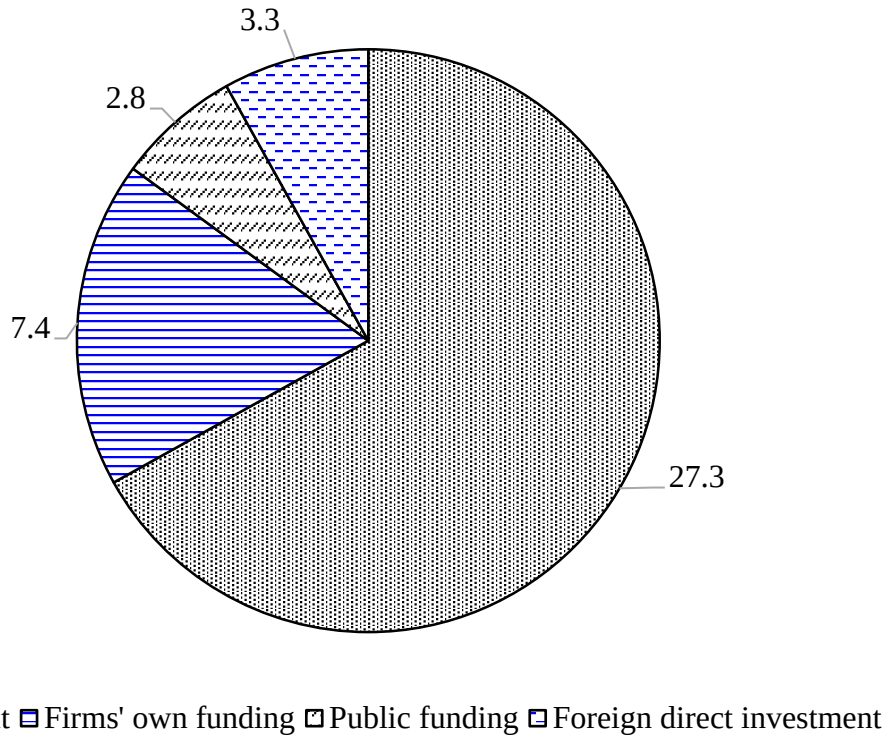
[29] Despite the changed rhetoric, SPID still reads more like a programme of industrial modernization, which supports investment in new production facilities, rather than a programme promoting and supporting high-risk innovative ventures. Moreover, the very objective of the programmes is to support the establishment of "new enterprises and production facilities", which is actually the final, low-risk phase of the innovation process, that of expansion and scaling-up. However, innovative firms and ventures that have reached this phase are in general expected to be mature enough to be able to raise the necessary funding in the financial markets. Public funding is most essential in the high-risk, early phases of the innovation process, when raising funding in the market is next to impossible. Thus, from the perspective of public policy as a whole, the opportunity cost of this policy orientation is that genuine high-risk innovation projects will be underfunded by the amount allocated to such low-risk projects. Furthermore, another downside is that allocating public funding for investment purposes *de facto* may crowd-out private funding which may be more easily available in the low-risk late phases.

[30] Of the 74 projects included in SPID 2016-2020, 18 are implemented in organizations of State ownership and three projects will be undertaken in organizations of mixed form of ownership. The remaining 53 projects are to be implemented in organizations of private ownership (of which only 12 projects are in open joint-stock companies with a dominant share held by the State). The SCST has highlighted that the list is not exhaustive, but it rather reflects only the most notable amongst innovative development projects. In general, SCST deliberately reduced the number of projects directly included in the SPID, which by its nature, covers more than 74 projects. The same applies to venture projects that are not directly included in the SPID. The rationale is that an artificial inclusion of projects in the SPID may complicate the coordination and procedures of their implementation

SPID contains also a number of broader objectives such as the further development of the NIS and innovation support institutions, the upgrading of innovation infrastructure, stimulating innovative entrepreneurship, among others. It also puts a special focus on the objective to raise the export activity of Belarusian firms and, in particular, to increase the exports of high value-added (high technological content) products and contains a range of quantitative target indicators which are referred to as "indicative targets". However it does not specify the range of policy and funding instruments for the pursuit of such broader objectives.[31]

SPID should be funded from different sources[32] and, actually, direct public funding only accounts only for a fraction of the total (Figure 1).[33]

Figure 1. Funding Sources for Programme for Innovative Development, 2016-2020, BYR trillion



Source: State Committee for Science and Technology.
Note: These are expected figures that exclude funding for Belarus nuclear power station.

[31] Probably the one exception is the public support to innovation support institutions which is classified as a separate budget line in the government budget.
[32] As of April 2016, the available estimates of funding amounts and sources were only tentative.
[33] The expected construction costs of the Belarus Nuclear Power Station exceed by a large margin the cost of all other SPID projects taken together. Another peculiarity is that this project is expected to be entirely funded by Russian credits. On top of this, as per international classifications, nuclear power is in general not considered as innovation activity. In view of the distorting effect of these factors, this project is excluded from the structure of funding in Figure 1.

It is expected that SPID will be predominantly financed by bank credit (some 55 per cent of total funding)[34] and from the participating firms' own sources (some 13 per cent of total). In addition, a large share of the bank credit will likely be channelled through the JSC Development Bank of the Republic of Belarus - the Belarus Development Bank.[35] Among the programmatic novelties in SPID 2016-2020 is the envisaged establishment of a centralized "innovation fund", which will be managed by SCST and will integrate the previously existing 25 sector innovation funds which were launched in 2012.[36] The selection of projects for the provision of State support is done on the basis of open competition, in particular for projects financed by Belinfund, but also for projects seeking financial support from the Republican budget and local innovation funds.[37]

Looking forward, the question of how will centralised funds be allocated and what indicators of performance and success will be set should be fundamental for effective monitoring The further development of innovation support infrastructure remains a strategic direction in SPID 2016-2020. As already noted, public funding earmarked for this purpose is treated as a separate line in the Republican budget which is a guarantee that funds will not be diverted to other purposes. Although the actual funding varies from year to year, this arrangement provides for a medium-term predictability of the public investment in this area. SPID 2016-2020 actually contains detailed quantitative annual targets for the development of the innovation support infrastructure in Belarus until 2020 and envisages concrete plans for public investment in the development and modernization of nine technoparks in Belarus.

At the same time, some important objectives and targets of SPID 2016-2020 remain in the "grey area" of ambiguous funding. One example is the declared objective to support innovative SMEs and the target to increase their contribution to GDP. Despite this declared intention, the programme does not envisage many concrete policy instruments to support innovative entrepreneurship and does not indicate specific public funds earmarked for this purpose. An exception is the highlighting of the role of techno-parks, as technology parks are one of the most important innovation business support tools. SPID provides for specific amounts of

[34] Of the six banks involved in financing projects of the SPID, two are public (Development Bank and ASB «Belorusbank»). Another three are foreign banks (Bank Commerzbank, China Development Bank, export-import Bank of China). A significant portion of the funds allocated for the financing of projects by public banks of Belarus, are credit line banks in China, Germany, Russia and other countries.

[35]The Development Bank of the Republic of Belarus is a specialized financial institution established with the main objective to support the financing of government programmes and the implementation of large investment projects.

[36] Presidential Edict 357 of 2012 prescribed line ministries and regional administrations to allocate 10 per cent of the profit tax due of State-owned enterprises under their functional responsibility into such innovation funds. Указ Президента Республики Беларусь № 357, 7 августа 2012 г. "О порядке формирования и использования средств инновационных фондов" (Presidential Edict No. 357 on the Approach to the Mobilization of Innovation Funds and Their Use), available at: http://president.gov.by/ru/official_documents_ru/view/ukaz-357-ot-7-avgusta-2012-g-1414/.

[37] See пунктом 7 Положения о порядке формирования и использования средств инновационных фондов, утвержденного Указом Президента Республики Беларусь от 7 августа 2012 г. № 357; пунктом 13 Положения о порядке конкурсного отбора и реализации проектов и работ, финансируемых за счет средств республиканского бюджета, в том числе инновационных фондов, утвержденного постановлением Совета Министров Республики Беларусь от 10 октября 2006 г. № 1329. The selection of venture capital fundraising projects involving Belarusian-Russian venture companies, provides a dual competition with equal opportunities for participants.

funding for the development of the technology park, including the national budget and innovation funds.[38]

On a similar vein, the programme puts a special focus on the objective to raise the export activity of Belarusian firms and, in particular, to increase the exports of high value-added (high technological content) products. Again, SPID 2016-2020 does not refer to specific policy instruments directed towards stimulating such export activity so it remains to be seen how the authorities plan to pursue such an objective.[39] Despite the upgrading of its status, SPID is not exhaustive in its coverage of innovation activity in the broader sense. Thus, key ingredients of the innovation process such as R&D activities and their governance have been left out of the scope of SPID and are addressed by other policy documents.

Other state programmes supporting S&T&I activity

Ironically, the public support of genuine high-risk innovation projects is not part of SPID at all but is being undertaken by the State science and technology programmes. There is even no mention in SPID of science and technology developments (as targeted by other programmes), as part and parcel of Belarusian innovative development. On the other hand, the SPID objectives are very broad and one would expect that science and technology development is also part of them. This discrepancy in coverage creates both a conceptual inconsistency and a mismatch between SPID ambition and objectives and the mechanisms to pursue these targets.

Science and R&D activities are governed by separate legislative documents via two types of funding programmes: 1) State programmes for scientific research (in the past also referred to as “fundamental research”) and 2) State science and technology programmes (in the past also referred to as “applied research”). Both types of programmes provide grant funding to R&D projects in selected research areas in accordance with the policy priorities of the country in the respective funding period. Table 3 contains the list of State programmes for scientific research and State science and technology programmes in 2016-2020.

Table 3. State programmes for scientific research and State science and technology programmes 2016-2020

State programmes for scientific research	
1	Energy systems, processes and technologies
2	Chemical technologies and materials
3	Biotechnologies
4	Health-related fundamental and applied research
5	IT, space and security
6	Photonics, opto- and microelectronics
7	Mechanics, metallurgy and diagnostics in engineering

[38] Support measures include the development of a venture financing system; innovation vouchers and grants; and the holding of a Republican contest of innovative projects; support for start-ups - including the provision of organizational, informational and financial support; as well as the establishment of professional and business relationships inventors and young innovative entrepreneurs with potential investors and partners

[39] When the new SPID is reviewed, it could draw on existing international experiences with regards to developing instruments for SMEs. It should be born in mind that the lifecycle of an innovative small company involves various steps, each involving different types of risk tolerance (e.g. start up, seed, venture, etc.).

Table 3. State programmes for scientific research and State science and technology programmes 2016-2020 *(continued)*

State programmes for scientific research	
8	Materials science, new materials and technologies
9	Quality and efficiency of agricultural production
10	Nature and environment
11	Convergence-2020 (science)
12	Economy and human development of the Belarusian society
State science and technology programmes	
1	Energy
2	Agriculture and food
3	Mechanical engineering and technologies
4	Radioelectronics
5	Microelectronics
6	Measurement standards and precision instruments
7	Efficient use of resources, new materials and technologies
8	Construction frames, materials and technologies
9	New methods of healthcare
10	New chemical products
11	Industrial bio- and nano-technologies
12	Data protection
13	Smart information technologies
14	Robotic systems and aerospace technology
15	Nature and environmental risks
16	Sustainable management of Belarusian forests
17	Disaster prevention and protection
Regional science and technology programmes	
1	Innovative development of Brest region
2	Innovative development of Vitebsk region
3	Innovative development of Gomel region
4	Innovative development of Grodno region
5	Innovative development of Minsk region
6	Innovative development of Mogilev region

Source: Постановление Совета министров республики Беларусь от 10 июня 2015 г. № 483 Об утверждении перечня государственных программ научных исследований на 2016–2020 годы (http://www.pravo.by/main.aspx?guid=8111&p0=13.06.2015&p1=13.06.2015); Постановление Совета министров республики Беларусь от 25 февраля 2016 г. № 153 Об утверждении перечней государственных и региональных научно-технических программ на 2016–2020 годы (http://www.pravo.by/main.aspx?guid=1681&p0=26.02.2016&p1=26.02.2016).

The design of the actual programmes is preceded by a complex and staged foresight process with the participation of the National Academy of Sciences, other R&D centres and the government which ends with the formulation of the so-called "priority directions of scientific and technical activities" which are approved in a Presidential Edict.[40] Thus the formation of the

[40] Указ Президента Республики Беларусь № 166, 22 апреля 2015 г. "О приоритетных направлениях научно-технической деятельности в Республике Беларусь на 2016–2020 годы". (Presidential Edict No. 166 "On the

content of State R&D programmes also largely follows a vertical policy approach whereby both the key R&D directions and the institutions that will implement the research are set and decided *ex ante*, with the approval of the programmes. State R&D programmes leave very little room, if any at all, for new, bottom-up initiatives even in the R&D directions that they prescribe.

The funding of the two types of State R&D programmes comes directly from the Republican budget and is not part of the public funding under SPID. In principle, apart from the process of *ex ante* evaluation and screening of project proposals discussed in the next section, there were no major changes in the way of functioning of the State programmes for scientific research and the State science and technology programmes, as discussed in the first Innovation Performance Review of Belarus.[41]

In addition to LSIPIA and SPID, there were other important legislative and regulatory developments that affect innovation activity and performance in recent years. For instance, in 2012, the Belarusian parliament passed a new law on public procurement.[42] This new law which replaced the outdated legislation on this topic form 1993 is aligned with international good practice and opens the way, among other things, to implement various demand-driven innovation policies through public procurement. However, so far there has been no experience of targeted application of this law in the innovation area.

Another piece of new legislation with a broader effect on the market environment was the anti-monopoly law enacted in 2013,[43] replacing a range of earlier existing piecemeal legislative and regulatory acts in this area. In terms of its spirit, the new law is in principle aligned with international good practice in this area; however, the implementation of some important norms envisaged in the law is still undefined. Nonetheless, establishment of the Ministry of Antimonopoly Regulation and Trade as a responsible body for the enforcement of public anti-monopoly policy represents a step forward.

Two Presidential Edicts of 2013 introduced new regulatory norms aimed at stimulating innovation activity and the commercialization of research results. Edict No. 229 deals with the public funding aimed to support early stage (pre-seed and seed) innovative projects initiated by individual entrepreneurs and SMEs.[44] In particular, it introduced for the first time in Belarus the possibility to use public grant funding instruments (innovation vouchers and grants[45]) for the above purposes, along with the traditionally applied loan type financing (at preferential terms but subject to recovery). The new funding instruments are to be operated mainly by the

priority directions of scientific and technical activities in the Republic of Belarus in 2016-2020", 22 April 2015). Available at: http://www.bsuir.by/m/12_100229_1_92158.pdf.

[41] UNECE, *Innovation Performance Review Belarus*, New York and Geneva, 2011.

[42] Закон Республики Беларусь № 419-З О государственных закупках товаров (работ, услуг), 13 июля 2012 г. (Belarus, Law of the Republic of Belarus "On the public procurement of goods and services", 13 July 2012)

[43] Закон Республики Беларусь № 94-З О противодействии монополистической деятельности и развитии конкуренции, 12 декабря 2013 г. (Belarus, Law of the Republic of Belarus "On the counteraction to monopolistic activities and the development of competition", 12 December 2013).

[44] Указ Президента Республики Беларусь № 229, 20 мая 2013 г. "О некоторых мерах по стимулированию реализации инновационных проектов" (Presidential Edict No. 229 "On some measures for stimulating the implementation of innovation projects", 20 May 2013). Available at: http://www.pravo.by/main.aspx?guid=3871&p0=P31300229&p1=1.

[45] Vouchers are usually small volumes and are paid after the service has been consumed by the recipient. Vouchers are widely used in the EU. Their use is linked to a very low level of administrative barriers and hence a very easy access for small business and entrepreneurs.

Belarusian Innovation Foundation (Belinfund), but also by the Belarusian Fund for Financial Support of Entrepreneurs. Furthermore, Edict No. 223 of 2016[46] raised the status of Belinfund and granted it further competences in the funding of innovative projects including through venture funding.

Edict No. 59 regulates the process of commercializing the results of research undertaken with the support of public funding. [47] In particular, it is a first attempt in Belarus to regulate the ownership of the intellectual property rights stemming from such results and contains provisions allowing the sharing of ownership rights between the organizations undertaking such research and the individual researchers who contributed to the results.

In 2014, the Government of Belarus endorsed a policy document aimed at stimulating cluster development in the country, featuring clusters centred on innovation activity.[48] This document outlines a range of initiatives that public bodies are encouraged to undertake for the formation of innovation-centred clusters. Related to that, the term "industrial cluster" as used in these policy documents has some specific nuances. Thus while a business cluster in the *Porterian* sense[49] can be a group of businesses engaged in cooperative arrangements of a rather loose and informal nature, the Belarus policy initiative stresses that cooperation among the businesses participating in the cluster should be established on a strict contractual basis. The Government also recommended that the participants in more complex clusters establish a new joint "cluster body" – a commercial firm performing the coordination functions. The implied assumption is that large State-owned firms would take the lead and initiative in establishing such clusters.

With regard to changes in the tax regime, over the past five-year period a system of tax incentives for scientific-technological parks and scientific organizations has been adopted that provides tax benefits for a list of innovative and high-tech products and manufactures. As a result of the measures taken, the amount of tax credits rose from approx. US$86.5 million to US$119.3 million (or 0.13 per cent to 0.22 per cent of GDP). (Table 4).

[46] Указ Президента Республики Беларусь № 223, 15 июня 2016 г. "О внесении дополнений и изменений в Указ Президента Республики Беларусь" (Presidential Edict No. 223 "On changes and amendments in the Presidential Edict", 15 June 2016). Available at: http://www.pravo.by/main.aspx?guid=1681&p0=16.06.2016&p1=16.06.2016

[47] Указ Президента Республики Беларусь № 59, 4 февраля 2013 г. "О коммерциализации результатов научной и научно-технической деятельности, созданных за счет государственных средств" (Presidential Edict No. 59 "On the commercialization of the results of R&D activity undertaken on the basis of public funding", 5 February 2013). Available at: http://www.pravo.by/main.aspx?guid=3871&p0=P31300059&p1=1.

[48] Постановление Совета Министров Республики Беларусь № 27, 16 января 2014 г. "Об утверждении Концепци формирования и развития инновационно-промышленных кластеров в Республике Беларусь" (Government Decree No. 27 "On the approval of the concept of formation and development of innovation and industrial clusters in the Republic of Belarus", 16 January 2014).

[49] Michael Porter (1990) *The Competitive Advantage of Nations,* Free Press: New York.

Table 4. Indicators of tax incentives for scientific, scientific engineering and innovation activity 2011-2015

Indicator	2011	2013	2015
The amount of tax relief (US$ million).	86.5	118.5	119.3
Share of GDP (per cent)	0.13	0.16	0.22
Share of consolidated budget (per cent)	0.47	0.56	0.71

Source: State Committee on Science and Technology.

Finally, the recently adopted State programme on education and youth policy in 2016-2020 years[50] places a special emphasis on better linking higher education, on the one hand, with the system of secondary education and, on the other hand on better matching university education with the needs of the society and the economy. The programme also calls for further alignment of curricula of university education in Belarus with international good practice.

Funding mechanisms and instruments: recent developments on innovation finance

Ensuring adequate access to innovation financing is an important factor in a modern economy. Mostly young, but also mature companies are only partially able to finance their R&D and innovation activities - or any investments for modernization in general. Therefore, external financial sources play a significant role, be it in the form of loans, venture capital, business angels (informal equity) or from public sources in the form of grants, soft loans, public venture capital or guarantees.

In Belarus, programme-based funding takes the predominant share in the budgetary expenditure earmarked for R&D and innovation (Table 5) although in relative terms, this funding was on a downward trend in recent years.

Table 5. Budgetary and non-budgetary expenditure on R&D&I activities, 2010-2016

	2010	2011	2012	2013	2014	2015	2016[i]
Total budgetary R&D expenditure, bn BYR	**659.8**	**936.4**	**1542.6**	**2079.7**	**1954.3**	**1946.6**	**2298.5**
Share of total budget expenditure (%)	*1.7*	*1.9*	*1.7*	*1.7*	*1.6*	*1.4*	*1.4*
Share of GDP (%)	*0.40*	*0.32*	*0.29*	*0.32*	*0.25*	*0.22*	*0.24*
Total non-budgetary R&D expenditure, bn BYR	**480.8**	**1145.5**	**1995.2**	**2292.6**	**2118.8**	**n.a.**	**n.a.**
Share of GDP (%)	*0.29*	*0.39*	*0.38*	*0.35*	*0.27*	*n.a.*	*n.a.*
Total budgetary and non-budgetary R&D expenditure, share of GDP (%)	*0.69*	*0.70*	*0.67*	*0.67*	*0.52*	*n.a.*	*n.a.*

[50] Постановление Совета Министров Республики Беларусь № 250, 28 марта 2016 г. “Об утверждении Государственной программы ‘Образование и молодежная политика’ на 2016 – 2020 годы” (Government Decree No. 250 “On the approval of the ‘State programme on education and youth policy’ in 2016-2020”, 28 March 2016).

Table 5. Budgetary and non-budgetary expenditure on R&D&I activities, 2010-2016 *(continued)*

	2010	2011	2012	2013	2014	2015	2016[i]
Breakdown of Republican budget expenditure[ii] by funding areas (share of total, per cent)							
Programme-based R&D funding, of which	71.4	70.5	71.9	65.8	63.0	57.7	57.5
State programmes for scientific research	*33.1*	*32.0*	*32.5*	*31.6*	*34.9*	*35.5*	*31.4*
State science and technology programmes	*38.3*	*38.4*	*39.3*	*34.2*	*28.1*	*22.2*	*26.1*
Support to National Academy of Sciences	2.5	2.5	2.8	3.9	4.8	5.4	6.4
Support to sectoral R&D institutes	5.3	4.9	4.9	3.5	3.9	4.5	5.0
Support of State science and technology expertise	0.1	0.1	0.0	0.0	0.0	0.1	0.1
Support of the State system of scientific information	4.7	4.6	4.6	4.3	4.7	4.8	4.7
Support to innovation projects	2.2	1.7	1.8	1.4	1.7	1.5	0.8
International R&D cooperation	3.6	3.3	3.6	3.0	3.5	5.5	7.0
Support to post-graduate studies	1.7	1.4	1.5	3.7	4.5	4.6	4.1
Investment in R&D infrastructure (public R&D institutes)	6.4	6.9	7.4	11.2	9.8	12.8	6.3
Development of innovation infrastructure institutions	0.7	1.5	0.8	1.5	1.8	0.9	0.4
Various R&D-related expenditure	1.3	2.6	0.8	1.7	2.3	2.4	7.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

[i] Budgetary targets.
[ii] Republican budget expenditures do not cover all public R&D spending.
Source: National Statistical Committee; State Committee for Science and Technology.

About actual policy instruments for funding programme-based R&D activity, there was no significant change from the situation of several years ago.[51] Upon successful screening and evaluation, public funding is extended in the form of grants. To be eligible for funding, S&T project consortia under the State S&T programmes must include both R&D organizations and business partner(s) from the industry. Besides, the business partner must take the commitment for commercialization of the R&D result or technology. The business partners in S&T projects are strongly encouraged to co-finance the project with up to 50 per cent of total costs.[52]

While public funding is extended in the form of grants both for scientific research and for S&T projects, S&T projects have an important contractual distinction. In case the project partners fail to implement the commercialization phase, the consortium must repay the whole grant funding received for the project. This very strong commercialization pressure and the absence of risk-mitigating financial mechanisms in the now existing instruments create distortions and a selection bias both in the phase of project design and during the screening and ex ante evaluation of proposals.

[51] UNECE (2011) *Innovation Performance Review Belarus*, United Nations: New York and Geneva, pp. 80-81.
[52] The procedures of releasing public funding for R&D and innovation involve similar, multi-stage and lengthy bureaucratic processes, which mirror the existing complicated systems of distributed decision-making authority.

Among the few novelties in the area of innovation financing is the explicit reference to public support for the development of innovation support infrastructure. After the adoption of LSIPIA,[53] the status of public funding earmarked for this purpose has been raised, thus preventing its eventual redeployment for other purposes. Budgetary allocations for innovation support infrastructure helped fund public investment in new construction and/or the renovation of several techno-parks in 2014-2015.

It should be highlighted that Belarus relies on a banking sector that is dominated by State-owned institutions, with most decisions on financing innovation in Belarus taken by public authorities. Thus, although private initiatives and institutions originated over the last five years are important complementary actors in the field of innovation financing, their regulatory frameworks remain under-developed.[54] However, since the time of the last Innovation Performance Review in 2010, actions have been taken to bolster the Belarusian R&D and innovation financing system.

Firstly, *a Development Bank* was created, which is the newest developmental financial institution in Belarus. It is a specialized financial institution with main directions in the fields of development infrastructure, providing expert support through the financing of foreign companies and support of SMEs. The plans for 2016 indicate that the Development Bank will become the single channel to finance projects under all Government programmes, including possible innovative investment projects.

With regard to SME financing,[55]credit facilities are provided to 11 partner banks, which act as intermediaries to fund SMEs. Currently, a distinction between innovative and non-innovative products is not carried out. The financial products offered for SMEs are primarily geared towards modernization of production (or services) rather than on the generation of new products or services. In addition to the SME programme, a new product to support start-ups has been launched at the end of 2015 in the form of a loan or credit, typically for up to five - seven years.

Concerning the *Belarusian Innovation Fund* (BIF), which was established in 1998,[56] on the whole, the objectives of the fund have not fundamentally changed. They mainly relate to the financial support of innovative projects, financing R&D and production in science- and technology-based areas, assistance in the stimulation of foreign economic activity, attracting foreign investment, support of entrepreneurship and marketing-oriented activities (e.g. exhibitions, fairs, seminars, conferences, etc). Recent developments relate to a set of new presidential decrees aimed at improving the BIF. On the basis of the legislative changes, the

[53] The part dealing with the financing of innovation activity fell short of identifying new sources of funding or specifying new funding instruments. Instead, it merely enumerates the traditional sources of funding that have been applied for this purpose also before the adoption of the Law.

[54]The latest *Doing Business Report 2016* by the World Bank, for instance, ranks Belarus at 109 in the ranking of 189 regarding the credit information system, collateral and bankruptcy laws facilitating access to credit. Comparator economies like Russian Federation, Ukraine or Georgia are significantly higher ranked. Typical challenges in Belarus relate to the strengthening of the legal rights of lenders and borrowers and the increase of the scope, coverage and accessibility of credit information. Furthermore, the protection of minority investors in Belarus (e.g. through new or amended company laws, securities regulations or civil procedure rules) needs to be further strengthened (see World Bank. *Doing Business Report 2016* Washington DC. pp.59).

[55] In addition to The Development Bank, the most important Belarusian Banks for SME support are Belgazprom Bank, BPS Sberbank, and MTB Bank.

[56] See: Постановлением правительства Республики Беларусь №1739 от 12.11.1998 г

BIF is now able to finance the latest stages of the innovation process (i.e. commercialization, market entry). Furthermore, new instruments are available to support the initial innovation phase (i.e. grants and vouchers), which are granted on a non-repayable basis.

Since 2010, BIF provides funding to 16-24 projects a year with projects worth BYR324.8 billion for the period 2010-2014. The highest volume was spent in 2012 with BYR114.6 billion. For the years 2016 and 2017, BYR65 billion and BYR52.7 billion respectively are planned (according to the State Programme on Innovation Development 2016-2020). The core technological field or industries to be offered support are in the fields of pharmaceuticals, mechanical engineering, medical devices, agriculture and devices for research needs. Regarding the selection criteria of the fund, the following criteria are given priority: projects with a focus on energy efficiency; technology focus; job creation for highly qualified specialists; increase of labour efficiency per person; and export orientation.

The new regulation on public grant funding in the form of *vouchers and grants,* which are distributed by BIF as well, pursues the objective to support early stage innovation projects. Applicants for these schemes are typically individuals who have an agreement with a Techno-park (or an incubator) and who have elaborated a business plan to be evaluated in the course of the application procedure. Grants are also distributed among SMEs but only for the design phase (not for the R&D phase).

Both vouchers and grants are awarded on a non-repayable basis. Vouchers are available for two stages: for the preparatory stage (up to approx. US$25,000) mainly for the development of the business plan, patenting and market research. For the second stage (up to approx. US$100,000) for creating pilot projects or product samples. Within the last year (2015) there have been seven applications for grants, but the interest for vouchers meanwhile is much lower. Despite a very sophisticated selection process at the BIF, due to insufficient financial resources, almost no actual disbursement has been conducted.

Further recent developments at BIF refer to the establishment or intensification of cooperation activities with different (foreign) organizations. Agreements are in place with institutions based in China, and various EU countries, but primarily in the former Soviet Union (Russian Federation and Kazakhstan).

In addition to BIF, the sectoral innovation funds constituted an integrated scheme with the R&D funding system of Belarus. In 2015, these consisted of 25 single funds, which were accumulated by different ministries, State-owned companies and the National Academy of Science. In addition to these 25 funds, another seven funds are operating as regional or local funds (in Minsk and the six provinces). The sectoral ministries used their own established funds to finance innovation in key economic sectors, such as construction, industry and housing. Firms had to apply for these funds in a competitive process. According to the UNESCO Science Report, the most successful of these funds was the one targeting ICT companies (run by two ministries: the Ministry of Communications and Informatization and the Ministry of Information).

An analysis by the SCST of the performance of these funds over the last three years came to the conclusion that the financial resources were not spent efficiently and effectively (Table 6). The situation was that some funds were quite large (see above), whereas others were too small

to achieve a significant output.[57] As shown in the table, the total revenues of all 25 funds in 2015 amounted to BYR433.5 billion (plan) or BYR419.3 billion (State); the expenditures in that year amounted to BYR323.3 billion (plan) and BYR 265.9 billion (State). Among the total number of funds, 16 ministries had their own funds.

Table 6. Revenues and Expenditures of the Republican Innovation Funds (Sectoral Funds) 2015 (BYR million)

	Revenues			Expenditures		
	Plan	State	% of Plan	Plan	State	% of Plan
Ministry of Industry	7,404.8	7,520.3	101.6	18,523.2	18,421.7	99.5
Ministry of Architecture	24,400	21,082.9	86.4	60,502.1	41,245.7	68.2
Ministry of Agriculture	6,500	7,533	115.9	4,801	1,575.5	32.8
Ministry of Communications	25,371.7	26,140.7	103	16,176.5	16,088.5	99.5
Ministry of Information	1,300	1,784.4	103	16,176.5	16,088.5	99.5
Ministry of Transport	92,789.3	92,555.4	99.7	68,535	63,078.8	92
Ministry of Emergency Situations	3,735.2	4,145.7	111	2,758.8	2,677.7	97.1
Ministry of Energy	79,961	80,477.7	100.6	9,407.3	8,735.4	92.9
Ministry of Health	20,600	22,967.3	111.5	14,029.3	11,375.5	81.1
Ministry of Defence	1,106.2	1,051.4	95	817	762	93.3
Ministry of Education	5,804.9	5,705.1	98.3	5,867.9	5,848.5	99.7
Ministry of Forestry	7,200	9,129	126.8	5,318	5,318	100
Ministry of Finance	29,110	25,944	89.1	15,516.3	8,935.9	57.7
Ministry of Sports	480	443.4	92.4	0	0	0
Ministry of Trade	2,400	2,780.2	115.8	0	0	0
Belneftekhim concern	58,981.5	43,060.6	73	48,174.1	33,696.2	69.9
Bellesbumprom concern	20	0.0	0	14.8	0	0
Bellegprom concern	1,480	1,085.2	73.3	1,093.1	731.6	66.9
Belgospischeprom concern	15,752.9	19,165.3	121.7	11,635.2	11,609.1	99.8

[57] Among these 25 funds, 15 ministries had their own funds. Among them, three ministries account for the bulk of expenditure (State): the Ministry of Transport (24 per cent), the Ministry of Architecture (16 per cent) and the Ministry of Industry (7 per cent). Among the concerns, the Belneftekhim concern with 13 per cent accounts for the largest share.

Table 6. Revenues and Expenditures of the Republican Innovation Funds (Sectoral Funds) 2015 (BYR million) *(continued)*

	Revenues			Expenditures		
	Plan	State	% of Plan	Plan	State	% of Plan
Goskomvoenprom concern	27,600	27,783.8	100.7	20,385.6	19,457.3	95.4
Belkoopsoyuz concern	11,000	8,706.3	79.1	10,450	7,741.8	74.1
Minzhilkomhoz	285	261	91.6	0	0	0
State Committee on Standardization	2,517.9	2,717	107.9	1,859.8	1,859.8	100
State Committee for Property	4,200	3,579.5	85.2	3,102.2	2,549.7	82.2
National Academy of Sciences	3,505	3,666.1	104.6	3,329.7	3,329.7	100
Total	***433,505***	***419,285***	***96.7***	***323,257***	***265,998***	***82.3***

Source: State Committee on Science and Technology

In the future, a new *Republican centralized innovation fund*,[58] resulting from the merger of the sectoral funds, will help better mobilize, select and finance innovative projects and to better align innovation funding to national priorities. The justification for the merger of existing sectoral innovation funds into a centralized one was to rationalize and make the R&D&I expenditure managed by many different bodies more targeted and more efficient. A comparison of the structure of spending at different layers of public management also indicates that a significant share of the expenditure by the regional and sectoral funds was channelled to investment in production facilities, rather than to the support of innovation activity (Figure 2).

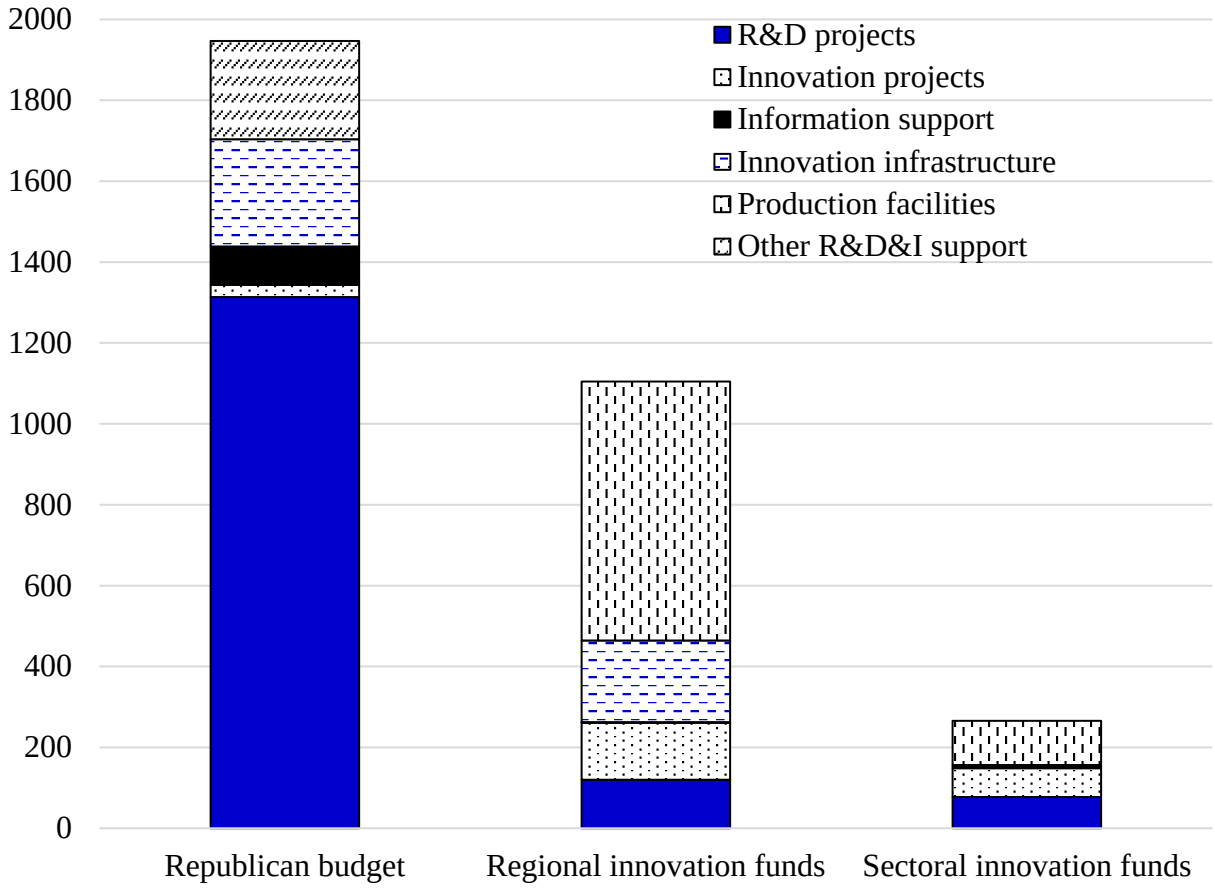
SPID envisages that at least 50 per cent of financial resources accumulated in the centralized fund will be allocated for the funding of innovation projects that have successfully passed screening and evaluation under SPID rules. Compared to the highly fragmented system of sectoral and regional funds lacking centralized coordination and control mechanisms, the establishment of a centralized innovation fund is in principle a positive development, as it will allow a better alignment of funding with national priorities and the pursuit of coherent funding practices at the national level.

The fund will be implemented and managed by the SCST and has its own budget line in the current State Programme for Innovative Development 2016-2020. The centralized fund will

[58] The Republican Centralized Innovation Fund was formally launched at the end of 2016 under Presidential Edict 431 of 28 November 2016 (its establishment had already been acknowledged with the adoption of the 2016 Republican budget, where it features as a separate budget line).

have a financial volume of 743.5 billion roubles for the period 2016-2020,[59] and four operating areas: financing innovation projects from the State Programme; financing R&D aimed at production of new products, services and technologies; funding the development of innovation infrastructure; and funding the development of sector laboratories.[60]

Figure 2. Structure of R&D&I spending under Republican budget, sectoral and regional innovation funds, 2015 (in BYR billion)



Source: State Committee for Science and Technology.

Concerning venture finance, the first steps in establishing venture capital companies have been taken in cooperation with Russia and Kazakhstan. The *Russian-Belarusian Fund for Venture Investment* has been set up on the basis of a long-term programme supported by both countries. The fund acts as a venture company in both countries with a common budget financed by

[59] The current amount of both innovation and investment funds is BYR1.5-1.6 trillion. The seven regional/local funds will not be affected; the use of these funds is under the supervision of the State Committee on Science and Technology (interview at the State Committee on Science and Technology)

[60] To obtain funding, three criteria must be fulfilled: first of all, a new technology, product or service has to be requested; second, the new technology, product or service must have the potential to be exported; third, the expected technological and economic impact should be equivalent to European countries. Exceptions apply for socially-oriented projects, which only need to meet two of the above criteria, and projects in the field of medicine (technologies) for which softer conditions, in terms of matching funds will be valid.

Belarus and Russia in equal shares. Another venture investment company is in its initial stage, a trilateral company with *Russia, Kazakhstan and Belarus*. However, at the time of writing, no activities had been undertaken.

Other recent changes in the innovation financing system concern cooperation activities with the Russian Innovation Centre regarding the financing of young entrepreneurs. Since 2010, a first round of cooperation has been implemented and the support of entrepreneurship within a special programme of the Ministry of Economy focusing on business incubation of start-ups was also launched.[61] Also, the venture tool Business Angels and Venture Investors Network (BAVIN) was developed as well as other initiatives, for instance the establishment of different Belarusian crowd-funding platforms.[62]

To sum up, the system of R&D and innovation funding has been conceptually improved since the first Innovation Performance Review, especially with regard to the creation of institutions providing venture capital, the creation of a development bank, the setting up of an informal risk capital market, the establishment of foreign partnerships, the revision of the sectoral innovation funds, the setting-up of support schemes offered by the Belarusian Innovation Fund, and the set-up of complementary institutions/platforms like business incubators. However, except for the centralization of the Innovation Fund to act as a trust fund of SPID and a source of venture capital investments, most of these mechanisms are yet to be fully implemented.

2.2 National Innovation System and innovation governance

National Innovation System

Public institutions

Belarus has a relatively well developed system of public institutions supporting innovation activity which form the backbone of the National Innovation System (NIS). There were no radical changes in the composition of such public bodies compared to the situation in 2010,[63] however, there was some evolution in their functional responsibilities. Many of the essential NIS building blocks are already in place, especially as regards the role of the public sector. The portfolio of policy instruments supporting innovation activity was enriched with new ones, specifically tailored to the specificity of early-stage financing. Overall, the public bodies in the NIS have well-defined functional responsibilities and roles in innovation governance. In addition, the information brokerage functions performed by these institutions (such as support to R&D and technology-oriented forums, exhibitions, fairs, etc.) facilitate linkages and match-making between innovation stakeholders thus contributing to the generation of new business opportunities targeting innovation.

[61] A draft Programme for Entrepreneurship Development is currently being developed.
[62] The following crowd-funding platforms exist: Ulej, StartIdea, MaeSensa and Talaka. See http://ictt.by (accessed 15 June 2016).
[63] UNECE (2011) *Innovation Performance Review Belarus.* United Nations: New York and Geneva.

The State Committee for Science and Technology (SCST) is a public body under the Council of Ministers of the Republic of Belarus which is tasked with a range of important responsibilities in the area of innovation policy and governance including (but not limited to):

- Implementation of the State Innovation and S&T Policy and the protection of intellectual property rights;
- Coordination of the activities of other public bodies in the areas of the S&T, innovation activity and intellectual property rights;
- Development of innovation support infrastructure;
- Support to innovative entrepreneurship;
- Technical support for the commercialization of R&D results; and
- Monitoring of the implementation of public R&D programmes.

Following the adoption of the LSIPIA, SCST was mandated with additional responsibilities, including those related to the implementation of the SPID and the coordination of the "unified system of State scientific and State science and technology expertise".[64] The system is administratively managed by the State Committee for Science and Technology while the National Academy of Sciences provides expert support.

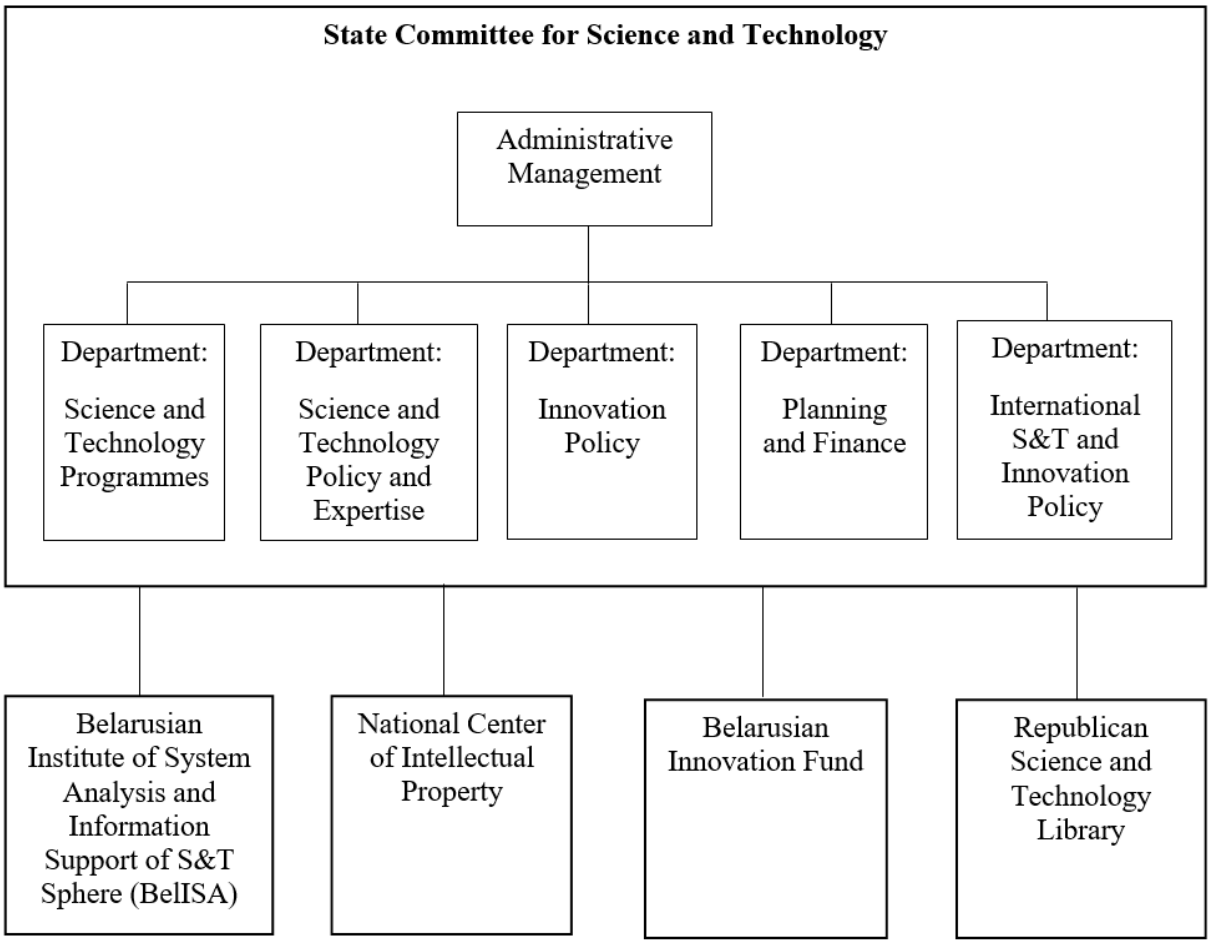
However, even after these changes, SCST has mostly coordinating functions in the area of policy implementation and almost no decision-making authority in this area. In order to implement its tasks, the SCST develops a draft budget for research, technology and innovation activities and presents it to the Minsitry of Economy and the Ministry of Finance. In this process, the SCST coordinates the applications from sector ministries and the NAS of Belarus that act as thematic S&T programmes or research programme owners. Due to lack of a subordinated research agency, budget allocation is not straightforward (i.e. It involves programme owners acting as intermediaries between the funding entities and executers of R&D). Since 2017, the SCST administrates the funds of the Centralised Innovation Fund. The SCST has a right to stop any research or innovation project funded or co-funded from the Republican budget in case of non-targeted use of funds.[65] In reality, funding decisions are usually being taken as the outcome of complex bureaucratic processes involving a range of different public bodies with distributed authority, concentrated at higher levels of governance (the National Assembly, the President's Office and the Council of Ministers).

In addition to its core functions, STSC also controls several subordinate bodies with related responsibilities. The Belarusian Institute of System Analysis and Information Support of S&T Sphere (BelISA) is a research institute whose operations should support SCST in performing its core functions, including a system of monitoring the implementation of State R&D programmes, information support for S&T and innovation activities in Belarus and support to Belarus's international S&T cooperation. Figure 3 shows the current structure of the SCST and its subordinate bodies.

[64] Постановление Совета министров Республики Беларусь № 431 "О порядке функционирования единой системы государственной научной и государственной научно-технической экспертиз", 22 мая 2015 г. (Government Decree No. 431, 22 May 2015 "On the functioning of the unified system of State scientific and State science and technology expertise"), available at: http://www.gknt.gov.by/opencms/export/sites/default/ru/nti/Info-po-GSNTI/PSM-RB-22.05.2015-431.pdf

[65] http://www.pravo.by/document/?guid=3871&p0=C20400282 (accessed 1 April 2017)

Figure 3. Aggregated functional structure of State Committee for Science and Technology (SCST) and its subordinate bodies



Source: State Committee for Science and Technology.

The Belarusian Innovation Foundation (BelInFund) is a public body whose core mission is the support of innovative entrepreneurship in Belarus (see above). BelInFund provides opportunities for early stage financing of innovative SMEs and entrepreneurs using budgetary funding. Most of the funding is in the form of repayable loans extended at preferential conditions. Recently adopted regulation opened the opportunity for BelInFund to extend non-repayable innovation vouchers and grants but this activity is still to be fully operationalized. An important - and commendable - recent initiative by SCST and BelInFund is the organization of annual national competitions for innovative projects which target young innovators. These competitions promote awareness-raising on innovative entrepreneurship among young people while the winners are awarded small grants to support their further work on the projects.

The National Center of Intellectual Property (NCIP) is a public institution that provides protection for intellectual property rights.Jointly with other stakeholders in the country, NCIP provides support for the development and enforcement of adequate legislation and regulation in the area of IPR.

The Republican Scientific and Technology Library (RSTL), composed of five regional branches, is the main link of the State system of scientific and technical information and the

primary information base for the development of innovative activities in the country. It has the most complete domestic and foreign information resources on Science and Technology, including the Government patent inventory as well as other inventories of normative documents, industrial directories, as well as books and periodicals. RSLT generates electronic databases and provides library and information services for companies and organizations through the use of modern computer technology. Also, RSLT has established and successfully operates the Sustainable Development Library and Information Center on Resource Conservation.

The National Academy of Sciences of Belarus (NAS) is a complex hierarchical structure which brings together the most important R&D organizations in the country. The organizational structure of the NAS includes some 70 research organizations as well as a number of laboratories, design bureaus, production facilities, experimental stations and other support bodies. Formally, the NAS has a very high administrative status, equivalent to that of a ministry: it reports directly to the President of the Republic of Belarus and the Council of Ministers.

An important recent trend in the overall activity of the NAS has been the increasing emphasis on the commercialization of some of its R&D results. This matches a similar change in the general orientation of Belarus S&T and innovation policy as reflected in some of the recent legislative and regulatory changes. Thus the existing downstream production facilities within the NAS, established with the specific purpose to commercialize NAS R&D results, have been steadily growing in size and in the volume of their commercial output. Another recent development has been the formation of a number of "clusters", in response to the recent government policy initiative to support cluster development (cf. section 2.2.4).

The entire system of education in Belarus, including higher education, falls under the functional responsibilities of the Ministry of Education. Within the Ministry of Education there is a Department of Science and Innovation, whose main functional responsibility is the practical implementation of public S&T and innovation policy within the Belarus education system as well as the establishment of specific incentives promoting innovative activity in educational institutions.

The Ministry of the Economy is another public body which is mandated with some responsibilities that have an effect on innovation activity. These include participation in the formulation of public S&T and innovation policy as well as the related legislation and regulation of State R&D programmes. The ministry has a unit dealing with economic innovation activities (UEID), which develops proposals on directions for State innovation policy and innovation in priority areas of research, scientific and technical activities. It also undertakes projects on the development of the business education system and cluster development of the national economy, which coordinates the implementation of such responsibilities within the ministry.

Innovation governance

Given the complex structure of public bodies with distributed responsibilities in the conduct of S&T and innovation policy, *innovation governance* in Belarus is a challenging issue.[66] The specificity of Belarus's policy-making process, which is dominated by the top-down administrative approach, has laid its footprint on innovation governance as well. Unlike the practice of many countries, including economies in transition such as Armenia and Tajikistan, which have established various horizontal councils tasked with policy coordination among different public and private bodies and stakeholders,[67] innovation governance in Belarus is by and large performed hierarchically and instead of inter-agency coordination it usually takes the form of a top-down decision-making process which is then communicated along vertical reporting lines to the parties involved. More often than not, such decision-making is preceded by a lengthy and cumbersome preparatory bureaucratic processing by the institutions involved. What follows illustrates the current innovation governance practice in Belarus on the example of the funding process of R&D and the screening of innovation projects.

As noted, at present Belarus follows two types of R&D programmes. The programmes for scientific research support basic science and the expected outcome is a research product. By contrast, the science and technology programmes support innovation activity and the expected final result is a deliverable in the form of a new product or a new technology. Importantly, the S&T projects need to prove that at the project endpoint, their result is already brought to a market phase (the new product is being produced or the new technology is operational as a production facility). Both types of programmes allocate grant funding on the basis of competitive bids. Projects under science and technology programmes may also attract funding by project participants from the business sector.

Funding of "scientific research" and "science and technology" projects is done on the basis of bids which are in principle open to local R&D institutes (mostly from the Academy of Sciences but also sectoral R&D institutes and companies). However, another specificity of the Belarusian practice of R&D funding is that the prospective "leading organizations" for the implementation of each "scientific research" and "science and technology" programme are already listed in the respective government decrees approving the programmes. This approach to a large degree predetermines that the leading organisations would also host a large share of the funded projects and, respectively, would receive the bulk of the budget funding allocated to the respective programme.[68]

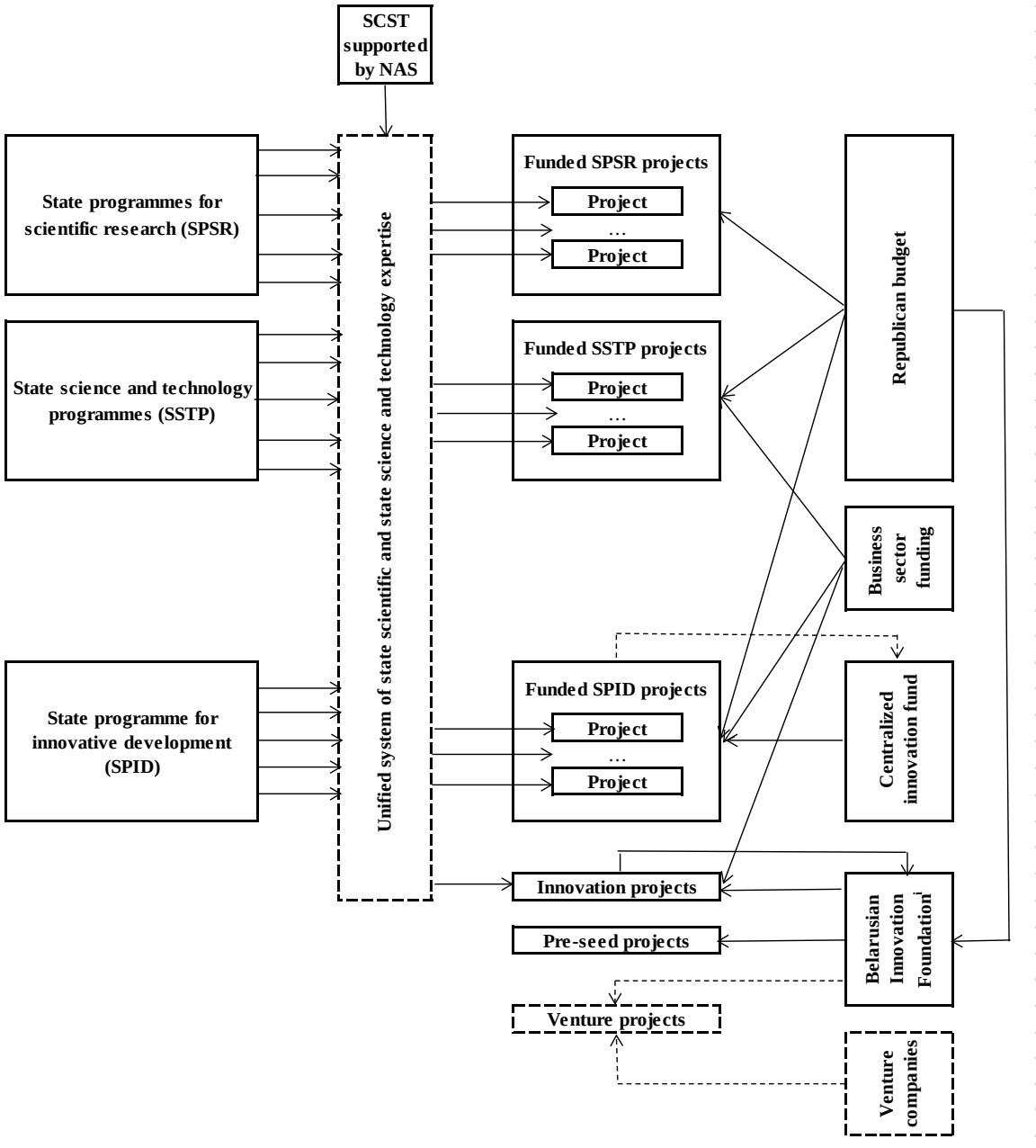
[66] Innovation governance includes both the decision-making rules and interactions between innovation stakeholders taking such decisions, which may, in turn, feed back to the decision- making processes. It has both a formal component related to existing legislation, regulations and other policy decisions and an informal or behavioural component, which is related to the incentives and motivation of NIS stakeholders and actors. Innovation governance includes both public sector (competent government bodies) and private sector actors (businesses, financial institutions, innovation intermediaries, etc.)

[67] UNECE (2014) *Innovation Performance Review of Armenia*, United Nations: New York and Geneva; UNECE (2015) *Innovation Performance Review of Tajikistan*, United Nations: New York and Geneva.

[68] Although in the case of the SPID 2016-2020 there is a mechanism for project selection and approval that in principle is transparent, as mentioned before, many of the projects included there are not what elsewhere is understood as "innovation", but rather come closer to industrial development or modernization.

Historically, there was separate evaluation and screening processes for "scientific research" and "science and technology" project proposals but, following recent regulatory changes,[69] a "unified system of State scientific and State science and technology expertise" was established for both types of project (Figure 4).

Figure 4. Screening of national R&D and innovation projects and funding sources



[i] Similar funding can also be extended by the Belarusian Fund for Financial Support of Entrepreneurs.
Source: Based on official documents provided by SCST.

[69] Government Decree No. 431, 22 May 2015 "On the functioning of the unified system of State scientific and State science and technology expertise".

The public funding of concrete projects under these programmes, as well as those under SPID, comes either directly from the Republican budget or indirectly, through the innovation funds, which are also sourced by the budget (Figure 4).[70] Small amounts of public funding to support R&D and innovation projects are also allocated through the Belarusian Innovation Fund (BelInFund). In addition, there are a number of projects under preparation on the basis of funding at the earliest (pre-seed and seed) stage with World Bank funds.[71]

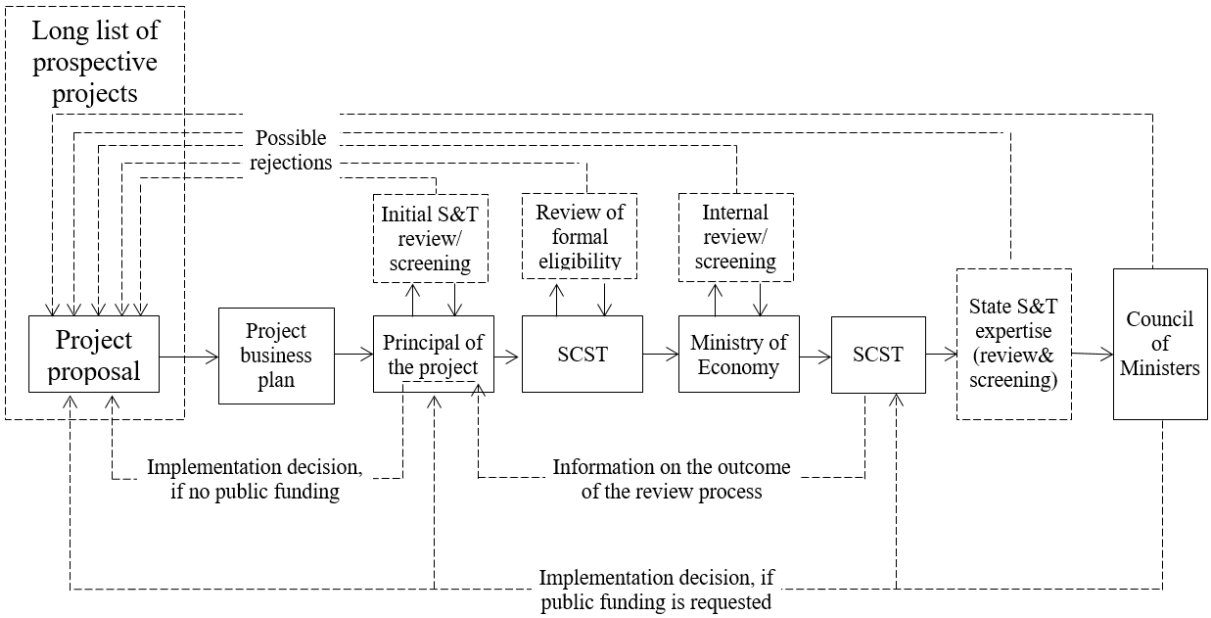
The intention of Belarusian policymakers is to mobilize and channel significant amounts of business investment (including FDI), towards the implementation of R&D and innovation projects. Another mechanism of attracting business investment into this sphere, more specifically, for the early-stage financing of innovative companies which is now being operationalized is through the newly established (with public support) venture fund.[72]

Following a historic tradition, the budget funds supporting concrete projects under different State-support programmes are allocated directly to organizations implementing these projects. The actual screening of prospective projects from the project proposal to the release of funds follows an elaborate bureaucratic procedure which includes evaluation through the "unified system of State scientific and State science and technology expertise" and involves the participation of many public institutions.

This procedure is especially intricate for the screening of prospective projects from the State Programme for Innovative Development (Figure 5), even if it should be noted that this helps to minimize wrong decisions and ensure the better quality of policymaking. In this case, the screening of project proposals may involve up to four different reviews/evaluations performed by four different bodies (the public body that acts as "principal", SCST, the Ministry of the Economy and the evaluation through the "unified system of State scientific and State science and technology expertise") plus a final decision-making component at the level of the Council of Ministers.

[70] The centralized national innovation fund and local innovation funds are State budget funds, formed by contributions of 10 per cent of income tax paid to the national and/or local budget by subordinated organizations.
[71] For the 2011-2015 timeframe the financing of scientific and technical programmes amounted to US$279,262.3. During the same period, the refundable finance of the BelinFund innovative projects totalled US$47,090.0, which amounted to 15 per cent of the portfolio. It should be highlighted that the bulk of State support for innovation projects remains available on a grant basis. For instance, the SPID 2016-2020 projects financed from the funds of innovation funds (Republican and local) in a non-refundable manner will be 93 per cent of the total, and from Belinfund (repayable) will amount to seven per cent of the total amount of projects. Thus, organizations involved in carrying out projects of scientific and technical programmes will not assume obligations to return the budget in the of case of successful realization.
[72] One such fund, the Eurasian Venture Company "Center for High Technologies" has already formally been established with the participation of a joint Russia, Kazakhstan and Belarus (see below). Another similar Russia-Belarus venture company is being negotiated among the two countries at present.

Figure 5. Screening and evaluation process for projects under State Programme for Innovative Development



Source: Based on the State Programme for Innovative Development, 2016-2020.

International cooperation

Belarus is a small open economy and efficient international S&T and economic cooperation are essential for a well-functioning NIS. To facilitate international S&T&I cooperation, SCST and the Belarusian Institute of System Analysis and Information Support of S&T Sphere (BelISA) recently launched a National S&T Portal which provides comprehensive information on the existing international cooperation agreements to which Belarus is party (at present Belarus is party to 56 such agreements) and the acting regulatory framework for such cooperation.[73]

An important recent integrative development of a more general nature involving Belarus was the establishment in 2014-2015 of the Eurasian Economic Union. The operational regulatory supranational body of the Union is the Eurasian Economic Commission modelled after the European Commission. One of the first practical cooperative steps in the area of innovation support was the establishment of the Eurasian Venture Company "Center for High Technologies". Its mission is to support high-growth early stage high-tech innovative companies targeting the market of the Eurasian Union.

In addition to that, Belarus participates in the CIS intergovernmental programme of cooperation in the area of innovation until the year 2020. However, this programme is mostly of a coordinating nature and until now has not put forward new international policy instruments or funding sources.

Being the EU Eastern neighbour, Belarus takes part in the EU Framework Programmes for Research and Innovation and, currently, in the Horizon 2020 programme. Within FP7,

[73] See http://www.scienceportal.org.by/.

Belarusian researchers took part in 63 international R&D projects, and raised some €4.22 million of EU funding. Within Horizon 2020, as of the moment of writing, Belarusian participants were part of 20 international projects, raising some €2.82 million of EU funding.[74] BelISA maintains a National Information Office on the EU's S&T&I programmes which provides technical support to prospective Belarusian projects in different such EU programmes and coordinates the national networking activities related to this cooperation. In April 2016 Belarus and the European Commission agreed to launch a new, sectoral dialogue in science and technology which will aim to increase Belarus's participation in EU S&T&I programmes. In 2016 Belarus concluded with the EU a financing agreement for the programme "Strengthening Air Quality Monitoring and Environmental Management" worth €14.5 million.

Belarus has a range of bilateral S&T cooperation agreements with a number of countries. The most significant are those within the Union State of Belarus and Russia. These include a number of bilateral cooperative S&T initiatives which are funded within the budget of the Union State. Some other bilateral agreements (e.g. those with China, India, Lithuania, Latvia, Serbia, Ukraine, etc.) are also accompanied by instruments for funding of joint bilateral projects in mutually agreed areas.

2.3 Knowledge generation and innovation support institutions: ISLs, FDI and internationalization

Industry-science linkages

Against the background of the worsening of Belarusian macroeconomic conditions, pressure on the enterprise sector to increase their international competitiveness remains high with regard to increasing innovative output. As mentioned above, legislative changes in the last years underline the policy focus on R&D development, the establishment of science-industry linkages (technology and knowledge transfer), the improvement of the R&D funding system, the establishment of a technology-oriented infrastructure and the improvement of the overall framework conditions. However, important features of the R&D system are hindered by insufficient funding and human capital.

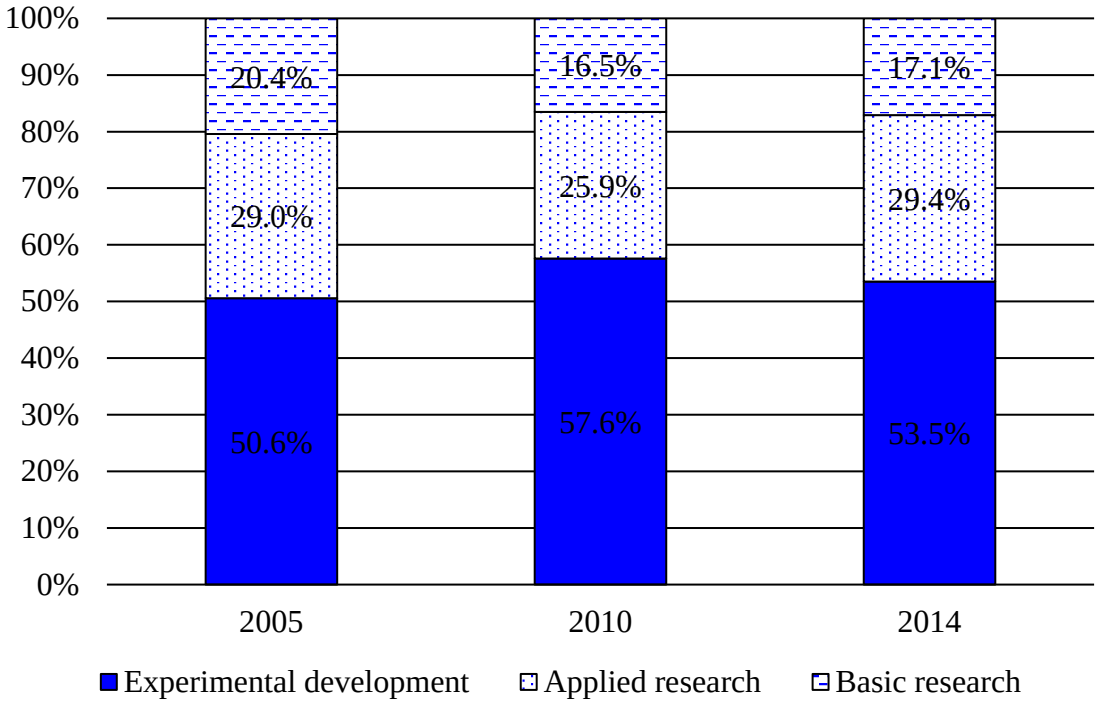
For instance, domestic R&D expenditure as a percentage of GDP has decreased from 0.68 per cent in 2005 to 0.52 per cent in 2014. The R&D expenditures in that period could not catch up with the (modest) growth of the economy as a whole. The major source of R&D and new technologies is extra-mural, not enterprise-based R&D (cf. chapter 4). The current structure of *domestic business R&D expenditure* by sources of funds indicates that the sector itself contributes a mere 25 per cent of the total R&D expenditure (BYR2,552,204 million) from its own funds.[75]

In comparison, private companies in Western European countries primarily finance their R&D activities by using own funds (e.g. In Germany for instance two thirds of all R&D expenditures are financed by private companies: in 2013 €54.6 billion from €79.2 billion total R&D expenditures).[76] The remaining 75 per cent comes from State-budgets, extra-budgetary funds,

[74] Source: http://fp7-nip.org.by/ru/hor20/BelPr/
[75] National Statistical Committee of the Republic of Belarus (2015): *Science and Innovation Activity in the Republic of Belarus. Statistical Book*. Minsk 2015
[76] Bundesministerium für Bildung und Forschung (Hrsg.) (2016): *Bundesbericht Forschung und Innovation 2016, Ergänzungsband I: Daten und Fakten zum deutschen Forschungs- und Innovationssystem*, Berlin.

foreign investments and other organisations. Finally, regarding the types of R&D activities, the composition has marginally changed since the time of the last review. Basic research activities slightly increased afterwards reaching 17.1 per cent in 2014. Whereas applied research gained in importance (rising from 25.9 per cent to 29.4 per cent), experimental development - the riskiest of the three types - decreased by 4.1 per cent (Figure 6).

Figure 6. Structure of domestic business R&D expenditure (shares in per cent)



Source: National Statistical Committee of the Republic of Belarus (2015): *Science and Innovation Activity in the Republic of Belarus*. Statistical Book. Minsk 2015

Regarding the development of *human capital in the business sector* Belarus has made progress since 2001 when 837 researchers (head count) per one million inhabitants were employed by business enterprises. In 2013, the number increased to 1,183.[77] Compared to countries like Ukraine (511), Azerbaijan (124) or Moldova (73), Belarus therefore ranks high among countries with economies in transition. However, with a view to the overall *employment in high-technology industries and knowledge-intensive services* a decrease since 2010 can be observed [78] (cf. chapters 3 and 4). The most important high-technology/medium high-technology industries in terms of employment are currently the fields “manufacture of medical, precision and optical instruments and equipment; watches and clocks” and “manufacture of machinery and equipment”. Regarding the employment in knowledge-intensive services, a slight decrease in the period from 2010 (29.8 per cent) to 2014 (29.3 per cent) can be observed.

[77] UNESCO (2015): *UNESCO Science Report. Towards 2030*. United Nations: Paris.

[78] The share of employment in high-technology industries in 2014 amounts to 0.93 per cent compared to 1.25 per cent in 2010; the same applies to medium high-technology industries with a decrease from 7.4 per cent to 6.8 per cent *Ibid*.

On the basis of the quantitative indicators, it can be concluded that Belarus went through a phase of stagnation in recent years, partly due to external shocks. On the other hand, structural weaknesses of the Belarusian business sector in general and R&D, and its innovation activities in particular, prevented a more solid performance. In particular, a lack of export-orientation is a hindrance, as it could act as a complement to importing, adapting and adopting foreign technologies. It is likely that innovations will be more successful when Belarus integrates itself into global supply chains, when it invests in the highest and high-end technology from around the world and becomes more independent from the imports required to produce at a world level of quality/excellence.

Furthermore, knowledge generation in the Belarusian enterprise sectors is currently limited due to the absence of real growth centres with the potential to initiate *cluster effects* (with the exception of the IT sector).[79] Also, potential *spill-over effects* are hampered because of the dominance of large companies within the R&D and innovation process and the fragmentation of the country`s industries (cf. chapter 4).

Role of FDI and internationalization

Foreign direct investment, both inflows and outflows as well as non-equity forms of international production (e.g. subcontracting, licensing, franchising); represent important channels for increasing innovation activities and technological output. Relevant underlying mechanisms regarding technology transfer include imported equipment, learning through FDI, and direct learning by the labour force working in foreign-owned firms, plus learning from co-operation with foreign firms.

Since 2010, Belarus has made progress to improve the investment environment in the country. In 2014 the *"Law On Investment"* entered into force, which should facilitate the attraction of investments into the Belarusian economy by guaranteeing protection of investors' rights and interests, as well as non-discrimination, free disposal of profits made from investment and protection against interference in investors' private affairs. In particular Belarus supports investors and provides incentives in the following areas:

- Medium and small towns, and in the countryside (if doing business on the territory of the Republic of Belarus);
- Hi-Tech Park (Minsk) and in other industrial parks;
- Free Economic Zones (FEZ); and
- When entering into an investment agreement (i.e. contract) with the Republic of Belarus.[80]

Concerning the FEZs, these have been established since 1996 to foster investment and growth. They offer taxation and regulatory incentives, including five year exemption from tax. At the time of the fact-finding mission, six of the FEZs were fully operational. Its residents are local

[79] In successful national (or regional) innovation systems, clusters of specific industries or technologies are crucial as a critical mass of companies in the same or related industries tends to initiate permanent feedback loops and self-enhancing effects (cluster dynamics). Such cluster effects partly occur along the value chain, but also within the division of labour in the innovation process. The more (highly specialized) partners are involved in the innovation process, the more information - and ultimately knowledge - circulates within certain industries or sectors

[80] See http://belarusfacts.by

entrepreneurs and foreign investors (almost 270 foreign businesses have taken advantage of FEZ).[81]

The current status of net foreign direct inflows for Belarus is displayed in table 7. Since 2011, the net foreign direct inflows remain on a very low level (slightly above or below US$2 billion). Industry wise, the largest inflows are geared to categories of low-tech activities like food, wood, coke, refined petroleum products. Priority medium-technology industries are the manufacture of machinery and motor vehicles/equipment and transport/communications. At present the main investors in Belarus are Russia, United Kingdom, Netherlands, Cyprus, Austria, Germany, and China. According to the SCST[82] there are at present 5,000 commercial companies with foreign capital located in Belarus. About 60 companies are affiliates from large, multinational companies.

Table 7. Net foreign direct inflows 2008–2014, total and by key industries (US$ million)

	2008	2009	2010	2011	2012	2013	2014
Total	**682.7**	**420.9**	**360.6**	**2,159.3**	**-88.8**	**1,707.3**	**1,230.7**
of which:							
Industry	358.2	103.8	111.8	431.2	312.4	675.6	600.6
Manufacture of food products	71.5	51.0	5.3	86.4	66.5	59.1	134.9
Manufacture of wood products	7.2	-5.7	4.1	15.8	77.7	80.5	95.0
Manufacture of coke, refined petroleum products and nuclear materials	51.8	-0.5	0.3	10.3	-1.3	140.2	64.1
Manufacture of chemicals and chemical products	8.1	6.8	20.7	35.5	30.3	75.5	64.6
Manufacture of motor vehicles and equipment	13.1	-0.2	1.7	70.1	38.7	66.5	64.1
Manufacture of machinery and equipment	32.7	7.1	22.0	39.9	-40.8	49.4	48.3
Trade, household and personal goods	99.6	55.1	-29.9	703.9	-245.9	265.1	105.7
Real estate, renting and business services	59.9	107.9	10.8	250.3	144.4	299.9	195.9
Transport and communications	106.8	119.7	251.1	674.3	-442.2	222.1	88.9

Source: National Statistical Committee of the Republic of Belarus: Statistical Yearbook 2015

With regard to the export of high-tech products, a recent study by UNESCO shows that Belarus has improved in recent years. According to this indicator Belarus is placed in the same group as Russia and Ukraine (exports per capita in US$).[83] Compared to other countries of the Black Sea basin, statistics show Belarus has achieved significant progress and has achieved per capita figures above those of Russia and Ukraine (Table 8). However their performance in absolute

[81] See http://belarusfacts.by
[82] State Committee on Science and Technology of the Republic of Belarus: Belarus in Figures, Minsk 2015.
[83] See UNESCO (2015): UNESCO Science Report. Towards 2030. United Nations: Paris.

and relative values is significantly lagging behind countries with a high degree of competitiveness through technology-intensive production.[84]

Table 8. High-tech merchandise exports of selected countries, 2008 and 2013

	Total, US$ million		Per capita, US$	
	2008	**2013**	**2008**	**2013**
Armenia	7	9	2.3	3.1
Azerbaijan	6	42	0.7	4.4
Belarus	422	769	44.1	82.2
Georgia	21	23	4.7	5.3
Ukraine	1,554	2,232	33.5	49.3
Russia	5,208	9,103	36.2	63.7

Source: UNESCO 20015, based on COMTRADE Database of the United Nations Statistics Division

Role of universities, research centres and intellectual property

The Belarusian Government regards the universities as well as the non-university research centres as essential drivers of innovation and knowledge generation. For the Ministry of Education the development of universities and innovation activities is a co-dependant process. Therefore, legislative changes since 2010 put emphasis on priority areas like strengthening science-industry linkages, commercialization of scientific results, of IPR issues, establishment of start-up centres and technoparks/incubators at universities (cf. section 2.2.5) or the possibility to set up small companies at the university to transfer technologies to the market. These focus areas often resulted in new organizational structures, particularly at the large scientific research organizations like the National Academy of Sciences, the Belarusian State University or the Technical University.

As of 2015, Belarus had 54 higher education institutes of which 34 are universities and seven are academies.[85] The total enrolment amounts to 362,900, of which 185,000 are full-time students (and 176,700 correspondents). The higher education institutes had 81,100 graduates, which is equal to 178 graduates per 10,000-employed population. According to the UNESCO Science Report 2015, Belarus compares well with developed countries for the gross tertiary enrolment rate: more than nine-tenths of 19-25 years olds. Government expenditure on education is quite high for Belarus, with 5.12 per cent of GDP for total education expenditure and 0.92 per cent of GDP for expenditure on higher education. Compared to other countries with economies in transition like Ukraine, Georgia, Armenia or Azerbaijan, only Ukraine spends more on education - 6.66 per cent of GDP for total education expenditure and 2.16% on GDP for higher education. (cf. chapter 3).[86]

[84] The revealed comparative advantage (RCA) of selected countries gives evidence that countries like Japan, South Korea or Switzerland have a positive export/import relation of R&D intensive goods compared to the export/import relation of the overall production. See Expertenkommission Forschung und Innovation (EFI) (2016): Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2016, Berlin: EFI.

[85] National Statistical Committee of the Republic of Belarus (2015): Science and Innovation Activity in the Republic of Belarus.

[86] See UNESCO (2015): *UNESCO Science Report. Towards 2030*. United Nations: Paris

With a view on the scientific fields, most Belarusian students graduate in communications, law, economics, management, business administration (34,600 from a total of 81,100 in 2014/2015). In second place are graduates in engineering and technology (14,300) followed by teacher education (8,600) and agriculture, forestry, landscape architecture (5,300). Meanwhile, the post-graduate programmes (total enrolment in 2014: 4,900) are strong in engineering, economics, and medicine.

In addition to the qualification level, R&D activities in the public research sector (universities, non-university research centres), give evidence on the capability to generate scientific results, technological solutions and contribute to innovations. In Belarus, the domestic expenditure on R&D (GERD) in 2014 amounted to BYR4,073 billion, of which the higher education sector accounts for 11.7 per cent followed by the government sector, which accounts for 26.4 per cent. Compared to 2005, the significance of the higher education sector has considerably decreased (contributing to GERD merely 17 per cent). The same applies to the government sector, which reduced its share on GERD from 38.5 per cent in 2005 to 26.4 per cent. In terms of relative figures and without adjustment for inflation, the Belarusian business sector expanded its share on GERD from 44.4 per cent in 2005 to 62 per cent in 2014.

Looking at R&D expenditure of the higher education sector according to its sources of funds, table 9 shows changes in the composition of the different funding sources since 2005.

Table 9. R&D expenditure of higher education sector by funding source (BYR mn.)

	2005	2010	2011	2012	2013	2014	2015
Total R&D expenditure	75,123	144,092	19,559	354,107	474,006	475,456	485,388
By funding source							
own funds	2,327	2,908	3,102	4,549	3,454	4,728	4,374
budget	44,837	96,426	132,516	233,668	324,437	311,951	294,554
extrabudgetary funds	1,714	33	238	191	3,949	2,805	4,258
foreign investment, incl. foreign credits and loans	1,824	7,582	15,225	29,919	32,118	29,948	57,526
funds of other organizations	24,421	37,135	48,478	85,780	110,048	126,024	124,460

Source: National Statistical Committee: Science and Innovation activity in the Republic of Belarus 2015

The National Academy of Sciences, as well as Belarusian universities and research centres have diversified the sources of R&D funding by setting-up new organizational units to generate revenues by facilitating the commercialization of research results, be it internally (e.g. enterprises subordinated to the NAS), or through improving linkages to external organizations to establish new support infrastructures like technoparks, incubators or start-up centres.

For the *National Academy of Sciences of Belarus* (NAS), innovation is at the top of the agenda. The main changes since 2010 relate to the implementation of new legislation and regulation. In this regard, the adoption of the law on innovation activities and the Presidential Edict on

commercialization of scientific research resulted in a significant impact on innovation activities in the country.[87]

For instance, as *the* institution still carrying out the bulk of R&D in Belarus, a gradual shift has been made since 2010 from scientific research activities (basic research) to scientific-technical research projects, which are more applied-oriented and pursue the goal to provide services for innovation. Due to the existence of commercial enterprises within the NAS sphere (in total, there are 122 different organizations subordinated to the NAS – institutions and enterprises), NAS seeks to encourage own production[88] and to facilitate access to external support for the export of science-based production.

Within the context of a gradual change of NAS from being a purely scientific organization to a more applied organization, *72 innovation centres* have been considered to link scientists and consumers with the participation of NAS R&D organisations. Many of the NAS research institutes have initiated the formation of their own "clusters" with the participation of businesses with which they have been cooperating traditionally. These shifts in NAS activity have also associated with changes in the structure and sources of NAS funding, with growing emphasis on NAS's self-funding. The rationale behind this approach is that research results are transferred to industry as soon as the results meet the demand. NAS was also involved in the establishment of the new innovation and technology park BelBiograd (see below).

With regard to *higher education institutions, universities and facilities*, recent legislative and operative changes put emphasis on strengthening industry-science linkages, for instance by supporting internships, affiliates of university chairs in companies or the creation of joint laboratories with several companies. Furthermore, researchers and student can participate in innovation competitions and create start-up centres. Four of the seven technoparks are based at universities.

A milestone in recent legislation is that universities are allowed to establish small companies to transfer technologies to the market. The Belarusian State University (BSU) for instance has nine unitary enterprises as separate legal entities. Furthermore, according to BSU authorities, the school has a number of production facilities and also provides research results to existing enterprises and institutions. Thus, the nine production units at BSU generated a value of US$20 million in 2015. There is a central fund at BSU, which is used to develop research and new production units. The budget comes from companies in the BSU Technopark. The companies do not pay rent for their premises, but allocate a share of revenues to the central fund.

At the universities, much attention is paid to IPR issues and the contribution to the improvement of regulations and frameworks. One piece of legislation adopted in 2013 (i.e. Presidential Edict No. 59) introduced new regulatory norms aimed at stimulating innovation activity and the commercialization of research results. It was a positive development in the regulation of ownership of intellectual property rights stemming from the results of R&D activity supported with public funds.

[87] Programmes that have been implemented (and mostly completed in 2015) focus, respectively, on biotechnology, the creation of high-technology in industry, and the development of new technologies in agriculture.
[88] Currently, 70 per cent of the total budget of NAS is generated by production facilities, only 30 per cent comes from the State budget. There are ten such companies which make a significant contribution to the NAS budget.

Practical experience has indicated that further reforms are needed for the efficient management of IPRs. In particular, the existing legal framework does not contain sufficient provisions for identifying the actual legal owners of the IPRs originating from R&D activity supported by public funding. Due to the existing ambiguities, even the leading R&D institutes performing S&T projects under the State S&T programmes still face difficulties in claiming legal ownership of such IPRs.

Thus while R&D institutes are entitled to the IPRs originating in R&D activities they undertook, these institutes are not able to sell the IPRs or engage in follow-up commercialization activities with third parties due to difficulties in the enforcement of the IPR regime. The experience of other countries indicates that properly settled IPR ownership for individual researchers and research teams has been a major driver of innovative entrepreneurship through the establishment of start-ups and spinoffs based on such IPRs. Opening up the potential of this driver in Belarus could provide a much-needed additional impetus to entrepreneurship and enterprise development in the country.

Another Edict of 2013 introduced for the first time in Belarus the possibility to use public grant funding instruments (innovation vouchers and grants). The new funding instruments are to be operated mainly by the Belarusian Innovation Fund (cf. section 2.1.1).

Under current regulation, the owner of IPR is the Ministry of Education, not the university. However, the rights can transferred from the Ministry to BSU within the context of a contract agreement. The Department of Protection of Intellectual Property is responsible for the management of scientific and innovative activity at BSU, providing legal protection of intellectual property, patent and licensing organization and rationalization of work, and assessment on intellectual property. However, despite some progress in the field of IP legislation in Belarus, there is still no clear-cut mechanism of sharing IP-related profits between the contracting party and the developer or inventor. There is good international experience available on how legislation can create an incentive system within IP regulation and science exploitation, which could inform future policy changes (Box 4).

Box 4. IP regulation and science exploitation at German universities

Until 2001, IP regulation in the German science sector was organized in such a way that the right to patenting or licensing an invention belonged entirely to the professors or employees of a university, even if the means for financing the research originated from public funds (Employees Invention Act, 1957). Thus, university employees were completely free to dispose of the inventions made in the context of their employment. In the view of legislators the "university lecturer privilege" would encourage research efforts and support the freedom of research and teaching.

Despite this arrangement, university employees (especially professors) were reluctant to register their research as a patent, often being unwilling to take the financial risk for patent application/granting. Another explanation was that scientists preferred to publish their research in peer-reviewed publications; and a patent application was no longer useful once the act of publication revealed key information about the invention.

Based on this experience and the belief that many university research results can only be transferred if the university receives the exclusive exploitation or patent right, the Federal Government decided in 2001 to abolish the university lecturer privilege. Since then, university employees are subject to the same regulations as any other employee (for instance, in the business sector).

Thus, since the implementation of the modified §42 of the Employees' Inventions Act in 2002, researchers must inform the university as their employer about an invention ("obligation of claims notification"). The university shall, within four months, make a decision on the claim of the invention. If the university does not claim its entitlement to the exploitation of the invention, it will be considered a "free invention", which implies that the patent right will be transferred to the inventor (university employee). In the case of exploitation by the university, the inventor (employee) receives a compensation of 30 per cent of the revenues generated by the sale of the invention. As an organizational innovation, universities since 2002 have been required to establish the necessary infrastructure to handle the exploitation process. This was managed in the form of the establishment or authorization of so-called "patent exploitation agencies".

The objectives of the modification of the Employees' Inventions Act - or the abolition of the university lecturer privilege - were the following:

- Stimulation of knowledge- and technology-transfer between universities and the business sector;
- Increased efficiency of knowledge- and technology-transfer by bundling the exploitation activities at one centre (i.e. "patent exploitation agencies");
- Mobilisation additional financial resources for the universities via exploitation revenues; and
- Increased incentives for exploitation on the level of university researchers as the costs of exploitation and risks will be transferred to the university without restricting the freedom to publish.

Source: Hochschulpatente zehn Jahre nach Abschaffung des Hochschullehrerprivilegs, Studien zum deutschen Innovationssystem, 12-2012.

Innovation support institutions - the intermediary system

Apart from innovation financing institutions and public innovation-related institutions, Belarus over the last five to ten years has established a complementary infrastructure to promote innovation and technology transfer. According to the SPID 2016-2020, the following institutions are shaping the innovation infrastructure: technoparks (Science, Industrial parks, incl. the establishment of a network of technoparks); financial institutions (Innovations Funds, Venture Capital, see above); information services (information networks); advisory services provided by experts; human resources in terms of training of specialists in the field of innovation management); network of technology transfer centres.

From 2012 to 2015 the number of jobs and the production volume of product innovation in organizations that are residents of industrial parks has nearly doubled. The basic directions of activity of residents of technoparks are instrumentation, mechanical engineering, electronics, information technology, software development, medicine, pharmaceuticals, medical equipment, optics, laser technology, energy, energy saving, bio-and nano-technology.[89]

Thus, according to statistics of the STST, as of year 2015, 101 resident companies are operating across all industrial parks, which is the maximum value since their inception. The total number of employees of organizations resident in industrial parks amounted to 1,137 people - a 10 per cent increase with respect to 2014, and 63.1 per cent with respect to 2012. The total area of premises operated by industrial parks has also reached the historical maximum value (totalling 127.5 thousand sq. meters). With regards to job creation, for the period 2012-2015, resident companies of technoparks created 712 new jobs (189 in 2015). The total volume of production of all resident firms totalled BYR1,205 billion (approx. US$116.9 million.) (Table 10). The share of innovative products for the entire period amounted to 68.1 per cent. Also, during the last four years there has been a trend to increase the share of innovative products in the total volume of goods produced (from 62.1 per cent in 2012 to 79.3 per cent in 2015).

[89] A full list of intermediary institutions include the following: Technoparks, Science parks, Industrial parks and Technology transfer centres. These include the Brest Science and Technology Park in the Brest region, the Science and Technology Park Vitebsk State Technological University; the Polotsk State University of Science and Technology Park, and the centre of technology transfer - ODO "Vitebsk Business Center." In the Grodno region there is a center of technology transfer (Apsel LLC). In the Gomel region there are two science and technology parks and one technology transfer centre: Gomel Scientific and Technological Park; Agency of development and investment promotion; and the "Centre of scientific, technical and business information.". In the Mogilev region there is the Technology Park Mogilev, while in the Minsk region, there is the KPTUP Minsk Regional Industrial Park.The innovative infrastructure of Minsk city also includes the Technopark National Technical University Polytechnic; the Company Minsk Industrial Park; and the Technology Transfer Center of CJSC Stroyizyskaniya (see http://ictt.by).

Table 10. Development of scientific-technological parks of Belarus

Indicators	2012	2013	2014	2015
Number of resident entities	65	91	84	101
Number of resident workers	697	1,146	1,034	1,137
Number of jobs created by technopark residents	126	272	125	189
Total volume of goods, works and services (BYR bn.)	286.4	292.2	290.0	336.5
Innovation products of own production (BYR mn.)	177.9	178.3	197.4	266.8
Proportion of innovative products in total output (per cent)	62.1	61.0	68.0	79.3

Source: State Committee on Science and Technology

Among the more important institutional innovations - compared to the 2010 Innovation Performance Review - is that public investments in the innovation infrastructure now depict a separate line in the Republican budget, which indicates a reliable budget plan on an annual basis with a clear commitment of the government to specific spending categories or policy priorities.

One key success story concerns the development of the hi-tech industry. The Hi-Tech Park in Minsk was established with the main goal to foster the ICT industry (Box 5). It receives strong governmental support and its activities are a key priority being promoted by authorities for export growth. Its first residents were registered in 2006. Currently, there are 164 companies registered as HTP residents. More than a half of them are foreign companies and joint ventures.[90]

Box 5. Belarus Hi-Tech Park

Among the technoparks established in Belarus, the Hi-Tech Park (HTP) has continued to grow quite strongly over the past 5 years. Already successful for some time, a number of technology-based enterprises have recorded growth more recently on the international market. Especially since 2010, key indicators show strong progress: sales have nearly quadrupled and export sales have shown even stronger growth. Latest figures show employees to number 24,037 - more than twice the figure for 2010. The export share in the total production volume exceeds 91 per cent (see Table 11, below).

According to the origin of investments attracted the structure is as follows:

- 41 per cent of HTP residents were set up by Belarusian investors;
- 24 per cent of HTP residents are joint ventures; and
- 35 per cent of HTP residents are enterprises with 100 per cent foreign investments.

Source: Interviews held at the Hi-Tech Park (see also http://www.park.by)

[90] See the following website: http://www.park.by

Box 5. Belarus Hi-Tech Park *(continued)*

The HTP is characterized by distinct features compared to other Technoparks, Science Parks and Industrial Parks in Belarus. The HTP has attracted major international software and hardware companies like IBM, SAP, Oracle and Microsoft, among others, and now constitutes a knowledge and innovation hub with international linkages. These international companies offer employment and training opportunities to young programmers and support around 80 joint research labs in Belarusian technical universities, helping the HTP and its residents establish strong linkages with the public research sector. This extends to developing specialized educational courses integrated into university curricula, free training courses for faculty members, and engagement of over 30 university research departments of computer science by IT companies.

This form of cooperation is intended to link the academic and business world by exchanging both academic and practical knowledge, by bringing together educational process and production, and improving the training of Belarusian IT specialists. Company employees conduct special courses, as well as supervising coursework and theses. In 2010, the Educational Center of the Hi-Tech Park was established with participation of HTP residents to provide re-education for adults with a technical background.

The Hi-Tech Park is managed by the Hi-Tech Park Administration, which is in charge of defining the trends and policies of the national software industry development (according to the Law - The Hi-Tech Park Administration). Its main goals are to promote export-oriented software development companies, to promote the competitiveness of the national hi-tech industry and to provide favourable economic, legal and other conditions for the development of R&D in information technologies and hi-tech exports as well as to attract foreign investments into this area.

A newly founded incubator within the Hi-Tech Park offers support services for companies in their pre-seed or seed-phase. The innovation support services performed by the incubator/Hi-Tech Park include: Pre-incubation, hackathons, matchmaking in early-stage fundraising (e.g. provision of informal venture capital by business angels), training on IP issues, taxation, business planning, basics of marketing and promotion. In 2015, the incubator started a programme to launch business ideas and from 100 ideas, seven promising projects were selected. These are now residents of the incubator.

Regarding regulation, with the Hi-Tech Park considered a major success, no significant changes have taken place. The idea to expand the Park to also include other technologies like nanotechnology, medical technology and bio-technology, among others, has been left aside. Instead, the alternative option to set-up separate organizations in these fields was chosen. The National Science and Technology Park “BelBiograd” is one such example.

Source: Interviews held at the Hi-Tech Park (see also http://www.park.by)

Table 11. Development of the Belarus Hi-Tech Park

	2006	2010	2015
Sales (thousand US$, current prices)	28, 148.3	197, 940.9	792, 913.1
Export Sales (thousand US$)	21, 859	161, 007.4	705, 630.4
Domestic sales (thousand US$)	6, 378.9	35,823.2	67, 433.3
Imports (thousand US$)	299.8 (2007)	801.7	3, 325
Total number of employees (headcount)	2, 506	9, 421	24, 037
Number of new employees (headcount)	795	1, 577	3, 042

Source: Belarus Hi-Tech Park

On the basis of the experience with the Hi-Tech Park, plans have been developed to establish a second, similar Park with a focus on biotechnology at the National Academy of Sciences. The planned *National Science and Technology Park "BelBiograd"* will be founded using the same principles as the Hi-Tech Park. The objective is to create favourable conditions for the rapid development and high competitiveness of the biotechnology, pharmaceutical and nanotechnology industries, to attract investment for the commercialization of R&D results and to introduce high technologies and production of innovative products. The target group of the park will be companies which carry out fundamental and applied research, experimental design, research and technology, experimental development, design, implementation and development of high technologies aimed at the production of innovative products, materials and equipment.

The administration responsible for the park established a special organization named BelBiograd Development Fund, which is responsible for the following activities: Promotion of basic and applied research in the fields of biotechnology, pharmaceuticals and nanotechnology by providing - on a competitive basis to scientists - grants for research and development. The competition procedure and definition of the conditions for the provision of grants to scientists will be determined by the National Academy of Sciences. Like the Hi-Tech Park, BelBiograd will be endowed with an incubator for small businesses.

One aspect that remains a barrier to the further development of scientific-technological parks in Belarus is the uneven development of tax relief instruments to attract new firms. On the one hand, over the past five-year period there was the approval of some significant incentives (cf. section 2.2.1). On the other hand, the amount of funds released as a result of the application of these benefits remains insignificant and in 2015, it amounted in total to BYR3.5 billion, or 0.18 per cent of the total tax relief provided to support scientific and innovation activity in the Republic of Belarus. The only exception to this trend has been the Hi-Tech park in Minsk, where the amount of tax relief to IT resident entities amounted to BYR1,037.8 billion or 54.8 per cent of the total tax relief.

Another main organization within the intermediary system of Belarus is *the Republican Center for Technology Transfer (RCTT),* which was founded in 2003 under the auspices of the State Committee on Science and Technology and the National Academy of Sciences of Belarus and with support from UNDP and UNIDO.

RCTT's primary objective is to promote cooperation between developers and users of high technologies and potential investors. The services are offered to domestic actors involved in

innovation activities as well as foreign companies and investors. In detail, the RCTT carries out the following specific tasks:

- Forming and maintaining information databases meant for serving clients in the technology transfer sector;
- Providing RCTT's clients with access to the UNIDO network and other international databases dedicated to technology transfer, research and development;
- Assisting in development and promotion of their innovation and investment projects;
- Instructing and training specialists in research- and innovation-related entrepreneurship;
- Establishing RCTT's regional innovation offices in the country, with the aim of creating a unified national network of technology transfer centres; and
- Assisting and promoting international research and development cooperation and exchange of specialists ("match-making").

Within its first decade, the RCTT has managed to set up and lead a so-called 'RCTT network' which, a part of RCTT, its coordinating body includes members, clients and partners. In 2011 the structure included 26 branches and five divisions (with two offices in China). As of March 2016, 32 branches were included, with 82 foreign partners in 28 countries.

In parallel with developing the network, the RCTT invested significant efforts in diversifying the financial sources for its operations and ensuring independence and financial sustainability. However, without direct support from the authorities for core activities, the latter has not been achieved and after several transformations the RCTT has ended as a legal entity. In 2015, it was incorporated as a department in the Center of System Analysis and Strategic Research of the NAS. This Center is a small research organization with dual functions: it is a 'think-tank' shaping NAS policy and a promoter of commercialization of the NAS's R&D results and international cooperation. The RCTT contributes to the latter function. One of the latest positive developments in this area is the setting up of a Business Cooperation Center "EEN - Belarus", a Belarusian branch of the Enterprise Europe Network - a joint project of the RCTT, Republican Confederation of Entrepreneurship and the European Commission till 2021. Thus, from being organized and developed as a national undertaking, the RCTT has gradually transformed into the NAS's facility serving mainly the needs of institutions inside the Academy and trying to commercialize the relationships with non-Academy clients (universities, SMEs, knowledge-intensive large industries, etc.).

The *Technopark at the Technical University (Polytechnic)* is explicitly mentioned in the State Programme on Innovation Development 2016-2020. Polytechnic is not a classic technopark (like the Hi-Tech Park), rather, it is a scientific research organization with different locations. It was founded to commercialize the results of the scientific and technical activities of the Belarusian National Technical University (BNTU). The establishment of new innovative enterprises as well as the generation of innovations are the main objectives of the Polytechnic. The benefits for the companies in the park are lower corporate taxes, lower rental rates and direct benefits in terms of funding from the national budget. The activities of the technopark are strongly connected with complementary priorities of BNTU, which for instance established eight centres with foreign countries under the principle of one centre at BNTU matching one

institution abroad,[91] 12 science and innovation support centres and seven new R&D and manufacturing departments.

In addition to the parks described so far, the *Minsk City Industrial Park* was founded in 2011 and has around 30 companies. It includes shared labs to facilitate the collective use of equipment. The park offers a submarket rental rate, a lower corporate tax rate (10 per cent) and exemptions from local taxation. The resident companies are among others engaged in applied electro-optical technologies, data protection systems, aircraft industry and navigation technologies, and nanotechnologies. The park is currently expanding with the construction of a manufacturing building.

Finally, the Government has launched another new project in the last five years: the Belarusian-Chinese Big Stone Industrial-Park, which is intended to include start-up support. The park will host high-tech and export-oriented companies in electronics, biomedicine, fine chemistry and engineering. Incentives for companies are exemptions from profit, land and real estate taxes granted to all Park residents for the first ten years. In addition, the income tax of the employees will be lower than for non-park employees.

Overall, the approach with regards to intermediary institutions in technoparks is promising and can be a role model for other industries or technological fields. The concept of BelBiograd as an attempt to transfer the experience of the Hi-Tech Park into other industries/technologies, and it certainly points into the right direction. Remarkably, however, all techno and science parks are organized in a way that no distinction is made between young companies (often unable to pay the rents), and successful international companies. The same applies to support services offered by the centres for all of their residents. International experience indicates that a differentiation of the business concepts between profit-orientation and public services is commonly made to discriminate among the needs of residents and with the goal that subsidies be lifted over time when financial capabilities improve.

With regards to the government strategy of setting-up international networks like the RCTT or strengthening partnerships with single countries (like the Polytechnic), the objective to combine innovation activities – as the key feature of Park residents - with supporting inflows of technologies from abroad, is a worthy one. However, this strategy will only be effective when concrete trade relationships, joint projects or joint ventures between companies from Belarus and abroad are defined and implemented. Therefore, the simple exchange of experience on the level of the parks or the memberships in foreign/international networks of Technology Centres needs to be complemented with a (bilateral) funding of joint projects.

2.4 Recommendations

2.1 Ensure conceptual consistency in the typology of innovation policy targets and align these targets with matching policy instruments. The SCST and other relevant institutions should undertake the following tasks:

[91] Examples for such a structure are: Belarusian-Latvian Center for Technology Transfer, Belarusian-Kazakh Center for Scientific and Technical Cooperation, Belarusian-Russian Center for Domestic Technologies Implementation, Belarusian Syrian Center for Scientific and Technical Cooperation.

- Further transform the State Programme for Innovative Development (SPID) into an overarching policy document incorporating also the objectives and targets of State R&D programmes;
- In cooperation with the NAS, consider identifying under the State science and technology programmes a separate category of high-risk "science, technology and innovation" aligned with the provisions of LSIPIA and which is funded by a different category of specific instruments tolerating risk;
- Amend legislation, including Decree No 680 of the Council of Ministers of the Republic of Belarus of 2013 to provide for the risk of innovation, in acts regulating the issues of implementation of the various programmes and innovative projects; and
- In cooperation with the NAS and the Ministry of Economy, develop practical guidelines for the assessment and sharing of risk pertaining to the implementation of innovation projects in accordance with the provisions of LSIPIA; these should cover each of the following aspects:

  - Introduce in the instruments for funding risky innovation project mechanisms for incorporating some degrees of risk tolerance;
  - High-risk innovation projects should be organized on the basis of open competitive calls which would stimulate bottom-up initiatives by consortia ready to handle the project risks. Only dedicated innovation projects where the beneficiaries are clear (i.e. few limited actors exist that could participate), may be run by a direct negotiation procedure; and
  - Ensure that all projects identified as high-risk "innovation projects" as above are screened and evaluated by tsimilar criteria and procedures, even if they originate in different State programmes and are funded by instruments tolerating risk.

2.2 Initiate a gradual transition from predominantly vertical to predominantly horizontal policy mechanisms and instruments in the innovation policy mix. The SCST and other relevant institutions should undertake the following tasks:

- Increase the share of funding earmarked for high-risk "S&T innovation projects" and early-stage financing of innovative activity while at the same time reducing the share of low-risk investment projects;
- Within public early-stage financing, increase substantially the share of grant financing while at the same time reducing the share of loans; and
- Align the policy instruments and mechanisms and design new ones for the implementation of horizontal-type innovation policy. In particular, improve and enhance instruments to optimize selection procedures, so that competition between project proposals is held under conditions of openness and transparency.

2.3 Ensure a better match between the strategic objectives of innovative development,the available policy instruments and the public funding to pursue such objectives. The SCST and other relevant institutions should undertake the following tasks:

- In the cases of strategic objectives which are not matched by available policy instruments and funding, prepare proposals for the introduction of such instruments backed by adequate funding, to be designed and introduced in the course of implementation of the SPID 2016-2020;

- Consider, among the now missing policy instruments, introducing open horizontal competitive calls for collaborative innovation projects between research centres and industry; instruments supporting international linkages with global technology-centred value chains, such as expanding efficient matchmaking programmes that work in coordination with the investment promotion authorities; increase the amounts of grants supporting the establishment of innovative university startups or spinoffs based on clearly defined IPRs; set up new instruments and innovation programmes catering to the specificities of non-technological innovation; and
- Specify in the State S&T programmes what programmatic activities will be funded by which policy instruments.

2.4 Streamline innovation governance with a view to rationalizing public sector decision - making related to innovation policy implementation:

- SCST should prepare, in consultations with the public bodies concerned (i.e. Ministry of Economy, Council of Ministers, "principal" bodies) proposals for optimizing the screening and evaluation process of innovation and R&D projects from the respective State programmes and the related decision-making process for the release of public funds for project financing;
- A possible way of streamlining funding decision-making could be the establishment of a joint Interagency Funding Committee with delegated authority to take the final decision on the release of public funds for all R&D and innovation projects under different programmes. Alternatively, an Innovation Council could be established of which the SCST could act as secretariat; and
- Consider measures for better aligning the implementation of State Science and Technology Programmes with the objectives of the State Programme for Innovative Development, including the allocation of public funds. The joint Interagency Funding Committee could perform coordination functions to this effect.

2.5 SCST in cooperation with Belinfund, NAS and subordinate bodies should initiate measures for the further development and strengthening of the NIS and the enhancement of weak components:

- Define the strengthening of connectivity and collaboration in the NIS as a strategic objective of innovation policy. Introduce policy instruments to pursue this objective in line with Recommendation 2.3. Set up a system of monitoring linkages and collaboration in undertaking innovation activity among innovation stakeholders in the NIS by defining quantitative and qualitative indicators of linkage intensities and measuring them over time;
- In cooperation with technology parks and the RCTT, define the strengthening of international linkages leading to global technology-centred value chains as a strategic objective of innovation policy. Introduce policy instruments to pursue this objective in line with Recommendations 2.3 and 2.6. Set up a system of monitoring such international linkages;
- Complement these measures with additional non-financial coordination instruments to support connectivity and linkages, in particular those facilitating networking and information-sharing among potential stakeholders. Thus, financial instruments at present could be accompanied with "mentorship", which is especially useful for start-ups and small innovation companies;

- In cooperation with the NCIP, strengthen the systemic role of intellectual property rights (IPR). To this effect further strengthen regulation and implementation guidelines which allow straightforward procedures for the sharing of IPR ownership between legal owners, including individual researchers and research teams;
- In cooperation with the Ministry of Economy, Ministry of Taxes and Levies, and the Ministry of Finance, design targeted tax incentives to encourage private sector engagement in the early stages (business angel and venture) financing of innovation activity;
- In cooperation with the Ministry of Economy, the Ministry of Taxes and Levies and the Ministry of Finance, develop additional tax incentives to promote the development of science and technology parks and technology transfer centres comparable to those existing for residents at the Hi-Tech Park and the Sino-Belarusian industrial park Great Stone;[92]
- Cluster development is on the agenda of Strategies but progress is still limited. In cooperation with other public bodies (i.e. SCST, NAS), the Ministry of Economy should seek further transformation of organizations and incentives needed to overcome the fragmented business structure, the shortage of R&D centres in several specialized fields of applied science, a lack of engineering and other innovation service firms, and a weak tradition in open innovation; and
- In cooperation with the Belarusian Fund for Financial Support of Entrepreneurs, launch programmes and supporting schemes to nurture competitive supplier firms around leading innovative companies.

2.6 SCST in cooperation with the Ministry of Antimonopoly Regulation and Commerce should set up a system of measures to strengthen innovation-related competition and spur bottom-up entrepreneurial initiatives:

- Consider possibly aligning competitive calls with the Law on public procurement;
- Define stimulating regulatory incentives for the participation of foreign applicants of a desired type (e.g. linked to global technological value chains) in some of the open competitive calls for innovation and R&D projects; and
- Define the significant increase of innovative entrepreneurship (in particular, private individual innovative entrepreneurs and SMEs) as a strategic objective of innovation policy and set concrete targets to this effect. Introduce policy instruments to pursue this objective in line with Recommendations 2.3 and 2.5, in particular, for the support of

[92] These include the following tax waivers for technoparks: exemption from income tax in respect of incomes derived from providing the residents with buildings and isolated premises; exemption from land tax when renting buildings (structures) to residents of technoparks; release of technoparks, technology transfer centres and technopark residents from taxes and fees to local budgets; waivers from income tax for residents that implement innovation projects in line with the requirements of the Decree of the President of Belarus No357 in respect of profits derived from the sale of own goods (works, services) produced in the technopark from the date of registration and for the next five calendar years; release of value-added and customs taxation on goods (manufacturing equipment, equipment, tools, accessories and spare parts, raw materials) imported into the territory of Belarus to be used exclusively in its territory for the needs of a technopark or implementing R&D activities in a technopark, including construction and equipping the technopark facilities, from import customs duties (in accordance with international obligations of the Republic of Belarus); resumption of benefits for business entities that are residents of technoparks at the rate of tax under the simplified system of taxation; securing possibilities for technoparks to implement flexible rental policy, taking into account the degree of development of residents (phase of the innovation project) and the need to attract suppliers.

technology-based start-ups and spin-offs. Set up a system of monitoring the development of innovative entrepreneurship and the degree of achievement of targets.

2.7 The system of R&D and innovation funding has been conceptually improved since the first Innovation Performance Review. However, most financial mechanisms are not yet fully implemented. With a view to the further improvement of innovation financing, the following measures are recommended:

- The new schemes conceptualized by the Belarusian Innovation Fund (BIF), like the support of early-stage or the initial R&D phase, vouchers and grants as well as venture funding should be implemented, particularly against the background that the BIF has already fulfilled most of the preparatory steps;
- In general, the shift from financing low-risk (infrastructure) projects to (early-stage) high-risk projects should be consequently followed;
- The establishment of foreign partnerships within the context of venture financing is welcome and should be further implemented by BIF; in addition, it is recommended to seek ways to actively attract further foreign investors or set-up respective partnerships - be it formal venture capital companies or business angels; and
- The "good practice" example of the incubator established at the Hi-Tech Park, especially regarding the financing mechanisms of new ventures, should be extended to scientific-technological parks and other industries/areas of technology.

2.8 The Development Bank has recently been founded as a measure to bolster the financial/banking sector in Belarus and to provide complementary innovation and SME-related financing products. It is recommended that innovation-related loans by the new Development Bank, particularly regarding the financing of SMEs and start-ups, should be intensified.

2.9 For a small economy like Belarus, the opening to foreign direct investments and good framework conditions for cross-border technology transfer (incl. sub-contracting within global value chains), are essential for increasing the innovative and technological level and ultimately national competitiveness. To improve both the innovation potential inherent to foreign direct inflows and cross-border technology transfer, the following is recommended:

- Evaluate the mechanisms of the National Agency of Investment and Privatization concerning innovation-related and technological issues or science-intensive investments;
- Take necessary steps or instruments to improve international co-operation in technology-transfer activities, including the network approach of the Republican Center for Technology Transfer, the members of foreign networks of Technology Centers and the institutions responsible for participation in EU projects; and
- Identify "good practice" examples with a view to a successful participation of Belarusian companies in global value chains or regarding the establishment of strategic partnerships with foreign technology-oriented companies and identify the critical factors and implications for already implemented measures.

Chapter 3

MEASURING INNOVATION PERFORMANCE

This chapter explores the position of Belarus in different international rankings from the perspective of the country's potential for technology upgrading and economic growth. Belarus is a European country with an economy in transition which has managed to preserve its inherited manufacturing capabilities to a significant extent. It is an economy that has an educated population but is not rich in natural resources. Despite its close proximity to the EU, it is not, unlike its neighbouring Central European and Baltic economies, integrated into European industrial networks.

Belarus policy makers are very keen to benchmark the economy internationally. This is to be commended for two reasons. First, benchmarking is a critical mechanism of transnational learning, i.e. it is a good way to learn from other economies which for Belarus represent models to follow. Second, international benchmarking is an accepted way to raise the attention of the international community and of investors to economic opportunities in the country and the progress it has made.

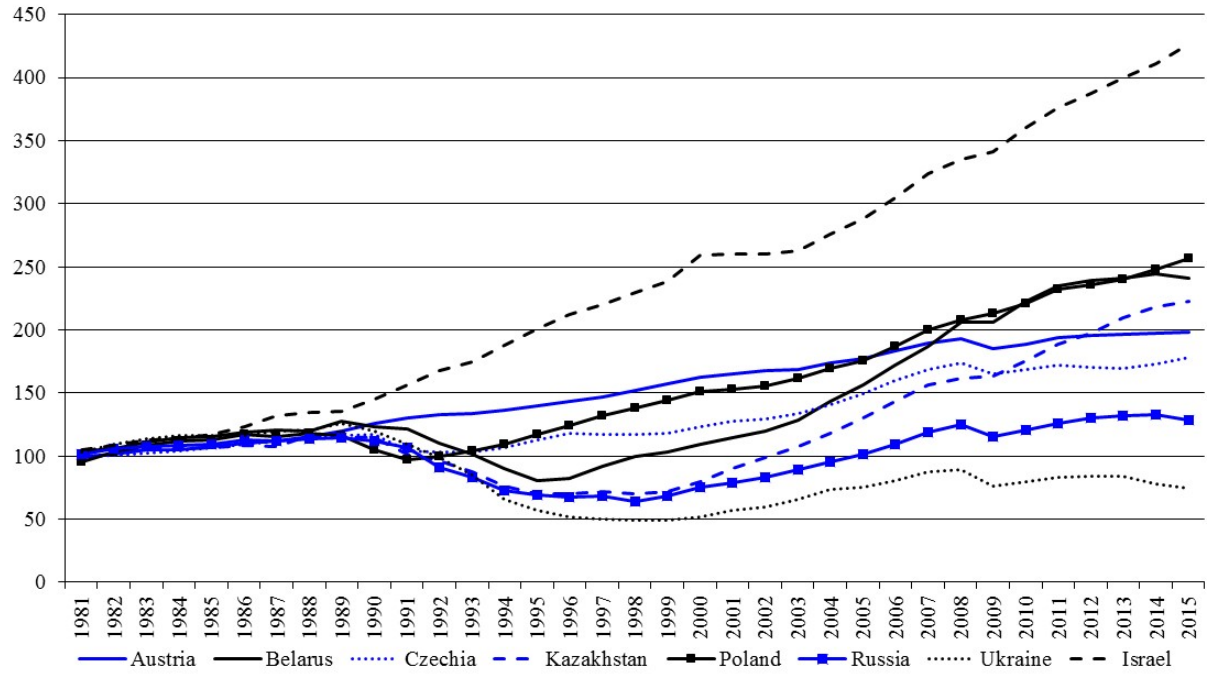
The second section of this chapter looks at major determinants of productivity in a comparative perspective. We compare Belarus to Russia, Kazakhstan and Ukraine as peers by geographical and institutional proximity due to their recent history of economies in transition with development paths characterized by homegrown modernization. Poland, the Czech Republic, Israel and Austria are highly integrated into regional and global value chains. Poland and Czechia are included as former centrally-planned economies that have successfully completed the transition process largely thanks to their accession to the European Union. Israel and Austria are used as aspiration peers. Israel reflects well the case of growth based on the development of high technology, a path that Belarus aims to pursue. On the other hand, Austria represents an alternative model of a successful high income economy based on medium technologies, an option which seems to reflect some of the Belarusian potential as well.

The following two sections provide an assessment of Belarus' performance in several global indices and on selected STI indicators that are relevant for technology upgrading. A section identifying strength and weaknesses in the innovation performance of Belarus follows, building on the key findings of the comparative analysis. The final section looks at changes in the methodology for the collection of innovation-related statistics by the National Statistical Committee of Belarus since 2010.

3.1 Trends in productivity and economic growth

Figure 7 shows annual GDP growth rates in the long-term which suggest that regarding economic dynamics, Belarus has outperformed Czechia, Russia and Ukraine. Its performance compared to Kazakhstan is also significant given that Belarus does not have comparable natural resources. The economy that clearly stands as the best performer in this group is Israel whose long-term rate of GDP growth was 4.2 per cent compared to the Belarusian 2.6 per cent annual rate in the 1981-2015 period.

Figure 7. Growth of GDP 1981-2015 (based on 2014 price level with updated 2011 PPPs)

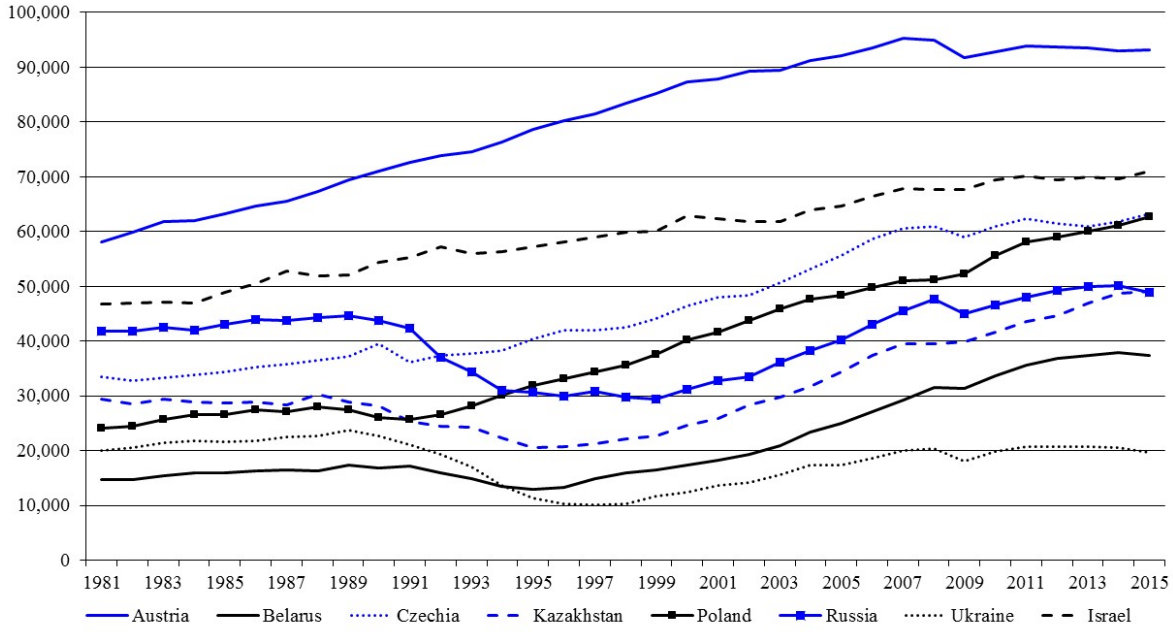


Source: Based on The Conference Board. 2015. The Conference Board Total Economy Database, September 2015, http://www.conference-board.org/data/economydatabase/
Note: 1980 = 100

When compared to 1981, the country's GDP increased by 2.4 times in 2015. However, the growth of Belarus has significantly slowed since 2010, and it is not clear that the economy will be able to repeat previous growth rates. This trend may be strongly impacted by the overall slowdown in the EU and Russian Federation, which have affected Belarus as well. The growth determinants of the Belarusian economy in the future remain uncertain.

The growth of productivity is one of the best proxies for the quality of growth of the economy and can be an indicator of its sustainability over time. Figure 8 depicts trends in labour productivity over the 1981-2015 period. When compared to the socialist period, Belarus has managed to reduce the productivity gap compared to Ukraine, but this is still well behind Polish or Czech levels. In 2015, Belarusian GDP per employee was US$37,000compared to US$63,000 and US$62,000 for Czechia and Poland, respectively.

Figure 8. Trends in labour productivity per person employed, 1981-2015, in 2014 US$ (converted to 2014 prices with updated 2011 PPPs)

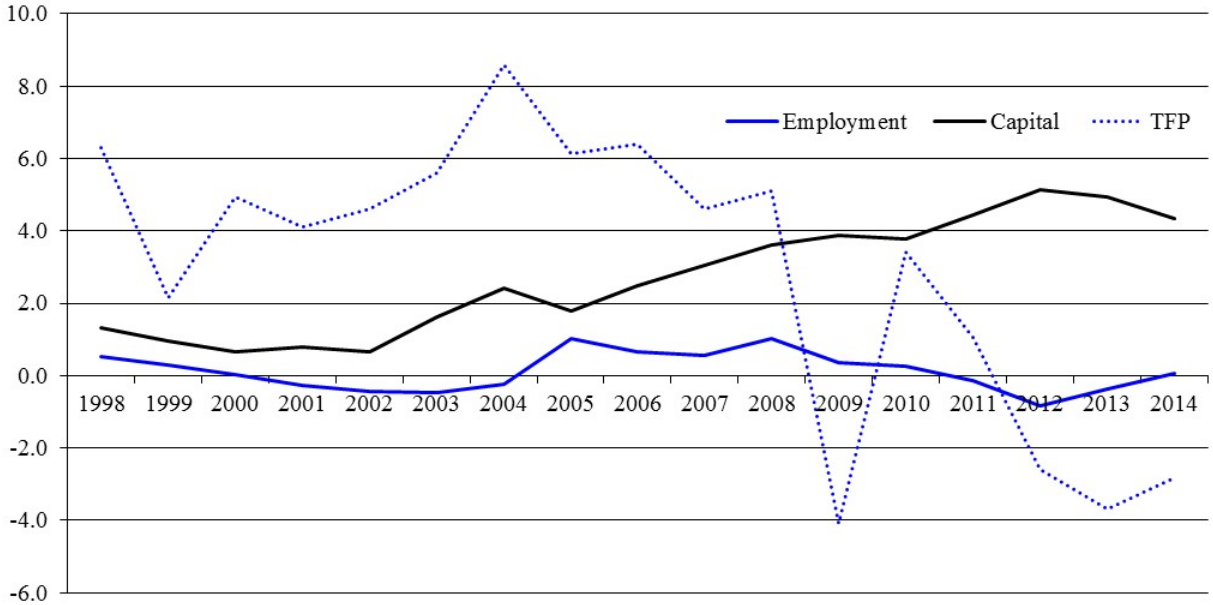


Source: Based on The Conference Board. 2015. The Conference Board Total Economy Database, September 2015, http://www.conference-board.org/data/economydatabase/

After the initial transition crisis (from 1996 onwards), the rates of growth of labour productivity of Belarus as well as other CIS economies were quite impressive until 2010. However, the recent period shows a slowdown in labour productivity growth in all CIS countries except Kazakhstan.

Figure 9 reveals that growth in Belarus during the late 1990s and early 2000s has been driven by so-called Total Factor Productivity growth, i.e. improved efficiency in the use of capital and labour - enabled by organizational changes, technology upgrading and other innovations. The rate of TFP growth has slowed since about 2010. This suggests that renewed efforts to stimulate innovation are necessary to sustain economic growth.

Figure 9. Contributions of employment, capital accumulation and TFP growth to GDP growth, 1998-2014



* TFP (Total Factor Productivity) growth is the component of GDP growth that is not accounted for by capital accumulation and employment growth. It reflects improvements in the efficiency of resource use, including through innovation.
Source: Based on The Conference Board. 2015. The Conference Board Total Economy Database™, September 2015, http://www.conference-board.org/data/economydatabase/

In the majority of the European ex-socialist economies, the transition process has been characterized by de-industrialization. Belarus is unique in that it has not de-industrialized to the same extent (the share of industry is still above 40 per cent of GDP). This is quite important as industry is still the main focus of R&D and innovation activities. However, although the level of productivity in Belarusian manufacturing is above CIS economies, it is five times lower than Austria, 2.5 times lower than in Czechia and two times lower than in Israel. It is interesting that Israel, despite being a successful high-tech economy, has not spread its technological achievements into the rest of manufacturing to the same extent (Table 12). This is a very important lesson for Belarus, which has an aspiration to become a high-tech economy focused on ICT.

Table 12. Average rate of change of manufacturing value added per capita

	1990-95	1996-200	2001-2005	2006-2010	2011-2012	1990-2012
Austria	0.82	0.04	0.93	2.46	-0.42	1.92
Belarus	-7.61	3.33	10.20	13.03	1.57	4.76
Czechia	-2.62	8.89	5.76	8.60	-0.99	3.02
Israel	-0.02	3.65	0.90	2.07	0.02	0.86
Kazakhstan	-4.71	3.34	6.09	7.52	1.65	2.85
Poland	13.01	4.62	5.61	8.82	1.42	8.99
Russia	-10.08	6.29	5.53	6.93	1.98	-0.14
Ukraine	-16.33	3.65	9.42	11.52	1.12	-0.66

Source: UNIDO Industrial Performance Index database

Although Belarusian performance has been above other CIS economies, Belarus has faced dwindling export opportunities in the period post-2008. Overall, the performance of Belarus has been satisfactory regarding growth and productivity. However, its future growth - based on productivity and innovation - is uncertain. Its preserved industrial capacity needs rejuvenation given that increased service and knowledge content together with automation are changing the nature of the industry.

3.2 Benchmarking of Belarus' NIS

As mentioned above, improved international ranking is an explicit policy aim of the Belarus authorities. The NSSID-2030 has targeted reaching improved positions in several indexes and ratings until 2030. Specifically, the following targets are proposed to be achieved: top 40 countries in HDI; top 30 in Doing Business index; top 30 in ICT index. Also, in 2011, the Council of Ministers established a target to enter by 2015 into the top 30 countries of the Global Competitiveness Index (GCI); the top 50 countries of the Index of Human Development; and the top 70 countries of the Economic Freedom Index.

A motivation behind the policy target to improve the country's ranking on a specific index represent a genuine wish to improve performance by taking easily understood benchmarks. Also, benchmarking is useful for policy purposes as it provides an international perspective on the position of the country. If used in a smart way it can provide a critical and unbiased view of a country's strengths and weaknesses. However, comparisons at face value or without understanding of the underlying conceptual approach and country differences in terms of levels of income and institutional differences may lead to misleading or irrelevant policy conclusions.

Firstly, indicators are always only proxies of the real processes, strengths and weaknesses. They are approximations of underlying categories and thus cannot always be used as direct policy targets. For example, increasing R&D in the context of limited local demand may lead to R&D capacities for which there is no real demand. Also, composite indicators and international rankings tend to homogenise and standardize drivers of growth which are very much country-, technology- and income-level specific. For example, innovation rankings ignore far too much non-R&D and non-innovation drivers of productivity and growth which are paramount for middle-income economies. Drivers of growth are changing over time as an economy grows; and where countries stand in that respect should be recognized when interpreting indicators.

In a nutshell, if taken critically, the positioning on international indexes for the purpose of benchmarking may be useful, especially for a country like Belarus, which is not fully represented in various international benchmarks. Table 13 below shows the international rankings in which Belarus is present and where it is missing.

Table 13. Belarus in various international rankings

Ranking	Belarus is ranked?
Human Development Index	Yes
Global Innovation Index	Yes
Index of Economic Complexity	Yes
UNIDO Index of Industrial Competitiveness	Yes
THE (Times Higher Education) ranking of universities	Yes
WIPO rankings	Yes
E-Government Index	Yes
ICT Index	Yes
Doing Business of the World Bank	Yes
Innovation Union Scoreboard	No
WEF Global Competitiveness Report	No
Global Entrepreneurship Monitor	No
Academic Ranking of World Universities (Shanghai)	No
Bloomberg's Global Innovation Index	No

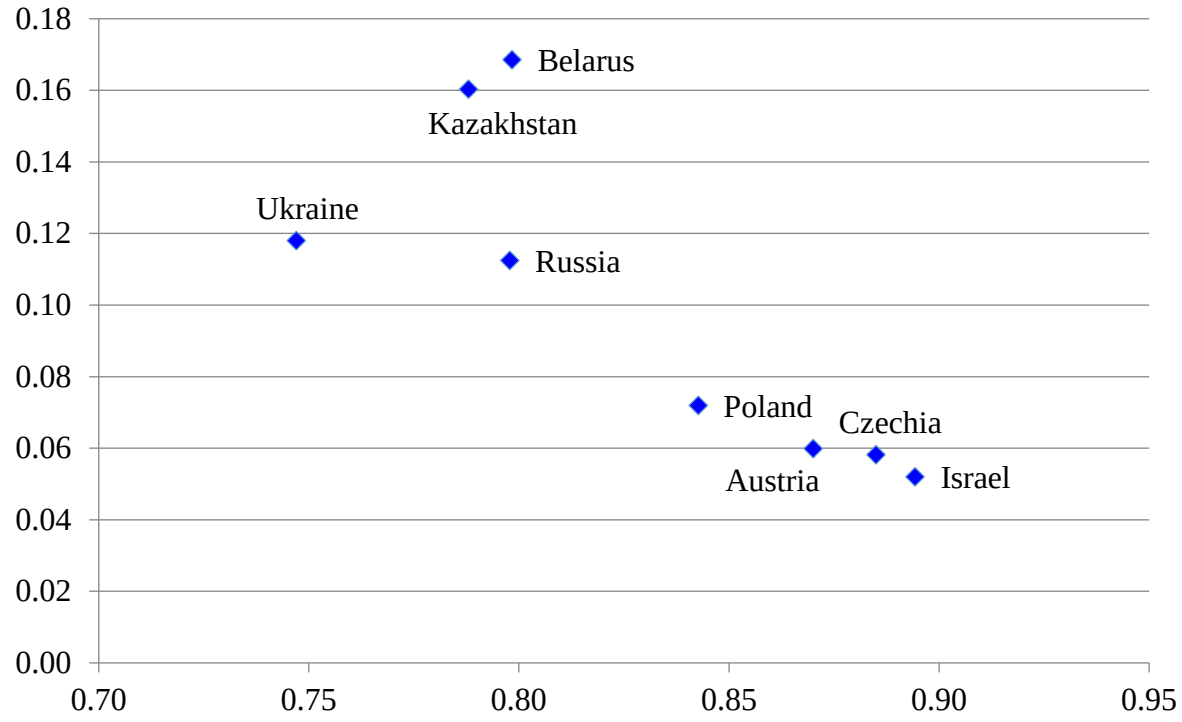
With these caveats, it is useful to provide an assessment of the Belarus position in certain rankings that could enlighten some of the existing challenges affecting the country's NIS. The analysis that follows addresses the most relevant policy issues that arise from the different rankings, with a focus on the innovation capacity of Belarus. Belarusian Institute BelISA has been producing annually very thorough and valuable analyses of the positioning of Belarus in international rankings (see 2015 report BELISA «Межстрановая оценка состояния научно-технической и инновационной сферы Республики Беларусь на основе анализа международных статистических данных и рейтингов и предложения по улучшению позиций Республики Беларусь в этих рейтингах»). This section does not intend to repeat this type of analysis, but rather to shed a new light in view of available evidence.

Human development

The UNDP Human Development Index (HDI) is considered as a better proxy of societal welfare than GDP, which accounts for economic well-being but does not consider a long and healthy life as well as the knowledge-level of population. HDI takes into account GNI per capita but also takes into account life expectancy at birth and education level of population by measuring mean years of schooling and expected years of schooling. So, even if the HDI index does not account for inequalities, poverty, human security, and empowerment it does constitute a rich measure of levels of development.

One of the major contributors to the 53rd place of Belarus on HDI rankings is the high education indicators regarding current and expected years of schooling, which are disproportionally high when compared to income level. Provided that other preconditions are also in place, substantial investments in education represent a sound basis for improving the Belarusian knowledge-based economy. However, education requires complementary inputs and factors as learning also takes place on the job, not only in the classroom. So, for increased productivity, workplace training is also important. The challenge is to integrate education into an effective national system of innovation through close links between educational and productive systems at all levels.

Figure 10. Level of human development (x-axis) and change over 2000-2014 (y-axis)



Source: UNDP HDI database

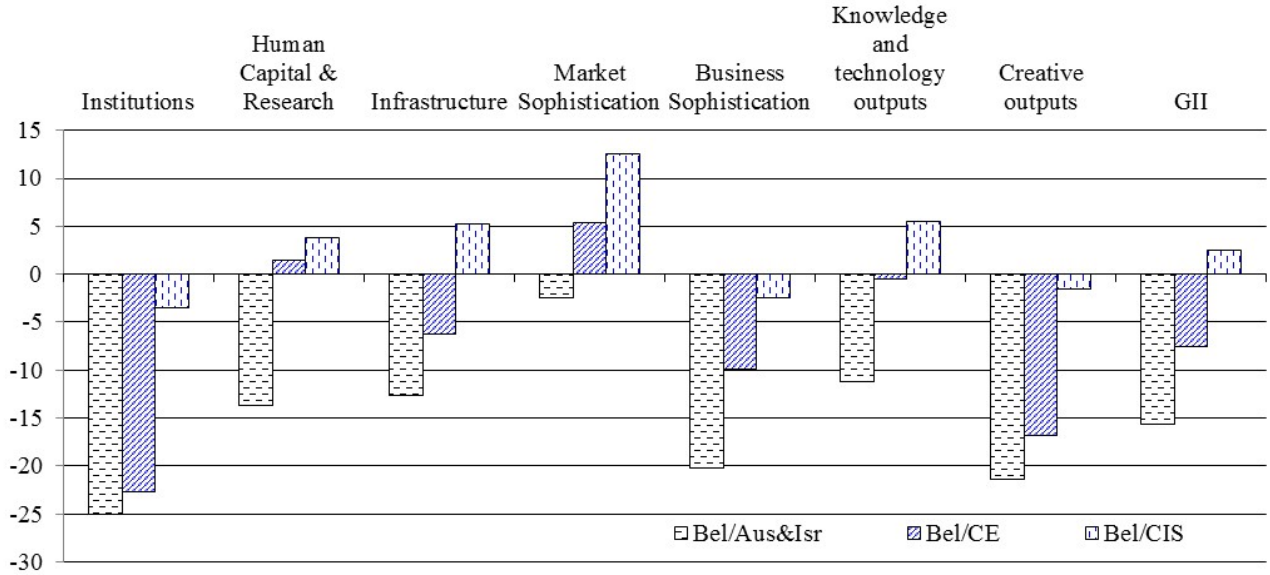
Global Innovation Index

The Global Innovation Index (GII) is a comprehensive statistical framework which gathers data from more than 30 sources, covering a vast spectrum of innovation drivers. Its conceptual framework stands on eight pillars, which include inputs (institutions, human capital and research, infrastructure, market sophistication, business sophistication) and outputs (knowledge and technology outputs and creative outputs).[93]

Figure 11 compares Belarus in different dimensions of the Global Innovation Index (GII) to its three types of peer economies: high income aspiration peers (Austria and Israel), two ex-transition economies of Central Europe (CE) (Poland, Czechia), and three CIS peer economies (Russia, Ukraine and Kazakhstan).

[93] Its conceptual framework stands on eight pillars which include inputs (institutions, human capital and research, infrastructure, market sophistication, business sophistication), and outputs (knowledge and technology outputs and creative outputs). However, cause and effect remain unclear. Business sophistication is as much output as input. Also, its innovation outputs are much more representative of the world frontier economies and regions rather than a reflection of growth drivers of middle- and upper-middle income economies. Still, its impressive coverage of the range of innovation activities makes it a relevant benchmark for Belarus.

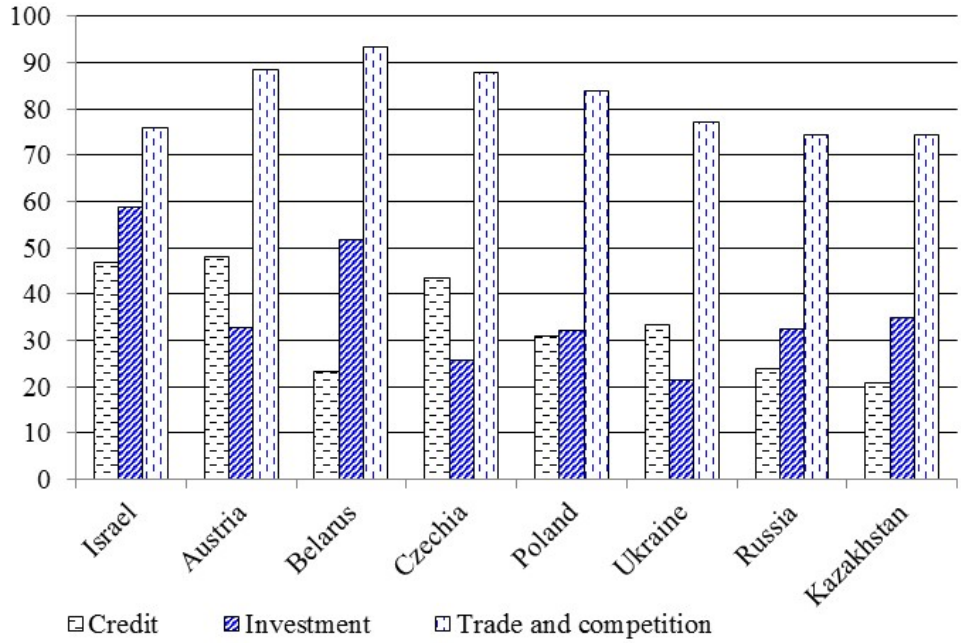
Figure 11. Relative position of Belarus in Global Innovation Index 2015 in relation to three peer groups: aspiration peers, central Europe, and CIS (expressed in GII scores)



Source: Global Innovation Index 2015

The main gaps between Belarus and high-income peers (Austria/Israel) are substantial in all dimensions except for a much smaller gap regarding market sophistication, which includes proxies for credit, investments and trade/competition conditions. When compared to high-income peers Belarus has disproportionally worse credit constraints, as opposed to very favourable trade and competition conditions. Figure 12 breaks down the relative position regarding three dimensions of market sophistication: credit, investment, and trade/competition. When compared to high-income peers, Belarus has disproportionally worse credit constraints than when compared to very favourable trade and competition conditions. Its credit constraints (i.e. ease of getting credit, domestic credit to private sector, microfinance gross loan portfolio as percentage of GDP) are similar to its CIS peers. Also, Belarus firms enjoy better investment conditions than their CIS/CE peers (i.e. ease of protecting investors, the market capitalization of listed companies, stock traded as percentage of GDP, venture capital per GDP) and also slightly better trade and competition conditions (tariff rates, the intensity of local competition) than their CIS peers.

Figure 12. Relative position of Belarus and peer countries on various dimensions of market sophistication (based on GII scores)

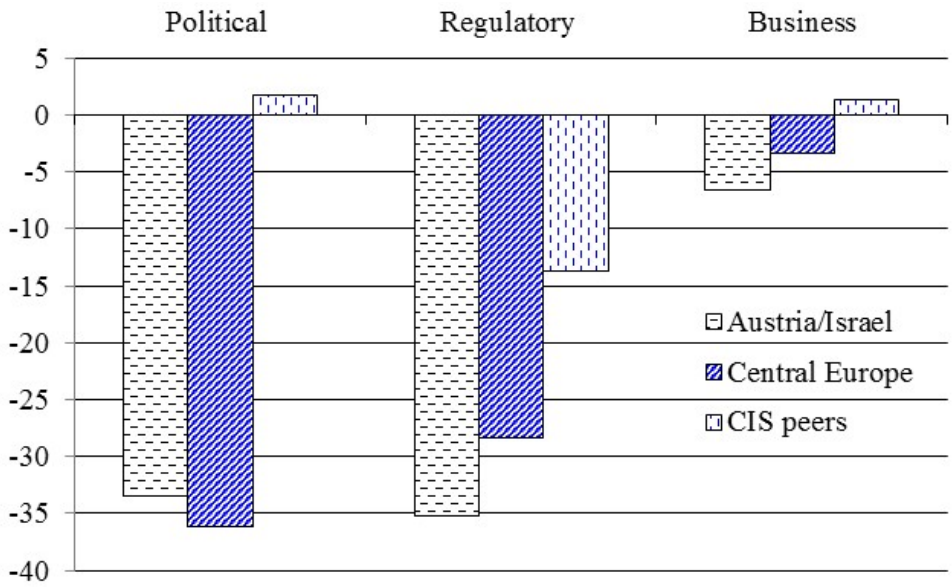


Source: Global Innovation Index 2015

However, the innovation capacity is driven not only by the quality of markets but also by the quality of institutions, infrastructure, human capital and business. When compared to two Central European (CE) peers Belarusian firms face much stronger constraints regarding institutions and business sophistication. This latter dimension includes knowledge intensity of the economy, innovation linkages and knowledge-absorption proxies. So, despite better position regarding human capital, Belarusian firms face other constraints which may affect their innovation capacity.

The biggest gap between Belarus and its high income and Central European peers is in terms of institutions. This factor is in GII decomposed on three dimensions: political, regulatory and business environment (Figure 13).

Figure 13. Relative position of Belarus in relation to three peer groups on institutional metrics (+/- denotes gaps in terms of GII scores)



Source: Global Innovation Index 2015

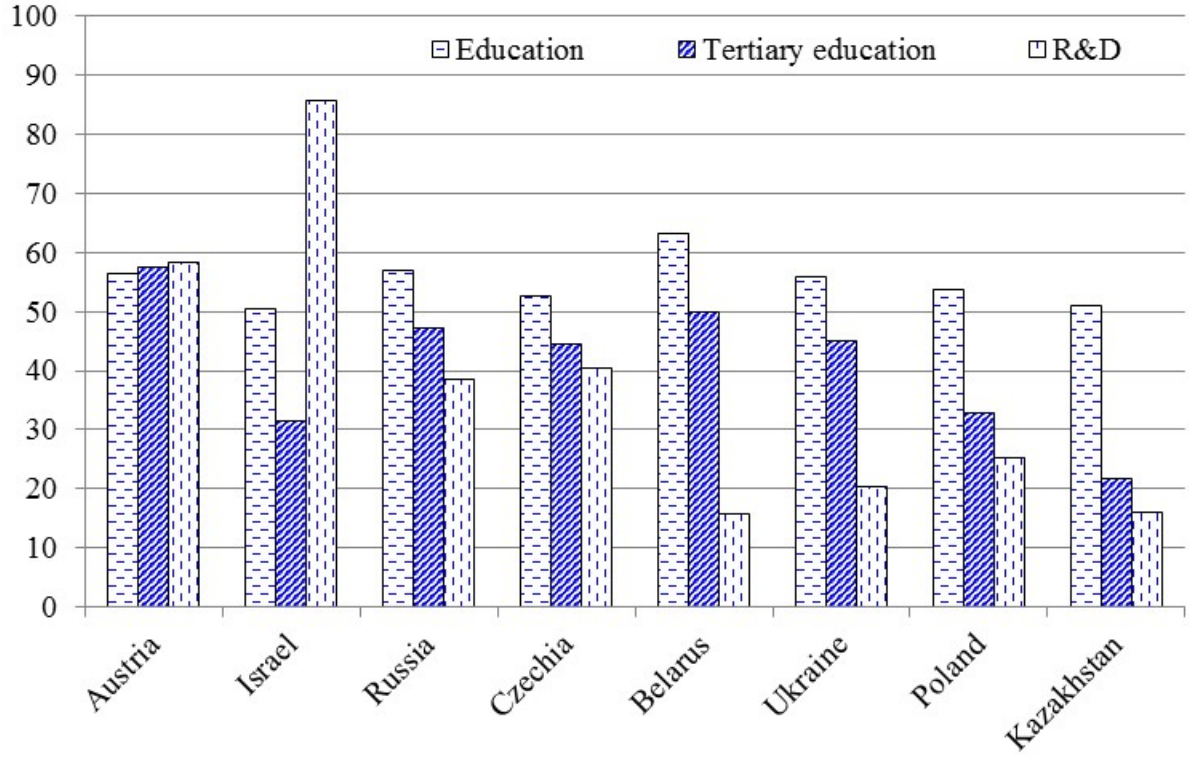
Belarusian business faces constraints (e.g. ease of starting business, of resolving insolvency and of paying taxes), that are not so dissimilar from those in other peer economies. So the real differences in terms of institutions are mostly confined to differences in the political and regulatory environment (e.g. stability, government effectiveness, regulatory quality, rule of law and costs of redundancy/dismissal).

Belarus also ranks very high regarding human capital and research factors. However, this aggregate hides excellent scores in terms of education (education expenditure, government expenditure per pupil, school life expectancy,[94] PISA results, pupil-teacher ratio in secondary education) and tertiary education (tertiary enrolment, graduates in Science and Engineering, tertiary inbound mobility)[95] and a lower position in relation to all peers in terms of R&D (Researchers, GERD, QS university ranking of top three universities) (Figure 14). This gap between a high ranking regarding education and low R&D capacity is a very important structural feature of Belarus, which has a strong impact on the level and nature of innovation capabilities.

[94] Total number of years of schooling that a child of a certain age can expect to receive in the future, assuming that the probability of his or her being enrolled in school at any particular age is equal to the current enrolment ratio for that age Source: UNESCO/GII

[95] The number of students from abroad studying in a given country, as a percentage of the total tertiary enrolment in that country. Source: UNESCO/GII

Figure 14. Relative position of Belarus in relation to peer economies on GII human capital and research dimensions



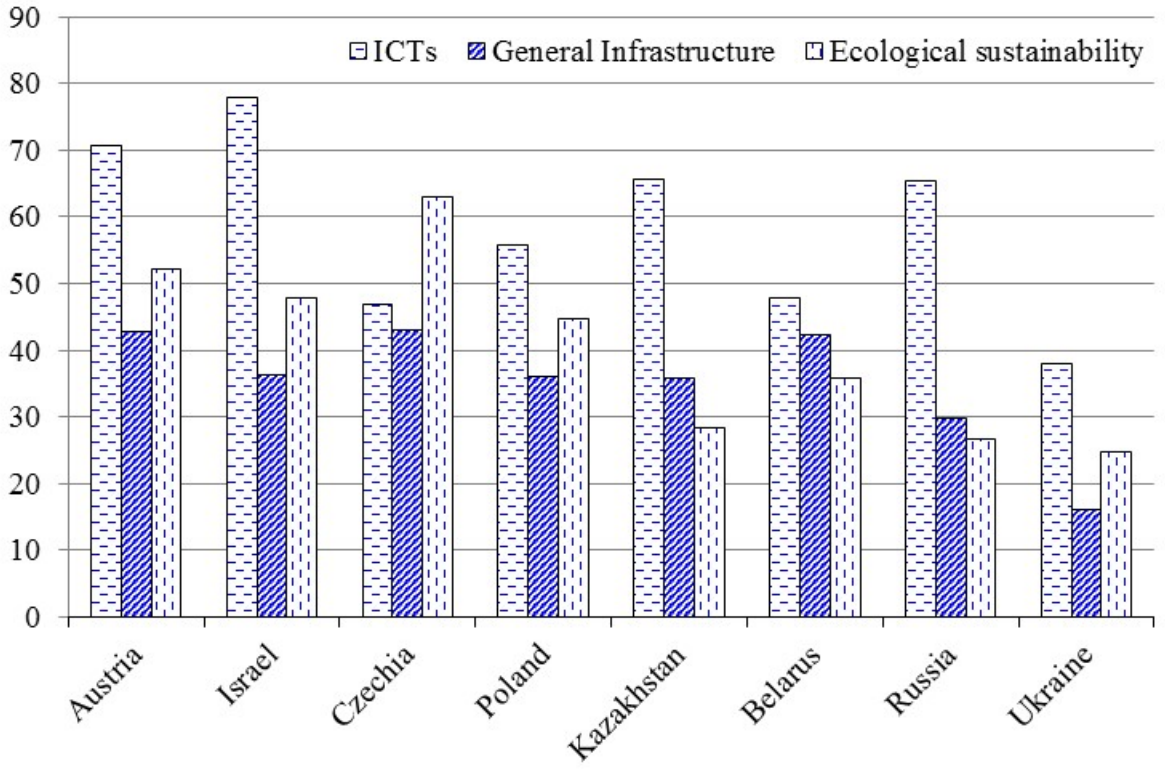
Source: Global Innovation Index 2015
Relative positions measured as ratios between Belarus' GII score and comparator country.

Innovation is a collective activity of many actors in the National Innovation System interacting with global and regional value chain actors engaged in production and innovation networks. In their innovation activities, local innovation actors are reliant on 'industrial commons' or infrastructure and public or public-private institutions that provide complementary inputs like R&D support, testing and measuring services, export promotion, venture capital, public goods like physical, ICT and software infrastructure ('infostructure'). The technological upgrading towards knowledge-based activities and high-productivity industry based on IT skills depends much more on ICT infrastructure than on physical infrastructure alone. GII data show that Belarusian general infrastructure[96] is much better when compared to its ICT infrastructure.

In fact, when compared to human capital indicators, its ICT is lagging behind despite the emerging islands of growth around software industry. This is quite important as it shows that the Belarus software industry may be constrained in its future growth by poor local ICT environment infrastructure (which in GII framework is measured by ICT access, ICT use, the government's online services, and online e-participation). Finally, resource efficiency and ecological sustainability are not only public goods but also a complement to knowledge-based growth. In that respect, Belarus is lagging behind advanced economies and is just slightly ahead of its three CIS peers.[97]

[96] General infrastructure is measured as composite of electricity output per capita, logistics performance and gross capital formation.
[97] Ecological sustainability is measured as composite of GDP per energy use, the Yale University environmental performance index, and ISO environment certificates.

Figure 15. Relative position of Belarus in relation to peer economies in terms of GII infrastructure dimensions



Source: Global Innovation Index 2015

Relative positions measured as ratios between Belarus' GII score and comparator country.

As a result, the innovation outcome is very similar to CE peers regarding knowledge and technology outputs (knowledge creation, impact and diffusion) but there is a much bigger lag regarding creative outputs (intangible assets, creative goods and services, online creativity). This latter can be already explained by the ICT challenges indicated above. The gap in creative outputs is even more striking given that Belarus fares better than its CE peers regarding human capital and market sophistication.

In conclusion, Belarus is the most similar to its three CIS peers where it scores very similarly regarding institutions, business sophistication, and creative outputs and is ahead of them regarding human capital, infrastructure, market sophistication, and knowledge and technology outputs. Overall, this results in a slightly better score of the country on the GII Index when compared to its CIS peers.

Innovation Union Scoreboard (IUS)

Another ranking, the EU Innovation Scoreboard (IUS), has become a dominant metric for measuring the progress of EU economies regarding their innovation performance. Its longevity, comparability, and comprehensive coverage have made it a standard composite indicator within the EU - with its coverage spreading to other economies. However, we should not forget its limits which are largely in its strong focus on R&D-based growth and neglect of other innovation modes which are based on production practices, users' involvement and engineering.[98]

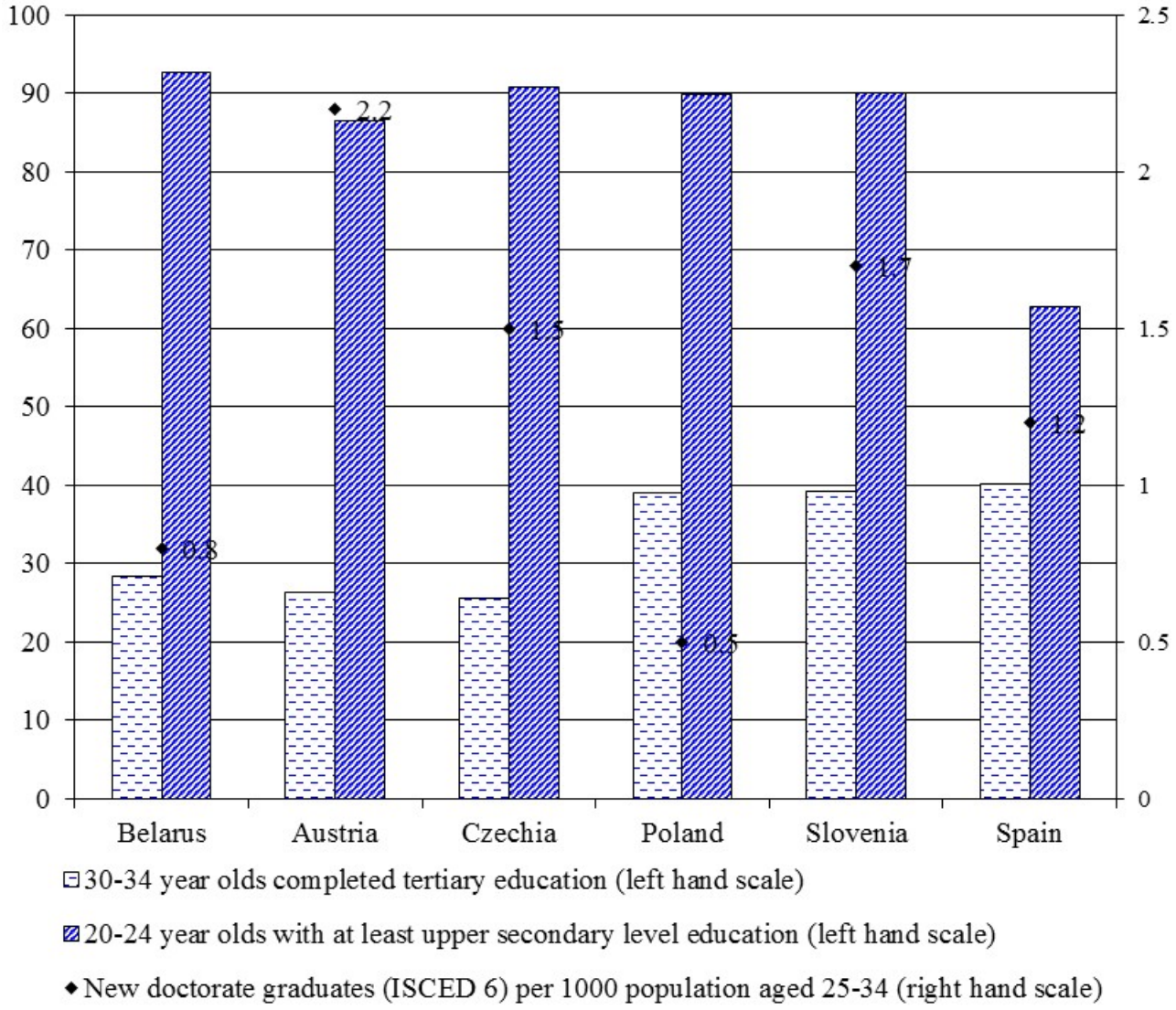
Belarus is not monitored through IUS. However, Belstat has produced 16 IUS indicators based on which Belarus can be compared to the EU. This leaves nine indicators that are not yet available for full comparisons. However, even this partial comparative picture based on 16 indicators offers highly policy-relevant insights.

The IUS considers human resources as one of the key enablers of innovation, and in that respect Belarus shows an uneven picture compared to selected EU countries (Figure 16).[99] Belarus scores better than the comparison countries regarding secondary education in the 20-24 years age group. It scores less well in tertiary education in the 30-34 age bracket and in new doctorates in the 25-34 years age group. These findings suggest that the young generation in Belarus is relatively well endowed with general skills, but much less so regarding R&D competencies.

[98] On the other hand, IUS does involve non-R&D activities data as much as they are available from the EU innovation surveys. It is important to recognize that growth is a much broader phenomenon, and the IUS is capturing very well its R&D-based component. In that respect, its usefulness is relatively smaller for less developed EU economies or middle-income economies when compared to those whose firms operate at the technology frontier.

[99] Other EU countries were selected for comparison due to lack of available data for other comparators.

Figure 16. Relative position of Belarus compared to EU peer economies regarding IUS human resource indicators



Source: Belstat

Regarding the percentage labour force with tertiary education across all age groups, Belarus scores below Russia, Ukraine, and Israel, and is on par with Kazakhstan and Poland, but above Austria and Czechia (Table 14).

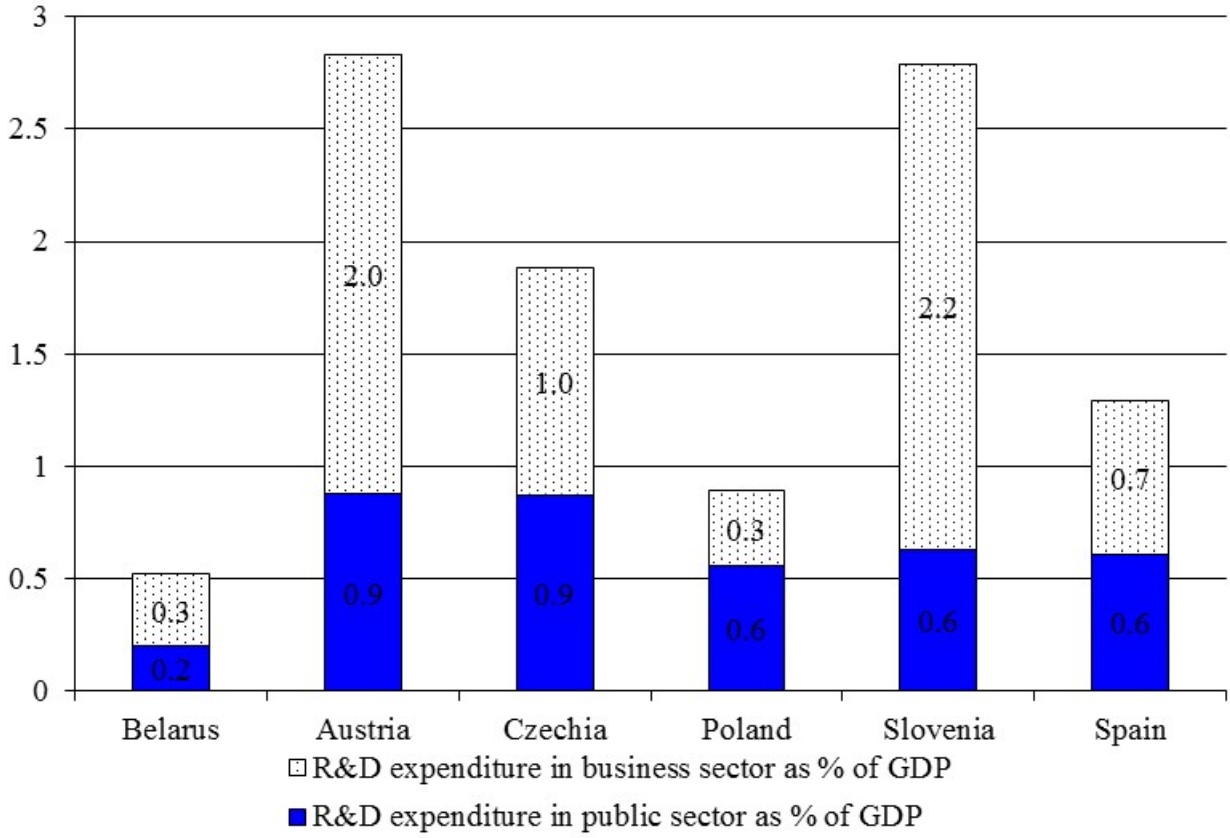
Table 14. Share of labour force with tertiary education (per cent)

	2009
Russia	53.6
Ukraine (2014)	45.8
Israel (2008)	45.1
Kazakhstan	24.9
Poland	24.5
Belarus	24.3
Austria	18.9
Czechia	16.4

Source: World Bank Development Indicators 2016

GII indicators (Figure 10) showed that Belarus scores low regarding investments in R&D. A comparison with its EU peers further confirms low investments in R&D by business and by public sector even when we take into account differences in income levels (Figure 17).

Figure 17. R&D expenditures in Belarus and the EU peer economies

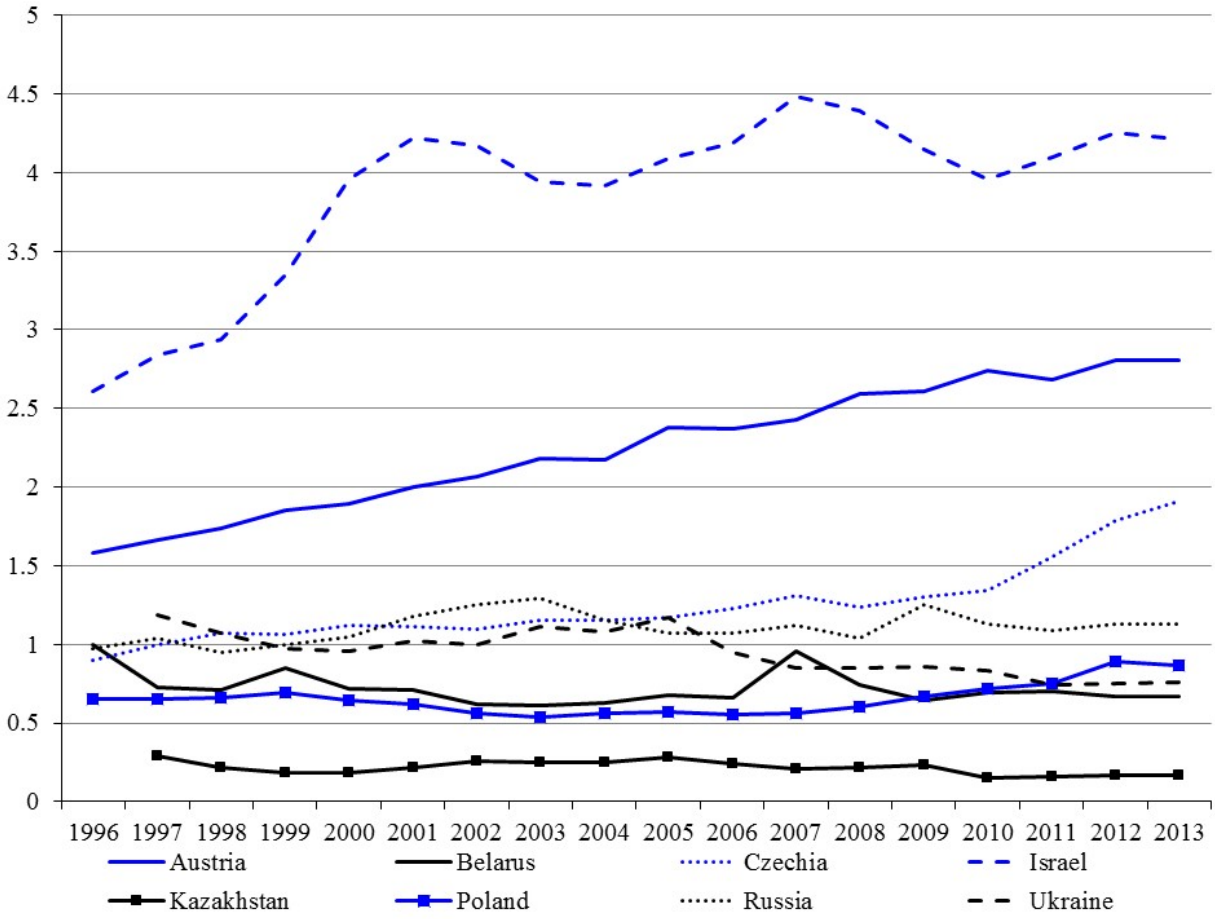


Source: Science and innovation activity in the Republic of Belarus, 2015, Statistical book, National Statistical Committee of the Republic of Belarus, Minsk 2015

Also, GERD has not been increasing but has remained at the level of around 0.7 per cent of GDP for the last 20 years (Figure 18). This reflects a deficit towards the greater role of R&D in innovation and absorption of foreign knowledge. The forecasted gradual increases contained

in SPID and NSSED in both the short- and medium-term should, if adequately implemented, contribute to improve this situation.

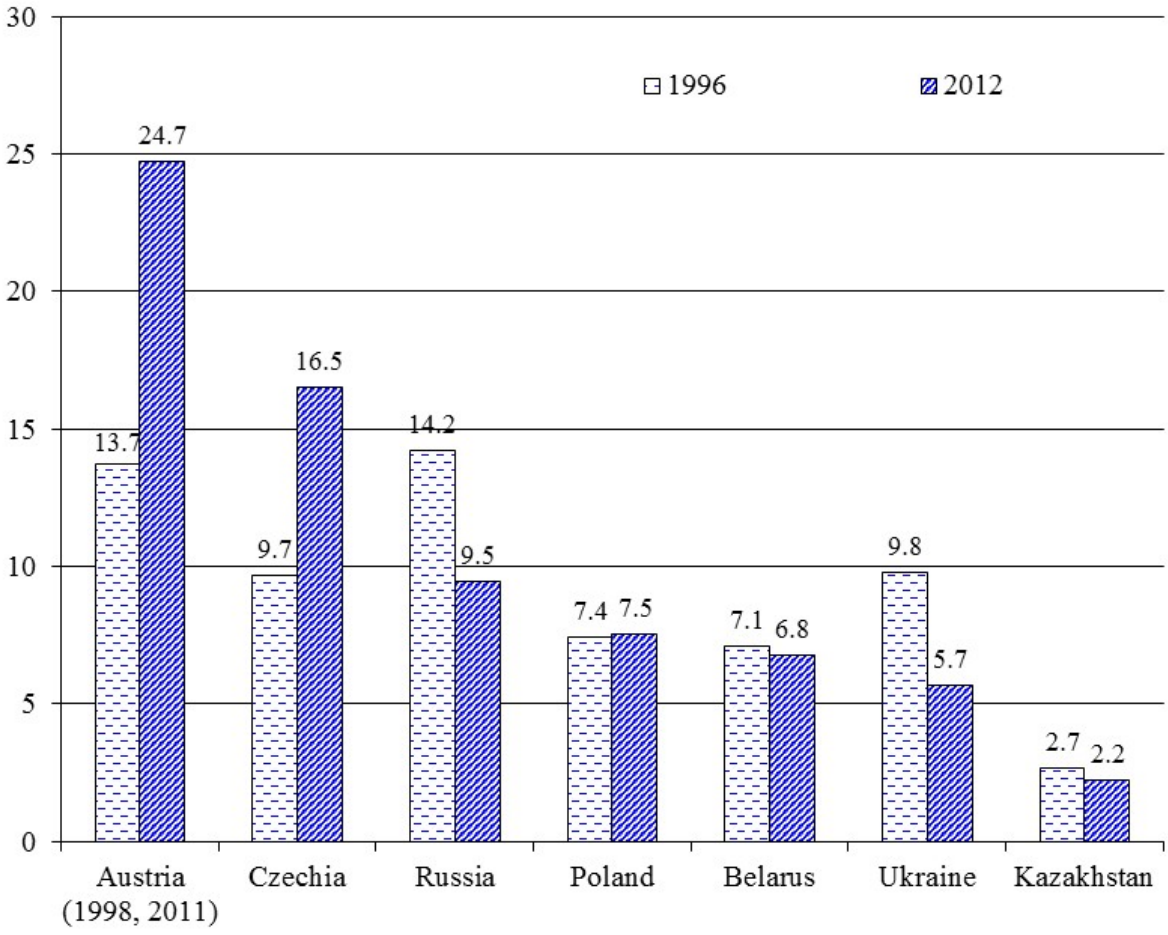
Figure 18. GERD as a share of GDP, per cent



Source: UNESCO S&T statistics database

Unlike Russia and Ukraine, which had to downsize their R&D activities radically during the transition period, the shock of the 1990s was less intense in Belarus regarding R&D. For instance, the share of R&D personnel in the labour force has remained at 7 per cent, similar to Poland (Figure 19). This leaves Belarus with an R&D sector that seems far too small in size if it is to grow based on R&D and technological capability.

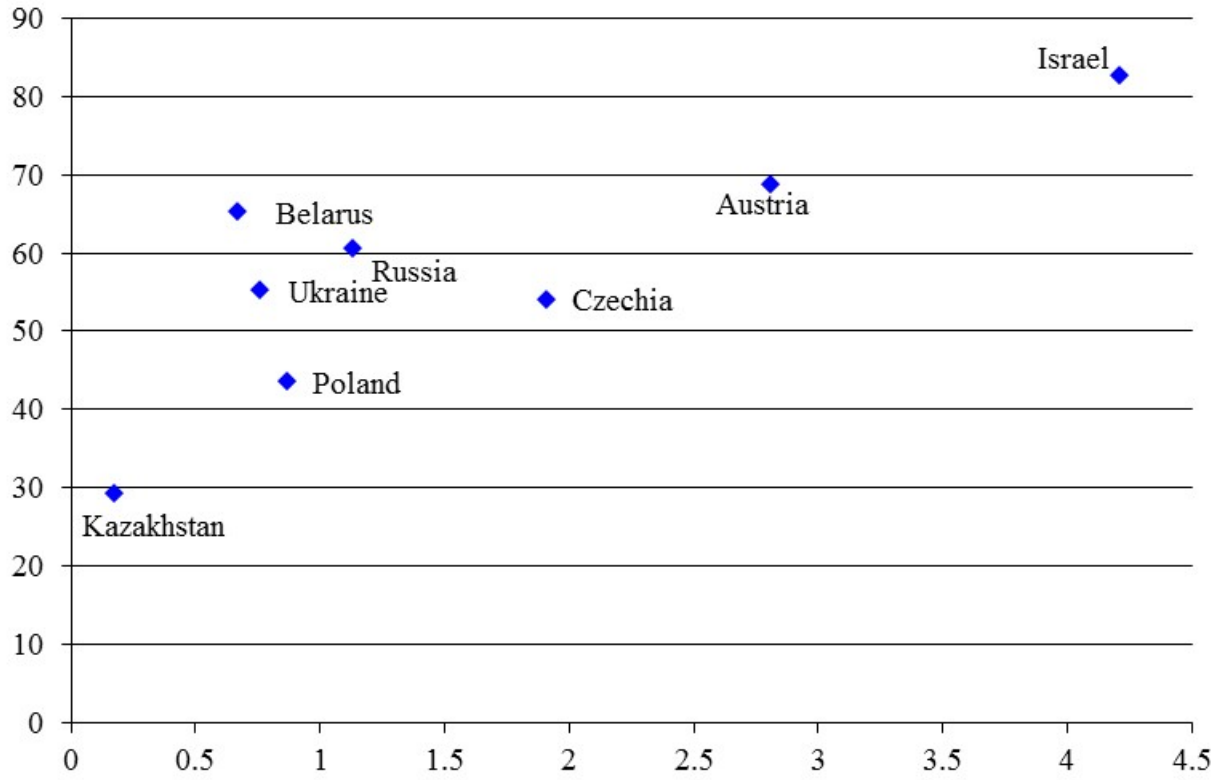
Figure 19. Total R&D personnel per thousand labour force (Head Count)



Source: UNESCO S&T statistics database

What makes Belarus exceptional is that although the human and financial resources committed to R&D are relatively small overall, they are strongly concentrated in the Business Enterprise Sector (BES) (Figure 20 and Table 14).

Figure 20. GERD/GDP (x-axis) and share of BES in performing R&D (y-axis) in 2012, per cent



For instance, Poland, which is very similar regarding relative investments and labour force concerning R&D, has a much lower share of the business sector in both R&D spending and employment (Table 15). As far as employment, this phenomenon is as recent as ten years earlier, when R&D concentration in the BES in Belarus was less pronounced than it is today.

Table 15. Share of the business sector in total R&D employment, per cent

	2002	2011
Belarus	48.6	64.1
Russia	65.3	57.1
Austria	51.8	54.3
Ukraine (2003)	45.1	47.9
Czechia	41.6	46.7
Kazakhstan (2000)	15.2	28.7
Poland	9.2	19.8

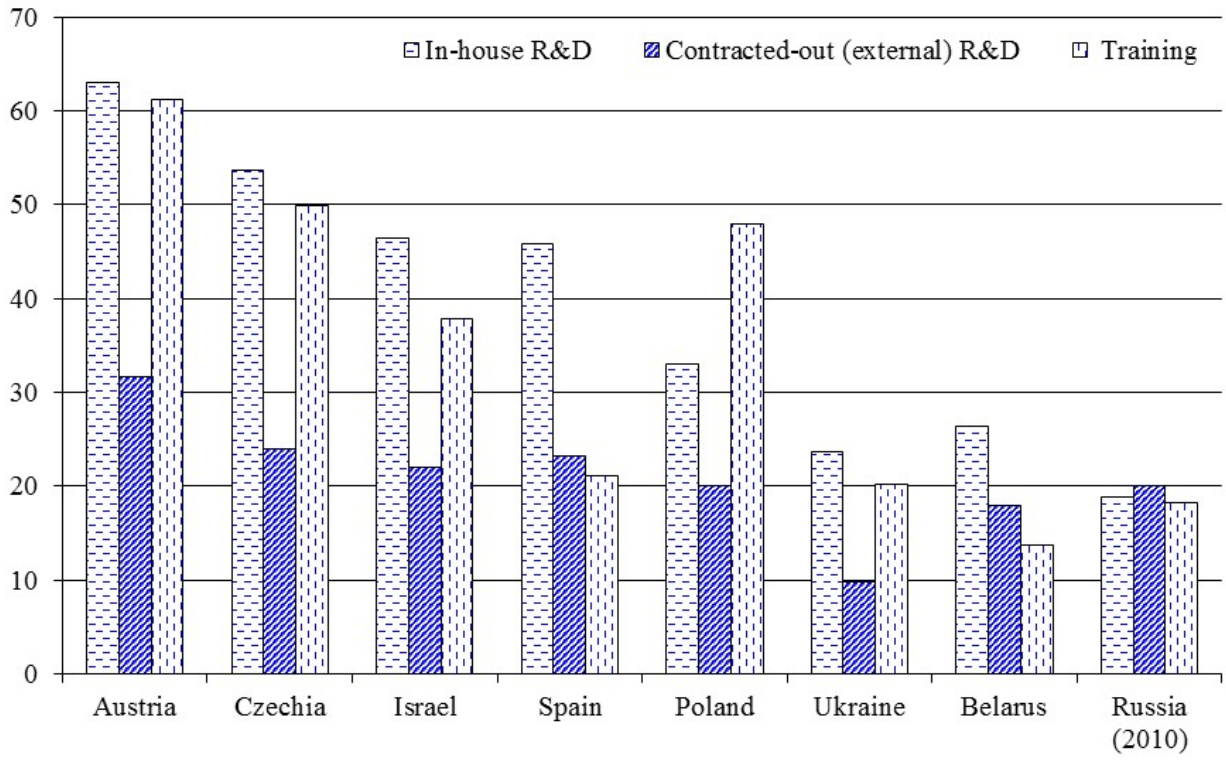
Source: UNESCO S&T statistics database

Is the strong concentration of Belarusian R&D in the BES a desirable feature or a weakness? If taken in isolation, it does represent a positive feature as it resembles the relative structure of

R&D in economies of much higher income levels. Radosevic (2011[100]) shows that BES-dominated R&D systems are characteristic of countries with incomes above US$15,000 per capita. However, we should bear in mind that in the case of Belarus, the BES is not the major origin of finance for its own R&D. It is largely funded by the Government (cf. also chapter 4).

Only 26 per cent of Belarusian manufacturing firms conduct in-house R&D activities in manufacturing compared to 33 per cent of Polish firms at a similar level of relative R&D expenditures (Figure 21). The gap is even bigger in training activities where the frequency of these activities is well below Poland. Belarus firms also rely less on external R&D. This feature is even more striking if we take into account that the industry structure of Belarus is characterised by a much higher share of big business, which is usually by and large R&D-active.

Figure 21. Share of manufacturing firms with in-house, contracted R&D and training activities, 2012



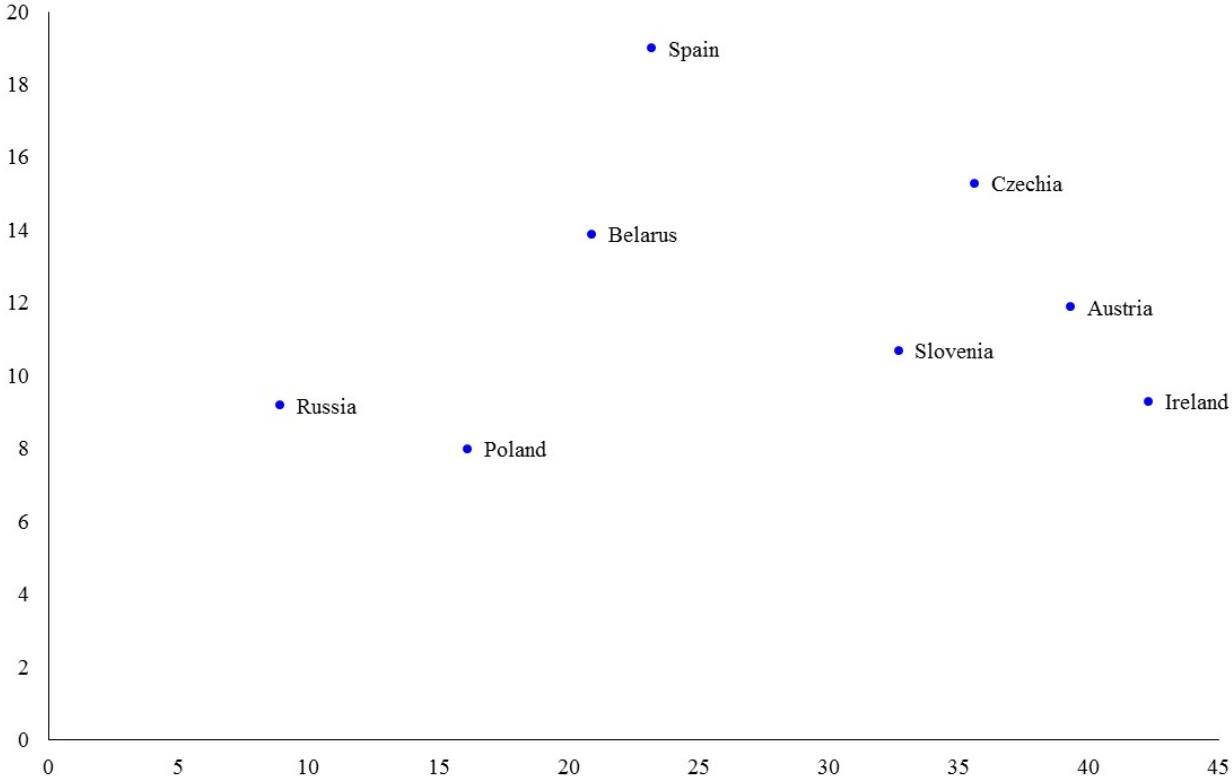
Source: UNESCO database

However, as already pointed out in the first innovation performance review of Belarus[101] , when compared to other countries, local firms are innovation-active. Figure 22 below shows that share of innovative companies and the commercial importance of innovation is above Poland and Russian Federation in both respects. Although with a lower share of innovative firms when compared to other EU peer economies, the business relevance of innovation activities of Belarusian firms is higher than in Slovenia, Ireland and Austria. So, empirical evidence shows

[100] S. Radosevic, (2011) Science-industry links in Central and Eastern Europe and the Commonwealth of Independent States: Conventional policy wisdom facing reality, *Science and Public Policy*, 38(5), June 2011
[101] UNECE (2010). *Innovation Performance Review: Belarus*. United Nations: New York and Geneva.

Belarusian firms are innovation-active, but the nature of their innovation activities is very much non-R&D oriented (Table 15).

Figure 22. Frequency vs. commercial importance of innovations, 2014 or latest available year



Source: Science and innovation activity in the Republic of Belarus, 2015, Statistical book, National Statistical Committee of the Republic of Belarus, Minsk 2015

Table 16 below shows that innovation activities of Belarus firms are characterized by an exceptionally high share of non-R&D innovation expenditures. So, innovation in Belarus is largely about the acquisition of equipment and machinery rather than about intangible activities like R&D and training (cf. chapter 4). When Belarus firms innovate their innovation activities are production-oriented, i.e., geared towards improved manufacturing processes.

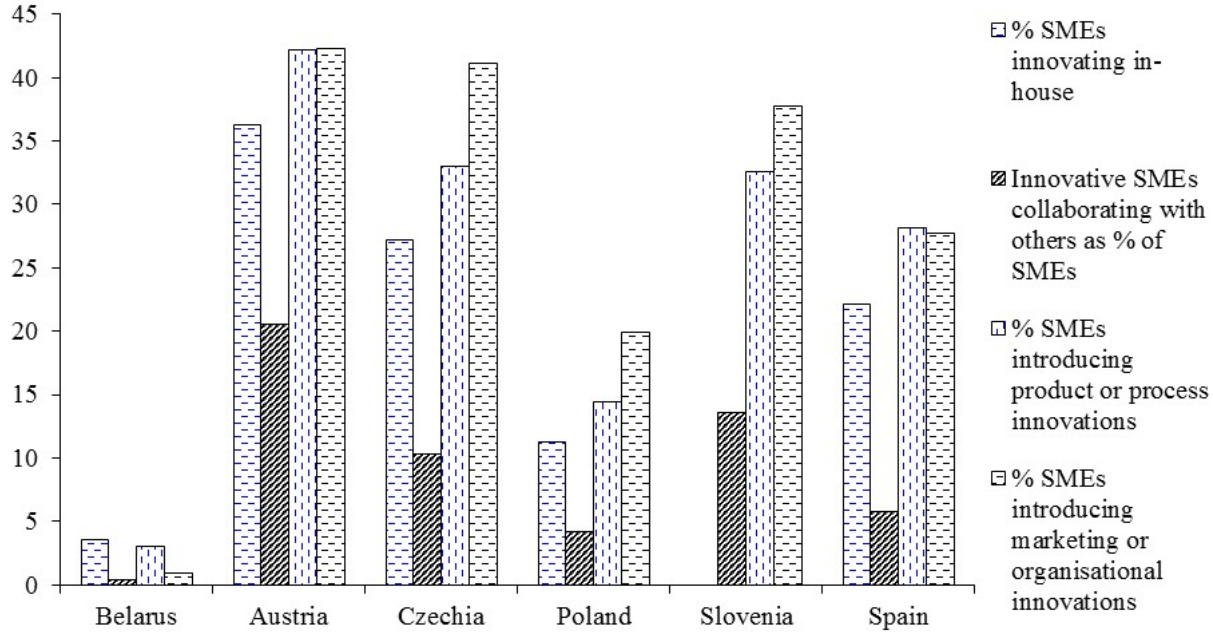
Table 16. Non-R&D innovation expenditures, share of turnover, selected countries

	Non-R&D innovation expenditure as % of turnover
Belarus	1.9
Poland	1.02
Czechia	0.69
Slovenia	0.56
Spain	0.39
Austria	0.35

Source: Science and innovation activity in the Republic of Belarus, 2015, Statistical book, National Statistical Committee of the Republic of Belarus, Minsk 2015

These features of innovation activities are further explained by the fact that innovation activity in Belarus is confined to a small circle of large enterprises. IUS data show a striking feature of the Belarusian innovation system which could be described as a 'black hole'- a very low share of SMEs that are innovators and that are engaged in any innovation activity (Figure 23). This feature is very strong when compared to all EU peer economies.

Figure 23. SMEs: a "black hole" in Belarusian innovation activities



Source: Science and innovation activity in the Republic of Belarus, 2015, Statistical book, National Statistical Committee of the Republic of Belarus, Minsk 2015

This structural deficit in the spectrum of innovation activities may have strong effects on the dynamics of innovation activities. First, it signals a lack of both small specialized suppliers and diversity of innovation efforts. These two roles are usually those that cannot be fulfilled by large enterprises. Second, it shows very limited scope for 'creative destruction' or opportunities for takeovers of technologically promising small firms by large firms and the scope for experimentation which is possible only at the SME level. Finally, it reduces the scope for autonomous and generic expansion of SMEs given a tiny share of innovative SMEs.

So, when compared to other CIS and Central European economies, Belarus is distinct in that it has preserved the organizational capabilities of large firms which are drivers of innovation and R&D activities in developed economies. However, in Belarus, these firms cannot rely on the range of SMEs as specialized suppliers and as co-creators of industry dynamics. The preservation of organizational capabilities of large firms has been paid for by the lacking dynamics of interactions between large and small businesses.

WEF Global Competitiveness Report

Another important benchmarking instrument is the WEF Global Competitiveness Report. Belarus is not yet part of this system which deprives it of important benchmarking insights and profile. However, as part of its efforts to benchmark itself internationally at least in some components of the WEF GCR framework, the government has been regularly funding a study which uses WEF data and criteria in positioning Belarus regarding innovation capacity.

Table 17 shows results of the part of WEF survey for 2015 conducted by BelISA, which is by and large based on subjective assessment of the business community. This survey has not been verified by the WEF team, but authors have tried as much as possible[102] to comply with the requirements of the survey and it could be used as a valid comparative tool. It shows the position of Belarus within the context of peer economies regarding several critical dimensions of innovation capacity. Indicators are a mix of 'hard' indicators and rankings from 1-7 in the case of subjective assessments. After considering the relative position of Belarus in relation to its peers as well as on absolute values of evaluations, we may draw a number of conclusions.

First, although in absolute terms Belarusian firms evaluate the availability of the latest technologies and firms-level technology absorption as satisfactory (assessments are around the 4.17 mark), in relative terms, this puts Belarus at the bottom end of the peer economies. Second, the biggest lag of Belarus is regarding companies spending on R&D (only 2.92) which shows that despite a high relative share of R&D expenditures in BES this is far from satisfactory given a very low overall share of R&D expenditures in BES. In this respect, Belarus is quite similar to Poland. This also shows that subjective assessments by a business community well reflect hard data on R&D expenditures in BES. Third, a striking fact is that business perceives that there is a quite high availability of scientists and engineers in the country, but this does not seem to convert into satisfactory collaboration with universities or the quality of scientific research institutes. On the other hand, this may not be a surprise given very low spending for R&D at universities despite several successful attempts to commercialise R&D results through spin-off companies.

This situation suggests that R&D institutes are not geared towards the needs of the business sector. However, given that Belarusian R&D is by and large oriented towards the corporate sector this seems quite counter-intuitive and deserves further scrutiny. Finally, Belarus is very marginally involved in world frontier technology activities as demonstrated by extremely low PCT patents per capita. This is partly due to challenges to the IPR support system and government procurement policy but is mainly due to the production orientation of Belarusian R&D. Belarusian innovation effort is much more around domestic technology effort and production activities than R&D and technology activity as an independent source of growth. Similar to Russia and Ukraine, the impact of FDI on technology transfer is also low mainly due to a low share of FDI.

[102]Заключительный отчет о научно-исследовательской работе «Межстрановая оценка состояния научно-технической и инновационной сферы Республики Беларусь на основе анализа международных статистических данных и рейтингов и предложения по улучшению позиций Республики Беларусь в этих рейтингах», Государственный комитет по науке и технологиям Республики Беларусь, Государственное учреждение «Белорусский институт системного анализа и информационного обеспечения научно-технической сферы» (ГУ «БелИСА») УДК 339.9:338.1;339.9:330.34;338.2 № госрегистрации 20151401.

Table 17. Belarus in 'innovation part' of WEF GCR 2015

	Israel	Austria	Czechia	Poland	Kaz.	Russia	**Belarus**	Ukraine
Availability of latest technologies	6.28	6.03	5.21	4.45	4.39	4.22	**4.18**	4.11
	Israel	Austria	Czechia	Kaz.	Russia	Ukraine	Poland	**Belarus**
Firm-level technology absoprtion	6.05	5.68	4.95	4.36	4.25	4.23	4.20	**4.17**
	Israel	Czechia	Austria	Poland	Kaz.	**Belarus**	Russia	Ukraine
FDI and technology transfer	5.37	4.98	4.63	4.63	4.07	**3.88**	3.77	3.69
	Israel	Austria	Czechia	**Belarus**	Russia	Poland	Kaz.	Ukraine
Capacity for innovation	5.82	4.96	4.60	**3.91**	3.77	3.76	3.75	3.64
	Israel	Austria	Czechia	Russia	Poland	Ukraine	**Belarus**	Kaz.
Quality of scientific research institutions	6.27	5.01	4.55	3.96	3.88	3.77	**3.47**	3.22
	Israel	Austria	Czechia	Russia	Ukraine	Kaz.	**Belarus**	Poland
Company spending on R&D	5.31	4.80	3.70	3.16	3.13	3.12	**2.92**	2.83
	Israel	Austria	Czechia	Russia	Poland	Ukraine	Kaz.	**Belarus**
University-industry collaboration in R&D	5.50	4.68	4.00	3.63	3.50	3.50	3.29	**3.10**
	Israel	**Belarus**	Ukraine	Austria	Czechia	Poland	Russia	Kaz.
Availability of scientists and engineers	5.20	**4.40**	4.33	4.27	4.24	4.17	4.06	3.88
	Israel	Austria	Czechia	Poland	Russia	Ukraine	Kaz.	**Belarus**
PCT patents, applications / million population	230.05	166.31	15.83	7.15	7.13	3.19	1.05	**1.04**
	Austria	Israel	Czechia	Poland	Kaz.	**Belarus**	Russia	Ukraine
Intellectual property protection	5.51	4.57	3.92	3.75	3.65	**3.22**	3.02	2.66
	Israel	Austria	Kaz.	Russia	Poland	**Belarus**	Czechia	Ukraine
Government procurement of advanced tech	4.34	3.66	3.42	3.34	3.24	**3.08**	2.98	2.87

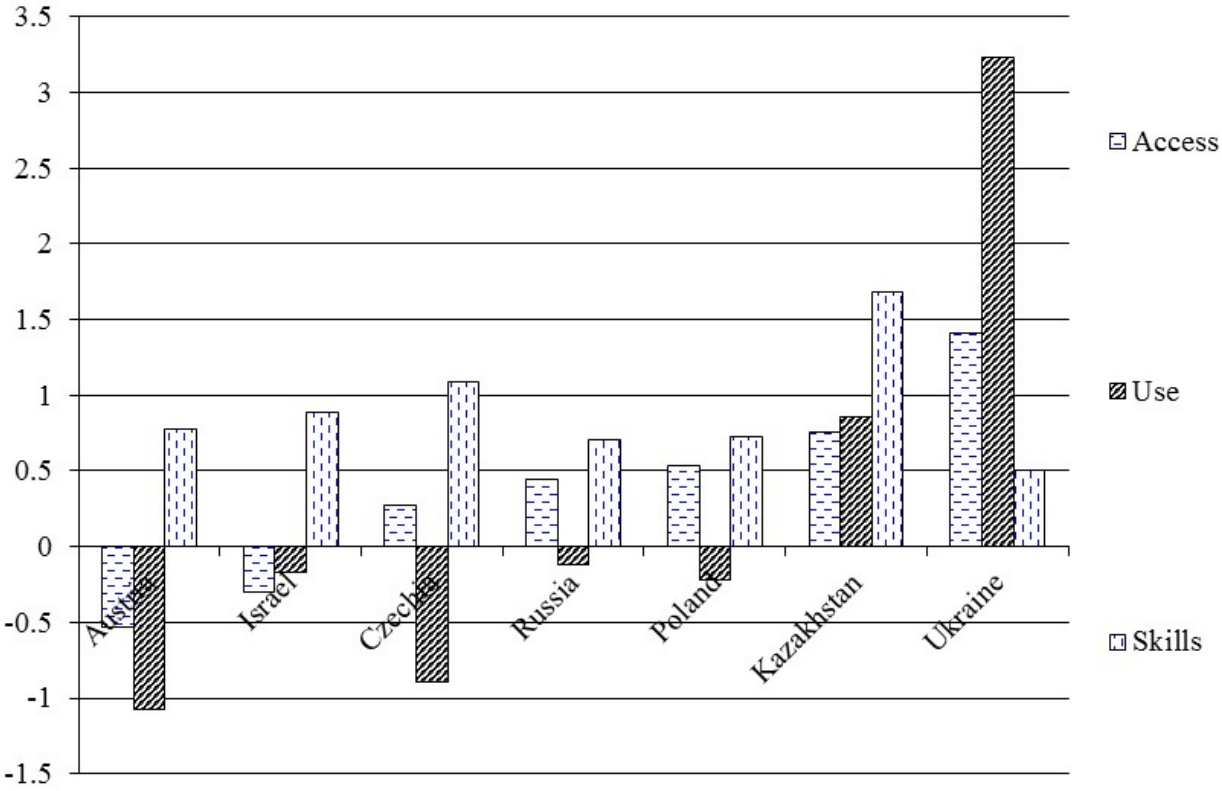
Source: BelISA 2015 Innovation and Company Survey
"Kaz." denotes data for Kazakhstan.

ICT index and e-Government index

ICT today represents probably the most significant infrastructure for firms as well as an area of business in itself. So, the extent to which Belarusian enterprises and population have access, are using, and the degree to which they possess skills to use ICT are important determinants of the overall innovative capacity of the economy. Figure 24 below summarises the gaps and leads of Belarus in ICT access, use and skills in relation to peer economies as measured by the ITU

indexes. These data are based on composite indicators for access, use and skills to use ICT and Belarus is taken as a reference case.

Figure 24. Gaps and leads of Belarus in ICT access, use and skills relative to peers (+ leads; - shortcomings in ICT Index)*



Source: ITU

*Note: Three sub-indexes are composed of the following indicators.

IDI ACCESS SUB-INDEX (Fixed-telephone subscriptions per 100 inhabitants; Mobile-cellular telephone subscriptions per 100 inhabitants; International Internet bandwidth per Internet user (Bit/s); Percentage of households with a computer; Percentage of households with Internet access).

IDI USE SUB-INDEX (Percentage of individuals using the Internet; Fixed (wired)-broadband subscriptions per 100 inhabitants; Active mobile-broadband subscriptions per 100 inhabitants)

IDI SKILLS SUB-INDEX (Adult literacy rate; Secondary gross enrolment ratio; Tertiary gross enrolment ratio).

Belarus scores very high regarding skills to use ICT, which is related to its superb ranking regarding education indicators. In that respect, it leads in relation to all peer economies. It also leads ahead of the CE and CIS peer economies, but it lags behind Austria and Israel regarding access to ICT as reflected in Internet access indicators and other indicators. However, concerning actual use of ICT, it is ahead of only Kazakhstan and Ukraine and behind all other peer economies. This suggests that real potential regarding skills to use and access to ICT is not yet followed by the actual use of ICT. Table 18 below further confirms this picture. It shows that the access to fixed telephony, fixed broadband and Internet bandwidth is quite high in Belarus. However, the share of individuals using the Internet as well as mobile phones is not yet at the Central European level. In part, this may reflect the structure of the economy which is not dominated by SMEs but by large firms.

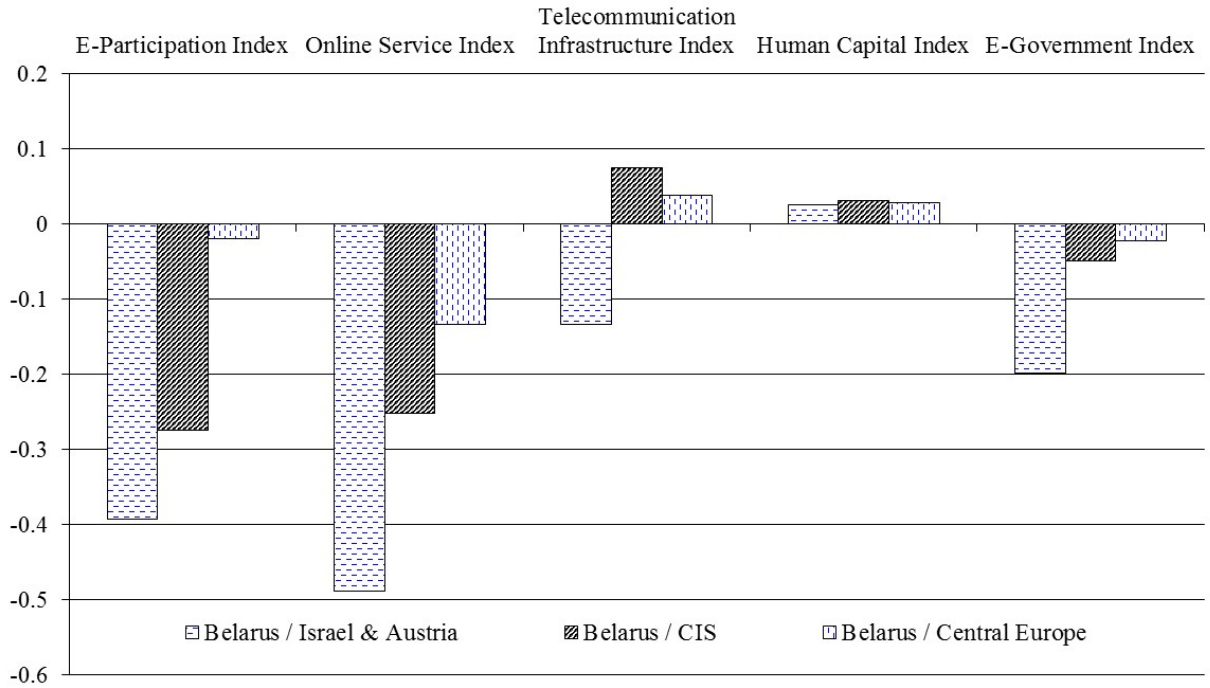
Table 18. ICT Indicators: Belarus compared to peer economies

	Belarus	Israel	Austria	Russia	Kaz.	Ukraine	Czechia	Poland
Fixed-telephone lines / 100 population	**48.50**	44.81	39.42	28.47	26.67	26.15	18.66	13.87
	Belarus	Austria	Israel	Czechia	Russia	Poland	Kaz.	Ukraine
Fixed-broadband Internet subscriptions / 100 population	**28.84**	26.01	25.67	17.03	16.62	15.61	11.60	8.83
	Belarus	Austria	Czechia	Israel	Poland	Ukraine	Kaz.	Russia
International Internet bandwidth, KB/s per user	**139.90**	128.49	111.20	100.46	73.03	52.88	49.84	41.25
	Austria	Russia	Poland	Kaz.	**Belarus**	Israel	Czechia	Ukraine
Mobile-broadband subscriptions / 100 population	62.83	60.13	58.52	56.55	**55.00**	52.98	45.32	5.43
	Austria	Czechia	Israel	Poland	Russia	**Belarus**	Kaz.	Ukraine
Individuals using Internet, %	80.62	74.11	70.80	62.85	61.40	**59.02**	54.00	41.80
	Kaz.	Austria	Russia	Poland	Ukraine	Czechia	Israel	**Belarus**
Mobile telephone subscriptions / 100 population	180.50	156.23	152.84	150.02	138.06	131.25	122.85	**122.50**

Source: BelISA 2015 study and ITU database
"Kaz." denotes data for Kazakhstan

Figure 25 below shows a similar picture with regards to dimensions of the e-government index. Belarus leads regarding human capital in relation to both developed, CE and CIS economies. It is ahead of CE and CIS regarding telecom infrastructure but trails behind all three groups on the online services and e-participation. Thus, it can be suggested that the potential for much more intensive use of ICT in government has not been converted into actual use.

Figure 25. e-government index and its dimensions in Belarus and peer economies



Source: UN e-Government Survey 2014

3.3 Selected STI indicators that measure technology upgrading

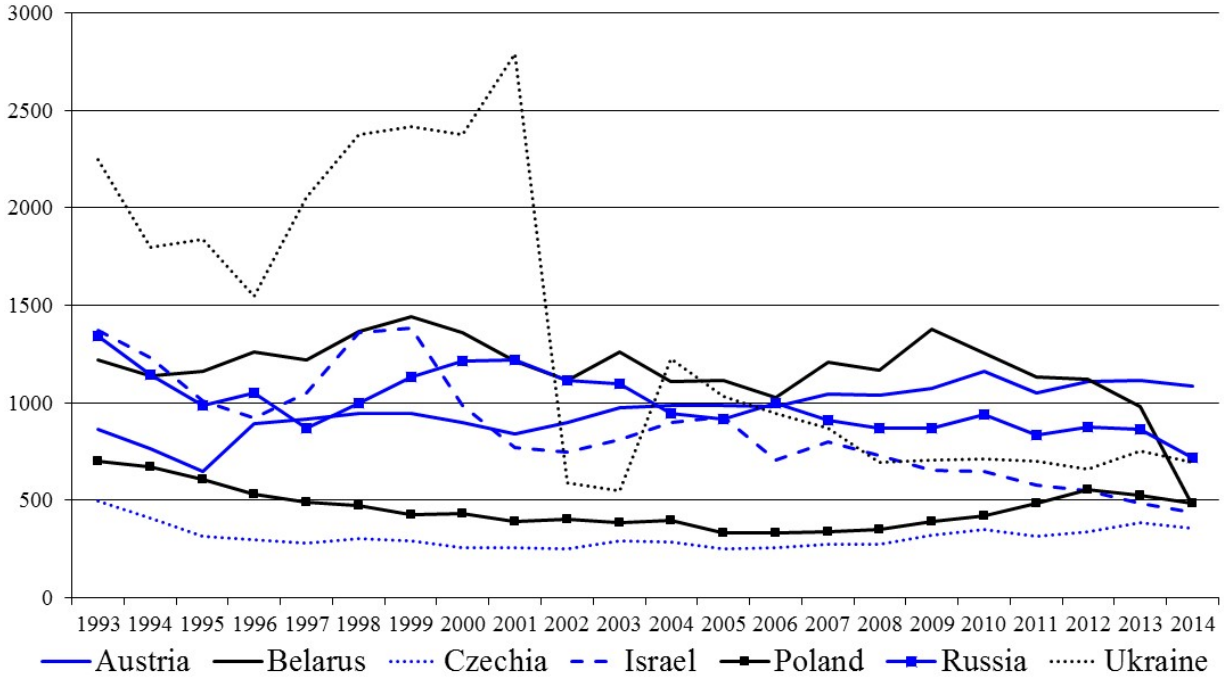
Technology upgrading is the process by which economies move from technologically low-value to relatively technologically high-value activities. It is a multidimensional conceptual framework which goes beyond R&D in explaining the building of technological capabilities which drive long-term growth. Some indicators of measurement of technology upgrading of the economies moving from middle to high-income status may be thus particularly relevant for Belarus.

Patents, ISO certification and trademarks

As countries move up towards the technology frontier *patenting* becomes more necessary. As economic activities move towards the technology frontier, transnational patenting also augments. This pattern may be somewhat different in very large catching-up economies where domestic patenting may continue to play an important role. However, their transnational patenting as a proxy for world frontier technology effort should continue to increase.

Figure 26 below shows the relative number of resident patent applications per GDP. It indicates that domestic technology effort is quite intensive in Belarus, and the country is at the top of its peer group. This could also be a reflection of the relative closeness of the domestic technology market and the lack of openness in which domestic technology effort would be substituted by foreign knowledge as is the case of Central Europe.

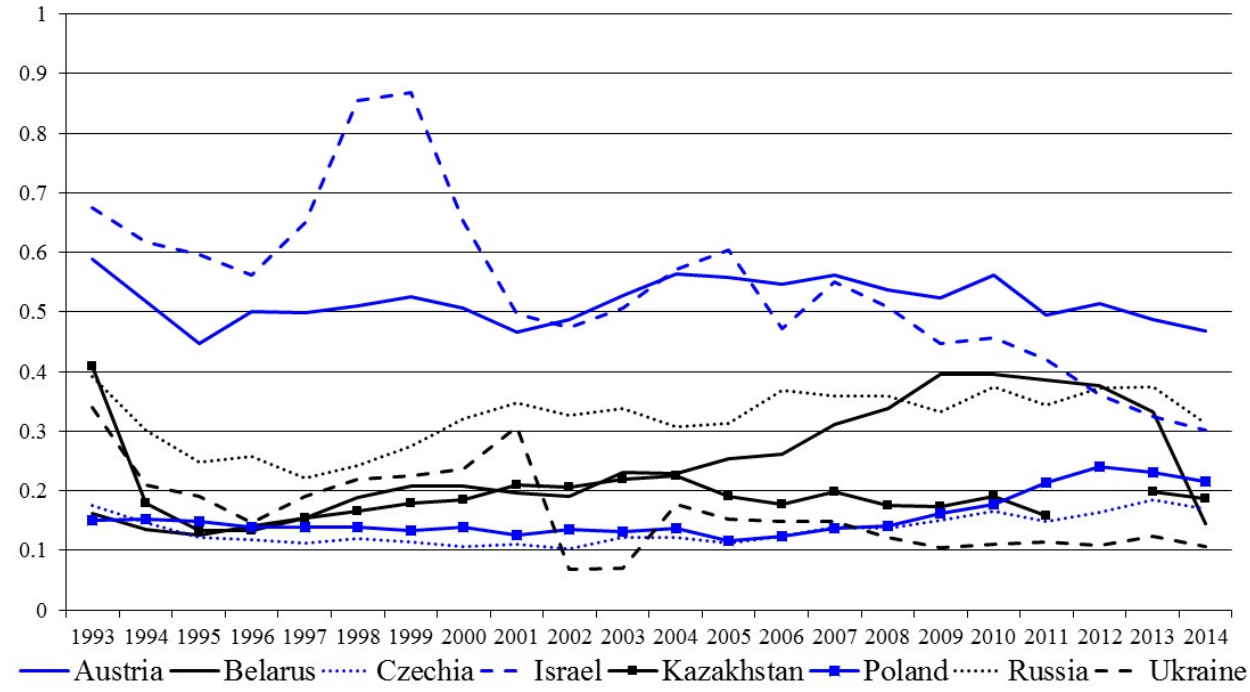
Figure 26. Resident applications per US$100 billion GDP (2011 PPP) (by origin)



Source: WIPO statistics database. Last updated: December 2015

The domestic technology effort intensity is somewhat lower when expressed relative to labour force, but is similar to Russia and well above Central Europe (Figure 27). However, we also notice a drop in relative intensity of patenting after 2008 and especially during the last two years. As there have not been significant changes in the IPR market, this probably reflects a tightening financial situation of firms, including tight credit constraints and the lack of potential demand for domestic technological activities (cf. chapter 4).

Figure 27. Resident patent applications per 1,000 labour force

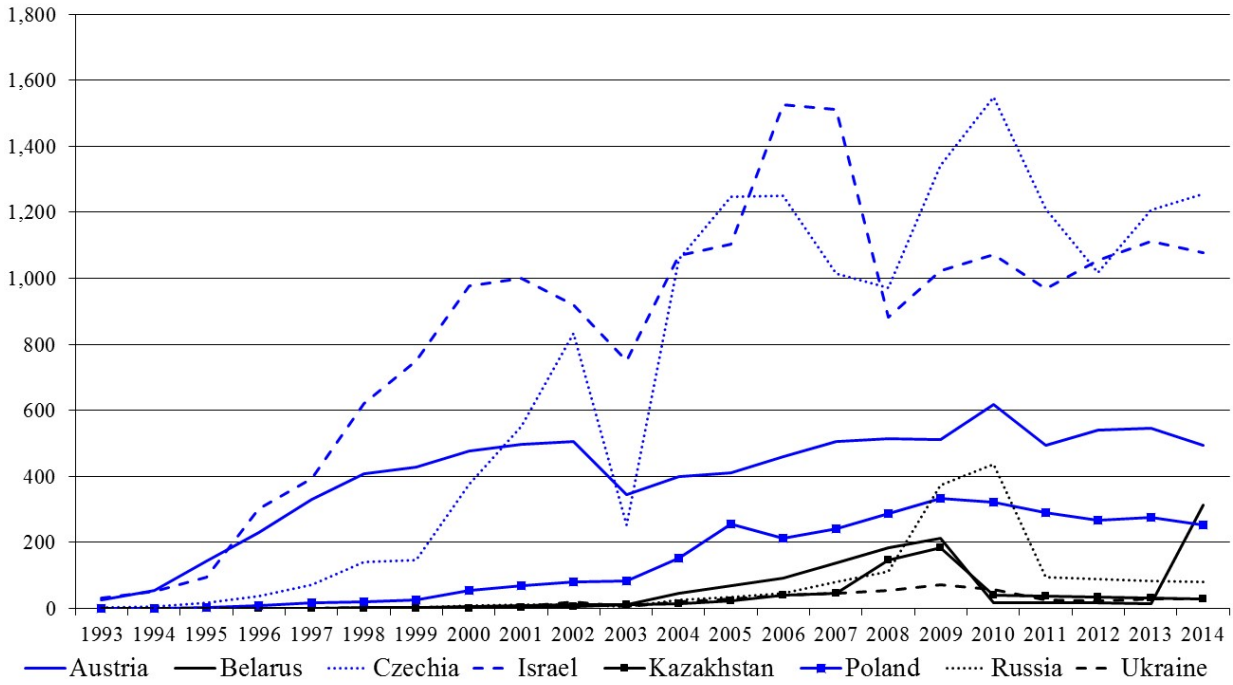


Source: WIPO database and WBDI database

It is not expected that countries of Belarusian technology and income level would be much more active in world technology frontier activities, but the relative involvement of Belarus is still below Ukraine and well behind the Central European peers. This suggests that the R&D and innovation system of Belarus is very much production-oriented, which may become a constraint for high-value-added growth in the longer run.

ISO Certificates are proxies of capability to produce at the required level of quality. ISO certificates 9001 are a generic management standard that indicates there are in place businesses process which should guarantee operational efficiency (though not necessarily its improvement). However, this is an important area of technological activity especially for middle-income economies that do not compete with technology. Figures on ISO9001 certificates shows that Belarusian firms only recently became involved in systematic improvements of quality (figure 24). Still, the number of ISO certificates per capita of Belarus is well below Central Europe, Austria and Israel. This ranking may be due to a relatively weak involvement of Belarus and other CIS economies in global and EU value chains where quality procedures are *sine qua non*. Radosevic and Kravtsova (2011) [103] show that production capability proxied by ISO9001 can be one of the most significant determinants of productivity growth in countries with economies in transition.

Figure 28. ISO certificates 9001 per million population



Source: ISO Database

Trademark applications can be a proxy for developed production capability regarding firm (product) differentiation. They also proxy for marketing innovation and measuring firm activity regarding differentiated production capability or brand. Although there has been a significant rise of Belarus regarding trademarks, the current situation puts it at a similar gap as regarding

[103] V. Kravtsovaand S. Radosevic, *Are systems of innovation in Eastern Europe efficient?* Economic Systems (2011), Volume 36, Issue 1, March 2012, Pages 109–126 doi:10.1016/j.ecosys.2011.04.005

ISO certificates (Table 19). This suggests that differentiation of service firms in Belarus is still below its peer CE and developed economies.

Table 19. Trademarks applications abroad by residents per 1,000 labour force[104]

	2010-2014, average
Austria	18.69
Czechia	4.92
Poland	3.67
Israel	3.23
Belarus	0.45
Russia	0.32
Ukraine	0.26
Kazakhstan	0.09

Source: WIPO database

Similar to trademarks, data on industrial design shows a relatively low ranking of Belarus in relation to Central Europe and its favourable position in relation to CIS (Table 20).

Table 20. Resident industrial design count per million population (by origin)[105]

	2010-2014, average
Austria	412.8
Czechia	183.4
Slovenia	160
Ukraine	100.4
Belarus	29.2
Russia	21
Kazakhstan	7.6

Source: WIPO

R&D capability

R&D can be considered to be undertaken both as a directly relevant commercial activity but also as a public activity whose main aim is a generation of new knowledge with indirect commercial relevance. Hence, its links to growth and productivity are far from

[104] Unlike patents, trademark registrations can potentially be maintained indefinitely, as long as the trademark holder pays the renewal fees and actually uses the trademark. Trademark rights are limited to the jurisdiction of the authority that issues the trademark (WIPO definition).

[105] Industrial designs refer to the ornamental or aesthetic aspects of a useful article, including compositions of lines or colours or any three-dimensional forms that give a special appearance to a product or handicraft. The holder of a registered industrial design has exclusive rights against unauthorized copying or imitation of the design by third parties. Industrial design registrations are valid for a limited period. The term of protection is usually 15 years for most jurisdictions.

straightforward.[106] Literature conventionally accepts that R&D has two faces.[107] One is as being the driver of world frontier innovation, and another as a driver of imitation activities or as a factor of absorptive capacity. It seems that R&D plays a different role in economies at various levels of development. For example, middle-income economies tend to grow more on imitation activities while transition towards high-income groups requires a shift towards frontier technology activities. So, in both groups, R&D plays an important but different role. In middle-income economies, R&D has a significant role in terms of absorptive capacity or capacity to use effectively knowledge from abroad in addition to its role as a driver of world frontier innovation.

Data on scientific and technical journal articles per million inhabitants (Table 21) shows that regarding S&T articles per capita, Belarus is at half of the Russian level and lags behind Central Europe and developed economies.

Table 21. Scientific and technical journal articles per million inhabitants (average 2007-2013)

Israel	1462
Austria	1323
Czechia	1150
Poland	637
Russia	222
Ukraine	129
Belarus	114
Kazakhstan	24

Source: World Bank Development Indicators database

This is further confirmed not only by the number of papers per capita but also by indicators of scientific quality (Table 22). In part, this may be a reflection of the inward orientation of the science system which is not widely engaged in international scientific communication and has therefore generated fewer international citations than comparison countries. It may also be the result of funding and human resources constraints, among other challenges to the country's "knowledge triangle".[108]

[106] Slavo Radosevic, *The role of public research in economic development*, In EU (2016) *Science, Research and Innovation performance of the EU. A contribution to the Open Innovation*
Open Science Open to the World agenda 2016, pp.119-139
[107] W. Cohen, and D. Levinthal, *Innovation and Learning: Two Faces of R&D*, Economic Journal 99 (1989), 569–596.
[108] See Government of Belarus (2016). "Analysis of the problems interfering in the interaction between higher education, research and innovation in the Republic of Belarus" of TEMPUS project 543853 on "fostering the knowledge triangle in Belarus, Ukraine and Moldova". Project approved by Council of Ministers of the Republic of Belarus by Order 742 of 31 July 2014 "on the approval of technical support projects".

Table 22. Indicators of science quality and impact (based on Scopus database)[109]

	H-index[i]	Citations per Document[ii]
Israel	496	21
Austria	449	19
Russia	390	7
Poland	371	10
Czechia	294	11
Ukraine	174	5
Belarus	122	6
Kazakhstan	64	5

Source: SciMago (Scopus database)

[i] Number of articles that have received at least H citations. It quantifies countries' scientific productivity and its scientific impact.

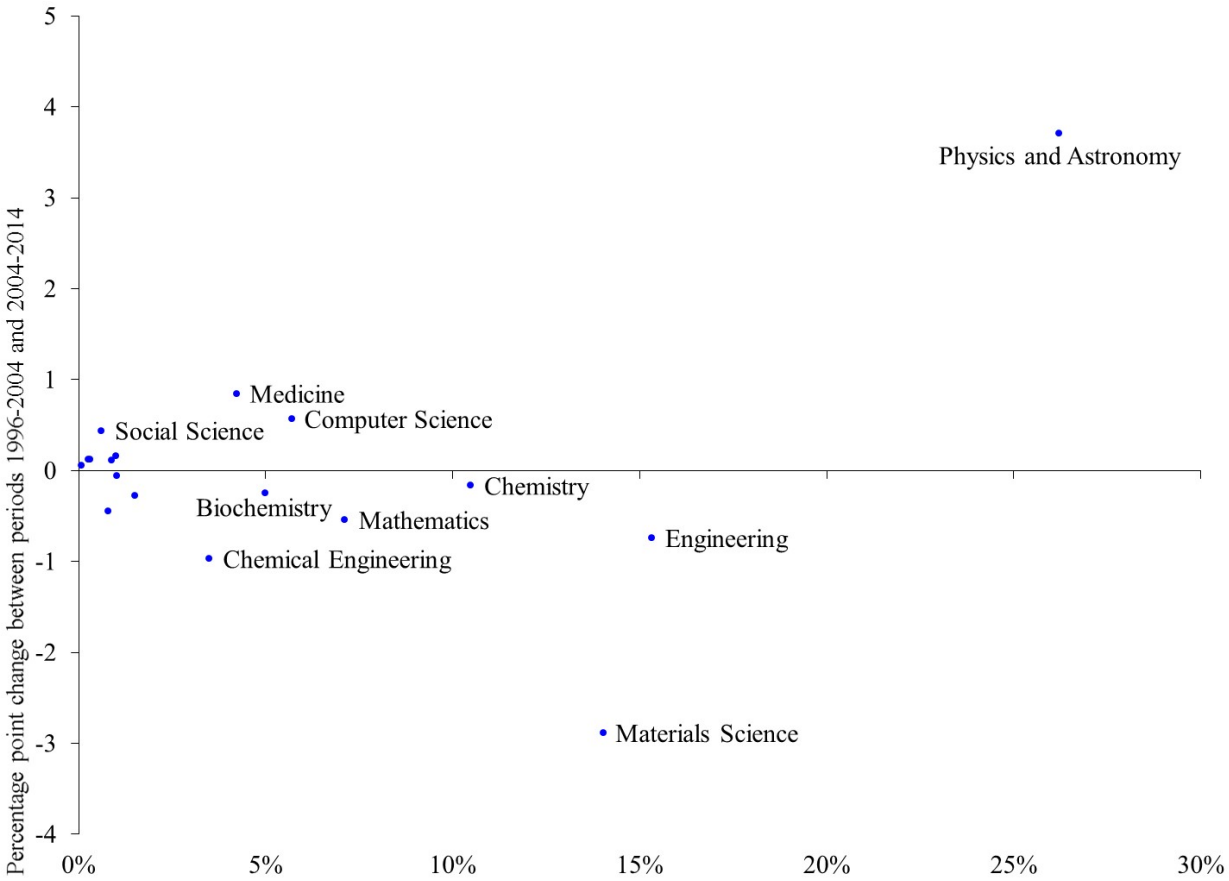
[ii] Average citations per document published in the 1996-2014 period.

Since 1996, the publishing profile - except for a few fields - has not changed significantly (Figure 29). The biggest contributors are Physics and Astronomy, Engineering, Material Science and Chemistry. Physics and Astronomy have increased their share in overall publications by 3.7 percentage points while the share of Material Science has decreased by 2.9 percentage points. Physics is an area of traditional strength in CIS countries, and this reinforcement of the past areas of excellence does not surprise.[110] It is encouraging that computer sciences have a share of 5.7 per cent. However, the overall share of other new dynamic areas like life sciences is still relatively low.

[109] The SCImago Journal & Country Rank is a portal that includes the journals and country scientific indicators developed from information contained in the Scopus® database (Elsevier B.V.).

[110] Slavo Radosevic and Esin Yoruk (2014) *Are there global shifts in world science base? Analysis of catching up and falling behind of world regions*, *Scientometrics*, June, 101: pp. 1897-1924, DOI 10.1007/s11192-014-1344-1

Figure 29. Shares of scientific publications in 2005-15 period (x-axis) and changes in shares between 2005 - 2014/1996 – 2004 (y-axis)



Source: SCImago (Scopus database)

Knowledge and technology exchange with the global economy

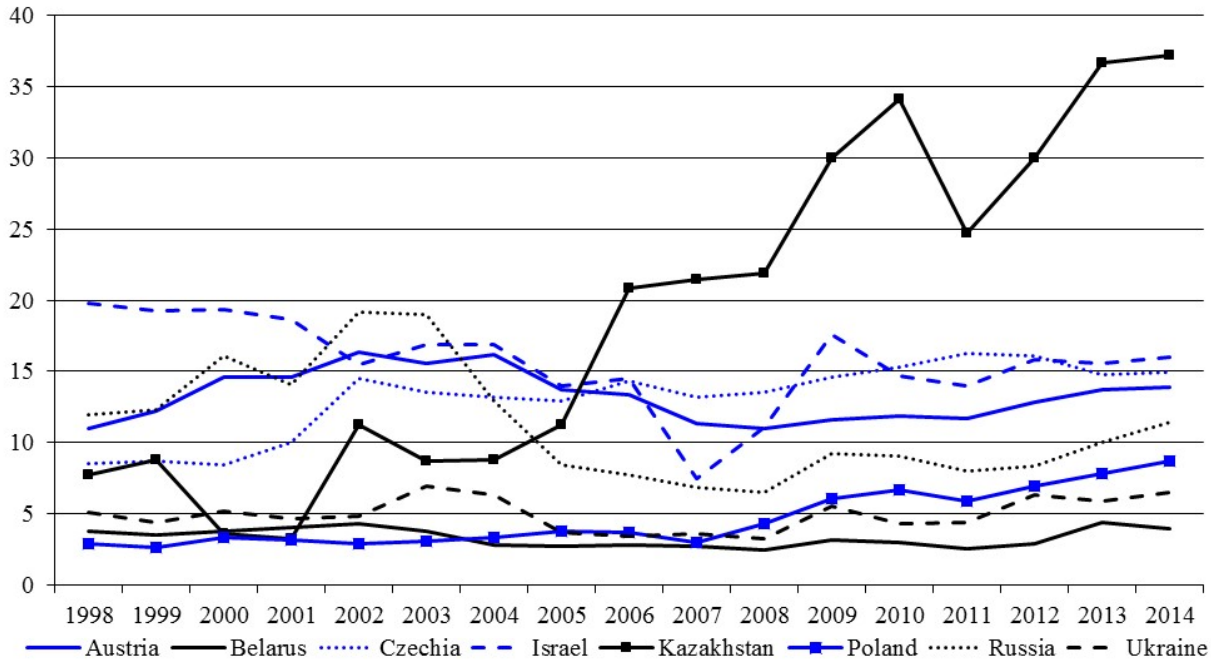
A successful technology upgrading is never an entirely autonomous process but is always linked to the inflow of foreign knowledge skills, which are coupled with intensive domestic technology effort. [111] Interaction with the global economy is difficult to capture since technology transfer happens through capital equipment import, and this is embedded in modes of FDI, networks and subcontracting or is disembodied (licences). However, the modes of transfer by themselves cannot be taken as proxies of the real knowledge transfer that has taken place. For example, FDI can bring knowledge and generate spill-overs, but equally, it may lead to insignificant or negative spill-overs. Thus, the technology balance of payment of countries may relate to real flows of knowledge, but also reflect an instrument of transfer pricing of MNEs.

Trade in high tech could be considered as a relevant proxy for technology structure of trade, although the share alone does not capture at which value-added segments countries that export high-tech operate. Also, it does not capture a share of domestic value added in gross export. Unfortunately, Belarus is not part of the new trade in value-added database (OECD/WTO),

[111] S. Radosevic, (1999) *International Technology Transfer and 'Catch Up' in Economic Development*, Edward Elgar: Cheltenham.

which could shed interesting insights on the local situation in Belarus. Figure 30 below shows shares of high technology exports as a percentage of manufactured exports. High technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. Belarus ranks below comparators in that respect. This shows not only the structure of Belarusian exports but also a limited involvement in global value chains.[112]

Figure 30. High-technology exports (share of manufactured exports, per cent)

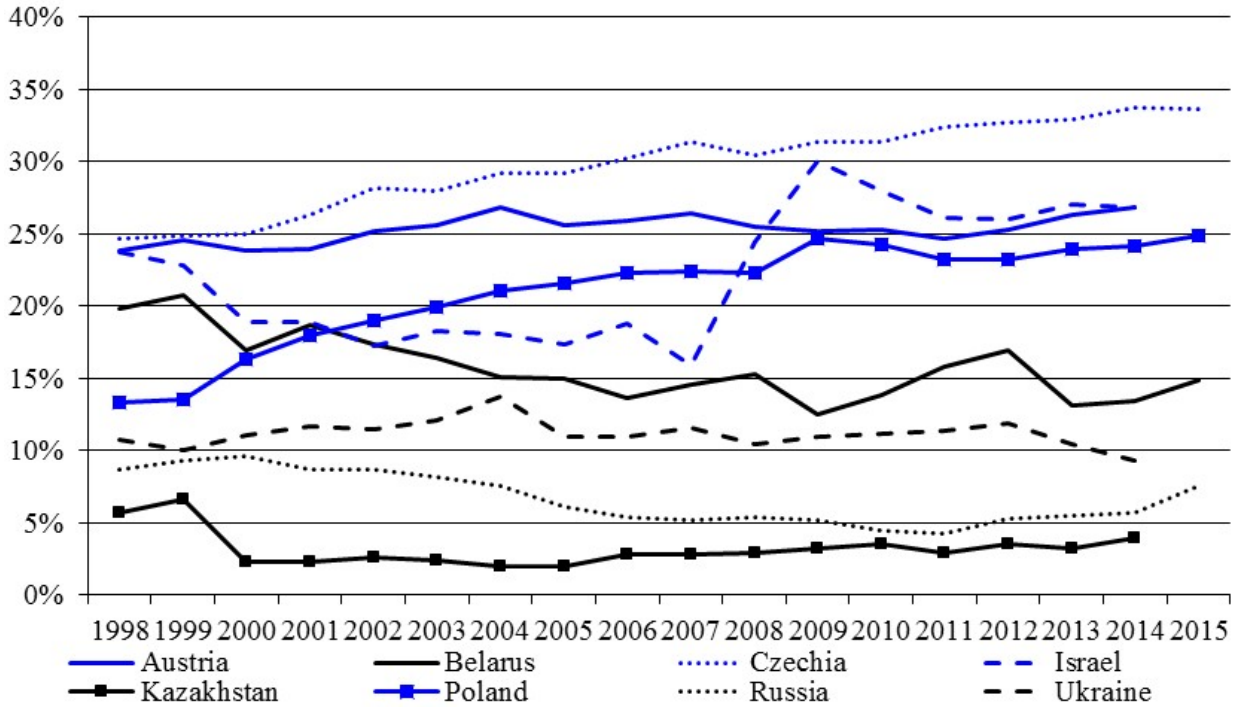


Source: World Bank Development Indicators

Still, technology content of trade cannot be reduced to a high-tech category especially if we do not have data on domestic value-added levels. As an alternative, to avoid the problem of narrow definitions - like "high-tech", which ignores value-added differences - the broad category of complex industries is considered, which include SITC Rev3 categories 5, 71-79, 87 and 88. It is assumed that export in these industries is on average of somewhat higher complexity than in other industry groups.[113]

[112] A high share of high-tech in Kazakh exports denotes a very low share of manufacturing in overall exports.
[113] For the use of complex industries data in the context of Central Europe see Bohle Dorotea and Bela Greskovits (2012) *Capitalist Diversity on Europe's Periphery*, Cornel University Press: Ithaca.

Figure 31. Share of exports of complex industries in total exports[114]

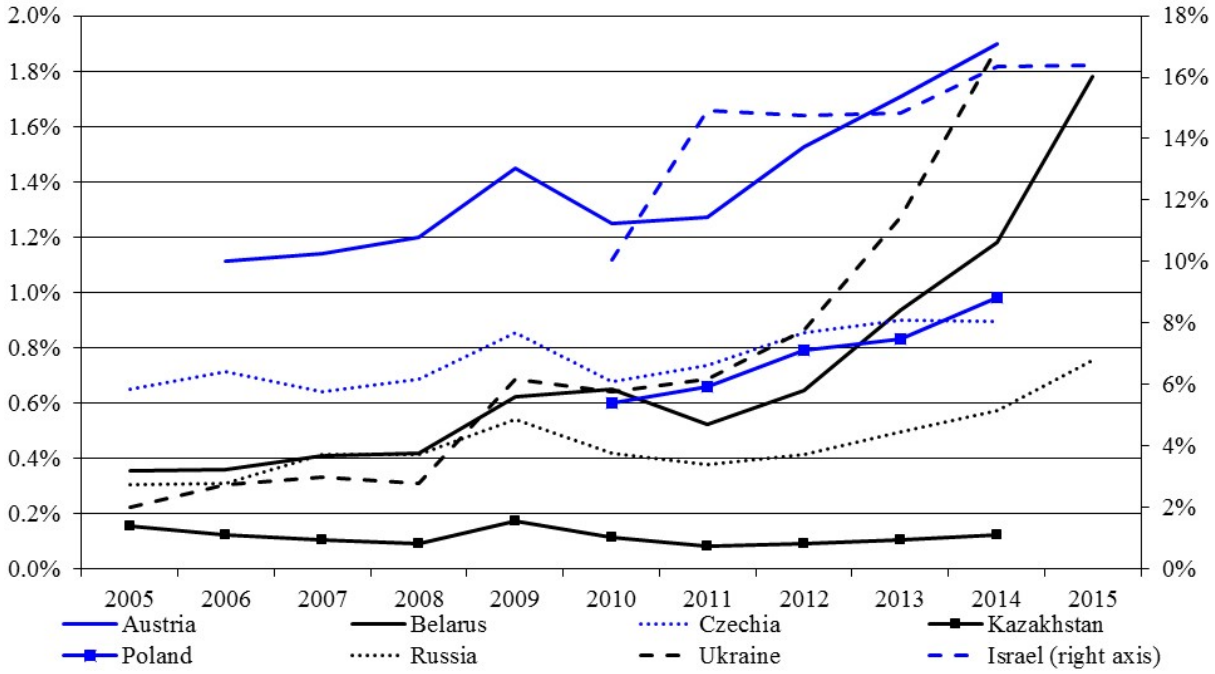


Source: Source UN Comtrade: http://comtrade.un.org/data/

A picture based on the share of complex industries in total exports shows a much more favourable picture of Belarusian exports, which suggests that its export sector is not about high-tech, but equally, it is not about labour-intensive industries and low-tech. Although the proportion of complex industries in export is above CIS peers, it is behind CE and developed country peers but as in other CIS its share of export is declining. This could be a sign of certain constraints due to the isolation of the country from international global value chains. On the other hand, ICT services are a newly emerging growth area of the Belarusian economy, which seems very promising but which is still not yet a macro driver of growth of the economy. It is encouraging that the share of ICT services of Belarus (similar to Ukraine) keeps rising and has reached a share of close to 2 per cent of total trade (Figure 32). IT is still well below the Israeli proportion of 16 per cent of exports, but this does seem to be a robust trend and Belarus figures show a very much positive outline when compared to central European peers.

[114] Note: Complex industries include the following categories: 5. Chemicals and related products, n.e.s., 77. Elec Mach Appar, Parts, Nes 74. General Industry. Mach.,Nes; 73. Metalworking Machinery; 75. Office Machines, Adp Mach; 79. Other.Transport Equipment; 88. Photo. Apparat. Nes; Clocks; 71. Power Generating Machines; 78. Road Vehicles; 87. Scientific Equipment Nes; 72. Special Industry Machinery. 76. Telecomm.Sound Equip. Etc.

Figure 32. Export share of ICT services as a share of total trade (computer services, information services and telecommunication services)



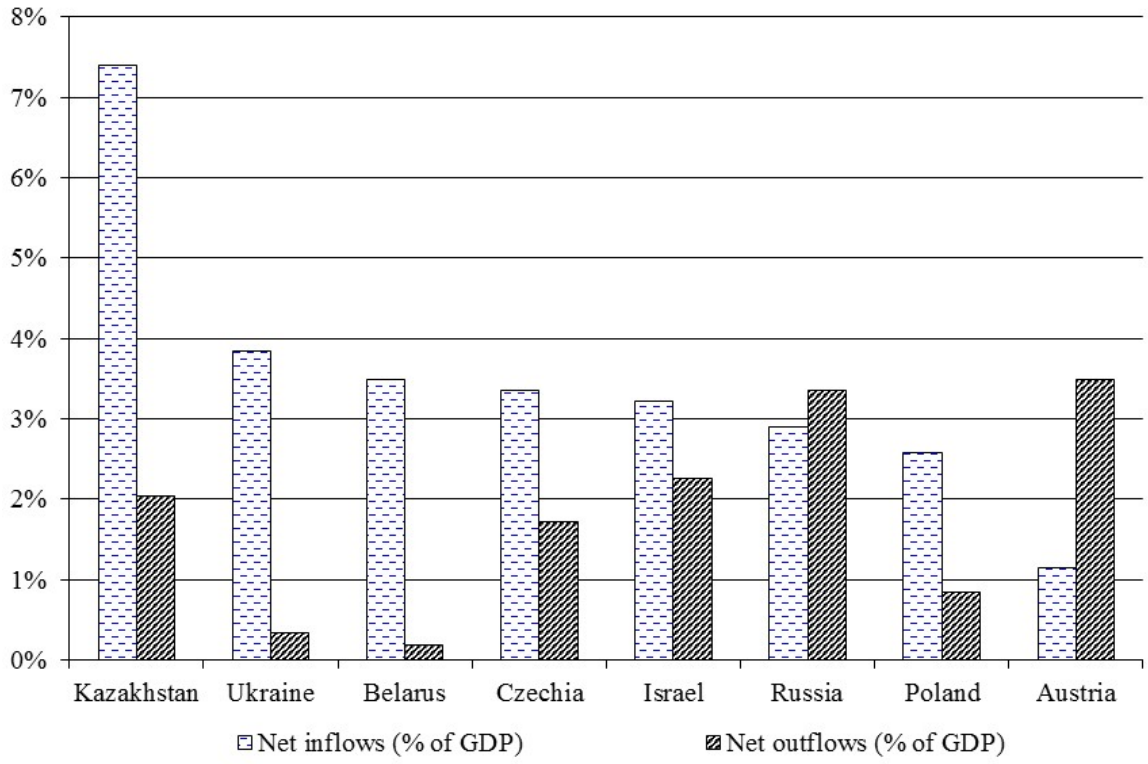
Source: WTO Trade in Commercial Services, 2005 - onwards
http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx?Language=E

Foreign direct investment and licenses as a proxy of knowledge exchange

FDI is a potential source of technology upgrading. Integration into the global economy and foreign direct investment (FDI) can act as important catalysts for change, but equally, they alone are not the drivers of technology upgrading. As literature suggests, their effects on upgrading are highly differentiated and dependent on indigenous technology effort. Still, FDI represented the potential for technology upgrading and provided that FDI presence is coupled with domestic technology effort they may represent a powerful lever for technology accumulation. Also, outward FDI indicates the strength of organizational capabilities of local firms and their capacity to access foreign markets and source technology from abroad.

In the past, levels of FDI in Belarus have been well below CE peers. In the post-2008 period, Belarus is gradually catching up. Considering the unfavourable global and EU economic context, it is quite encouraging to see that the share of FDI in the post-2008 period in Belarus is similar to other peer economies (except Kazakhstan) (Figure 33). However, flows are still low in absolute terms for a growth strategy based on high quality value-added (cf. chapter 2). Also, the lagging behind of the globalization of domestic firms is confirmed by figures on a low share of outward FDI, where Belarus ranks behind all peers.

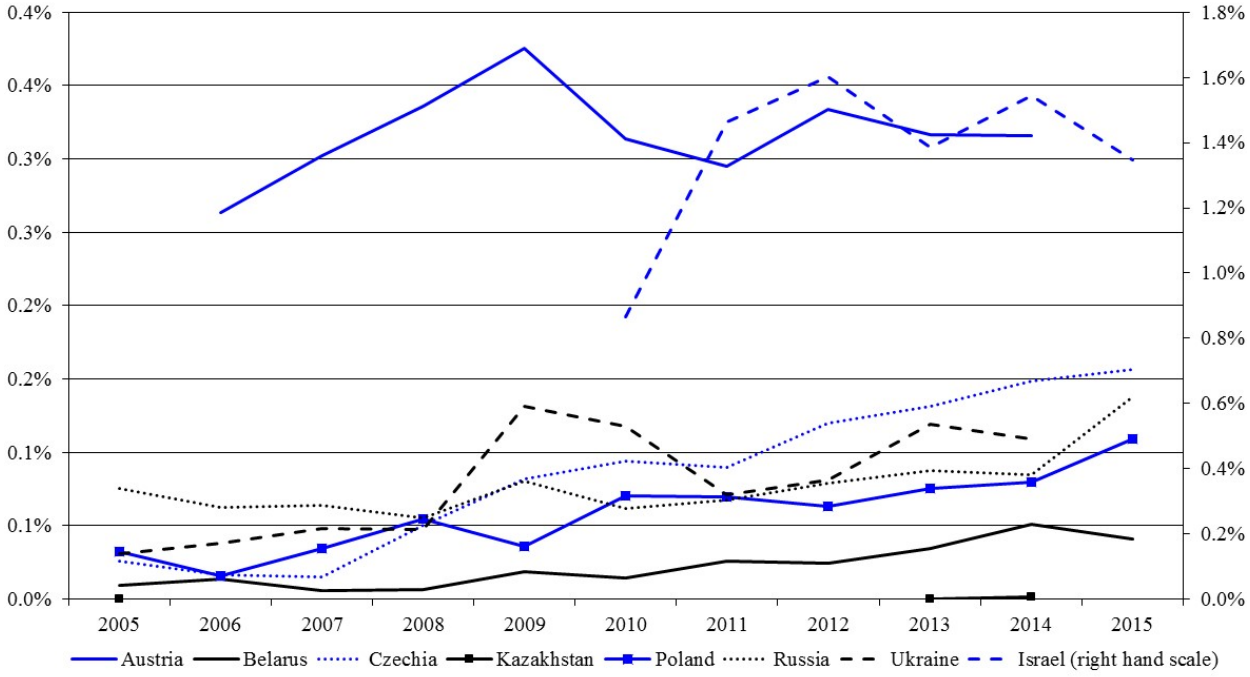
Figure 33. Foreign direct investments, 2008-2014 (average)



Source: World Bank Development Indicators database

The alternative channel of knowledge exchange is licences or knowledge in disembodied form. High shares of charges for the use of intellectual property for middle-income economies should be seen in a positive light as a sign of inflows of foreign knowledfge. Figure 34 below shows that share of these payments is rising, but also that Belarus lags behind its peers (with exception Kazakhstan).

Figure 34. Royalties and licence fee payments [i] (share of total trade, per cent)



Source: WTO http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx?Language=E

[i] Charges for the use of intellectual property n.i.e.)

3.4 Identifying strength and bottlenecks in national innovation performance

The overall conclusion of the comparative analysis of Belarus' performance in international rankings as well as indicators that are relevant for technology upgrading is three-fold. First, the potential for technology upgrading of Belarus is very firmly rooted in the CIS growth model and thus shares with countries in this region (e.g. Russian Federation, Ukraine and Kazakhstan) several structural features. The gap between developed and Central European peers is the biggest in the intensity of technology upgrading, R&D and technological capability. Second, Belarus does well regarding infrastructural (human and physical capital based), but lags regarding lacking structural change and firm-level capabilities. Third, similar to the CIS peers Belarus lags behind regarding intensity of interaction and knowledge exchange with the global economy. The country remains loosely connected to GVCs and, has a low share of FDI, even though post-2008 it has become more similar to its peers.

Still, some positive developments have occurred in recent years that could help revert this deficit. Scientists of Belarus have participated in the EU 7th Framework Programme for Research and Innovation and "Horizon 2020" (cf. chapter 4). The country has undertaken successful innovations in the development of space industry; nanotechnology, optics and information technology. It is encouraging that its share of ICT is growing and may become a major driver of macro growth if this sector continues to expand. Indeed, some companies of the Hi-Tech Park have managed to become world leaders in their fields.

Another aspect of the national system of innovation of Belarus is that it is very much oriented towards production capability or supporting problem-solving in the business enterprise sector. There is extensive support for new technology-based firms (NTBFs), but these efforts have not yet been reflected in any comparative indicators except in the export of ICT services.

Nevertheless, NTBFs are vital as knowledge brokers and specialised suppliers. Their growth is eventually dependent on the growth of large firms especially given that "gazelle" types of NTBFs are still in their early stages of internationalization with only a few high-profile exceptions (cf. chapter 4 for analysis of a dual path of technology upgrading in Belarus).

The production orientation of public R&D is visible in the high share of applied R&D at universities as well as through a very low proportion of blue sky basic research and close links between companies and universities (e.g. through commercialization activities of universities) (see chapter 2). Thus, the Belarusian R&D system is very much downstream-oriented when compared to its peer countries like EU new members States.

Furthermore, the business sector does not have developed in-house R&D and in that respect, the extramural R&D (academy and universities) plays the role of a knowledge-intensive service industry while branch R&D is *de facto* not very developed. The production-oriented R&D system is further reinforced by the low-risk approach to public funding of R&D with guaranteed return on budgetary funds.

Since the time of the first Innovation Performance Review, there has been further strengthening of the NTBFs path of technology upgrading of Belarus which is to be praised. This is visible through strengthening of two major technology parks and through successful operation of NTBFs and their good export performance. This is coupled with State support through financial and other incentives. However, a pending challenge is to enhance the other path (large enterprises) and to promote complementarities between the two paths (see chapter 4).

A new perspective argues that it is an innovation ecosystem rather than NTBFs or large firms per se that are driving innovation. In other words, large firms (such as Apple) interact with small technology-based firms (such as software companies developing apps for Apple products) which innovate based on large enterprises' stable technology platforms.[115]

Research shows that high growth firms are not necessarily high-tech firms and the capacity of a policy, or a State modernization project, to target such firms is expected to be quite limited. An alternative objective would be to think of NTBFs as new actors in industrial and knowledge systems which can foster structural change and productivity growth through linkages with other firms.

Elsewhere, the majority of NTBFs are not a direct and independent source of growth, but rather an indirect source of new knowledge, employment and value-added. They require a market (users) for the new technologies produced. The main drivers for the growth of NTBFs are large firms, provided that they are innovation-oriented. So, instead of only focusing on NTBFs, Belarusian RDI policy should focus much more on how to enhance the innovation behaviour of large firms. These agendas include reconsiderations of corporate governance, competition policy and strengthening links between large and small firms and the inclusion of large firms into global and regional value chains as subcontractors.

[115] M. Mandel, (2011*) Scale and Innovation in Today's Economy*, *Progressive Policy Institute*, Policy Memo, December. p.6. Available from: http://progressivepolicy.org/wp-content/uploads/2011/12/12.2011-Mandel_Scale-and-Innovation-in-Today's-Economy.pdf

3.5 Recent changes on methodology of statistics collection of innovation statistics

The first innovation policy review of Belarus had recommended the Government to update its methodology for the collection of innovation statistics with the goal to follow internationally-agreed standards in similar areas of statistical practice. Such reform would improve the benchmarking of national innovation performance levels across a broad range of EU and non-EU countries based on a common methodology. In order to introduce important components of internationally-accepted standards, the following measures were proposed:

- Adoption of a R&D survey according to the OECD (2002) Frascati Manual, Proposed Standard Practice for Surveys on Research and Experimental Development;
- Adoption of the system of monitoring of Government budget appropriations for R&D (i.e. GBOARD which monitors budget spending on S&T based on socio-economic objectives);
- Introduction and harmonization of Innovation Survey Statistics based on the OECD/European Commission (2005) Oslo Manual, Guidelines for Collecting and Interpreting Innovation Data;
- Harmonization of Science and Technology Statistics with guidelines in the OECD (1995) Canberra Manual on the Measurement of Human Resources devoted to Science and Technology (S&T); and
- Benchmarking the scope within the framework provided by the Community Innovation Survey (CIS) 2008 that is used in the EU for statistics on innovation activities of enterprises.

In addition, to achieve better comparability of the national innovation and R&D statistics it was also recommended to gradually introduce, harmonize or update a number of major classifications which serve as a basis for S&T and innovation statistics, including the system of national accounts, education, labour, trade as well as various activities, classifications and nomenclatures.[116]

During the period 2011-2016, the National Statistics Office (Belstat) made significant progress to better align national systems with international practice in line with the recommendations of the report. Important reforms were undertaken, including the adoption of indicators consistent with the EU Innovation Scoreboard and regular innovation surveys at the firm level.

With a view to improve the comparability of statistics, international standards were adopted to improve conceptual definitions, methodologies and approaches in the study of innovation. In particular, guidance by the Organisation for Economic Co-operation and Development (OECD), Eurostat, as well as the UNESCO Institute for Statistics, was used as a source. Accordingly, new definitions for the gathering of statistics were adopted including the following: definitions of what is innovation (with examples of product, process, organizational and marketing innovation); explanations of the components and range of innovation; and harmonization of existing questionnaires with international practice.

As a result, the questionnaires now contain both quantitative and qualitative data requests about the innovative activity of firms, including classification by type of costs, sources of financing

[116] See UNECE (2010). *Innovation Performance Review : Belarus*. United Nations: New York and Geneva, p. 18-19

and the impact of innovation on productivity. Also addressed are factors hindering innovation, as well as the ecological aspects of innovations. Given the priority of industrial production in the economic structure of Belarus, the population for the innovation surveys consists of firms belonging to the manufacturing and services sectors (i.e. communications and computer technology).

With regards to international comparisons, work was undertaken to produce indicators that allow for the comparative evaluation of Belarus with the other countries covered by the EU Innovation Scoreboard Union (IUS). Statistics are developed annually and published for 16 of the total 25 indicators.

Finally, methodological harmonization was undertaken to update forms used for statistical reporting by institutions carrying out research and development. At present, the objects of statistical observation are legal entities – and their subdivisions with separate balance sheets - that undertake research and development activities during the year under review. Basic concepts and definitions as well as the institutional classification (i.e. by sector, subject and type of scientific activities), are now based on guidance from the OECD Frascati Manual. The manual was also utilised to harmonize measures of internal research and development expenditures and financing.

Other reforms were also adopted in innovation-related statistics. Regarding the preparation of statistics of the national accounts, the system of national accounts-SNA-2008 was adopted; for education-related statistics, the UNESCO International Standard Classification of Education of 2011 was implemented. With regards to labour, Belstat refers to the international classification of occupations contained in the OECD labour statistics of 2007. Reforms were also undertaken on the nomenclature of economic activities and products. Since 1 January 2016, national classifications were harmonized with the latest relevant international versions: by activity (NACE 2008), and by product (CPA 2008). Finally, regarding trade, the commodity nomenclature of economic activities in Belarus was harmonized at the level of the six decimals standard of international trade classification and description of goods and coding of the WTO.

In spite of all the positive efforts to upgrade methodologies and mechanisms for statistics collection, it should also be noted that some important constraints remain in place that need to be removed in order to fully align the measurement of innovation performance with international standards as well as to improve the comparability of national statistics. For instance, with regards to the the preparation of the National Innovation Survey, although it is formally in line with the Oslo Manual and Eurostat's Community Innovation Surveys (CIS), there are some substantial differences. With regards to its coverage the innovation survey used by Besltat is limited. For example, the enterprise survey of innovation activities carried out by Belstat is focused only on the firms' R&D expenditure and innovation output (i.e. sales of innovative products), but it does not cover some of the most critical aspects of modern firms' innovation activity as is the case according to international best practice.

This problem can be best perceived when contrasting the coverage of BelStat's questionnaire with the CIS Harmonized Survey Questionnaire. Some key subject areas of the innovation process are missing from the questionnaire used in Belarus, including the following aspects: whether innovations are developed internally or in cooperation with other institutions; whether the innovations are new-to-the-market (i.e. frontier innovation) or new-to-the-firm only (i.e. imitation); the scope of novelties (e.g. local market, regional market, world market); the type

of firm's innovation activities (e.g. in-house R&D, external R&D, acquisition of technology or knowledge training); type of benefits from public support to innovation; sources of information and co-operation for product and process innovation and collaboration with other innovation stakeholders; and the protection of intellectual property by firms.

Another challenge concerns the population of the National Innovation Survey in Belarus. As mentioned, the questionnaires are distributed only among firms in the manufacturing and high-tech services. By contrast, Eurostat's practice is to cover a representative sample of firms from all sectors. In the most recent surveys, public sector organisation has also been covered as part of a section devoted to public sector innovation.

With regards to other aspects of measuring innovation performance, the Government has not yet adopted the system of monitoring Government budget appropriations for R&D (i.e. GBOARD, which monitors budget spending on S&T based on socio-economic objectives), neither has it harmonized the available Science and Technology Statistics with modern guidelines in this field (e.g. the OECD (1995) Canberra Manual on the Measurement of Human Resources devoted to Science and Technology (S&T), and the Frascati Manual).

Since 2010, there has also been progress in the collection of world statistics which may also have an impact on the measurement of innovation. For example, the rise of regional and global value chains has contributed to the emergence of an international project on world input-output tables and trade in value-added by OECD/WTO that can help inform government strategies on potential benefits and risks of participation in such types of international production. Other more traditional business statistics have also been improved, including the Structural Business Statistics (SBS); Trade by Enterprise Characteristics (TEC), Entrepreneurship Indicators, Business Demography (BD), and Foreign Affiliate Trade Statistics (FATS). Each of these sources of statistical indicators are required for the better understanding of innovation aspects of trade as well as modern entrepreneurship.

3.6 Recommendations

3.1. The National Statistical Committee should work towards fully adopting best international standards in the collection of innovation statistics as reflected in Eurostat's CIS Harmonized Survey Questionnaire as practiced by Eurostat and the EU member States. In conducting this work, it should take into account the expert advice of the UNESCO Institute for statistics on the proposals of the SCST on the improvement of statistical reporting forms "1-NT innovation".[117]

3.2. Training of statisticians is crucial to improve the quality of data and indicators. The National Statistical Committee should consider seeking technical cooperation support in introducing good practice, including through training activities with UNECE Statistical Division, Eurostat, OECD and/or UNESCO statistical office as well as with the participation of international experts with knowledge of CIS economies.

3.3. If the surveyed organizations are not familiar with the terms and logic of the questionnaire they will not provide good data. Consider extending the training activities beyond the National

[117] See official replies to letters: "Opinion of experts of the UNESCO Institute for statistics on proposals on Science and Technology to improve the structure of the "1-NT innovation";

Statistical Committee to include also surveyed organizations and potential users to understand better the logic of innovation survey and its indicators.

3.4. The National Statistical Committee should consider widening the scope and coverage of the innovation surveys in line with international best practice:

- The next innovation surveys should consider a broader population of enterprises and the questionnaire should also focus on non-technological innovations.
- More small firms should be included in the targeted population of the innovation survey.
- A more intensive use of the available data to serve the preparation of more indicators (including disaggregation of available information and providing more user-friendly presentations of survey information).
- Consider involving other stakeholders from civil society in the preparation of innovation statistics. For instance, during recent years the European Union developed a pilot databank (ETER) for benchmarking education institutions, which is a typical field where statistical offices and non-governmental organisations can collaborate further.

3.5. With regards to the country's ranking position in innovation performance indexes, it should be acknowledged that the link between the individual indicator and the overall innovation objective is very often vague and mediated through a variety of other factors. Indicators are only a proxy of deeper, more complex, social realities. Thus, at the time of designing national strategies and programmes there is no need for Government bodies to target individual indicators with the narrow aim to improve the country's ranking on a specific international index. Even if it is of utmost importance that Belarus benchmark itself in as many international rankings as possible, it should be done with the aim to understand better issues and challenges rather than reducing policies to achieving target levels of specific indicators. Indicators should inform policy, but only rarely should they become policy targets in their own right.

Chapter 4

INNOVATION IN THE ENTERPRISE SECTOR

Innovation activities can improve economic performance at the aggregate level of a national economy. Public and private enterprises are a key element of the eco-system for innovation that was discussed in chapter 2. In order to understand better the mechanisms behind innovation and to provide more specific recommendations, it is also important to look into the innovation activities that happen intra-mural within the innovative firms themselves.

In the last few decades, the way in which companies undertake innovation activity has fundamentally changed. According to the economic literature on innovation, the *closed* innovation paradigm - also known as the *linear* model of innovation - was replaced by *open* innovation,[118] which emphasises the importance of inter-organizational linkages for knowledge creation and diffusion in national and regional systems.[119] In a world of widely distributed knowledge, companies cannot afford to rely entirely on their own research, but need, instead, to buy or license processes or inventions from others.[120]

In Belarus, historical legacy means that the country's innovation system is still related to the innovation paradigm known as the *linear* model of innovation. Thus, networking is limited and the Belarusian innovation policy remains biased against the undertaking of intramural, risky, innovation activities. As discussed in Chapter 2, for projects receiving State finance, in cases where project partners fail to commercialize the resulting products, the consortium must repay the whole grant funding received for the project. Furthermore, the system is characterized by a lack of demand-driven innovation from firms.

Still, despite these shortcomings, Belarus counts on a growing business sector where innovative activities have taken place; and some success stories shed light on actual lessons that could be replicated elsewhere. This chapter considers the recent experience of innovation at the firm level in Belarus. It describes constraints that companies have to face as well as different types of available policy support. The last section offers some recommendations to improve the framework conditions for innovative enterprises and help them overcome the burdening factors to innovation.

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[118] H. W. Chesborough, *Open innovation - the new imperative for creating and profiting from technology.* Harvard Business School Press (2003). O. Gassmann and E. Enkel, *Towards a Theory of Open Innovation: Three Core Process Archetypes*, in: Proceedings of the R&D Management Conference (RADMA). Sessimbra, Portugal July 8-9, (2004).

[119] The linear model of innovation is an early model of innovation that suggests technical change happens in a linear fashion from invention to innovation and then to diffusion. It prioritises scientific research as the basis of innovation, and plays down the role of later players in the innovation process. For more details on innovation models see Roy Rothwell,"Towards the Fifth-generation Innovation Process" in *International Marketing Review*, Vol.11, no. 1, (1994), pp.7-31; B-A. Lundvall, (ed.), *National Systems of Innovation - Towards a theory of innovation and interactive learning*, (1992), Pinter Publishers, London, UK; R. Nelson,. (ed.), *National Innovation Systems*, New York, Oxford University Press, USA. (1993)

[120] A. Inzelt, *Collaborations in the Open Innovation Era* (2010) In: N. Ekekwe (ed.), *Nanotechnology and Microelectronics: Global diffusion, economics and policy*, pp. 68–86. USA, Hershey: IGI Global.

4.1 Recent trends and challenges of Belarus' innovation ecosystem for business

One of the great challenges for Belarusian authorities is to create proper framework conditions for nurturing the missing or weak actors of the country's innovation ecosystem. Since 2010, Belarus has made efforts to move towards a knowledge-based innovative economy and these steps have improved the environment for innovation. However, there are still numerous challenges to set up a competitive, innovative economy (cf. chapter 2). This section devotes attention to some elements of the innovation eco-system that are relevant for the undertaking of innovative activities in the business sector.[121]

The business environment

In Belarus, there have been significant changes in the business environment since the time of the previous review.[122] Although the recent economic crises have had a negative impact on the activities of public and private companies of all sizes, knowledge-intensive industries have managed to cope better with the effects of the economic downturn.

Overall, some important changes in the general business climate have influenced the innovation ecosystem. For instance, tax legislation has reduced the tax burden on business and simplified tax administration.[123] The profits tax was lowered from 24 per cent to 18 per cent. The International Financial Reporting Standards (IFRS) were adopted nationally, which will be implemented for the first time for the year 2016. Some accounting forms have been designed also in an electronic format as an alternative to paper format. These changes are deemed to reduce administrative costs and improve the transparency of economic organizations.

Other developments have been considered - but still need to be implemented - that could also have an impact on improving the business climate. These include establishing an independent competition watchdog, making the labour market more flexible, improving the effectiveness of employees' payments systems, improving real estate markets and other changes in the existing public procurement system to make it more accessible for SMEs.[124]

Government funding of innovation activities

Among other factors, scientific capacities and production depend on available financial resources for R&D activities and human resources. Comparing internationally, gross domestic expenditure on R&D to GDP, Belarus is among the low spending countries and the proportion of GERD to GDP has hardly changed over the years (cf. chapters 2 and 3). Chapter 2 analysed the contents of two mid-term State Programmes for Innovative Development (SPID 2010-2015

[121] *Innovation ecosystem* is the term used to describe the large and diverse array of participants and resources that contribute to and are necessary for ongoing innovation in a modern economy. This includes entrepreneurs, investors, researchers, university faculty, venture capitalists as well as business development and other technical service providers such as accountants, designers, contract manufacturers and providers of skills training and professional development. See http://masstech.org/innovation-ecosystem.

[122] UNECE Innovation Performance Review Belarus, New York and Geneva 2011

[123] Measures were undertaken to move forward with the implementation of the Directive of the President No. 4 of 31 December 2010 "on the development of entrepreneurial initiatives to stimulate business activity in Belarus". As of 1 July 2015, the Council of Ministers and the National Bank adopted 193 legal acts: 22 Laws of the Republic of Belarus, 41 decrees, 5 decrees and 3 Orders of the President, 73 resolutions of the Council of Ministers of Belarus, 7 Board resolutions of the National Bank, and 42 departmental acts of legislation.

[124] See various strategy documents, such as SPID 2010-2015 and SPID 2016-2020

and SPID 2016-2020). This chapter will comment on a few elements of these programmes where progress is crucial for innovations at the firm level.

In 2015, the expenditure from the Republican budget was BYR1,946.6 billion (slightly lower than budget estimates) on scientific, technical, and innovation activity. Of this amount, 70 per cent supported basic, applied research and the development of physical infrastructure in public research organizations; four to five per cent of the budget went to support several other items such as the statutory functions of the NAS of Belarus, international scientific and technical cooperation, to develop a State system of scientific and technical information and to train and certify highly qualified researchers. Smaller amounts were used for other support measures.

An important change has been introduced in STI financing: the establishment of Innovation Funds.[125] In the Republic of Belarus 32 funds were working (25 Republic Innovation Funds and seven Local Innovation Funds) in 2015. Although these were unified in 2016, it is worth investigating the support allocated by innovation funds. Data are available on expenditure by priority only for 2015. The expenditure of local innovation funds was much larger (allocated 80.5 per cent) than for Republic innovation funds (19.5 per cent) in 2015. Table 23 summarizes the directions in which Republic and local innovation funds were used in 2015.

Table 23. Expenditure of Innovation Funds by Direction of use 2015

Directions for the use of innovation funds	Local innovation funds		Republican innovation funds		Total innovation funds	
	BYR million	% of total	BYR million	% of total	BYR million	% of total
Financing innovation projects that meet the three criteria set out in Decree No. 357*	140,492.9	12.7	70,966.9	26.7	211,459.8	15.4
Financing R(T)D	120,227.4	10.9	77,611.2	29.2	197,838.9	14.4
Financing training and mastering of production of new or improved products (technologies)	640,745.1	58.0	109,387.9	41.1	750,133.0	54.7
Financing scientific-practical activities (conferences, seminars, exhibitions)	1,818.4	0.2	8,032.7	3.0	9,851.1	0.8
Financing innovation infrastructure entities	201,630.3	18.2	-	-	201,630.3	14.7
Total	**1,104,914.1**	**100.0**	**265,998.7**	**100.0**	**1,370,912.8**	**100.0**

Source: Справка на Президиум 15 February 2016, Table 1
Note: * The criteria are the following: to foster technological process and reach the level of average value-added per capita in EU for a corresponding economic activity; export orientation of innovation projects; creation and introduction of new technologies and/or production that are new at least for the country.

The introduction of innovation funds was an important step to modify the Belarus RDI financing structure from the time of the previous Innovation Review.[126] These funds placed

[125] Decree of the President of the Republic of Belarus from August 7, 2012 No. 357 Income and expenses of innovative funds, Decree of Council of Ministers of the Republic of Belarus of February 27, 2015 N 143 "on determining the income and expenses of innovative funds for Republican budget funds/ Republican innovation funds in the year 2015".
[126] UNECE, Innovation Performance Review Belarus, New York and Geneva, 2011

more emphasis on RDI and competition.[127] The forthcoming unification of the republican innovation funds may also offer a better opportunity for future-oriented innovative development.

There are other lessons to be learnt from the planned unified fund. The expenditure of all innovation funds was below the planned level in 2014 and 2015 and the funds could not fully utilise their resources.[128] It can be assumed that the integrated Republican innovation fund will allow for the centralization of funds as well as for increased efficiency and opportunities for reallocation of financial resources for innovations among relevant economic sectors (cf. chapter 2).

Entrepreneurship

A vibrant SME sector is an important driver of innovation activity in a country. In 2013, there were 12,515 SME industrial organizations of which 605 were medium-sized firms, 3,433 small- and 8,476 micro-entities.[129] The number of small- and micro-entities increased from 2010, whilst the number of medium-sized firms decreased. The volume of industrial production has grown faster in micro-firms than in others (at current prices). Thus, in 2010, the contribution of SMEs (without individual entrepreneurs) amounted to 19.8 per cent and, in 2013, it had increased to 22.3 per cent of GDP and employed 26.8 per cent of the workforce.

In Belarus, public resources (State budget, State run funds, decreased tax rate), are more important for innovative SMEs and start-ups than in mature market economies. In principle, SME development is a declared policy priority of the Belarusian government, which is embodied in the State programmes on SME entrepreneurship. Among other things, these programmes envisage the allocation of public financial resources to support SME development. Most of this support takes the form of the organization of forums, exhibitions, fairs, and other forms of information brokerage, which facilitate inter-firm linkages and linkages between industry and R&D institutions. There are also some limited sources of financial support for SMEs (in the form of repayable loans), through the Belarusian Fund for Financial Support of Entrepreneurs. As mentioned in chapter 2, Presidential Edict No. 229 of 2013 opened the way for using the instruments of the Belarusian Fund for Financial Support of Entrepreneurs also for early stage financial support to innovative SMEs.

Concerning innovation policies that foster entrepreneurship, already in 2009 a decision was made to allocate financial resources to clusters that support SME growth.[130] Later, the general government programmes (SPID 2011-2015 and SPID 2016-2020) have devoted special attention to small- and medium-sized enterprises (SMEs). The first one included the adoption of laws to facilitate financial, property and informational assistance for SMEs, through the creation of business promotion centres, small business incubators, financial support for businesspersons, mutual credit extension and other similar measures. The latter included the

[127] Decree No. 357 financing of innovation projects at the expense of the funds of innovation funds
[128] See Справка на Президиум 15.02.2016
[129] Statistical data on SMEs are from *Small and Medium-sized Business in the Republic of* Belarus, Statistical data book, 2014, National Statistical Committee of the Republic of Belarus, Minsk tables 1.1.1, 1.5.3., 1.5.4. 1.5.6, 1.9.1
[130] See Amendment to the Decree of the President of the Republic of Belarus decides "on certain measures of the State support of small entrepreneurship" with the extension of State support centres, clustered development and establish areas of expenditure of such support. May 21, 2009 No. 255, (national register of legal acts of the Republic of Belarus, 2009, no. 131, 10713/1)

stimulation of innovation activities of small businesses for the 2016-2020 period as an objective itself. *Business promotion or incubator centres* are required to provide basic infrastructure, information and other services *to support small and medium enterprises.* International organizations have also been involved on the launching of supporting organizations for Start-ups (Box 6).

At the same time, some important objectives and targets of SPID 2016-2020 remain in the "grey area" of ambiguous funding. One conspicuous example is the declared objective to support innovative SMEs and the target to increase their contribution to GDP. Despite this declared intention, the programme does not envisage any concrete policy instruments to support innovative entrepreneurship and does not indicate specific public funds earmarked for this purpose. In a similar vein, the programme puts a special focus on the objective to raise the export activity of Belarusian firms and, in particular, to increase the exports of high-value added (high technological content) products. However, it does not refer to specific policy instruments directed towards stimulating such export activity so it remains unclear how the authorities plan to pursue such an objective.

Box 6. Examples of supporting start-ups

Talaka.by is a Belarusian non-profit platform for project implementation where start-ups can gather a team, get support, feedback and receive funding. Talaka is a gathering point of independent people who jointly create social and entrepreneurial innovation. Everyone can publish and test their ideas, receive feedback from target groups, transform ideas into projects and then carry them out by means of crowd-sourcing and crowd-funding resources provided by the platform. The platform provides an efficient infrastructure for stimulation, selection and support for various innovative ideas. Talaka has been working already for two years in Belarus. The platform has more than 14,000 active users and more than 250 published projects, 55 of which were implemented without any financial support for two years. Nowadays the platform is seeking international partners in other countries. UNDP has been actively involving Talaka in running innovative initiatives over the last year. Recently Talaka has been involved within the EU/UNDP project "Support to Local Development in the Republic of Belarus".

Source: Talaka.by/UNDP

With regards to access to early-stage finance, in many countries with more sophisticated financial markets, SMEs and start-ups may obtain financial resources from venture capitalists, NGOs and business angels. In Belarus, as is the case in other post-socialist economies, business angels and venture capital hardly exist. One exception is the existing venture capitalist organization BAVIN, which selects promising business projects of private individuals and SMEs with the subsequent allocation of lump-sum grants of about US$ 50,000 (cf. chapter 2). Loans by international development banks could also help reduce the shortage of financial resources for SMEs. The authorities wish to use this external source to finance the innovation voucher projects, venture grants (through the Belarusian Fund), and financing business incubation (industrial parks) (See table 6.1 of BelISA report)[131]

[131] ОТЧЕТ О НАУЧНО-ИССЛЕДОВАТЕЛЬСКОЙ РАБОТЕ «Межстрановая оценка состояния научно-технической и инновационной сферы Республики Беларусь на основе анализа международных

IPR regulation, patenting activities and remuneration of inventors

IPRs have an important role in dissemination of knowledge since their protection and codification encourages the creation of novel knowledge. The registration of patents, utility models and industrial designs are influenced both by how competitive the business environment is and how strongly are the business actors pressed toward innovation. The transferability of the protected knowledge's ownership is also important for commercialization activities. Thus, decisions by inventors and their employing organizations to seek protection are influenced by existing regulations and incentives.

During recent years, Belarus has made important progress in improving its legal framework - including for licensing innovative products and improving cooperation mechanisms between scientific actors - in order to boost business innovation activity in recent years. Nevertheless, some challenges remain to be tackled (cf. chapter 2).

The Belarusian law on patents for inventions, utility models and industrial designs has been modified several times (the last amendment was made in 2012).[132] This law regulates the property and associated personal moral relations arising in connection with the creation, legal protection and use of inventions, utility models, and industrial designs. The legislation is in harmony with international treaties and, in principle; it enables the protection of intellectual property objects of domestic and foreign entities. In addition, some Government decrees have set the legal framework for the sharing of royalties and other IPR incomes between inventors and employers.[133] According to legislation, remuneration is paid in the amount and on the terms specified in agreements between the employee and the employer - the minimum level of remuneration shall be determined by the Council of Ministers of the Republic of Belarus.[134]

Legislation does not set limits to research organizations on the maximum remuneration of authors (co-authors) for the establishment of the objects of industrial property rights. If the employer decides not to protect an invention - and keep it secret - the reward for the creation of objects of industrial property rights to authors, co-authors and individuals is paid as a lump sum within three months of the employer's decision. Businesses may combine two solutions:

статистических данных и рейтингов и предложения по улучшению позиций Республики Беларусь в этих рейтингах» (заключительный) Государственный комитет по науке и технологиям;Республики Беларусь, Государственное учреждение «Белорусский институт системного анализа и информационного обеспечения научно-технической сферы» (ГУ «БелИСА») УДК 339.9:338.1;339.9:330.34;338.2 № госрегистрации 20151401 Инв

[132] Law of the Republic of Belarus, December 22, 2011, No. 328-З (National register of legal acts of the Republic of Belarus 2012, No. 2, 2/1880).

[133] Since 1998, the Council of Ministers has set up legislation that provided State incentives and encouraged the creation and use of objects of industrial property. The law **w**as amended by the decrees of the Council of Ministers № 237 of 2010, №122 and №1184 of 2011, №of 2013 and №of 2015.

[134] Постановление совета министров Республики Беларусь 6 марта 1998 г. N 368. Об утверждении положения о порядке и условиях государственного стимулирования создания и использования объектов промышленной собственности. Decree on regulations of conditions for stimulation of creation and use of objects of industrial property. As amended by the decrees of the Council of Ministers from 28.02.2002 N 288, 15.07.2002 N 949, 24.12.2003 N 1684, 15.12.2005 N 1459, 19.02.2010 N 237, 02.02.2011 N 122, 05.09.2011 N 1184, 24.01.2013 N 55, 27.02.2015 N 146).

to keep secret some inventions and to patent others abroad (e.g. exported innovative products). The inventor would be compensated equally regardless of the selected solution.

There are no legal factors preventing patenting abroad, but the lack of financial resources acts as a very serious constraint to firms. There is, however, one foreign region where Belarus has a good chance to register her intellectual properties at a relatively low expense: the Eurasian Economic Union.[135] This availability of inexpensive fees has had a measurable impact: the number of Eurasian applications filed by Belarusian applicants during 2015 increased by 46.6 per cent compared to 2014 (reaching 170 applications).[136] Because of the short history of the Eurasian Patent Convention, there is no information about the enforcement of the Eurasian patents. Looking forward, State support schemes to cover the cost of patenting abroad could provide good measures for better protection of Belarusian intellectual properties that can lead to higher income for the country from licences and exported goods.

Even though patent registration is low in general, performance by different patent classes has differed. Table 24 shows the number of patents by classes.

Table 24. Number of patents by NCL class, 2001-2015

Selected patent classes (NCL classification)*	Number of patents
35 covering advertising, business management, administrative activities in the field of business, office functions	796
05 covering pharmaceutical, veterinary preparations.	420
09 covering scientific, nautical, surveying, photographic, cinematographic, optical, weighing, measuring, signalling, checking (supervision), life-saving and teaching apparatus and instruments; data processing equipment, computers; computer software.	290
33 alcoholic beverage	284
30 covering coffee, tea, cocoa and artificial coffee; rice; tapioca and sago, etc**.**	278
29 covering meat, fish, poultry and game; meat extracts; preserved, frozen, dried and cooked fruits and vegetables.	272

* Nice International Classification, the International Classification of Goods and Services

Category Number 35 is the best performing patent class, followed by Number 05, where the country's industrial capacity is also remarkable[137]. There are also various agreements in place that grant the right to exploit intellectually protected goods.

According to statistics, the overall number of agreements registered in 2015 amounted to 633, including:

[135] An Agreement on Coordination of Actions for the Protection of Rights for Intellectual Property Objects was signed on September 8, 2015. If the applicants are from the member States of the Eurasian patent convention, they are required to pay ten per cent of the full rate for filing the patent. Beyond that, the Belarusian applicants pay an additional US$50 fee (for preliminary examination at the national level).

[136] e-mail from Head of International Cooperation Division, National Center of Intellectual Property

[137] Although the IT software industry is well advanced and knowledge production capabilities are very good, they do not appear highlighted among patent data, partly because software is not usually a patentable good.

- 339 license agreements;
- 258 industrial property objects assignment agreements;
- 35 franchise agreements; and
- One pledge agreement on the right to industrial property objects.[138]

IPR-related relationships with foreign firms also raise critical issues. Foreign applications for IPR are a sign of the importance of the domestic market for foreign investors. Foreigners apply for patents or trademarks if certification means a guarantee of real protection. (I.e. legislation is aligned with international norms and IPR laws are enforced). Thus, the presence of foreign applicants is a signal that they deem the local legislation and enforcement appropriate. These conditions need to be in place for foreigners to apply for protection (pay the fees), and be adequately protected from copying (or reverse engineering), with regards to their intellectual products. In Belarus, foreigners are most active in protecting trademarks. Patent application by foreigners is not very intensive, since the market is small. The highest number of applications was filed by residents of Russia and Kazakhstan, followed by residents of China - together amounting to 44 per cent of the total. In addition, a much lower proportion of applications arrived from some of the most innovative economies (e.g. Germany, USA, Italy and Netherlands). In the registration of industrial design, the bulk of applications arrived from Russia, and Ukraine (the number of applicants from USA, and France are also significant).[139]

Unlike in the case of countries with economies in transition that are EU members, in Belarus the number of national applicants was much higher than foreign applicants during the last few years. In 2011, the national patent application was 1,365, of which 109 was filled by foreign applicants. These figures were respectively 803 and 99 in year 2015.[140] The difference between the number of national and foreign applicants is much lower in the case of industrial designs: in 2015, national applications were 121 and foreign 90.

Thus, statistics show that foreigners are relatively more interested in protecting their industrial design than patents, which is likely due to the fact that, in the context of Belarus, counterfeiting is much more of a threat for trademarked goods and for industrial design than patented goods.

Finally, *co-patenting* has also occurred. This type of registering knowledge may be the result of joint R&D efforts, co-financing of R&D, or co-funding of the patent fee. The latter involves limited collaboration between inventors and owners, but its importance is not negligible. If a firm is ready to cover a part of the patent cost, it is a strong commitment for commercialization. Box 7 gives some examples of co-patenting. These examples illustrate business involvement in R&D and/or patenting activities. Both domestic and foreign firms were ready to invest in pre-commercialization; and had proper financial resources to cover the costs of patenting abroad.

[138] The NCIP is responsible for registering and maintaining the State Register of License Agreements, Assignment Agreements and Pledge Agreements on IP objects. The Resolution of the Council of Ministers of the Republic of Belarus on March 21, 2009 No. 346 «On Registration of the License Agreements, Assignment Agreements, Pledge Agreements on Rights of Industrial Property Objects and Contracts of Complex Business Licenses (Franchise)».Data comes from the NCIP Annual Report 2015, Table 11.

[139] Extracted from various tables of National Center of Intellectual Property (NCIP) Annual Reports 2015 and 2016.

[140] NCIP Annual Report 2015 Table 2,

Box 7. Examples of co-patenting activities and successful commercialization

Polotsk State University and the French firm "INSTRUMENTATION SCIENCE DE LABO" jointly patented in 13 countries around the world, an invention, implemented in devices for rapid analysis of oil characteristics. These devices are successfully sold in Eastern and Western Europe, USA, Asia, Africa and South America. Payments to Polotsk State University for joint use of the invention in 2002-2014 amounted to more than €782,000.

Research Institute for Physical-Chemical Problems of the Belarusian State University in 2011-2014 signed 63 contracts to perform R&Ds jointly with companies and enterprises of Belarus and 26 contracts with foreign firms. The total amount of raised funds amounted to BYR5.5 billion and US$1.3 million. In 2015, the Research Institute for Physical-Chemical Problems of BSU received royalties for 11 contracts in the amount of BYR476 million.

Source: National Center of Intellectual Property

The "knowledge triangle" of higher education, research institutions and businesses

The integration of innovation, science and education can create important synergies for economic development. While higher education plays a key role as a major supplier of human resources for science and business, it is also important that modern higher education be innovation-oriented and grounded on the basis of modern research approaches.

The concept of a "knowledge triangle," referring to the interaction between research, science and innovation has been highlighted to define three main components of modern innovation systems: education (in particular higher education institutions), innovation (both by enterprises of the public sector and private firms), and research (Academy of Sciences or research institutions within educational institutions).

In 2013, a consortium comprising organizations and agencies from Germany, Latvia, Slovakia, Belarus, Ukraine and Republic of Moldova received a grant from the European Commission to undertake the TEMPUS project on "support of the triangle of knowledge in Belarus, Ukraine and Republic of Moldova". Within Belarus, the national coordinator of the project was the Belarusian State economic university, which worked under the Ministry of Education with partner institutions that included a series of research and education institutes.[141]

The implementation of the project aims to support the development and integration of educational, scientific and innovation spheres, including in the area of improvement of legislative and normative acts related to their functioning. Between the years 2014-2015 the Government undertook a detailed analysis of the problems affecting the interrelationships between higher education, research and businesses based on the findings of the TEMPUS project, which signalled a series of hindrances to innovation that include aspects of the legal,

[141] See Project 543853-TEMPUS-1-2013-1-DE-TEMPUS-SMHES «Fostering the knowledge triangle in Belarus, Ukraine and Republic of Moldova».

organizational, and access to resources (both human and financial). The following are considered some of the key priorities by the authorities:

Legal

1. The amendment of legislation involves complex procedures with a large number of organizations and officials involved (e.g. for generating and submitting proposals; consideration; decision-making; among others).

2. Higher educational institutions have significant dependence on the Ministry of Education and lack sufficient autonomy in national regulations.

3. Higher education institutions do not have the right of preferential taxation in national regulations.

4 There is no legal base of innovative business incubators at higher educational institutions and technology parks (both at national and local levels).

5. The legal framework regulating the activities of innovative enterprises under universities, technological parks, as well as the activities of university department branches and research laboratories need further development.

Organizational

1. Professors at higher education institutions are often burdened with the risk of reduced time for research work due to high teaching workload, which in turn reduces opportunities for interaction with industry in the sphere of research.

2. The procedure of purchasing equipment by research institutions is very complicated and long, which creates a competitive disadvantage for research organizations within public institutions compared with more efficient private organizations and research laboratories of enterprises.

3. The use of new educational technologies is weak, which reduces opportunities to prepare qualified personnel for science and innovation enterprises. The following barriers will need to be removed:

- The need to more actively involve large corporations in the knowledge-intensive hi-tech sector to cooperate through linkages with SMEs by sourcing as well as creating associations; and
- The need to improve scientific-technical activity in the regions by strengthening the interaction between main sectors of regional science and industry in the sphere of regional scientific-technical programmes.

4. Some educational problems threaten the national competitiveness of Belarus and also result in organizational challenges, including:

- The fact that national technical, economic, and human resources policies of higher educational institutions are not focused on improving national competitiveness;
- Insufficient merging of higher education institutions with industrial complexes;
- Lack of timely updating of goals, content and technologies of higher professional education, which would involve improving the syllabuses by taking into account the achievements of scientific-technical and social improvements as well as requirements of new international standards;
- Insufficient universalization of the higher education and integration processes of all higher educational institutions into a system of leaders in the country and in the world, which could lead to emergence of large university complexes (e.g. scientific and educational State megalopolises of interregional significance);
- Insufficient democratization of the educational system by guaranteeing accessibility of education to all the population, especially for the talented youth irrespective of their social origin and financial position; and
- Inadequate implementation of modern information technologies and intensive development of distance learning.

Access to human resources

1. The progressive aging of the professional teaching population in Belarusian higher educational institutions is challenging as it could eventually lead to the closure of departments and research schools. The number of graduates has been diminishing and fewer PhD students decide to remain to work in schools after graduation.

2. There is an underdeveloped system of training and retraining of teachers (a problem that is particularly acute for IT-education).

3. Heads of State organizations can misunderstand the importance of innovative processes, transfer of technology, science, innovations and education integration; and often lack a vision of challenges to enterprise development linked to risk-taking (cf. chapter 2).

4. Higher educational institution employees are not often ready to undertake transfer of technology activities. Marketing strategies are undeveloped and, therefore, the potential of higher educational institutions can be unknown abroad.

5. Top business managers can be unable to undertake tasks for high-tech research and lack a developed system of business intelligence.

6. There has been a decrease in personnel capacity of higher educational institutions, which is linked to salary differentials (i.e. salaries in private companies can be higher than in education, between two and a half and three times, and up to ten to 15 times more). In addition, the subject of university work can often involve too many routine tasks, which reduces its attractiveness. Consequently, the problem of supplying higher education with high qualification personnel cannot be promptly solved.

Access to financial resources and other challenges

1. The extremely low salaries of teaching staff make it necessary for professors to find additional sources of income to ensure a decent standard of living. In turn, this situation adversely affects their ability to conduct scientific research, and the quality of teaching.

2. Due to insufficient funding, State organizations are not ready to invest in transfer of technologies. Due to the economic crisis, a number of industries are not ready to invest funds in the system of personnel training and innovation projects. The highest risks in financing the "knowledge triangle" are observed in mechanical engineering and metallurgy (the sphere of personnel training for IT industry is least of all subject to such risks).

3. Higher educational institutions do not have modern libraries, providing free access to books, electronic search systems, access to international publications and online libraries.

4. Increased safety requirements and aspects of commercial confidentiality became a problem for higher educational institutions to conduct research for companies. As a result, a number of projects which could be fulfilled in cooperation with higher educational institutions with scientific laboratories are unrealized.

Since the undertaking of the TEMPUS project, the working group established by the Government has also identified a series of mechanisms aimed at addressing the challenges impeding the effective implementation of the "triangle of knowledge". According to its conclusions, the following is a non-exhaustive list of priority actions identified by the authorities to improve public policy:

- Work towards the expansion of opportunities for academic mobility;
- Creation of educational-scientific and educational-scientific-production complexes and consortia;
- Creation of educational-scientific and educational-research-and-production centres;
- Development of the system of supplementary education for adults on innovation development related issues;
- Creation of a modern legislative framework for the activities of business incubators;
- Support of improved communications between Belarus with the European research space;
- Promoting and enhancing the public image of the work of teachers and scientists;
- Consolidating the work of young employees in the workplace by providing rental accommodation; and
- Introduction and development of financial mechanisms for export credit and leasing with participation of domestic and foreign banks, including the promotion of Belarusian product certification abroad. Also, improvement of the mechanism of export credits and insurance of export risks.[142]

[142] See Belarusian State Economic University "Proposals for the development of the legal framework conducive to the acceleration of the integration process of higher education, research and innovations", TEMPUS project. 2016

4.2 Innovation in the enterprise sector: case studies

In Belarus, many large firms are facing the problem of inadequate modernization of equipment. According to government assessments, the majority of organizations that belong to the large public sector use mid-20th century technologies. One of the main reasons for this reluctance to innovate is the generally low level of market competition.

The economic management of large enterprises is hierarchical and it is characterised by linkages - predominantly vertical - between ministries and economic entities and enterprises. Reorganization has hardly changed the traditional high degree of market concentration. In this context, small and medium-sized businesses are developing only slowly, which limits the pressure on incumbent companies and enables them to survive even without innovating (many large firms have a monopoly position in the Belarusian market).[143]

On the other hand, some firms undertaking research-intensive activities have presented a different path to innovation. Most of these were spin-offs created by university faculty or scientific institutes. Some of these firms are working in university/academy-linked technology parks; and often have undertaken commercialization activities in these venues.[144] Among all these firms, some small firms are valuable as knowledge-producers. They are often spin-offs, knowledge-based, high-tech, innovative firms. They are important actors in the commercialization of knowledge and exploit the inherited knowledge-producing capabilities from the Soviet era, combined with new ideas by more recent university graduates (cf. section 4.4 in this chapter for a discussion of Belarus' *dual path*).[145]

This section analyses case studies of selected successful, innovative firms interviewed during and after the fact-finding mission of this Review (i.e. Polimaster, Polimag, Atomtex, KBTEM-OMO). These firms include examples of small, medium and large companies of different forms of property ownership. The information contained in each case presents the results of in-depth interviews with the management of firms. They provide detailed information on how enterprises innovate, that cannot - to the same extent - be obtained from survey analysis. These case studies also provide more insight on what constraints they face, and how they use available policy support.

Case study: Atomtex Scientific and Production Enterprise.

The Minsk Scientific and Research Instrument-Making Institute is a joint-stock company, which owns four subsidiaries that have worked in different fields. One of them is ATOMTEX, which was established in 1995 as a scientific and engineering, manufacturing and support company that has joint public and private ownership. It produces various high-tech science-based nuclear instruments and pieces of equipment that are used in fields such as the nuclear power industry, nuclear medicine, radiology, geophysics and radioecology.

[143] See in Regulation the Council of Ministers of the Republic of Belarus, 2014 No. 27, On approval of the concept of formation and development of innovative industrial clusters in the Republic of Belarus and its realization (pp.4-5)

[144] The advantages to be in university/academy-linked technology parks are related to significant preferential treatment for residents, such as lower corporate tax, subsidized or free residential and rental premises, low or near-zero rate local taxes (these vary by region), and access to budget funding.

[145] One of the specificities of the autarchic and vertically organised Soviet-system was that universities and research organizations were involved in small-scale production either for their own needs or for dedicated clients.

In 2016, the number of employees was 190, 50 per cent of whom were under 35 years old. The average annual output per employee was US$50,000 in the period between 2011 and 2015. Exports make up more than 90 per cent of total production and the firm exports to 80 countries. The profit margin is around 20 per cent.

ATOMTEX is considered a very active innovative company. Every year, it brings to market three to four new competitive products, in addition to another five to six products that are upgraded significantly compared to previous production lines. For example, after the Fukushima disaster in Japan, the company delivered an under-water radiation spectrometer that could measure at a depth of 500 meters, which had no competitor in the Japanese market. Another novel product by ATOMTEX has been used to prevent the traffic of nuclear products across borders - which has been deemed very important to combat nuclear terrorism. Thanks to its innovations, the company has won several awards and prizes. In addition, the ATOMTEX trademark has been registered in several countries.

The company recently undertook a modernization of its production and research base, which helped expand the range of knowledge-based competitive products, including test equipment, control and measurement instruments, equipment for automated assembly of printed circuit boards between 2011 and 2015. In this period, the company also obtained an ISO 9001 certificate, purchased roughly 500 software licences and further expanded the range of products. This included new calibration equipment in the field of ionizing radiation measurement, which in certain cases outperforms national standards.

The basis for ATOMTEX's innovation capabilities are integrated design algorithms developed in the Soviet period. On this basis, new products are developed using marketing research, product optimization, and pricing and complete process management procedures. Design and production conform to the relevant international standards.

In the early years of the company, State investment was important to develop and commercialize equipment for rectification of the consequences of the Chernobyl nuclear power plant accident.

Since that time, foreign suppliers have become very important partners. Today, 85 per cent of electronic components and 70 per cent overall are imported. A special quality control department ensures the quality of components. The company also trains its local suppliers to enable them to meet its quality standards. The firm works closely together with relevant international organizations: International Atomic Energy Agency (IAEA), Comprehensive Nuclear-Test-Ban Organisation (CTBTO), UNDP and others. The company is an associated member of the European Nuclear Society.

In spite of its success, this firm has faced some challenges during recent years that are linked to financial regulations and the character of State funded R&D programmes. The company's declared policy is to avoid State projects because the size of available public resources is very limited in relation to the monthly financial needs of the firm. In addition, the timely presentation of reporting requirements is time-consuming; and it distracts human resources from focusing on goal achievement and the releasing of new products. Thus, since 2000, there is no public budget funding for its innovation and the company has operated from its own funds and sales revenues. However, in some individual and exclusive cases demanding highly professional

specialists with firm-specific knowledge, the company may choose to participate in government projects.

Case study: Kbtem - omo

The second case study presents a successful joint-stock company that belongs to a holding company. The history of KBTEM-OMO dates back to 1962 when a decision was made by the Soviet authorities to set up in Minsk facilities for the manufacturing of optical-mechanical equipment. KBTEM-OMO was at the time a division of the Design Office for Precision Electronic Engineering (KBTEM). In 1991, KBTEM was split and KBTEM-OMO was re-named as the Scientific and Production Republican Unitary Enterprise. It became a unit of the Belarusian conglomerate State Scientific and Production Corporation for Precision Engineering ("Planar"). In 2014, KBTEM-OMO was reorganized again into a joint stock company with the goal to attract private investment.

KBTEM-OMO relies on a high level of vertical integration that enables concentrating all key technologies needed for the development and manufacturing of its products. There were strong initiatives during the transformation time of Perestroika to promote a diversification of the activities, but a decision was made to remain focused on its expertise in optical/ mechanical technological development and production. As a result, over time the firm developed State-of-the-art competences in the field of optics, precision mechanics and electronics used for manufacturing. The main production lines include scientific and technological developments in precision engineering and manufacturing, including equipment for wafer pattern generation and inspection, chip production, laser processing, medical equipment, microscopy and optical components.

In 2015, the firm obtained revenues worth BYR103.7 billion. Almost all products of KBTEM-OMO are new-to-international market. Most of production does not have analogues in the world and there are no or only few equivalent competitors. KBTEM-OMO's main markets are in Russia, Israel, China, South Korea, Mexico, Taiwan, India and some EU countries (i.e. Italy, Germany, France and Poland).

Since KBTEM-OMO is an export-oriented company, it has been negatively affected by recent macroeconomic and external constraints. Still, during the past five years (2011-2015), the value of exports grew 27 per cent compared to the previous five-year period. KBTEM-OMO employs experienced and dedicated technicians, engineers and designers. The total number of employees is 510 employees, 470 of which are R&D personnel (i.e. mechanical and chemical engineers, programmers and physicists) who work full time with R&D projects.

In spite of its R&D orientation, KBTEM-OMO employs only two Doctors of Science, five PhDs and five PhD fellows. These figures are substantially lower than average in Belarus for companies conducting R&D activities, which amounted to 12 per cent doctorates in 2012, according to official statistics. In part, this relative lack of a high-skill workforce can be attributed to the brain drain that occurred in the early 1990s. During the past 15 years, however, the situation has improved, partly thanks to a Government programme for post-university students that includes a mandatory two-year-paid employment period after graduation.

The company mostly accepts university students from three relevant universities (i.e. Belarusian State University, Belarusian National Technical University, and Belarusian State

University of Informatics and Radio Electronics). KBTEM-OMO cooperates with other NIS stakeholders, including public organizations; and it cooperates with universities mainly through teaching and training with the goal to retain potential employees. In addition, it is a member of several international organizations such as Semiconductor Equipment and Materials International (SEMI) and The International Society of Optical Instruments Engineering (SPIE).

The company owns more than 100 patents, fifteen of which were registered in 2015. Most patents were granted abroad because, in the absence of agreements between Belarus and the countries that are KBTEM-OMO's export destinations, there is a risk that ideas may leak away if registered only nationally. Thus, KBTEM-OMO usually patents its innovation in a country where it is going to export each specific product. Patents belong to the enterprise, but the authorship rights belong to the developer, who is also eligible to receive some type of bonus compensation that varies according to the degree of commercialization achieved.

Concerning State aid, KBTEM-OMO enjoys various forms of State support. Depending on the project, it can apply for State funding within the framework of the State Scientific Technical Programmes. The amount of State funding can reach up to 50 per cent of expenditures on R&D, although the bulk of funding for R&D comes from re-invested profits.

Officially, government financial support is not a loan in commercial terms. However, it is stipulated that the enterprise will develop and sell a defined volume of new products or services. If the enterprise fails to commercialize a new product/service, it must return the full amount of the loan. Obtaining financial support is also a long process to follow given the administrative procedures involved. Considering that the manufactured equipment is characterized by a long cycle of development and production, given the high technical complexity of products (i.e. about two and a half to three years), the re-payment scheme shifts most of the risk to the firm, a situation that acts as a disincentive for investing in R&D (cf. chapter 2).

In addition to the strict performance requirements, other factors negatively affect the results of financial and economic activities of the company. Given its export orientation, firms like KBTEM-OMO face a very complex legislation in the field of taxation, customs and currency regulations. As is the case with other firms in the sector, the excessive reporting requirements significantly reduces the effectiveness of R&D expenditures, and it further hinders scientific and technological development in priority areas such as electronic engineering. Other challenges concern access to skills. In Minsk, there is a shortage of flats and the system of renting houses is not well developed. Thus, the enterprise cannot provide housing and registration services to new staff. More government involvement and support would be needed to improve recruitment, as in the case of the High Technologies Park (HTP), where funds from the city budget have been used to build housing facilities that reduce the burden of resident firms to attract a high-skilled labour force.

Case study: Polimaster

Polimaster, a leading international company in the field of nuclear monitoring, safety and security, was founded in 1992. The start-up capital was an individual's seed investment. The company has since grown to become an international conglomerate, building its competitive edge on the accumulated knowledge of its founder and staff, who previously had long-term R&D experience in the field of radiation protection at MRIMI,[146] one of the oldest and most capable research and production centres in the field of electronic instruments in Soviet times. Thus, the long-term scientific and technical expertise in the development of instruments for radiation monitoring and control became one of the key strengths and the basis for the firms' early success.

Over the last twenty-years, Polimaster also earned recognition abroad. Since Belarus is small for such niche markets as radiation monitoring, Polimaster began exporting to Europe at the beginning of the 1990s. At present, the firm exports to more than 75 countries around the world and has dealers in 45 countries. Production has also expanded across borders. Today, Polimaster owns business facilities, including manufacturing and service companies, not only in Belarus but also in Austria, Lithuania, Japan, Cyprus and the United States.

Although the firm's headquarters are located in Austria, the key human resources (engineers and managers), and the essential part of the production processes (manufacturing important components of devices), are based in Minsk. As of 2016, the company employs around 200, with the number of R&D personnel at more than 40. Although official figures are not made public, sales revenues in recent years are estimated at between US$5 million and US$20 million. In terms of market share, the Belarusian market takes four per cent of total sales, while the USA accounts for 38 per cent, the Commonwealth of Independent States (CIS) 26 per cent, Europe 12 per cent, while other countries comprise the remaining 20 per cent of sales.[147]

Polimaster primarily uses its own funds to finance R&D, but the company has also gained some positive experience in using public investments. During recent years, the company has introduced between five and ten new products on an annual basis, even if their commercial success rate has been uneven. One key success was the development of a dosimeter in the shape of wristwatch, which was a novel invention. The company also pioneered the development and production of compact gamma devices of a pager type, which allowed Polimaster to gain a foothold in the US market. The development of systems of radiation control enabling data transmission in real-time from distributed network of devices was another key innovation.

[146] After the Chernobyl catastrophe, the Institute had developed dosimeters to measure an absorbed dose of ionizing radiation. Indeed, the founder of Polimaster himself developed a simple personal dosimeter to be commercialized among manufacturers. Most of the initial employees of Polimaster had also worked at the Minsk Research Instrument Institute "MRIMI", today a Public Joint Stock Company which is one of the leading research and production centres in the field of electronics instruments, with a history that dates back to 1954. www.mnipi.by

[147] Polimaster was recognized by authorities as the best Belarusian exporter in 2015 under the category "Electronics, instrumentation, electrical and optic-mechanical industry" See http://www.belta.by/economics/view/pobediteli-konkursa-luchshij-eksporter-2015-goda-obespechili-15-eksporta-belarusi-192353-2016/ (accessed on 15 June 2016).

Although Polimaster does not undertake joint R&D activities with universities, it provides internships for students and graduates. The company maintains ties with key departments and faculties of Belarusian education institutions where students obtain specialties relevant to Polimaster's activities. The company has also been in close cooperation with government institutions (e.g. NAS). However, most cooperation occurs in terms of finding investment for new products rather than conducting joint research to develop innovation. The company also cooperates with its users, suppliers, and other organizations in pursuit of new knowledge, ideas, and business solutions. Key stakeholders include laboratories, such as Thermo Fisher Scientific and Mirion Technologies, both of which have headquarters in the USA. Some of Polimaster's key employees visit its overseas offices and have collaborated with American and European colleagues. Others have key research experience in leading institutions such as CERN, the European Organization for Nuclear Research.

Historically, the company did not ordinarily register patents as it found it disadvantageous to disclose the details of its inventions. Nevertheless, some key inventions are protected. As for royalties and licences, Polimaster has a company in the US and one in Cyprus that own the company's IP respectively in the American and European markets.

With regards to its organizational capacities, Polimaster is considered nimble and flexible, which has enabled it to identify and explore new types of activities in short periods of time. This is an advantage vis-à-vis its primary competitors, which are often large companies with product portfolios covering many market segments without strong specialization. Polimaster managers regard R&D as a core competence, while R&D expenditures amount to about between 10 and 15 per cent of sales. In order to increase the productivity of its employees, the company offers bonuses for commercial success when certain performance indicators are met (e.g. volume of sales, customer satisfaction). This allows the company to maintain high salaries and motivates developers to reach significant results.

Regarding public policies, the firm has enjoyed significant support from the Belarusian government. This included participation in investment programmes and access to innovation funds, taxation privileges and land rental discounts. However, its success also led it to face additional controls and related bureaucratic obstacles, such as an increase in reporting requirements. Still, the largest impediments to undertaking innovations were economic ones. These include a low demand for new products in times of crises and high costs and risks of research activities, coupled with long payback periods. Looking forward, two major challenges can also be identified that if properly addressed could facilitate the firm's further expansion. They concern access to skills and knowledge, plus branding and certification activities.

Access to skills was a key advantage in the growth performance of the firm, but it has become a challenge. At the time of its inception, the labour and capital costs were low compared with similar costs in Western countries, given the firm's access to highly skilled researchers and more or less modern equipment. Such a base would allow researchers to carry out experiments and develop innovative products rapidly. However, at present, some significant potential in terms of R&D and human resources has been lost, and the cost of labour has gone up.[148] The company also suffers from a lack of a sufficiently modern scientific and industrial base in

[148] The company tries to attract Belarusian scientists, realizing that it is a very specific area to work with. Belarus is a non-nuclear country and few people are engaged in nuclear research, although this may change with the construction of the Belarusian nuclear power plant, which has led to increased interest in nuclear sciences.

Belarus, and it needs to rely on internal resources notwithstanding the difficulty for businesses to finance such activities. More State involvement through the development of basic research at, inter alia, educational institutions could go a long way to meet these needs.

Regarding certification and branding, sales and development staff have indicated that access to foreign markets has been hard to achieve, as foreigners tend to have ambiguous perceptions or lack sufficient knowledge of Belarusian producers. This situation has forced the firm to enter some markets through the licensing of its products to foreign-owned firms. Another challenge concerns certification, as standards of production concerning technology, quality and service in the advanced industrialized world are often much higher than the ones prevailing in the CIS countries. Improved access to finance and business advisory services could facilitate removing these hindrances.

Case study: Polimag

Polimag is a micro- republican unitary enterprise[149] that performs scientific research, design and technological works in the field of surface finishing of machine parts and devices. It was created in 1991 on the basis of a research group of 20 scientists who had worked at the Physics-Technical Institute of the Academy of Sciences in the Soviet period. In 2001, the company became part of the Technopark Metolit (now Science and Technology Park of the Belarusian National Technical University "Polytechnic").

In the past, Belarus was one of the leading countries in the field of scientific research. The country had a large R&D infrastructure oriented mainly towards the military industry. Nevertheless, this was affected by the critical institutional transformation and a substantial reduction in public spending in R&D after the collapse of the Soviet system, which led to a decrease in demand for R&D products and to a significant reduction of investments in the development of new technologies. In this context, the research team of Polimag was reduced to three persons during the 1990s. In recent times, the company has been reorganized. It has significantly increased the volume of production and sales of products, which is produced by a team of 13 experts.

The main activity of Polimag is research and experimental development in natural sciences and engineering. The company develops original processes, creates and produces equipment for magnetic-abrasive machining (MAM). The successful activity of Polimag is based on the great experience in development of technologies of superfine polishing and surface modification of critical parts (substrate integrated circuits, optical glass, laser crystals and metal products), for electronics, optics, laser technology, nuclear engineering, electronic, aviation, shipbuilding and other industries. As a small enterprise, Polimag has flexibility in the organization of its R&D and commercial activities. The company is not burdened with overhead requirements and statistical reporting, which are typical for large organizations, allowing it to provide high quality at reasonable prices.

In 2015, the firm’s revenue was BYR1, 362 billion. In that year, most of Polimag’s innovative products and services - 70 per cent - were sold in the domestic market, whereas 30 per cent

[149] According to the Civil Code of the Republic of Belarus, a republican unitary enterprise is a commercial organization property of which belongs to the Republic of Belarus.

were exported to Italy. In 2016, Polimag intends to diversify its export markets through starting sales to Russia. In the longer run, all the economies of the larger Eurasian market are perceived as an opportunity. Its significant size and the long traditions in science and technology of its Member States, combined with the absence of language barriers and common mentality, are important factors for Polimag to realize its commercial aspirations.

Polimag is a resident of Technopark of the Belarusian National Technical University "Polytechnic", and benefits from its help and support in marketing, advertising, access to international networks, as well as access to office and industrial space.

The company actively cooperates with many research organizations and industrial enterprises in Belarus and abroad. Among the main partners are the following institutions: Technopark of the Belarusian National Technical University "Polytechnic", Institute of Industrial Nuclear Technology NRNU "MiFi" (Moscow, Russia), Institute of Optics, Fine Mechanics and Physics of the Chinese Academy of Sciences (Beijing, China), Research Centre EWE of Energy Technology (Oldenburg, Germany), JSC Peleng (Minsk, Belarus), Vologda Factory of Special Bearings (Vologda, Russia) and others.

In 2015, 60 per cent of expenditures on R&D were spent on the development of new products, methods and processes of production.[150] The remaining funds were spent on maintenance of existing production and purchase of equipment related to technological innovation. However, some weaknesses retard faster development. One of them is the lack of financial resources to acquire expensive scientific measuring equipment for the further expansion of production, such as high-precision atomic-force microscopes and laser interferometers. Sources of financing of innovation activities are the company’s own funds, which amount to 50 per cent of R&D expenditures, and another 50 per cent of funding from local innovation funds. In a context of government restructuring, the company plans to increase the share of self-financing up to 65 per cent in 2016.

However, the amounts raised from reinvested earnings and loans from innovation funds are too small to finance expensive R&D, while other forms of State support remain insufficient. For example, the available tax incentives in the form of the 10 per cent reduction of income tax on profits play a minor role in Polimag, since profits have been small in recent times. Managers of Polimag predict moderate growth and development of the company in the coming years, which corresponds to the current trend since 2010. Expectations are based on the growing interest of domestic and foreign enterprises and organizations in the technology and equipment produced by Polimag. Nevertheless, the company's ability to maintain its innovative development is hampered by the uncertainty of the macroeconomic environment, high taxes and low level of public funding in the field of science and education.

[150] Expenditures on technological innovation amounted to BYR1.374 billion, and were funded 50 per cent with own resources of the firm and 50 per cent public funds. Total revenue was BYR1.362 billion.

Assessment

Overall, the cases studies referred to above help inform on the existing challenges to innovation in the enterprise sector and point to priority areas for policy reform. The selected firms were established either privately or by several State-owned entities on special conditions. At the time of their establishment, they obtained the most important equipment and instruments from research institutes. Furthermore, their workforces were well educated, well trained and had substantial experience with scientific collaboration. They also had experience producing innovative products and commercializing the results of their scientific advances. Their managers were usually innately talented managers with good scientific records.

However, some of these conditions have significantly changed during recent years; and new challenges have emerged that call for policy reforms in order to sustain their innovative edge. These include the consequences of macro-economic recession, the impact of the progressive reduction in R&D spending and finance, and problems accessing qualified personnel. This information is confirmed by the analysis of survey data included in the next section.

4.3 Firm-level analysis of innovation performance in Belarus

This section focuses on the quantitative analysis of innovation activities in the enterprise sector. This section employs two statistical surveys on innovation to provide information on innovation activities in the Belarusian industrial sector. These are respectively the innovation survey of Belstat (the National Statistical Office of Belarus), and the EBRD - World Bank Business Environment and Enterprise (EBRD BEEPS V) section on innovation. Some methodological considerations relating to these surveys are presented in the box 8.

Box 8. Methodological aspects of firm-level surveys of innovation activities

According to international standards, the definitions for measuring innovation are the following: “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. An innovation can be more narrowly categorised as the implementation of one or more types of innovation, for instance product and process innovation. . An innovation can include products, processes and methods that firms are the first to develop, as well as those that have been adapted from other firms or organizations. The Oslo Manual* on innovation statistics also distinguishes between innovative firms and innovation activities.

In the case of Belarus, according to the Belstat definitions, an innovation-active organization is an organization that incurs expenditure on technological innovation. This definition measures the input for innovation instead of the output of innovation process. Belstat operationalized the internationally accepted definitions for its own survey with the following definition: “innovation activity is an activity related to the transformation of novelty into innovation”. The Belstat survey was carried out through a postal survey and it covered 383 innovation-active industrial organizations in 2014 (i.e. industrial organizations having expenditure on innovations).

Box 8. Methodological aspects of firm-level surveys of innovation activities *(continued)*

The EBRD BEEPS (Business Environment and Enterprise Performance Survey) incorporates definitions of the Oslo Manual. It was undertaken with a face-to-face interview method. The sub-sample used for this study from the BEEPS survey contained 126 manufacturing firms.

The most significant difference between the two surveys is that the sample size of BEEPS was smaller, and the surveying period is also slightly different.

Note: * OECD (2005).Oslo Manual: guidelines for collecting and interpreting innovation data. Third edition. OECD and Eurostat: Paris.

Innovation activities of a country's firms are influenced by the economic situation, knowledge and management capabilities as well as the available modes of financing. If the financial resources for innovation are heavily depending on the State budget, enterprises have little chance to respond to the economic downturn with more intensive innovation activities. In Belarus, gross value added in industry compared to GDP has decreased from 31 per cent in 2011 to 27 per cent in 2014. In the same period, the fixed capital investment in industry to GDP has also shrunk from 13 to 11 per cent.[151]

Many firms are facing the problem of modernization of equipment as a basic constraint to innovation. Some of these firms have a monopoly position in the Belarusian market, which makes them reluctant to innovate. In addition, FDI is limited and does not create strong impulses for innovation. Table 25 shows some main innovation indicators by the type of ownership of companies.

Table 25. Innovation indicators of industry by type of ownership

Ownership	*Innovation-active companies engaged in technological innovation expenditures (product and process)*		*Organizations engaged in technological, organizational and marketing innovation expenditures*		*Percentage of innovative products in the total volume of shipped products*	
	Percentage of total number of organizations					
	2010	*2015*	*2010*	*2015*	*2010*	*2015*
Public	9.3	10.1	12.2	10.6	15.5	1.3
Private	19.0	22.9	23.5	24.5	14.4	15.9
Foreign	5.9	10.3	11.8	15.4	1.1	3.1

Source: Compilation from Belstat letter 20/04/2016

The percentage of firms that undertook expenditures on technological innovations was higher in the private sector both in 2010 and in 2015. While public firms had a higher share of the sales of innovative products to total sales in 2010, this drastically decreased by 2015. In

[151] Science and Innovation Activity in the Republic of Belarus, Statistical Book, National Committee of the Republic of Belarus, Belstat, Minsk 2015, table 6.1.

addition, foreign-owned companies represent a small but increasing share, which goes largely into low- and medium-tech industry.

The business climate

According to respondents to the EBRD BEEPS survey, the most important obstacles to the business climate can have an impact on innovation. Table 26 presents the relevance of the business environment obstacles using the average values of responses.

Table 26. Business environment obstacles by innovative/non-innovative companies

Obstacles	*Nr of responses reporting obstacles*	*Average*		
		Total	*Innovative firms*	*Non-innovative firms*
Tax rates	90	2.22	2.30	2.09
Inadequately Educated Workforce	85	2.06	2.29	1.63
Access to Finance	74	1.93	2.07	1.74
Access to Land	52	2.21	2.40	1.82
Political Instability	52	2.10	2.24	1.83
Access to Telecommunications	50	1.76	1.83	1.60
Practices of Competitors	49	1.98	1.97	2.00
Labour Regulations	46	1.57	1.59	1.50
Corruption	44	1.98	2.10	1.73
Customs and Trade Regulation	43	2.05	2.26	1.69
Access to Electricity	42	2.26	2.37	2.00
Tax Administration	41	1.61	1.61	1.61
Access to Transport	39	1.79	1.84	1.71
Crime, Theft and Disorder	36	1.67	1.81	1.47
Access to Business Licensing and Permits	33	2.00	2.23	1.55
Courts	20	1.80	1.69	2.00

Source: author calculation from EBRD BEEPS V data
Note: Applied values: Minor obstacle=1, Moderate obstacle=2, Major obstacle=3, Very severe obstacle=4. From the average value, the respondents with 'does not apply or no obstacle' is not included.

The figures in Table 26 show that the majority of obstacles hamper more strongly the innovative rather than non-innovative firms.[152] Thus, it may be suggested that firms that undertake innovation tend to be more sensitive to hindrances affecting the business environment than other firms in a context that favours the status quo.

The greatest number of firms felt that tax rates and access to finance at least moderately hamper their general business activity. In addition, businesses manifested that they have to cope with an inadequately educated workforce. The problem of inadequate skills may arise from the structure of student enrolment by fields; and from the shortage of certain subjects in teaching

[152] The group of innovative firms contain all that have introduced any types of innovation.

curricula, which are not optimal to promote innovation-related activities.[153] The country does suffer from the loss of skilled workers, mainly population outflows to Russia, where average wages are higher. Because of the downturn in the Russian economy, the outflow of highly skilled workers has somewhat slowed, which may improve access to skilled workers in the future.

It should be highlighted that there are several obstacles, which are more important for small companies than for medium and large ones. Access to land, access to electricity, political instability and customs and trade regulations appear to be a priority for smaller firms. In addition, some other factors hamper more the non-innovative medium companies, such as tax rates, the practice of competitors and access to finance. Whereas the BEEPs study covered general factors originating in the business environment, the Belstat survey included variables that address specific constraints affecting innovation by firms in the industrial sector. These include three kinds of hampering factors: economic, production and other. Table 27 summarizes key survey findings.

Table 27. Rating of factors hampering innovation by industrial sector

	Average value
Economic factors	
lack of funds within the organization	2.31
cost too high	2.18
excessive perceived risks	1.98
long payback time of innovations	1.94
lack of financial support from public sources	1.79
low consumer demand for new products	1.71
Production factors	
innovation potential insufficient	1.75
lack of qualified personnel	1.59
lack of information on markets	1.42
lack of information on new technology	1.38
difficulty in finding cooperation partners	1.35
non-responsiveness of the organization to innovation	1.31
Other factors	
undeveloped technology market	1.59
low demand for innovative products	1.58
uncertainty of the period of innovation process	1.52
undeveloped innovation infrastructure (intermediary, information, legal, banking and other services)	1.52
shortcomings in legislation regulating and stimulating innovation activity	1.43

Source: author compilation from Belstat Science and Innovation Activity in the Republic of Belarus, Statistical Book, National Committee of the Republic of Belarus, Minsk 2015, table 6.37
Note: Applied values: main or crucial =3; significant =2; insignificant =1. Averages calculated on the basis of total available respondents

The most important hampering factors are *economic* ones, which confirm the findings of the BEEPs survey. “Lack of funds within the organization” is the strongest and that evaluation was

[153]The highest share of enrolled students goes into communications; law; economics; management; business administration (41% in 2010/11 and 36% in 2014/15). This field of education was followed by engineering and technology. Its share was much lower but slightly increased over time (18.7% in 2010/11 and 19.5% in 2014/15). Source: Belstat. (2015).Science and innovation activity in the Republic of Belarus. Statistical book. Minsk: National Statistical Committee of the Republic of Belarus (Belstat). ISBN 978-985-7115-27-3

strengthened by interviews during the fact-finding mission. The "lack of financial support from public resources" was evaluated as a less important factor. These differences in the evaluation of two financial resources highlights the firms' wish to finance their modernization and innovation from their own resources and the fact that they rely less on the availability of public resources. Among the *production factors*, the "insufficient innovation potential" and the "lack of qualified personnel" are the main hampering factors of innovation. BelISA's report based on surveys among the heads of companies also identified similar problems. According to findings from this study, the organizations have low innovative capacity, shortage of trained personnel (technical and scientific personnel) and limited financial possibilities for development.[154]

Main quantitative indicators of innovation performance

The Belstat innovation survey has provided important information shedding some light on current processes characterizing the innovation performance and behaviour of business organizations. It should be highlighted that the Belstat survey focuses mainly on large- and medium-sized organizations.[155]

Table 28 contains indicators of innovation at the firm level. It shows significant fluctuation during recent years for both the number of innovation-active firms as well as their share among total industrial organisations surveyed.

Table 28. Indicators of intramural innovation and industrial activities

Indicators	2010	2011	2012	2013	2014	2015
Number of innovation-active industrial organizations	324	443	437	411	383	342
Share of innovation-active organizations of total industrial organizations surveyed, per cent	15.4	22.7	22.8	21.7	20.9	19.6
Share of shipped innovative output in total industrial output shipped, per cent	14.5	14.4	17.8	17.8	13.9	13.1

Source: Belstat Science and Innovation Activity in the Republic of Belarus, Statistical Book, National Committee of the Republic of Belarus, Minsk 2015, Table 6.1., and Belstat letter 20/04/2016

Within the period under consideration, the number of innovation-active industrial organisations and their share to total industrial organizations has jumped from 2010 to 2012, although both figures began to decline in 2013, a process that has continued till 2015. On the other hand, the share of shipped innovative output showed some minor fluctuations between one and three per cent above or below the average of 14.5 per cent. These trends seem understandable when

[154] ОТЧЕТ О НАУЧНО-ИССЛЕДОВАТЕЛЬСКОЙ РАБОТЕ «Межстрановая оценка состояния научно-технической и инновационной сферы Республики Беларусь на основе анализа международных статистических данных и рейтингов и предложения по улучшению позиций Республики Беларусь в этих рейтингах» (заключительный) Государственный комитет по науке и технологиям;Республики Беларусь, Государственное учреждение «Белорусский институт системного анализа и информационного обеспечения научно-технической сферы» (ГУ «БелИСА») УДК 339.9:338.1;339.9:330.34;338.2 № госрегистрации 20151401 Инв.

[155] Belstat letter 11/05/2016.

taking into account the impact of the economic crises and the deteriorating financial conditions for innovations.[156]

A recent analysis by BelISA helps explain the survey findings. It concludes that Belarusian companies do not have sufficient own funds to finance RDI (research, development and innovation), or are hesitant to invest in risky projects. At the same time, the State could not provide them with sufficient financial support, which is also due to the crisis and a tight budgetary policy.[157] This situation produced a decline in innovation development and, consequently, the number of innovation-active enterprises decreased.

Innovation performance can also vary by economic sectors and activities. If a firm introduces more than one type of innovation, it can also create synergistic effects. According to Belstat statistics, 92.7 per cent of manufacturing organisations made expenditure on technological innovation, 11.7 per cent on organizational innovation and 16.5 per cent on marketing innovation in 2015.[158] The various types of innovation can support each other and improve the firm's chances of market success.

Concerning innovation in specific economic sectors of firms (Table 29), high-tech and other emerging activities are usually more innovative than traditional sectors. For Belarus, ICT activities are the "innovation driver" and activities in nuclear sciences are good performers in novel innovation. Notably, among selected manufacturing industries the number of innovative firms seems stable over time across sectors, with some slight increases in certain activities (i.e.; manufacturing of electrical and optical equipment, chemical production and manufacture of pharmaceutical products).[159]

[156]In the industrial sector, a large share (64 per cent) of innovative output was exported in 2015 (51.4 per cent of this went to CIS countries). In the context of SPID 2016-2020, the Ministry of Industry plans to implement only 13 investment projects, among which nine are scheduled to release innovative products. However, none of these projects imply new modern-world technologies. The share of innovative products in the volume of industrial production for 2016 -2020 is estimated to be in the the order of 30 per cent.

[157] Государственный комитет по науке и технологиям, Республики Беларусь: Государственное учреждение, «Белорусский институт системного анализа и информационного обеспечения научно-технической сферы» (ГУ «БелИСА») УДК 339.9:338.1;339.9:330.34;338.2, № госрегистрации 20151401, Инв. № (item 6.2).

[158]Belstat letter communication № 01-05/2-18/1329 of 16 September 2016.

[159] At present, it is uncertain if the critical mass of funding is available for basic and applied research in other activities. The distribution of expenditure by type of science and phase of R&D suggests engineering science is substantial. On the other hand, medical and agricultural sciences devote relatively large shares to applied research, but much less to experimental development. See K. Pavitt, "The social shaping of the national science base". (1998) *Research Policy* 27: 793–805; Léa Velho, "Building a critical mass of researchers in the least developed countries: new challenges", 2006, in *Science and Technology Policy for Development, Dialogues at the Interface* by Louk Box and Rutger Engelhard (eds) (2006) Anthem Press: London UK; " Pharma R&D needs large funds to gain critical mass", *The Financial Express* 29 November 2007

Table 29. Number of innovation-active organizations in main sectors and in selected manufacturing sectors (2010 and 2015)

Sector	***Number of organizations***					
	Organizations surveyed, (units)	*Innovation-active companies with expenditure on technological (product and/or process) innovation*	*Companies engaged in expenditure on technological, organizational, and marketing innovation*	*Organizations surveyed, (units)*	*Innovation-active companies with expenditure on technological (product and/or process) innovation*	*Companies engaged in expenditures on technological, organizational, and marketing innovation*
	2010			2015		
Industry total	2103	324	381	1745	342	369
mining industry	32	5	5	31	3	4
production and distribution of electricity, gas and water	191	6	9	180	9	9
Manufacturing	1880	313	367	1534	330	356
Selected high-tech and medium-tech industries						
Chemical production	54	24	27	51	27	28
• manufacture of pharmaceutical products	19	10	10	16	14	14
Manufacture of machinery and equipment	220	72	75	208	73	75
Manufacture of electrical and optical equipment	131	57	57	118	58	59
Manufacture of transport equipment	55	23	26	56	23	23

Source: Compilation from BelStat letter 11 May 2016

Based on Belstat statistics, it is possible to rank the sectors on which firms have undertaken innovation expenditures. The highest spending sector is the manufacture of coke, petroleum products and nuclear materials - accounting for 30.9 per cent of the total (Table 30).

Table 30. Share of expenditure on technological innovation by industrial activity

Rank	*Sector*	*Share (%)*	*Main financial source (%)*
1	Manufacture of coke, petroleum products and nuclear materials	30.9	own funds (76)
2	Manufacture of machinery and equipment	17.4	own funds (70)
3	Manufacture of basic metals and fabricated metal products	15.3	foreign investment incl. credits and loans (53)
4	Manufacture of transport vehicle and equipment	7.5	own funds (46)
5	Manufacture of other non-metallic mineral products	5.9	own funds (43)
6	Manufacture of food, beverages and tobacco	5.6	credits and loans (66)
7	Manufacture of electrical, electronic and optical equipment	4.0	own funds (64)
-	Other sectors	13.4	miscellaneous
-	Total	100.0	

Source: Compilation from Belstat Science and Innovation Activity in the Republic of Belarus, Statistical Book, National Committee of the Republic of Belarus, Minsk 2015 from table 6.20

Notably, the most significant activities in terms of the share of expenditures do not necessarily coincide with those activities where innovations are more likely to occur. For instance, the manufacture of electrical, electronic and optical equipment has the lowest share among the top spending sectors. Concerning the sources of finance for innovation expenditures, survey information indicates that own funds of firms are the most important source of financing in the majority of sectors. For some activities, self-financing constitutes the bulk of any innovation finance, with figures reaching above two thirds of all funding (e.g. manufacture of machinery and equipment; manufacture of coke, petroleum products, and nuclear materials; manufacture of food, beverages and tobacco).

Still, the external resources available to share the business risk of innovation can also be significant. Table 30 shows the structure of intramural expenditure on technological innovation by source of funds for the industrial sector. In Belarus, self-finance by firms is the first source of funding (67.3 per cent), followed by credits and loans for innovation activity (19.1 per cent). Notably, whereas self-finance increased, the proportion of the latter decreased significantly between 2010 and 2015. A third source of funding was foreign investment (9.7 per cent in 2015), which only partially meant direct investment; with the balance comprising credits and loans. The central and local budgets funded less than 10 per cent of technological innovation

expenditure over the last five years, which shows their limited influence, which was particularly low in the last year[160].

Overall, the current finance structure is not ideal to foster demand-driven innovation in the enterprise sector. The changing ratios of funding show, however, that initial steps have been taken towards a more innovation-friendly financing structure. Public resources, for instance, have increased, which is crucial for the most risky innovation activities (cf. chapter 2). Still, the problem remains in Belarus that enterprises are undercapitalized and the limited public resources devoted to innovation are minuscule fractions of what would be needed to share the business risks for breakthrough innovation.

Table 31. Structure of intramural expenditure on technological innovation in industry by source of funds (per cent)

Funds	***2010***	***2011***	***2014***	***2015***
Total expenditure on technological innovations	100	100	100	100
Own funds	39.2	60.7	54.3	67.3
Public sources:				
• Republican budget	6.5	3.0	6.2	1.7
- of which innovation funds	4.3	1.3	2.8	0.9
• Local budget	0.3	0.1	1.4	14
- of which innovation funds	0.2	0.03	1.0	1.4
• Budget of the Union State	0.04	0.2	0.1	0.1
• Extra-budgetary funds	-	0.4	0.4	0.2
Credits and loans	36.7	30.2	25.9	19.1
Foreign investment, including foreign credits and loans	15.9	5.2	11.2	9.7
Other sources	1.4	0.3	0.6	0.5

Source: Compilation from Belstat Science and Innovation Activity in the Republic of Belarus, Statistical Book, National Committee of the Republic of Belarus, Minsk 2015; Table 6.19 and letter of communication № 01-05/2-18/1329, 16 September 2016.

Another significant aspect determining innovation performance in firms is the type of innovation activities that they undertake. Table 32 shows how the type of innovation activities by innovative-active firms changed from 2011 to 2015.[161]

[160] Belstat Science and Innovation Activity in the Republic of Belarus, Statistical Book, National Committee of the Republic of Belarus, Minsk 2015 from table 6.20, and letter communication № 01-05/2-18/1329 of 16 September 2016.

[161] A firm can perform more than one type of innovation activity.

Table 32. Innovation-related activities at innovation-active organizations in the industrial sector (per cent)

Types of innovation activities	*2010*	*2011*	*2014*	*2015*
R&D of new products, services and methods of new processes (either adaptation or development)	59	56	29	36
Acquisition of machinery and equipment linked to technological innovation	63	55	53	44
Production designing, other pre-production activities for introducing new products or services or methods of their production (transfer)	42	38	54	54
Training, retraining and advanced training linked to technological innovations	15	13	10	10
Marketing research linked to technological innovation	12	9	10	9
Other expenditures on technological innovation	5	5	9	10
Acquisition of new and high technologies	6	2	3	3
of which acquisition of property rights to inventions, useful models, industrial designs, topology of integrated circuits under assignment agreements; acquisition of rights to their use under licence agreements	20	27	67	60
acquisition of computer software and databases linked to technological innovation	12	7	6	5

Source: Author compilation from Belstat Science and Innovation Activity in the Republic of Belarus, Statistical Book, National Committee of the Republic of Belarus, Minsk 2015; Table 6.3 and letter of communication № 01-05/2-18/1329, 16 September 2016.

The lowest ranked activity, which has not changed over time, was the "acquisition of new and high technologies". This is a sign of the limited relevance of accumulation of external knowledge in Belarusian firms. Still, within this group, the percentage of firms engaged in the acquisition of property rights to new and high technologies has increased.

At the same time, the "production design, other preproduction activities for introducing new products, services or methods of production (transfer)" significantly increased and became the most important category for 2015. This may be interpreted as the firms engaging in less expensive innovation at a time of economic crisis. "Acquisition of machinery and equipment for technological innovation" practically retained its rank and percentage levels. However, these activities might be seen as simple modernization (plug-in) and are not necessarily process innovation activities (cf. Chapter 3).

"R&D of new products" was the largest in 2011, but decreased sharply by 2015. As discussed above, R&D is only one type of innovation activity and, for many firms it is not the most important. On the other hand, some incremental innovations are very important for any enterprise to improve its competitiveness and retain market share.[162]

[162] The sources of such innovation may originate from non-R&D persons within the company or be initiated by suppliers/buyers, or based on adaptation. The presence or lack of complementary innovation service organizations also influences the innovation performance of companies (e.g. the existence of engineering firms, testing laboratories). In a fully-fledged innovation eco-system those organizations can upgrade the absorption capabilities of companies.

Finally, regarding the type of innovation undertaken by firms and the synergies that may result from their interaction, survey responses are also insightful. In the industrial sector, the number of product and process innovators slightly increased from 2010 to 2015 (from 324 to 342), whilst those firms involved in organizational or marketing innovation decreased significantly (Table 33). This trend indicates that the bias towards innovation understood as technological modernization has increased over time.

Table 33. Number of industry organizations engaged in innovation, by type

Types of innovations	***2010***	***2015***
Product and process innovations	324	342
Organizational innovations	92	43
Marketing innovations	113	61
All innovative firms[i]	381	369

Source: author compilation from Belstat letter 20/04/2016

[i] firms with one or more types of innovation.

However, concerning the frequency of back-to-back innovation the BEEPS survey provides some insightful information.[163] Table 34 shows how many manufacturing enterprises have introduced single and multiple types of innovation during the period investigated.

Table 34. Innovative enterprises with at least two types of innovation

Types of Innovations	***Products or services innovation***	***Process innovation***	***Organizational or management innovation***	***Marketing innovation***
Products or services innovation	*59*	44	33	41
Process innovation		*63*	42	46
Organizational or management innovation			*51*	40
Marketing innovation				*62*

Source: author calculation on the base of BEEPS V databank, EBRD Transition Report 2014

Bold numbers show the total number of firms that introduced a given innovation. For example, 63 firms introduced process innovation. Of these, 42 also introduced organizational innovation and 46 process and marketing innovation. In this small sample, a relatively large proportion of innovative firms introduced at least two types of innovation within the same period. The relative frequency of more than one type of innovation highlights that innovative companies understood the importance of parallel innovations. According to innovation literature, if product innovation goes hand in hand with process innovation and/or organizational and /or marketing innovation, the chances of success can increase.

[163] From a survey of a total 126 manufacturing firms, 78 introduced product and/or process innovation according to the BEEPs survey. Anonimised Belstat data were not available.

4.4 Firm-level typology of innovators and the dual path of technology upgrading

The findings of firm-survey analysis confirm some of the insights from the review of case studies. They are also in line with the conclusions from the analysis of the NIS system and international comparison of innovation performance presented in chapters 2 and 3. Overall, it could be suggested that the pattern of innovation and technology upgrading in Belarus is twofold, with some characteristics that apply more closely to large firms and others that are more specific to the technology-based sector. The next section discusses this dichotomy

Belarus has tens of new technology-based firms (NTBFs). Many of them base their success on knowledge from the Soviet period, very often linked to the military industry or to the area where local companies had developed unique expertise like in measuring radiation due to the Chernobyl disaster. Others are successful due to skilled software engineers in applications where barriers to entry are low. The core knowledge of such firms is their know-how or lead-time (and much less often patents). Overall, these companies understand well user-needs and have developed an internal organization that rewards meeting user-needs. Often, they are supported by specific favourable measures like low taxation and discounted rents for premises. Very often, they have good cooperation with universities regarding employment of graduates, but much less regarding R&D. These firms indeed cooperate in R&D with universities or academy institutes only if they have a specific problem that they cannot resolve. They may, however, cooperate more intensely with suppliers of materials and often with potential users.

These firms are in technological areas where the technology/product gap is small or the time required for conversion of technological knowledge into product is quite short. This enables them to convert technological knowledge directly into product or service without a long and expensive R&D process. They are in niche areas, not in commodity or standardized product businesses. Their expansion is about finding new niches or new uses of their technological knowledge. Their markets, when selling under their name, are non-Western markets. They may export to Western markets (US, EU) but largely under different labels. It could be argued that exporting to Western markets has acted as a threshold level, which only a few have managed to cross.

NTBFs differ significantly from large Belarusian industrial enterprises, which are still vertically integrated with their design and engineering capacities. This is partly due to a lack of specialized domestic suppliers. The major markets for large firms are also CIS countries. They are often ISO9001 compliant, but the quality-drive is not spread into the rest of the economy, which limits reliance of large firms on local SMEs.

Among NTBFs, we can differentiate between specialised suppliers and so-called ‘gazelles’. Gazelles are high profile firms, which have grown, based on unique technological knowledge and have ‘gone global’. Several small enterprises within the Hi-Tech Park have the potential to develop into similar types of companies. The key future point of disjunction is whether they will continue to develop as stand-alone firms or will they be able to integrate other local firms into their knowledge network, which will generate a critical mass of complementary skills and knowledge that in turn can lead to the formation of clusters? Only then could it be expected that this path of technology upgrading will have macroeconomic effects regarding increased productivity, jobs and value-added in the economy.

However, many NTBFs are specialized supplier firms, which are of small- or medium-size serving specific market niches based on their understanding of user-needs and accumulated know-how. They usually operate as 'knowledge brokers' and are an indispensable part of the national knowledge or innovation system. They are a rarely an independent source of growth but are a necessary ingredient of growth of either 'gazelles' or - most often - of the large enterprises.

Belarus is one of a few ex-transition economies that managed to preserve the organizational capabilities of large firms, although its industry structure is lacking sufficient growth of SMEs. This represents a potentially significant advantage regarding future growth potential and has been the mainstay of its employment and growth in the past. However, this group of enterprises is in need of restructuring if it is to continue to contribute to growth.

Some of the large firms have preserved their previous levels of vertical integration, which enabled them to produce complex products for the CIS markets at the price of lower productivity and sophistication. Some of them have strong clustering potential, which has not yet been realised due to weakness regarding corporate governance, specialization and the lacking layer of small competitive firms, which would operate as subcontractors of the large enterprises. These companies are the major generators of employment, giving them a privileged position regarding the use of government subsidies and the costs of capital.

Thus, it could be concluded that technology upgrading in Belarus takes place along two paths: a path of new technology-based businesses and large enterprises. These two types of firms are operating relatively independently of each other though in the long term they should be either cooperating or competing. Table 35 below summarises the major traits of these two types of firms.

Table 35. Challenges of dual path of technology upgrading of Belarus

	New technology-based firms	***Large enterprises***
Focus on technology upgrading	Meeting user requirements	Improved quality
Clustering	Not yet present	Not developed links with small firms
Clients	Large Belarusian enterprises and CIS exports	CIS export except software where export to the West is developing
Growth strategy	New niches or new user-needs	Standardized and low cost products for CIS customers
Nature of accumulated capabilities	Accumulated technological know -how	Accumulated production capabilities
Competition regime	State support but competitive foreign markets	Extensive State subsidies but still secure position on CIS markets

Table 35. Challenges of dual path of technology upgrading of Belarus *(continued)*

	New technology-based firms	***Large enterprises***
Position in relation of global value chains	Mixed picture: some 'gazelles' are integrating into global supply networks	Outside of Global Value Chains
Competitive advantage	Understanding of user-needs and produce/service differentiation	Standardized products with presumably acceptable value for money
Supporting infrastructure (Technoparks)	Developed by public authorities	Not promoters of infrastructure for SMEs

It can be concluded that the NTBFs have not yet built new ecosystems or have not become the main drivers of growth. Therefore, although important regarding distinctive RDI capabilities their macroeconomic impacts are still not very significant. The Hi-Tech Park is on the way to becoming an innovation ecosystem with potential macroeconomic impacts. However, this process is long-term, and it requires shared visions based on consensus-building and collective action. So far, the key to the success of the HT Park - leadership, close links to the education system and collective action or coordination between different parts of government by providing a stable environment - have been preserved, and it is hoped that they will continue to be present (cf. chapter 2).

A key policy challenge is how to couple and complement the two paths of industry upgrading among NTBFs and large enterprises. Specifically, the policy challenge refers to how to engage more entrepreneurs in innovative activities, how to address weaknesses in the implementation of commercialization projects, how to shorten the time and improve the effectiveness of commercialization efforts. Although the Government has articulated strategic priorities in the area of R&D and innovative development and has a long-standing system of implementation of State S&T programmes, the on-going orientation of Belarusian RDI policy is still to recognise the need to enhance complementarities between these two paths.

It should be highlighted that Belarusian R&D and innovation policy is firmly oriented towards commercialization, and hence, it may be insufficient to support the whole process from R&D to commercialized products. Incentives to invest in demanding new products and processes are weak, given risk and uncertainty about results but also given weak local demand for such endeavours. This is further exacerbated by the undeveloped market for technological knowledge and insufficient supporting infrastructure.

What underlies much of Belarusian R&D and innovation policy is a simplified model of how R&D and innovation influences economic growth, and how R&D contributes to productivity, employment, and export. The basis of the policy is an R&D 'push' model or the idea that R&D and knowledge-intensive activities can directly generate increased value-added, growth and jobs. However, modern innovation policies also require business enterprises that are in close contact with markets, and that can successfully address different performance - cost trade-offs.

Indeed, R&D is not the only mode of innovation as many industries operate based on so-called DUI or Doing, Using and Interacting mode of innovation.[164] The neglect of the DUI mode of innovation in Belarusian policy explains diminished importance given to the quality of products, incremental innovations in firms, cost-reduction programmes, non-R&D innovation, engineering improvements (process and products engineering), and management practices.

In summary, insufficient attention is given to demand-led innovation or technological activities which firms would need to undertake to meet the quality standards on the most demanding export markets. Instead, there is strong policy focus on commercialization with the aim to sell 'disembodied' technological knowledge in the form of patent licences, and know-how despite its minor economic significance regarding value-added, job creation and export. On the positive side, it should be emphasized that the country relies on a very well developed legal and financial support framework for growth of new technology-based firms, a high priority given to innovation by top policy makers and by political leadership and several high profile cases of successful technology-based growth.

4.5 Recommendations

4.1. *Risk-sharing*. Risk sharing is always important between business organizations (including private organizations) and other actors in the field of business R&D and innovation. Naturally, R&D-based innovations are more risky than others. Public resources have a distinguished role to encourage innovation through taking on the risky costs. Beyond the public sector, some other actors may play a role in funding RDI such as venture capitalists or business angels. Because in Belarus the latter actors are in practice missing, the State has to create better conditions for financing risky RDI activities and start-ups. The following is recommended to improve risk-sharing between firms and Government:

- The SCST and other bodies should be investing in expensive, risky innovation from public funds, including through co-financing (cf. chapter 2).
- For establishing and nurturing financial actors (venture capital, business angels) the BIF should consider options providing seed capital and introduce tax breaks for them, not only for legal persons, but also for individuals. (cf. chapter 2).
- The RDI bidding system has to offer equal opportunities to enterprises owned publicly or privately. Pre-determined competition has to be eliminated to make the competition conditions equal for State-owned and private firms including foreign entities operating in Belarus. (cf. chapter 2)

4.2. *State aid and incentives:* State financial support has to be provided on a larger scale to approach better the critical mass of financial resources for RDI. Adequate financial support from the State was hampered by the recent crisis and a tight budgetary policy, but it will be

[164] This is the mode of technology upgrading at firm level which is generated by employees, engineers and enterprises partners in solving ambitious and less ambitious development and production challenges. It is mistakenly assumed that only the first mode of innovation - R&D push or STI-mode matters for growth and productivity. See M. B. Jensen, B. Johnson, E. Lorenz, and B.A. Lundvall; "Forms of knowledge and modes of innovation", *Research Policy*, (2007) Vol. 36, No. 5, pp. 680-693. Evidence shows that DUI mode is equally important as R&D and that both ways of innovation are necessary and should be complementary. R&D is also critical in this mode of innovation but in its absorptive capacity, i.e., firms and country need to undertake R&D not only to generate new products and processes but also to be able to absorb new knowledge and to adapt imported technologies

necessary in the long term to ensure development objectives. With regard to State incentives, at present these are scarce. The following measures are recommended:

- The allocation of public funds for financing innovation should meet development objectives, which involve a holistic approach that considers the phases of R&D, sector diversification and regional development needs (see chapter 2).
- SCST in cooperation with the Ministry of Economy should work towards changing the allocation of State support from slow growing low- and medium-tech sectors to the promising medium-high and high-tech sectors.
- Public support is available mainly as repayable funds. The Government has to provide more non-reimbursable financial support for risky projects. Repayment for an unsuccessful project means retroactive withdrawal from risk-sharing. This mechanism does not seem to be a good incentive to engage private actors into risk-taking, as it puts all risks on the company (SCST in cooperation with the Ministry of Economy may consider introducing the partial re-payment of non-repayable funds if the project is successful) (cf. chapter 2)
- Set up with sizeable financial resources the planned schemes in the programmes for nurturing innovative start-ups and further developing innovative SMEs. Government institutions providing finance for innovation activities (i.e. the Development Bank Belinfund, the Belarusian Fund for Financial Support of Entrepreneurs) could consider subsidizing interest rates for the loans in the case of business R&D, early stage innovation, start-ups and SMEs.
- The SCST in cooperation with the tax authorities should consider setting up tax exemptions and tax credits on intramural R&D activities.
- In cooperation with the NCIP and the RCCT, SCST should discuss strategies for obtaining assistance for international patents and incentives for patenting abroad in order to protect Belarus intellectual property.
- Consider business views and reduce significantly bureaucratic effort for public R&D and innovation support. Implement funding schemes as speedy as possible (as time is crucial for innovation), consult also international experts and representatives of the Belarusian scientific diaspora for evaluation, and follow a transparent approach to evaluation (i.e. communicate evaluation criteria and results to applicants).

4.3. *Improve labour and skills development policies.* An adequately educated and trained skilled labour-force is crucial for an innovative economy. The insufficient quantity and quality of human resources may hamper R&D and innovation activities. SCST, in cooperation with the NAS and the Ministry of Education should consider some reforms of the educational system to meet the needs of economic development, including:

- Provide training for manager-practitioners in the field of R&D, innovation, knowledge management, technology transfer for upgrading naturally-talented managers' capabilities.
- Provide educational, training and consulting services for innovative enterprises and scientific-research organizations involving practitioners and researchers.
- In the phase of knowledge adjustment to modern market economies, attract international experts with complementary knowledge, support on-the-job training and coaching.
- Continue successful initiatives to improve the business environment, as the development of private businesses is a source of innovation and employment.

- Consider supporting placements of PhD students, graduates and researchers in companies (e.g. via an industrial PhD).

4.4. *Undertake measures to strengthen the Belarusian knowledge triangle.* In Belarus, certain prerequisites for the integration of education, research and innovation activities to commercialize scientific and technological development and the creation of innovative products are already in place. However, there are certain challenges affecting legislation, organizational matters, staffing, and access to finance that need to be addressed to improve innovation performance in the enterprise sector. The Government should undertake measures with the goal to remove these barriers, in line with the recommendations of findings of the Government Working Group under the TEMPUS project.

Chapter 5

THE ROLE OF ECO-INNOVATION IN FOSTERING SUSTAINABLE DEVELOPMENT

In the European Union, eco-innovation has been deemed to support the wider objectives of its Lisbon Strategy for competitiveness and economic growth. The concept is promoted primarily through the Environmental Technology Action Plan (ETAP), which defines eco-innovation as "the production, assimilation or exploitation of a novelty in products, production processes, services or in management and business methods, which aims, throughout its lifecycle, to prevent or substantially reduce environmental risk, pollution and other negative impacts of resource use (including energy)".[165] In Belarus, government policies for the promotion of eco-innovation are embedded in the country's broader sustainable development agenda, which among other goals, aims to reduce major negative anthropogenic effects on the environment and promote social inclusion (cf. chapter 1).

This chapter presents an assessment of policies promoting eco-innovation as a tool to achieve sustainable development outcomes. It considers broader trends and policies on environmental management and describes the role of eco-innovation in existing innovation development programmes. The chapter also discusses aspects of the Government agendas on the promotion of energy efficiency and the use of renewable sources of energy. The last section provides a summary of best international practice on eco-innovation as compiled by the UNECE and other international organisations in order to inform policy recommendations. The recommendations focus on measures to improve innovation performance by national institutions and firms in green sectors as well as on creating awareness in the population that could result in enhanced markets for sustainable products.

5.1 Recent environmental performance trends and policies

The Ministry of Natural Resources and Environmental Protection (MNREP) is the main agency in charge of environmental policy. This agency has worked with some stability during recent years, which improved the consistency in policy implementation as well as contributing to the mainstreaming of environmental considerations into sectoral policies and legislation. As was described in chapter 1, the Government has developed a system of strategic planning that is enshrined in the NSSSED-2030.

Environmental trends

A look at national statistics of Belarus shows that some success has occurred with regards to environmental policy during recent years, but important challenges remain to be addressed. Firstly, significant progress occurred in reducing the incidence of ozone-depleting substances during recent years. For instance, the installation of dust- and gas-traps contributed to raising the proportion of trapped and neutralized emissions from stationary sources. The amount of

[165] See OECD. *Sustainable Manufacturing and Eco-Innovation Synthesis Report Framework, Practices and Measurement.* OECD: Paris, 2008.

SO2 per capita in 2013 was 5.2 kg, which is less than half of the European Union (EU) 2010 average of 11.9 kg. Some progress has also occurred with regards to GHG emissions, where significant change was attained compared with the UNFCCC's figures for the base year of 1990. In 2013, Belarus' aggregate emissions were 56.92 per cent lower. However, much of this progress only occurred before 2005; and after this year the total GHG emissions measured in CO2 equivalent actually increased by about 10 per cent, from 84,173.71 Gg in 2005 to 93,200 Gg in 2013.[166]

Waste management, which has significant implications for disease control, is another priority area in the field of environmental protection. In Belarus, numerous types of waste are generated by industries, including toxic and hazardous ones whose production has slightly increased in recent times.[167] A specific issue that has attracted Government attention is the management of radioactive pollution from the 1986 Chernobyl NPP accident. The initial explosion and the ensuing fire carried radionuclides from Chernobyl in Ukraine over the border to Belarus, contaminating 47,600 km2 (23 per cent) of the country's land area, where 20 per cent of its population lived. A decrease in economic activity resulted from affected infrastructure and the resettling of 135,000 persons from contaminated areas. The total cost of the accident over 30 years is estimated at US$235 billion (in 2005).[168]

With regards to international commitments, while Belarus is already a party to most multilateral environmental agreements, envisaged actions will facilitate its participation in the remaining ones. Steps have also been identified to ensure stronger application of the principles of Shared Environmental Information System (SEIS). For instance, in 2013, Belarus set national targets in the field of water management, supply and sanitation in order to fulfil its obligations under the Protocol on Water and Health. In the next years, UNECE and UNDP will support the Government in trans-boundary cooperation on water management and climate change adaptation in the Neman River basin.[169]

It should also be highlighted that, during recent years, Belarus has improved its environmental policy-making with the help of UNECE advice. In December 2014, MNREP requested that UNECE undertakes a third Environmental Performance Review (EPR) of Belarus, which was carried out in 2015. The report addressed the following areas: air protection; the sustainable management and protection of water resources; waste management; biodiversity and protected areas; energy; transport; forestry; tourism; the relationship between education and the environment; and health.

The EPR found that during recent years several policies were implemented in Belarus that sought to promote sustainable development, encompassing actions to reduce the impact of climate change, protect landscapes and biological diversity, improve energy efficiency and encourage the use of local and renewable sources of energy. The EPR also recognizes key areas for improvement, among which it identifies public participation in strategic planning and the

[166] UNECE, *3rd Environmental Performance Review of Belarus*. New York and Geneva, United Nations, 2016, p. 3.

[167] Between 2005 and 2013, the generation of municipal solid waste (MSW) increased by 38.23 per cent, from 2,812,000 tons to 3,887,000 tons (UNECE 2016, p.11).

[168] Approximately 21 per cent of the country's agricultural land, 23 per cent of its forested land and 132 deposits of mineral resources were contaminated. UNECE, 3rd Environmental Performance Review of Belarus. New York and Geneva, United Nations, 2016.

[169] UNDP, *United Nations Development Assistance Framework (UNDAF) For The Republic of Belarus for 2016-2020*, UNDP, Minsk, 2015.

development of legislation, the management of diffuse pollution, the introduction of economic incentives to facilitate the renewal of an ageing transport fleet and a reduction in the use of asbestos in construction. As it is shown in section 5.2, targeted innovation policies towards the development of green economies could help achieve these goals.

It is expected that the EPR will be followed by technical assistance activities in cooperation with the Government to implement the policy recommendations. After the EPR findings were endorsed by the authorities, the Government enacted an Action Plan for the implementation of its recommendations during the period 2016–2020, which defines activities and measures to be undertaken by 16 central Government bodies, as well as the regional and local authorities.[170] Such measures include further developing the national framework for public participation in environmental decision-making, setting up the national ecological network, optimization of the waste management infrastructure and the introduction of river sediments monitoring. Many measures go far beyond the environmental area and refer to improvements needed in the energy, transport, forestry, tourism, housing and health sectors to ensure sustainable management of natural resources, preservation of the environment and protection of human health.[171] Policies that steer innovation efforts into these areas will be critical in realizing these improvements.

Environmental policy instruments

With regards to policy instruments, Belarus applies a range of measures aimed at increasing incentives for sustainable practices in industry and other sectors. Among *supply-side* measures, these include environmental taxes on air pollution and waste, compensation for damages, and specific charges for pollutants (such as motor fuels), among others.

Taxation is integrated with a system of annual emission limits, which are specified in corresponding environmental permits. Several reforms have taken place since 2011:

- As of the beginning of 2011, a system of payments of compensation for environmental damage in combination with administrative fines was set up, which replaced a special tax that applied to large polluters;
- A number of environmental taxes were abolished in 2010-2011 - including for petroleum refineries, transportation of oil products, and the production and import of goods containing over 50 per cent of volatile organic compounds (VOCs), plastic and paper packaging, and emissions from motor vehicles - with the general intention to simplify the tax system for enterprises;
- A large number of taxes were replaced by a single tax with a simplified calculation procedure for SMEs;
- The abolition of the Republican and local nature protection funds in 2011; and

[170] http://www.unece.org/info/media/presscurrent-press-h/environment/2016/belarus-adopts-action-plan-to-implement-environmental-performance-review-recommendations/doc.html

[171] See: http://eng.belta.by/economics/view/around-100km-of-forest-roads-to-be-built-in-belarus-annually-88566-2016/

- The approval of legislation obliging producers and importers of harmful products to assume the responsibility for collecting, neutralizing and/or recycling them.[172]

Total revenues from environmental taxation have remained largely flat in real terms in the 2010-2014 period.[173] This is due to the fact that annual changes in the various rates and the tax bases for specific pollutants, the volumes of emissions, and the waste generated, may compensate for gains and losses. Overall, aggregate revenues corresponded to a mere 0.3 per cent of general government revenue. Although no methodology for environmental taxation has been published, it is likely that the various tax rates do not fully reflect the entire environmental and other social costs of pollution and waste; and thus have not significantly changed patterns of production.

On the other hand, compensation for environmental damage has been applied in cases where the existing annual limits to emissions of air pollutants from stationary sources, storage and disposal of production waste and discharge of wastewater exceed predetermined limits. In addition, financial incentives for investments in environmentally-friendly technologies have also been implemented.

With regards to government expenditures on environmental protection, these have remained around 0.5 per cent of total government spending in recent years.

On the *demand side*, raising environmental awareness and promoting behavioural change within the population is also a priority for both adaptation and mitigation of climate change. Several agencies (e.g. UNDP, UNECE, UNICEF, UNIDO and UNESCO) have been involved in environmental education and awareness-raising campaigns on the sustainable management of natural resources.

Priorities on the need for mainstreaming green economy principles in education have been formulated in the National Action Plan for the Implementation of the UN Economic Commission for Europe (UNECE) Strategy on Education for Sustainable Development in the Republic of Belarus for 2010-2014 as well as on sectoral education development programmes. Attention has been given to the qualitative transformation of the education system covering all types of schools: pre-schools, secondary schools, specialized secondary schools and higher education institutions.

As part of the Action Plan, “green” subjects have been introduced in all types of educational institutions including lessons in elementary schools, high schools, vocational education and training institutions, as well as extra-curricular courses. In pre-school institutions, the Republican Ecological Center for Children and Youth coordinates efforts to encourage environmental awareness in children. In the system of secondary education, corresponding themes and topics have been included in curricula that deepen and elaborate some aspects of environmental education. With regard to education for sustainable development, the

[172] The range of products includes plastic, glass, paper and cardboard packaging, tyres, waste oil, refrigerators, TV sets, and PCs. Firms can decide between applying their own system of waste collection or requesting services for a fee to a State-owned waste operator under the remit of the Ministry of Housing and Public Utilities.
[173] UNECE, *3rd Environmental Performance Review of Belarus*. United Nations, New York and Geneva, 2016 p. 76.

Republican budget is not the most important source of finance, and projects rely on international cooperation initiatives, including those by UNDP, the European Commission, OSCE, and bilateral aid agencies.[174]

Overall, both "supply" and "demand" side measures contributed to a number of achievements to improve environmental performance, with improvements such as a decrease in air pollution from mobile sources, progress in integrating environmental education and education for sustainable development in formal, non-formal and informal instruction.

Finally, the institutional framework that supports environmental awareness at the national level is not very stable. An inter-ministerial Coordination Council on Education for Sustainable Development at the Ministry of Education, which was established in 2006, has met only two times, and its membership has frequently changed. Also, no monitoring and evaluation procedures have been established to assess policy implementation.[175]

So-called "green public procurement" policies have also been initiated, but remain at the very early stage of implementation. For instance, in addition to setting technological standards, the System of Measures to Strengthen Technological Potential of the National Economy to Ensure its Functioning on Environmental Principles also envisaged the introduction of green public procurement. But regulations have not been enacted with this purpose and the extent to which procurement actually considers any environmental criteria cannot be established.

Eco-innovations within existing Government development programmes and policies

The Government has a vertical structure to implement environmental policy through MNREP. According to information provided by the SCST, MNREP has been the implementing agency of significant innovation projects related to improving environmental protection, which were included in the State Programme of Innovation Development for the period 2011-2015.

During that period, seven projects involved innovation activities on environmentally-significant areas. The total invested funds for the implementation of these projects amounted to BYR1.976 billion , including from both the national budget and other sources.[176] Among these, five were in the field of Geology and two in the field of Hydrometeorology, although their impact on sustainability is not always clear. The table below summarizes main developments for each of these projects (Table 36).

[174] Ministry of Economy, *Sustainable Development of the Republic of Belarus Based on "Green" Economy Principles*, Scientific Research- Economic Institute of the Ministry of Economy, Minsk, 2012. Available at: https://sustainabledevelopment.un.org/content/documents/792belarus.pdf (accessed 1 June 2016).

[175] UNECE (2016) *3rd Environmental Performance Review of Belarus*. United Nations: New York and Geneva.

[176] It should be highlighted that the amounts spent are also small in relative terms. A study by the Academy of Public Administration of Belarus has showed that 62 per cent of projects included in the SPID programmes are not at all related to the promotion of green economies or the sustainable development agenda more generally. To address this deficit, it is recommended that criteria be developed for the inclusion of innovative projects on various cross-cutting areas of sustainable development in Belarus, such as "sustainable agriculture", "sustainable energy supply", "education for sustainable development", and others. See V. V. Yermolenkov, "Innovation for Sustainable Development, a review of Belarus". Presentation at the national SCST national workshop, Minsk, 6 October 2016.

In addition, funds allocated to the various R&D activities were established in the 2011 Resolution of the Council of Ministers No. 116, approving the list of scientific and technical programmes for 2011-2015. Projects financed covered R&D of innovative technologies for the efficient use of natural resources; sustainable forest management; new technologies for water supply and wastewater treatment and processing of secondary municipal waste, and improvements in energy efficiency.[177]

MNREP has also developed a programme of its own that involves some R&D activities by research centres and institutes. Namely, the "State Programme on Environmental Protection and Sustainable Use of Natural Resources for 2016-2020", which includes five sub-programmes.[178] In addition, there are more than ten other sector strategies related to sustainable development that may involve the promotion of innovations, including on the protection of water resources and pollution.

With regards to the promotion of green economy, the MNREP works in full interaction with the Ministry of Economy. The authorities have identified priority areas where they will focus most resources, some of which involve the funding of innovation-related initiatives. Whereas not all projects under the auspices of MNREP are "innovative" in a strict sense (i.e. they may amount to lower risk modernization), the authorities are eager to encourage the development of new technologies that are dynamic and could be instrumental in solving urgent environmental problems faced by the country.

Regarding international cooperation, MNREP enjoys the support of the EU and some initiatives have been held to bring expert advice on eco-innovation.[179] The goal has been to set up a plan for the development of the green economy and to develop sustainable patterns of consumption and production through the use of incentives. However, whereas MNREP has the research capacity to assist in the development of innovative products, its knowledge of aspects of the commercial viability of green products is limited. Because greening the economy is a multi-faceted sphere, there is a need for coordinated policy action involving delegates from other ministries not linked directly to the environment (e.g. social protection, trade). Such an approach could result in more informed policy making, also with regard to recent international commitments.[180]

[177] UNECE (2016) *3rd Environmental Performance Review of Belarus*. United Nations: New York and Geneva.
[178] These are: Sub-programme 1 "Study of subsoil and development of mineral resources base of the Republic of Belarus"; Sub-programme 2 "Development of the Hydro-meteorological Service, mitigating climate change, improving air quality and water resources"; Sub-programme 3 "Handling persistent organic pollutants"; Sub-programme 4 "Conservation and sustainable use of biological and landscape diversity"; and Sub-programme 5 "Ensuring the functioning, development and improvement of national environmental monitoring system in Belarus".
[179] See Olga Meerovskaya, Yauhen Huryanau,, et al. (2014). *Belarus Energy Sector: The Potential for Renewable Energy Sources and Energy Efficiency* European Commission, the FP7 project ENER2I.
[180] The need for improved policy coordination also applies to other agencies and ministries. For instance, with regards to "green" procurement policy, the Ministry of Trade has become the focal point for policy making after the country's accession to the EAEU, which includes specific regulations in this domain.

Table 36. Projects in State Programme of Innovation Development 2011-2015 under the Ministry of Environment and Natural Resources

Project	*Area*	*Status of achievement*
Project on integrated technology development on atomic geochemistry research and development/application of polymer and biopolymer drilling.	Geology	Project completed.
Project on development and implementation of system of aerospace monitoring of natural landscapes using unmanned aircraft systems and the Belarusian space system for remote sensing (State Enterprise “NTC on Geology")	Geology	In implementation (2015 budget BYR200 million).
Project on modernization of operated drilling rigs and introduction of a system of automated control of drilling process (State Enterprise “NTC on Geology")	Geology	In implemented (2015 budget BYR150 million).
Project on introduction of new methods of weather forecasting using digital predictive models (Republican Hydrometeorological Center).	Geology	Project completed. (Self-funded by the enterprise, estimated 2015 funds BYR1,469.9 million).
Project on developing software for crop forecasting using satellite information to improve performance.	Hydrometeorology	To be implemented. A joint-stock company for scientific production “Belsoft” was awarded a contract amounting to BYR882.356 million by competitive tender.
Project on introduction of technology for regular atmospheric sounding in accordance with requirements of the World Meteorological Organization (WMO).	Hydrometeorology	To be implemented. The Government held procedures for public procurement of technical equipment. Contracts worth BYR239,760 signed for supply of technical equipment.

Source: State Committee on Science and Technology

With regards to the current State Programme on Innovation Development 2016-2020, the environmental authorities have deemed that about 20 of the approved projects are environmentally significant and additional projects could be initiated in the future. MNREP is considered to be a ”scientific intensive” Ministry in Belarus and the Ministry has a few units that cooperate with the SCST and the NAS in research activities. Notably, these include the RUE “Scientific Production Centre for Geology”, the RUE “Central Research Institute for Complex Use of Water Resources” and the RUE Belarusian Research Centre “Ecology”. In late 2014, the MNREP adopted a “Strategy for the development of scientific, technical and innovative activity on environmental protection and rational use of natural resources in 2014–2015 and for the period until 2025” (Decision of the Ministry’s Board No. 112P of 2014), with priority areas in scientific activities including resources and energy saving, public health and

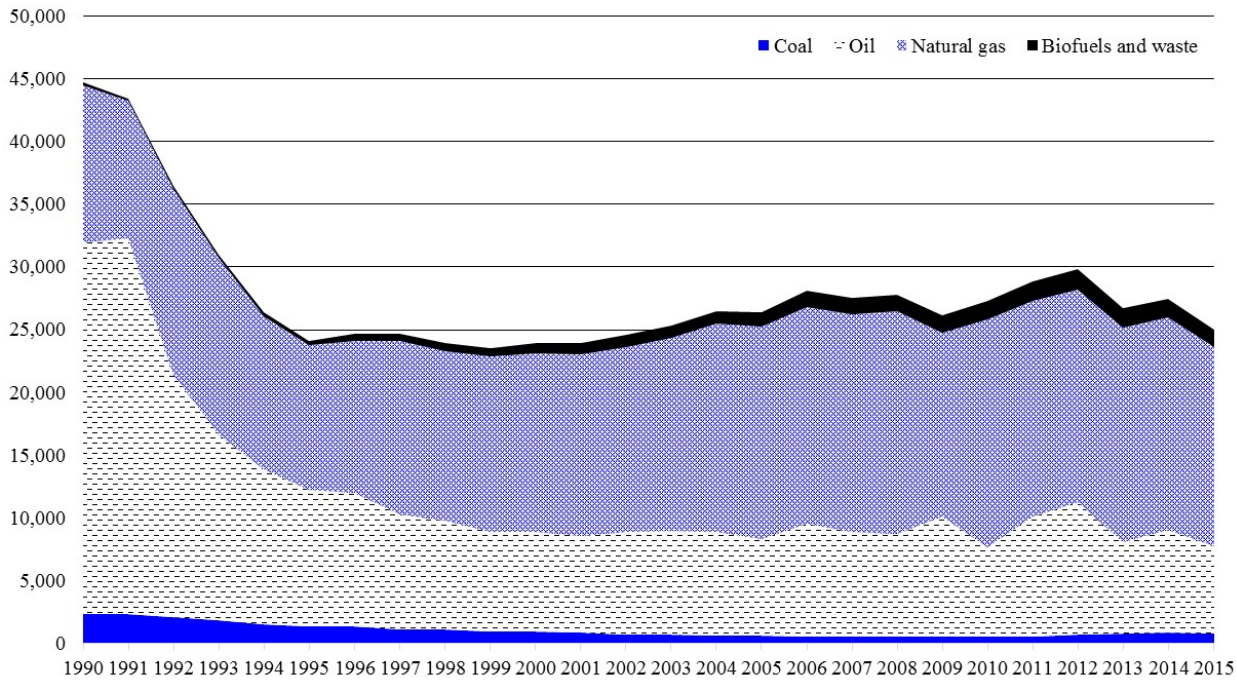
environmental protection[181]. It is thanks to these interactions that much of the best practice from European experiences became translated into legislation in Belarus (e.g. the introduction of a new water code, with regulations on basin management of water resources).

5.2 Eco-innovations and policies to boost renewable energy and energy efficiency

Recent trends and strategies to improve energy use sustainability

The Belarusian economy relies heavily on mineral resources (including crude oil, shale oil, natural gas and peats), which account for over 90 per cent of the country's production. In addition, Belarus counts with important potential for renewable sources in the form of wood, biomass, hydro-energy, wind and waste wood. Significantly, the energy balance is negative and the country needs to import energy from Russia. At present, Belarus also shows lower rates of energy intensity than other countries with economies in transition, particularly among CIS, but the level is still higher than in the average European OECD economies.

Figure 35. Total primary energy supply of Belarus, 1990–2015



Source: International Energy Agency
Total primary energy supply in thousand tonnes of oil equivalent (ktoe) on a net calorific value basis. Excludes electricity trade.

The Department of Energy Efficiency of the State Committee for Standardization is the main Government agency implementing policies to promote energy efficiency.[182] In 2009, Belarus

[181] See UNECE (2016) 3rd Environmental Performance Review of Belarus. United Nations: New York and Geneva.
[182] Other relevant agencies for science, technology and innovation activities in this field include the Ministry of Energy, the National Academy of Sciences, the Ministry of Education, the State Committee on Science and Technology and the Ministry of Industry.

became a member of the International Renewable Energy Agency; and since that time it already adopted a Law on Renewable Energy (2010).

In 2010, a National Energy Saving Programme for 2011–2015 was approved by the 2010 Resolution of the Council of Ministers No. 1882 with the very ambitious goal to reduce the energy intensity of GDP in 2015 by half, taking into account environmental requirements, social standards and provisions of energy-security indicators. The adoption of another programme followed with a focus on renewable sources of energy; namely, the National Programme for the Development of Local and Renewable Energy Sources for 2011-2015 (PDLRES), which has built on a series of other regulations aiming at improving the energy efficiency of the national economy.[183]

The goal of PDLRES was to nearly double the use of renewables in Belarus from 3 million tons of oil equivalent (toe) to 5.7 million (toe). Also, in 2012, the authorities approved a System of Measures to Strengthen Technological Potential of the National Economy to Ensure its Functioning on Environmental Principles. This initiative encouraged the undertaking of green economy measures by various governmental institutions. It specified short-term (until 2015) and long-term (2015–2020) policy measures in the areas of public utilities, oil, chemicals, construction, agriculture, transport and forestry. As of 2015, Belarus had already established over 100 technical standards for energy efficiency, including regulations for fuel, electrification, industrial production and a comprehensive list of energy-intensive consumer appliances.[184] As a result of the implementation of these standards policies, Belarus reduced its energy intensity from 0.69 (toe) per US$ of GDP in 1990 to about 0.21 (toe) - PPP 2005 value in 2015.[185]

Although PDLRES has succeeded in significantly reducing the energy intensity of GDP,[186] it has not had a transformative impact yet on the composition of the energy sources. The share of renewable sources of energy still amounts to only a marginal amount of total supply of energy resources in Belarus, fluctuating between four and five per cent in recent years. Also, most standards have not been embraced by private firms. Although the legal framework for private

[183] Other legislations that informed the programme include the following: Закон РБ от 15 июля 1998 года «Об энергосбережении» (Ведамасці Нацыянальнага сходу Рэспублікі Беларусь, 1998 г., № 31-32, ст. 470); Закон РБ от 27 декабря 2010 года «О возобновляемых источниках энергии»; постановление Совета Министров РБ Беларусь от 23 января 2008 г. № 94 «Об утверждении Государственной программы «Торф» на 2008–2010 годы и на период до 2020 года»; постановление Совета Министров РБ от 22 февраля 2010 г. № 248 «О мерах по повышению эффективности использования топливно-энергетических ресурсов на период до 2012 года»; постановление Совета Министров РБ от 9 июня 2010 г. № 885 «Об утверждении Программы строительства энергоисточников, работающих на биогазе, на 2010–2012 годы»; постановление Совета Министров РБ от 19 июля 2010 г. № 1076 «Об утверждении Государственной программы строительства энергоисточников на местных видах топлива в 2010–2015 годах»; постановление Совета Министров РБ от 9 августа 2010 г. № 1180 «Об утверждении стратегии развития энергетического потенциала РБ»; постановление Совета Министров РБ от 3 ноября 2010 г. № 1626 «Об утверждении Государственной программы развития лесного хозяйства РБ на 2011–2015 годы».

[184] A full list is available by the State Committee on Standardization: http://energoeffekt.gov.by/laws/standards/1927---------01032015.html (accessed 1 May 2016)

[185] See UNDP, *United Nations Development Assistance Framework (UNDAF) For The Republic of Belarus for 2016-2020*, UNDP, Minsk, 2015.

[186] On the other hand, energy use has been on the rise during recent years, from 2,800 kg/capita to 3,100 kg/capita between 2005 and 2011. At present, the energy intensity of the economy is 1.4-1.8 times lower than in Kazakhstan, Russia and Ukraine, but still 1.5-1.8 times higher than the average energy intensity in Europe. See UNECE (2016) *3rd Environmental Performance Review of Belarus*. United Nations: New York and Geneva.

firm certification and eco-labelling is broadly based on modern international standards (i.e. ISO 14024 and EU requirements), the practical implementation of product eco-labelling has lagged and no independent body for environmental certification of products is in place. However, voluntary approaches to standard setting are emerging as a result of competitive pressures on enterprises that work on markets with stricter environmental management regulations. Indeed, a few large enterprises have adopted the ISO 14000 series.[187]

Furthermore, the utility sector is dominated by State-owned companies, with Beltpogas and Belenergo being the key dominant players in the energy markets.[188] The total installed capacity of the national power system is 8979.2 MW. The power system has 23 hydroelectric stations with potential installed capacity of 26.3 MW and one wind power plant with capacity of 1.5 MW. (Table 37).

Table 37. Key indicators of the Belarusian energy system

The installed capacity of the power system as of 1 January 2016	8 979.2	MW
Electricity generation sources "Belenergo"	30.606	billion kWh
Heat supply	32.84	million Gcal
Electricity imports	2.816	billion kWh
Development of block stations power	3.476	billion kWh
Electricity exports	0.194	billion kWh
Total consumption of electricity in Belarus	36.704	billion kWh
Specific consumption:		
for electricity	2 35.5	g / kWh
for heat supply	167.52	kg / Gcal

Source: Belenergo: http://www.energo.by/okon/p21.htm (accessed 1 May 2016)

Belarus also has 1,840 sites for potential wind farm location with multiple grid connection points. These amounts to 1600 MW possible wind energy capacity. With regards to hydro-energy, the estimated capacity is 850 MW, with the largest hydropower potential concentrated in the Grodno, Vitebsk and Mogilev regions in the river basins of Neman, Western Dvina and Dnepr. Concerning the use of local fuels, there is large economic potential for the use of biogas and biomass, including the availability of cheap raw materials (municipal solid waste, agricultural waste, waste water treatment facilities).[189] Overall, the authorities have estimated

[187] In 2015, there were 69 enterprises in Belarus covered by ISO 14001 certificates, according to an ISO survey. Eco-labelling is also at an initial stage. Standards were set for non-food products, (e.g. refrigerators, furniture and some detergents), based on EU benchmarks. Certificates of conformity are extended for three-year periods by the State Committee for Standardization, which can annul them in cases of non-compliance. UNECE, *3rd Environmental Performance Review of Belarus.* United Nations, New York and Geneva, 2016.

[188] The role of the private sector is marginal and limited mainly to a public–private partnership (PPP) that handles waste management in the City of Minsk; a number of private companies in the district heating sector; and in the production of electricity from renewables. (UNECE (2016) *3rd Environmental Performance Review of Belarus*. United Nations: New York and Geneva.

[189] In particular, opportunities exist for biodiesel production using rape-seed in the Gomel region, which is also a Chernobyl-affected territory not suitable for agriculture (See UNDAF 2015).

850 MW possible bioenergy capacity. Finally, there is also some potential for the use of solar panels on the territory of Belarus.

Since 2012, private firms can generate and re-sell electricity using existing electricity grids, provided it is from renewable sources. Legislation also allows foreign investors to build up and operate power installations based on renewable energy sources. Indeed, the renewables sector - together with the pharmaceuticals, automotive and food industry- is one of the four priority areas for FDI attraction highlighted by the National Agency for Investment and Privatization. The feed-in-tariff (FIT) offered to producers of electricity from renewables in Belarus has led to several investment projects on building solar power plants with total capacity of 120 MW.[190] FIT rates to be paid by Belenergo to private producers during the first ten years of commissioning are set at the level of electricity tariffs for industrial or similar clients (with connected power up to 750 kVA), multiplied by a specific coefficient, which is determined by the type of energy source. As of 1 January 2015, the following coefficient and rates applied:

- Wind, wood, biogas and geothermal installations: 1.3 / US$0.174/kWh;
- Hydro installations: 1.1 / US$0.147/kWh;
- Solar installations: 2.7 / US$0.362/kWh.

In addition, foreign producers of renewable energy are legally guaranteed connection to the State electricity grid and purchase by the State energy utility of all proposed energy produced from RES. This is in addition to the benefits generally available to foreign-owned firms: eligibility for several incentives under the conclusion of investment agreements, including tax exemptions from import duties and VAT on imported equipment for its use within the framework of the investment project; exemptions from the land tax or rent payment for State-owned land plots provided for the construction of the project; direct access to renting a land plot of the required size; entitlements for the deduction of the full amount of VAT paid during the acquisition of the goods and other rights related to the project planning; construction and equipment of the investment project; among others.

In addition, foreign investments in small and medium towns and rural areas are exempt from import duties and VAT on imported equipment for its use within the framework of the investment project. These investors are also exempt from profit tax for the first seven years from the registration date, real estate tax, and State duties linked to special permissions (licenses).[191]

Domestic private sector involvement in the renewable energy sector remains limited, but some national enterprises have become involved in productive activities mainly by acting as intermediaries. In particular, SMEs are involved in such areas as consulting and representing big energy brands, but also on the production of local fuels, with a focus on wood and agricultural waste fuels.[192]

Although innovation could make a significant contribution to the expansion of renewable energy and thus energy sustainability in Belarus, significant constraints remain due to a lack of

[190] See Ministry of Economy, *Belarus Investment Guide 2014*, Government of Belarus, Minsk. Available at: http://investinbelarus.by/docs/Belarus_Investment_Guide_Sorainen.pdf (accessed 1 June 2016).
[191] *Ibid.*
[192] Olga Meerovskaya, Yauhen Huryanau, et al. (2014). *Belarus Energy Sector: The Potential for Renewable Energy Sources and Energy Efficiency* European Commission, the FP7 project ENER2I.

demand from households - whose energy bills remain significantly subsidized - and a resulting lack of profitability and access to funds for investment on the part of utilities. Tariffs for public utilities are set by the Government based on proposals of the utility providers to the Ministry of Energy and the Ministry of Economy. Notably, residential tariffs for utility services corresponded to only some 30 per cent of actual costs of production. Even though tariffs have increased since early 2013, the gap between the cost of production and tariffs paid is significant. Expenditures on housing and utility services accounted for only 4.4 per cent of household expenditures in Belarus in 2014, which is low compared to amounts above 10 per cent in neighbouring countries such as Lithuania, Russia and Ukraine. Utility companies have been compensating for the operating losses associated with low residential tariffs by obliging non-residential customers to pay tariffs significantly above the cost recovery level. When cross-subsidies are not sufficient, local governments have provided direct subsidies to their municipal utility companies (e.g. in the district heating sector).[193] Most public utilities also suffer from operational losses, which are linked to the unsatisfactory condition of equipment. In the context of current macro-economic constraints, this situation is not likely to improve in the near future.

With regards to the role of private providers, although the Law provides for a guaranteed connection of certified RES plants to the grid, the predictability of the regime is questionable, given the fact that the Government can modify the industrial tariffs to which coefficients are applied, which in turns affects the effective price paid and the profitability of investments.[194]

In spite of these constraints, the authorities of Belarus are aware of the potential gains of a smooth transition towards energy sustainability, and have signalled that improvements in energy efficiency are a priority for science and technology development. A study by UNDP estimated that the energy savings potential in the State sector in Belarus for the period 2011-2015 could amount to between five to six per cent of gross energy consumption, with the highest potential in the sectors of industrial processing, power, housing, agriculture and construction.

At the time of this Review, the Government had recently adopted the Concept on Energy Security of the Republic of Belarus. While this concept focuses on security, the measures envisaged can also improve environmental performance in the long run, because in the absence of large deposits of non-renewable sources, achieving energy security will necessarily have to involve the development of renewable sources. The third edition of the document, which built on previous versions of 2007 and 2014, was approved by the Council of Ministers of the Republic of Belarus on 23 December 2015 (Resolution 1084).

[193] UNECE (2016). *3rd Environmental Performance Review of Belarus*. United Nations, New York and Geneva, p. 82

[194] The purchase guarantee by Belenergo is also at a reduced rate for the second ten year period of operations, since the FIT is then calculated through a uniform coefficient of 0.85 regardless of the type of RES plant.

This Concept on Energy Security addresses challenges linked to global trends in the fuel and energy markets and proposes actions to foster energy security in Belarus. It describes the national energy policy in the period until 2035, including setting goals and guidance for policy action in nine areas:

1. Energy independence: The goal is set to increase the share of national energy demands covered from domestic energy resources from 14 per cent to 20 per cent in the period 2015-2035.
2. Diversification of energy resources: Promote local renewable energy resources, including nuclear energy, with the goal to decrease the share of total imports of energy resources from 90 to 70 per cent in the period 2015-2035.
3. Reliability of energy supply: Improve storage and processing of fuel and energy resources.
4. Energy efficiency of end-consumption of fuel and energy resources: It is proposed to introduce new technologies and materials in various sectors with the goal to reduce the energy intensity of GDP by 37 per cent in 2035 compared to the level of 2010.
5. Efficiency of energy generation and distribution: Foster reforms in the legal framework for energy as well as the modernization and reconstruction of energy grids and infrastructure.
6. Affordability of fuel and energy resources for consumers: Eliminate cross-subsidization of electricity and heat tariffs.
7. Integration into global energy systems: Foster international cooperation with the Eurasian Economic Union, the EU and leading energy organizations as well as expanding energy exports to the EU.
8. Improving the management system in national energy sector: Create wholesale national electricity market and improve the law on electric power industry.
9. Providing a scientific and technology support for development of the energy system: Focus on such areas as energy efficient technologies, nuclear technologies, local fuel and renewables.[195]

Another recent initiative that will have an impact on energy policy was Belarus' decision to introduce nuclear power as a national development priority. The authorities have already commissioned the construction of two nuclear power units (2 x 1170) of a power capacity of 2340 MWe, which will be completed by 2021 (Presidential Decree No. 499 of 2013). Regardless of its potential to increase energy security, the project has been deemed controversial with regards to its sustainable development outcomes due to related risks with the use of nuclear energy. Its successful implementation will also require a strengthening of the country's institutional capacities for efficient regulatory oversight and for its safety in line with international standards of IAEA.

Going forward, the development of energy efficient technologies and production of alternative fuels will be an unavoidable feature of a successful strategy for sustainable development.[196] Although it is not envisaged that Belarus will have a specific programme on "green"

[195] See: https://ener2i.eu/object/news/86 (accessed 15 May 2016)

[196] Energy, energy efficiency, nuclear energy, domestic energy sources and RES have been included in the list of the priority areas of science and technology activities in Belarus for 2015-2020 and in the list of priority areas of scientific research. See "List of priority areas of scientific research approved by the Resolution No. 190 of the Council of Ministers of the Republic of Belarus of March 12, 2015," *National Legal Internet Portal of the Republic of Belarus*, http://www.pravo.by/main.aspx?guid=12551&p0=C21500190&p1=1, 20.01.2016.

innovations, there are several projects that imply incremental improvements in the use of existing technologies. For instance, in recent times, the MNREP, in cooperation with other interested parties, developed a national action plan on the introduction of green economic principles in the national industries of Belarus up to the period 2020.

With regards to encouraging private sector involvement, there is a political will to encourage the work of SMEs in the implementation of energy efficient initiatives, but the design of comprehensive policies is still at an early stage. Whereas international investors are ready to invest in such type of developments, at the same time, the authorities are also aware of the need to improve the level of entrepreneurship in the country to commercialize green products, since scientific knowledge will not be enough to guarantee their success. Also, existing limits on access to finance have prevented a more rapid development, even if international financial institutions (IFI)s have complemented Government funds.

Finally, in spite of government efforts, some legal and institutional constraints have prevented a more rapid expansion of energy-efficient technologies. Paramount among these is the fact that "Belenergo" remains a monopolistic firm with a dominant position in most components of the national energy sector. Although recent reforms have allowed for the development of independent electric power producers, the country lacks an independent regulatory authority that could ensure transparency and fairness in pricing decisions. Overall, Belarus is still characterised by an over-regulated electricity market with significant price distortions that are the result of heavily subsidized tariffs for electricity and heat; and a lack of awareness in the general population about green products that could increase demand and create more economies of scale for innovative products.

The role of eco-innovation in the advancement of energy sustainability in Belarus

In Belarus, R&D programmes have been developed with funding from the national budget during recent years to support innovation in energy efficiency, including new technologies for energy conservation. Among the key programmes, the State research programmes on "Energy Systems, Processes and Technologies for 2016–2020," under the auspices of the National Academy of Sciences and the Ministry of Education, is a basic research project that will be undertaken by the Heat and Mass Transfer Institute of the National Academy of Science and Belarusian National Technical University. Chapter 8 of the programme describes priority areas of Government action, including improvements in the transition towards green economies, such as the following: Energy and energy efficiency, nuclear energy; environmental management and deep processing of natural resources (Table 38). The SPID 2016–2020 also contains modernization and innovation projects to be undertaken by companies and research organizations. The SPID has as its goals to develop a national fuel and energy sector and it addresses the needs of industry and households with regards to access to energy.

The SPID also includes priorities for the formation and accelerated development of high-tech sectors of the national economy based on 5th and 6th "technological waves", including in the following activities: "Cloud" technologies; development of space-based remote sensing of the Earth; development of component-based microelectronics base for all industrial activities and transition to production of new components for fabless manufacturing (based on the Fabless-Foundry business model); creation and development of production based on deep-processing technology of local renewable raw materials (woodworking machinery). It also aims to reduce losses of raw material resources for the stages of production and processing; and to implement

projects aimed at the replacement of non-renewable resources with renewable, taking into account the dynamics of the depletion of their reserves (See SPID, Chapter 8).

Table 38. Energy and energy efficiency related projects in the SPID 2016-2020

Under remit of Ministry of Energy		
1. Design and construction of the Belarusian nuclear power plant	RUE "Belarusian nuclear power plant"	2008-2020
2. Construction of a wind energy park in the District of n.p. Grabniki Novogrudok district	The Unitary Enterprise "Grodnoenergo"	2013-2016
Under remit of Brest region Executive Committee		
3. Development and organization of manufacture of industrial gas meters in the pressure range up to 0.6 Mpa with nominal gas flow from 160 up to 1000 m3/h	"OOO RUSBELGAZ"	2016-2020
Under remit of Grodno oblast Executive Committee		
4. Construction of a plant for the mechanical sorting of waste in Grodno	PIMU "UKS Grodno"	2010-2017

However, the actual share of public funding for research activities in the field of energy among total spending remains very limited, with an average of only five per cent in recent years.[197] As is the norm in Belarus, research programmes have been developed in such a way that they are intended to cover the whole innovation cycle from ideas to their embodiment in a particular product or service. The results of the State research programmes form the scientific basis for technological development at the national and regional levels. These results are later copied into innovation projects, which may or not be included in the State Programme of Innovative Development. However, as discussed in Chapter 2, the programme allocates an excessively high share of the risks of commercialization to research organizations, and this discourages risky projects. The strict compliance requirements with State-funded projects contributed to the shrinking of completion frameworks and goals, which reduces the attractiveness for long-term private investments.

In addition to the programmes referred to above, innovative funding for innovation activities in energy efficiency is available from innovation funds. Since 2001, Belinfund has supported several projects in the field of energy saving, energy efficiency and renewable fuels, including the following: products on air conditioning, ventilation and heating installations with heat recovery on heat pipes and fans for a firm in Brest; a technology for biodiesel production from rapeseed oil in Grodno and biofuel installations in a plant in Mogilev; and developing technologies for the production of composite solid biofuel (pellets) based on rape straw and other garden waste.[198] Sector and regional funds are also involved in financing innovation activities for sustainable development.

[197] See. "Reinforcing cooperation with ENP countries on bridging the gap between energy research and energy innovation", Ener 21, 2014. available at: https://ener2i.eu/page/6/attach/D2_2_pre_final_version.pdf (accessed 15 October 2016).

[198] Olga Meerovskaya, Yauhen Huryanau, et al. (2014). *Belarus Energy Sector: The Potential for Renewable Energy Sources and Energy Efficiency* European Commission, the FP7 project ENER2I.

Other forms of support for innovation for sustainable development include technology parks, tax incentives, business support centers and business incubators and international cooperation. Also, with the help of UNDP and the European Union, some successful initiatives have been undertaken at the local level that involve innovation through the use of green technologies and social platforms (cf. chapter 1). Still, available finance from private sources remains limited. The challenges discussed in this Review in relation to venture capital and business angels are even more challenging with regards to the promotion of energy-efficient technologies due to the lack of sufficient market demand for these products and the institutional challenges related to the energy sector referred to in the previous section.

Finally, linkages between research institutes and universities are not yet well developed, especially in the international arena. Foreign partnerships are not common and local scientists are not often participating in international R&D programmes in the field of energy efficiency, even if some results have been remarkable and show potential for future development.[199]

5.3 Belarusian experience in light of international good practice in eco-innovation

Green growth can be best achieved through the successful integration between environmental and innovation policies. Such strategic planning has been widely used by a number of governments, providing an important input for eco-innovation policy. Those strategies often include stringent performance standards complemented with stimulus to R&D and innovation in selected industrial activities (e.g. energy generation and manufacturing). A wide variety of economic instruments is available, such as excise taxes on fossil fuels or subsidies for renewable energy, which can be calibrated towards enhancing sustainability. Most challenges relate to the fact that the available policy instruments are applied by Government agencies that are responsible for narrow policy areas and may or may not have a holistic view of the challenges involved.[200] Thus, a clear vision, leadership and coordination is necessary for an effective implementation of eco-innovation, as measures taken in isolation will likely fail to deliver on their promises.

Given the uncertainty about the nature of technological change with regards to green economies, government and the business sector should complement one another with regards to the creation of green solutions. This is best done if governments create an environment that can enable the business sector to fully deploy its managerial solutions, technical knowledge and finance. In countries with leading energy-efficient technologies, private firms have been involved in the development of new technologies in such areas as water management; agriculture; energy supply; insurance; natural resource management; as well as on information and consulting services for climate change issues. Successful experiences also show that Governments often support eco-innovation by funding research, providing grants for innovative start-ups, increasing demand for green technologies and improving the environment for doing business.

[199] A winning project of 7th EU Framework Programme for Innovation was a project for the automation of "smart" grids involving two Belarusian teams - the A.V. Luikov Institute of Heat and Mass Transfer of NAS Belarus and "Minskenergo". See Olga Meerovskaya, Yauhen Huryanau, et al. (2014) *Belarus Energy Sector: The Potential for Renewable Energy Sources and Energy Efficiency*, European Commission, the FP7 project ENER2I.

[200] UNIDO. *Promoting Innovative Industries and Technologies for a Sustainable Future in the Europe and NMS Region: Compendium of Background Papers.* Vienna, 2012.

Such policies need to be well coordinated across multiple domains to ensure the mainstreaming of sustainable development concerns across a variety of policy fields (e.g. In agriculture, education, science and technology, finance, energy, environment, industry, trade and investment). In addition, cross sector policies in some significant policy areas can also indirectly affect innovation policy (e.g. In trade, investment, competition, intellectual property, education, entrepreneurship). A weak horizontal coordination between the line ministries is a common reality to be overcome in countries with economies in transition, which have inherited political systems based on strong vertical lines of command. Such governance structures pose additional challenges with regards to innovative green technologies, as these are often multi-faceted.

Indeed, comprehensive government action is needed to disseminate eco-innovations (Table 39). The first step consists of developing a coherent national innovation programme or strategy that targets sustainable development. Such strategy should be embedded in a working regulatory framework that will provide a basis for policy implementation in various fields in order to increase markets for green products.

One type of policy consists of market-based instruments for the creation of clear and stable signals (e.g. energy taxes, carbon emission trading schemes, tax rebates for R&D), that could increase demand for eco-innovations. One relevant example among CIS countries is provided by Azerbaijan, which has been the first to use its trade policy to take advantage of the Kyoto Clean Development Mechanism.[201] Other countries with economies in transition have also been successful in the use of tax incentives for R&D, including in green technologies. These include new EU members such as Slovenia, Czech Republic and Hungary, as well as Russia and Kazakhstan.

Another type of policy consists of direct support for innovation activities. This group includes a wide spectrum of policies from loans and subsidies; public investment in basic research; public infrastructure investments in eco-clusters; and business advisory services. For instance, among financial instruments, programmes that support private sector involvement in the creation of new green technologies could involve targeted financial aid depending on the stage of development of the specific technology and the risks involved. These include early-stage financing through seed capital injected by the company founder (a private investor or fund), and government grants; angel investors providing additional funding in return for an equity stake and some managerial rights; and equity financing through either government-controlled or private venture capital funds. Although overall funding for SMEs has been scarce in countries with economies in transition, some governments have succeeded in policies matching to grants for a limited number of innovative projects (e.g. Estonia). Business advisory services could also be instrumental in providing logistical assistance in areas such as international patent protection (cf. chapter 4).

[201] Azerbaijan was the first country in the world that sold carbon credits earned through an energy-efficiency project. The project contributed to reducing GHG emissions of the country's largest thermal power station. Other examples of green energy projects with external assistance include the Sumgait Technologies Park for the development of renewable energy sources and a new hydro power station. See UNECE (2013) *Innovation Policy for Green Technologies: Guide for Policymakers in the Transition Economies of Europe and Central Asia*. New York and Geneva.

Finally, in order to increase efficiencies through economies of scales, cluster initiatives have been set up to promote energy efficient technologies through better linkages between regional innovation actors (universities, research organizations, firms and investors). Kazakhstan provides an example of such Government initiatives supporting clustering in a resource-rich CIS country.[202]

These market-based and direct-support instruments should be complemented by improved regulatory tools. These involve regulatory frameworks that mandate or create incentives for the use of green technologies by consumers through energy regulation and standards, permitting, and land use regulations, among others. Such regulatory instruments can influence economic behaviour by redefining the costs of available options. Examples include mandatory recycling schemes of household waste, minimum energy performance standards or labels for appliances and equipment, and minimum emission requirements for motor vehicles. General awareness in the population can also be encouraged through outreach campaigns promoting sustainable consumption patterns.

In addition, the setting up of capacity-building and demonstration measures for private stakeholders and the general public (e.g. professional training, eco-efficiency-capacity - building for enterprises; educational programmes), needs to be complemented by policy changes in public procurement to privilege suppliers that comply with green standards.

Table 39. Elements of a strategy supporting eco-innovation

Type	Examples of measures	Policy fields
Strategic planning	Climate change foresight Strategic spatial planning	Foresight is relevant for all policy fields
Market-based instruments	Fiscal measures (e.g. energy tax, resource tax, carbon emissions tax, R&D tax incentives) Emissions trading schemes	Fiscal policy Trade policy
Direct support for innovation activity	Financial schemes (loans and credits) Subsidies (e.g. renewable energy subsidies) Venture capital funds Business incubation programmes Targeted R&D and technology transfer Business advisory services Eco-clusters (involved in development of eco-innovations and support for eco-innovative solutions in existing clusters)	Economic policy Energy policy Innovation policy Entrepreneurship policy Research policy Regional policy

[202] See "Innovative Technological Park Cluster as a Mechanism to Build New Industries in Kazakhstan", Kazakhstan Institute for Strategic Studies under the President of the Republic of Kazakhstan, 9 October 2015. Available at: http://kisi.kz/en/categories/global-and-regional-economy/posts/innovative-technological-park-cluster-as-a-mechanism-to-bui (accessed 15 May 2016).

Table 39. Elements of a strategy supporting eco-innovation *(continued)*

Type	Examples of measures	Policy fields
Regulatory and normative framework	Energy regulation standards and norms (including technology regulations, energy saving requirements) Permits and bans Land use regulations Environmental management systems, eco-labels and other soft standardization instruments	Environmental policy Industrial policy Energy policy Trade policy Local development policy
Capacity building and demonstration measures	Professional training (eco-efficiency capacity-building for enterprises) Changes in educational programmes	Education and training policy
Public procurement	Green public procurement	All policy fields with public procurement capacity (e.g. transport, construction and housing, national defence)

Source: UNECE. *Innovation Policy for Green Technologies: Guide for Policymakers in the Transition Economies of Europe and Central Asia*, New York and Geneva, 2013.

This chapter has reviewed some important aspects of Belarus' innovation policy in the context of the country's sustainable development strategies. It has highlighted major achievements and pending challenges to enhance the potential of innovation policies to foster green economies in the national economy. When contrasted with international good practice, the Belarusian experience in a way replicates some of the biases of its national innovation system discussed elsewhere in this review.

On the one hand, there seems to be a clear policy will at the strategic level to prioritise green transformations and this has been translated on some important R&D projects financed by the State. In addition, important legislation and policy initiatives have been approved in recent years to promote energy efficiency and the use of renewables, including the setting up of ambitious targets. When contrasted to international policy initiatives, the spirit of the country's NSSSED does not differ in substance from major global initiatives with regards to mainstreaming the role of innovation policies. Finally, the regulatory and normative framework has been recently upgraded and the country's performance does not lag behind comparator countries with regards to introducing modern technology certifications.

On the other hand, it has also been shown that the energy mix of the national economy has not substantially changed and that the energy sector remains broadly under State control and market mechanisms for the development of energy markets remain underdeveloped. As is the case in other transition economies in Eastern Europe and Central Asia, the emerging green economy in Belarus is incipient. Insufficient market development acts as a constraint for the supply and demand of green products, which is compounded by the persistent lack of financial support. Due to their cost, most energy-efficient innovations could not develop as bankable projects without significant government subsidies in the shorter run. On the demand side, prices of water and energy services for households tend to be heavily subsidized, in part because applying cost-reflection to prices would affect their affordability. Still, those subsidies can result in inefficiencies if they are not properly targeted to lower-income groups and do not create incentives for energy saving.

In the longer term, these constraints may need to be tackled as new and cheaper green products are necessary for the success of Belarus' transition towards sustainable development.

5.4 Recommendations

5.1 Enhance R&D capacities on green technologies. In line with the recommendations to increase government spending on R&D, the authorities should also target this spending on green and eco-innovation projects. In particular, research on energy-efficient technologies should be encouraged by competitive allocation of resources.

5.2 Seek engagement on international initiatives. Additional financing could be obtained from international climate funds. Also, cooperation between national and foreign R&D institutes should be further encouraged.

5.3 Further deepen awareness campaigns. Build on existing initiatives with UNDP to further improve education about climate change and the sustainable development goals in education institutions and to address the general public.

5.4 Stimulate demand for eco-innovation. Green public procurement mechanisms have been considered and could be further developed with the goal to disseminate green products and eco-innovation. In the long run, public procurement processes should be simplified in order to enable SMEs to compete for State contracts on a level playing field.

5.5 Introduce modern energy-efficiency and fuel-efficiency standards as well as building codes and infrastructure resilience parameters in order to improve sustainability. Move towards the cost-reflective pricing of energy and water services with adequate social protection for the poor in order to enhance incentives for the adoption of progressive adaptation technologies and sustainable use of natural resources.

5.6 Improve policies for the generation of knowledge, absorptive capacity of the economy, the diffusion of innovation and demand for innovation. Given the complexity of eco-innovation, there is a need for better and more efficient policy coordination both in design and implementation in this area, including capacity building. Also, the authorities should consider introducing specific mechanisms and instruments that encourage and facilitate linkages among stakeholders, For instance, the creation of "green" technology business incubators and technology transfer agencies could be considered that will promote stronger linkages between FDI firms and local subcontractors;

5.7 Enhance financial instruments supporting eco-innovation. Firstly, consider introducing grant schemes to support R&D on eco-innovation; Establish project-based eco-innovation financing instruments that encourage the development of industry-science cooperation and inter-firm linkages - including by promoting climate-resilient infrastructure through public-private partnerships.

Innovation for Sustainable Development Review

The Innovation for Sustainable Development Review contains the findings of a participatory policy advisory service undertaken at the request of the national authorities.

It considers possible policy actions aimed at stimulating innovation activity in the country, enhancing its innovation capacity. It also provides policy recommendations on how to harness innovation to achieve national priorities under the United Nations 2030 Sustainable Development Agenda.

The series "Innovation for Sustainable Development reviews" is part of UNECE work on innovation and competitiveness.

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