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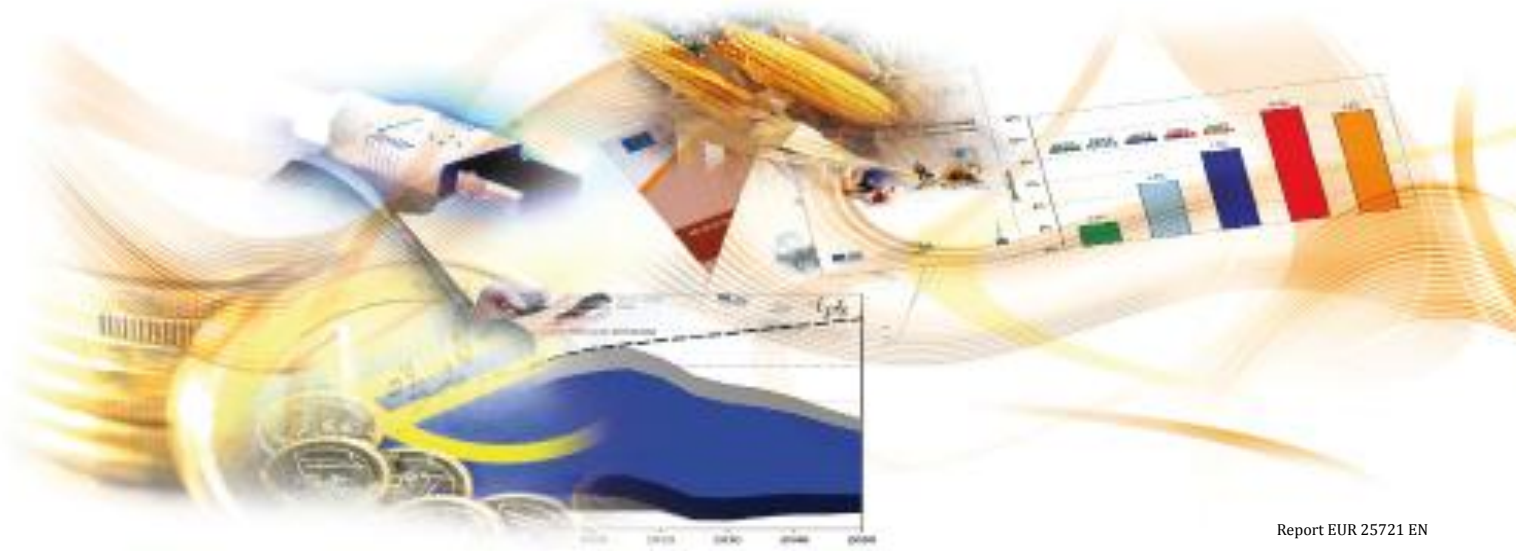

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Executive Summary

The Former Yugoslav Republic of Macedonia (FYROM) is a small country with a GDP per capita of only €3,380, that being 13.8% of the EU-27 average. After the 2009 GDP drop of 0.9%, the economy slowly started to recover in 2010 as the GDP grew by 1.8%, this recovery continuing into 2011. Macedonia's Gross Domestic Expenditure on R&D (GERD), which amounted to €13.27m, was decreased in 2009 by 12% when compared to 2008. GERD as a percentage of GDP was also decreased from 0.225% in 2008 to 0.199% in 2009, which is one of the lowest figures in Europe.

The main trends during the period of 2005-2009 were the decrease of relative share of government funds and the increase of the shares of funds from the business sector and abroad. However, in 2009 the governmental sector was still the biggest contributor to the total R&D expenditures by funding sources with 50.3%, while the funds from the business sector and abroad were 25.0% and 24.5% respectively. Contrary to general trends, in 2009 government funds were on almost the same level as they were in 2008, with the business R&D funds being decreased by 41% compared to 2008.

The structure of the FYROM GERD by its sector of performance in 2009 is not in line with the EU-27 averages. The share of Business Expenditure on R&D (BERD) in 2009, 21.1% of GERD, was significantly lower when compared to the corresponding EU average of 62.2%. On the contrary, the share of Government Intramural Expenditure on R&D (GOVERD) - 46.4% of GERD - and the share of Higher Education Expenditure on R&D (HERD) - 32.5% of GERD - were much higher when compared to the corresponding EU averages (13.4% and 23.9% respectively). Whilst the total number of researchers was decreased from 1,486 in 2007 to 1,254 in 2009, the number of candidates who received a PhD diploma increased from 119 in 2009 to 157 in 2010. The share of the population aged 30-34 having completed tertiary education increased in 2010 when compared to 2009 by 20%, i.e. to 17.1% in 2010 from 14.3% in 2009.

The main characteristics of the national RDI system in FYROM are the low level of public and private funds for R&D, the modest availability of quality research infrastructures, and the low quality of human resources regarding the output of publications, citations and patents. In 2011 one of the main focuses of the governmental policies was to provide new laboratories for state universities and public institutes, at the same time providing open access of equipment for the external users. In 2011, 50 new contracts for new laboratories were signed between the government and public institutes or state universities. There are considerable public funds allocated for this measure, which are granted by competitive calls. No financial data is available for 2011, but in 2010, €4.3m were planned for 22 laboratories through this measure. A progress in 2011 has been made with the FYROM Academic and Research Network (MARNet), since it became an independent public institution and was also recognised as a national public access point for Internet traffic exchange. This new role helps MARNet provide better national and international connectivity for all research institutions in the country, at the same time enabling a secure, reliable and efficient usage of network resources.

According to “Webometrics Ranking of World Universities”, the rank of the biggest and the oldest university “Ss. Cyril and Methodius” (UKIM) for the year 2011 was in 1,468th place from 12,006 universities, a significant improvement from 2010 where it had ranked at 1,928th place.

In 2010, the State Office of Industrial Property of the FYROM reported that the total number of filed patent, trademark and industrial design applications compared to 2009 were decreased by 13.7%, 6.4% and 1.9% respectively, i.e. from 422 to 364 patent

applications, from 5,027 to 4,703 trademark applications and from 774 to 760 applications for industrial design.
The structural challenges of the FYROM RDI system are as follows:

- Inefficient governance of the innovation system;
- Lack of quality human resources for RDI;
- Weak science-industry linkages;
- Low capacity for innovation by the companies; and
- Absence of a national roadmap for building quality research infrastructures.

The centralised governance of the national RDI system along with the shared responsibilities between the Ministry of Education and Science (MES) and the Ministry of Economy (ME) without involvement of the other stakeholders in the development and implementation of RDI policies creates a mismatch between the supply and demand side for innovation support and a disconnection of research and business sectors. The available RDI statistics show a very low quality of human resources and the higher education sector (HES) as the main provider of researchers. RDI data also shows the small capacity of the private sector to become directly involved in R&D and innovation activities, and to establish linkages with scientific institutions. The overcoming of these discussed weaknesses of the national RDI system is not feasible without investments in quality research infrastructures (RIs). Therefore, the government announced considerable investments in research laboratories for its state universities and public institutes. For better utilisation of the existing and the new RIs, the country needs a national roadmap for building higher quality RIs.
In 2011, the government adopted new changes on the Law on Higher Education (LHE), a new Programme founded by the Government of the FYROM (PGRM) for the period 2011-2015, and a new Law on Encouragement and Support of Technological Development (LESTD), whereas the draft version of the National R&D Strategy for 2011-2020 became a subject of public discussion. The purposes of these policies are to increase the quality of human resources and the HES (LHE); to strengthen university-industry linkages (LHE, PGRM 2011-2015); fostering know-how and technology transfer towards the industry (LESTD); and increasing the quality of national RDI system through the new dedicated agency (PGRM 2011-2015) and a new high-level committee (LESTD). The increase of the capacity of the companies as a priority is defined in the Industrial Policy 2009-2020, in which several dedicated measures are envisioned. The National R&D Strategy at this stage defines some social challenges along with general thematic priorities, which are mostly citizen- oriented. The priorities defined in the policies adopted by the government in the period 2008-2011 are partially matched with the discussed structural challenges. The appropriate policies were mainly well defined, but the existing structural challenges and the unavailability of sufficient funding from both public and private sources had a negative influence on the overall effectiveness of the measures, which in turn slowed down their implementation and caused an absence of any actual positive results.
The government through its Programme and an Action plan for 2008 set a goal for the annual increase in research funds until meeting the EU target of 3% of GDP. Since the GERD in 2009 was only 0.199% with a decreasing trend when compared to 2008, there is an obvious gap between the declarative and the feasible target for GERD. The newest target for GERD as a percentage of GDP proposed in the National R&D Strategy for the period of 2011-2020 is 1.8% with a 50% participation by the private sector. A structural analysis of the budgets for scientific and technological development in 2010 and 2011

shows that the government increased the funds that foster routes for stimulating greater R&D investments in R&D performing companies whilst attracting R&D performing companies (and universities) from abroad, however, the funds for the instruments that stimulate the increase of R&D in the public sector were decreased. This decrease is overcompensated by the government with two new measures; Equipping Laboratories for Scientific Research and Applicative Activities (ELSR); and the obligation of public universities to allocate 40% from tuition fees to R&D activities. There are no changes in the balance of other policy mix routes for 2011 when compared to 2010. Regarding funding procedures, evaluation of HE institutions, and promotion of professors, the general shift of national policy mix is the focus on quality criteria, rather than quantity criteria.

The economic growth of the country is the ultimate goal of main governmental programmes and RDI policies. The policies and measures envision increase of RDI expenditures and incentives, integration of the national R&D system in the European Research Area and alignment of the national R&D targets with European targets. However, the policies are mainly a declarative commitment of the government as of present, since the available R&D figures show that public funding is very low. Consequently, the effects of scientific and R&D related activities on the national economy are not evident, and it is therefore hard to establish a direct relationship between RDI investments and economic impacts.

The short-term evolving directions of the national policy mix are an increase of funding to companies through dedicated policies and measures that will efficiently increase their absorptive capacity for R&D, innovation and new technologies; and also will support science-industry linkages. Since there is an on-going large investment in research laboratories, the short-term imperative of the country should be to define a national roadmap for RIs, in order to maximise their utilisation. Medium-term evolvement of the national policy mix should be increasing the quality of the HES and human resources capable of RDI activities, and the development of an efficient monitoring system for the implementation of the RDI measures. The National R&D Strategy is in its final stage, so its finalisation, according to the previous directions, could contribute to an overall increase of the quality in the national RDI system. However, at present, the declarative prioritising of the RDI sector in the country along with the infeasible targets doesn't allow its steady growth and doesn't affect the structural challenges. Therefore, the RDI system in the country is still characterised with low quality RIs, inactive stakeholders, inefficient governance structure and an absence of the monitoring system.

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1 Introduction

The FYROM, a relatively small country, has a total area of 25,713 square meters and an estimated 2.06 million inhabitants as of 2011. This is based on the 2002 Census by the State Statistical Office of the FYROM (SSORM). The country was granted a candidate country status for European Union (EU) membership in 2005. When the country joins the EU, its surface area will be 0.6% of EU, while the country's population will be 0.41% as a share of the total EU population. The positive annual growth of the FYROM Gross Domestic Product (GDP) in the period 2006-2008 was up to 6%. The effects of the world economic crisis were mostly felt in the real estate sector in 2009, when the GDP dropped by 0.9%, a modest recession when compared to other EU economies. The economy slowly began to recover in 2010 when its GDP grew by 1.8%, this recovery continuing into 2011. The FYROM GDP reached €6.95b in 2010, which represents 0.056% of the EU's GDP. In 2010 the GDP per capita was €3,380 or only 13.8% of the EU-27 average. At the same time, the unemployment rate was 31%, which is one of the highest in Europe and more than triple the EU-27 average of 9.6%. In 2009, Macedonia's Gross Expenditure on Research and Development (GERD) was €13.27m, representing 0.0056% of EU-27 GERD. As a percentage of GDP, it was 0.199%, that being significantly lower in comparison to the EU-27 average of 2.01%. After a substantial increase of GERD as a percentage of GDP in 2008 when compared to 2007, in 2009 the GERD was decreased by 12% when compared to 2008. FYROM Business Expenditure on Research and Development (BERD) was €2.8m in 2009, or 21.1% of GERD. The share is significantly lower when compared to the corresponding EU average of 62.2%. On the contrary, FYROM Government Intramural Expenditure on Research and Development (GOVERD) and Higher Education Expenditure on Research and Development (HERD) as percentages of GERD (46.4% and 32.5% respectively) were much higher when compared with corresponding EU average (13.4% and 23.9% respectively).
When compared with international standards, the main characteristics of the national research and development (R&D) system in the FYROM are the low level of public and private funds for R&D, the modest availability of quality research infrastructures and the low quality of human resources regarding the output of publications, citations and patents. Strengthening the educational and research infrastructures has been set as one of the priorities in the Programme of the Government of the FYROM (PGRM) 2008-2012. In this direction, in 2011 the FYROM Academic and Research Network (MARNet) became an independent public institution with the goal of connecting all universities in the country. After implementing the new IPv6 protocol and getting included in the pan-European data network for research and education GÉANT, MARNet, together with the Ministry of Information Society and Administration (MISA), has started a project for national recognition of the network as a national public access point for Internet traffic exchange. One of the objectives of this project is to enable the entry of international Internet Service Providers (ISPs) in the country and thus increase the competitive opportunities for the end-users. This upgrade of MARNet enables secure, reliable and efficient usage of the domestic and international network resources by all research units in the country and their better regional connectivity. Except for GÉANT participating through MARNet, the FYROM has been actively participating in EUREKA, the pan-EU network for industrial R&D.
For the purpose of supporting and improving the existing research infrastructures in the country, in 2009 the Ministry for Education and Science (MES) launched a four-year project Equipping Laboratories for Scientific Research and Applicative Activities (ELSR).

Until November 2011 the Government has signed 72 contracts for scientific laboratories with different state universities and public scientific institutions. Once completed, the institutions are obligated to open the laboratories for external users.

The total number of researchers and the number of employees in R&D on an indefinite and definite period in the FYROM has steadily decreased in the period from 2007 to 2009, i.e. from 1,486 researchers in 2007 to 1,254 in 2009, and from 2,394 employees in 2007 to 2,050 in 2009. This decrease has been recorded in all sectors. The biggest share of the researchers is employed in higher education, 75.5%, while the business sector comprises only 1.5% of the total number of researchers.

The share of the population aged 30-34 having completed tertiary education was 17.1% in 2010, a significant increase from 2009, when it was 14.3%. In 2010, a total of 157 candidates received a PhD diploma. The new doctorate graduates per 1,000 population aged 25-34 in 2010 were 0.5, which is a third of the EU-27 average of 1.5. However, the number of candidates who received a PhD diploma increased in 2010 by 32%, due to the increase of diplomas in social sciences and humanities. The human resources in science and technologies as a share of total labour force in the country were 24.1% in 2010, which is a slight increase when compared to 2009.

According to the SCImago Journal & Country Rank portal, which includes the journals and country scientific indicators developed from the information contained in the Scopus database (Elsevier B.V.), the FYROM is ranked on the 98th place out of 231 countries, with the total of 464 published documents for the year 2010. In this regard, Macedonia scored lower than any EU country and some of the countries in the region such as Croatia (5,195 documents, ranked on 47th place) Serbia (4,843 documents, ranked on 48th place) and Slovenia (4,267 documents, ranked on 53rd place). According to the SSORM, the overall number of scientific publications in 2008, 1,431, was decreased by 25% when compared to 2007.

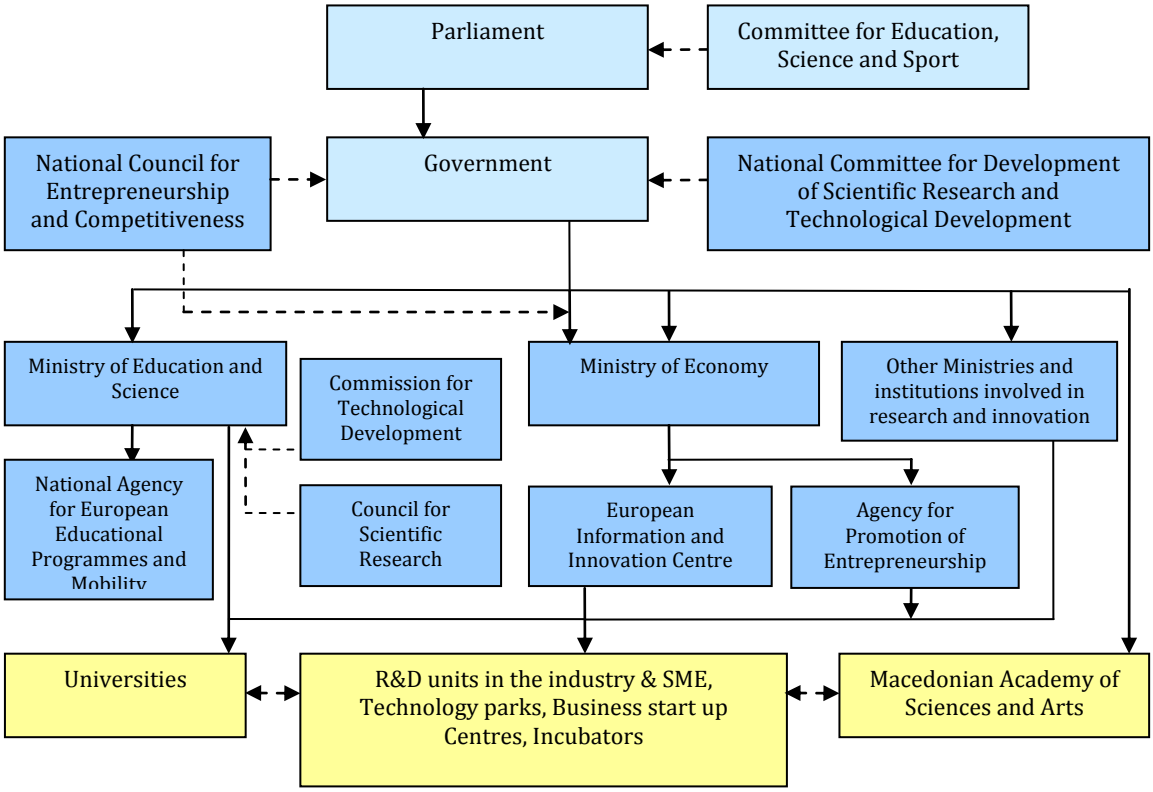
In 2010, a total of 364 patent applications were filed with the State Office of Industrial Property of the FYROM (SOIP), 27 national and 337 foreign. The number of filed patent applications in 2010 compared to 2009 was decreased by 13.7%. In the same year the SOIP received a total of 4,703 trademark applications, where 68.5% were under the Madrid Agreement, and the rest were filed to the SOIP. In the structure of the total number of applications 79.9% were foreign. The total number of applications was decreased by 6.4% compared to the previous year. Regarding the applications for industrial design, in the course of 2010, a total of 760 applications were filed to the SOIP. The total number of the filed applications for industrial design in 2010, compared to the previous year, has decreased by 1.9%.

Since the majority of researchers are employed in the Higher Education Sector (HES), the rank of the universities is a relevant indicator of the quality and excellence of knowledge production. The best ranked university from the country is the biggest and the oldest university “Ss. Cyril and Methodius” (UKIM), which for the year 2011 is ranked on 1,468th place from 12,006 universities according to “Webometrics Ranking of World Universities”. The rank of the university has significantly improved, since in 2010 it was ranked on the 1,928th place.

The FYROM economy is a small open economy in which exports and imports account for a considerable part of GDP. The economy has an unfavourable structure since it is based on traditional sectors that are by nature not knowledge-driven. Major exporters operate in the markets of basic metals, textiles, food and beverages where generally the price is the primary driver of competitiveness. Therefore, the FYROM industry builds its competitiveness on a relatively inexpensive workforce which negatively influences the demand for knowledge. In 2010, employment in high-tech manufacturing sectors was

4% and knowledge-intensive services as a percentage of the total workforce was 4.7% (Contesti 2011). Similarly, the export of medium and high-technology products as a share of total exports was only 0.98% in 2008 (Contesti 2011). According to SSORM, the private intramural research funding in 2009 was €2.8m. The total funding was directed towards the Manufacture of Chemicals and Chemical Products. However, in 2009 the computer and IT-related sectors along with the sector for composite materials had a considerable participation in R&D and innovation activities in the country. These industries are the main drivers for knowledge demand in the country. The investments in the high-tech industry sectors have a positive impact on knowledge demand, but due to the decreasing trend in Foreign Direct Investments (FDIs) and their small amount in absolute value (€221m for 2010), the impact is not significant.
The research and innovation system of the FYROM and its governance is presented in Figure 1.

Figure 1 : Overview of Macedonia's research and innovation system



Source: Adapted from ERAWATCH Research Inventory and TrendChart

Governmental bodies

The Parliament is the highest ranking policy-making authority in the country and together with the Parliamentary Committee on Education, Science and Sport is entitled to formulate and promulgate laws and policy documents of extreme importance. The Government of the FYROM is the highest executive body responsible for preparation and implementation of national research policies. The main advisory and expert bodies for R&D, implementation of the industry policy and innovation are the governmental National Committee for Development of Scientific Research and Technological Development and the non-governmental National Council for Entrepreneurship and Competitiveness.

Main bodies managing implementation of policies

On the operational level, the main ministries involved in R&D and innovation policies are the MES and the Ministry of Economy (ME). Up to the prototyping of the products and services, the overall responsibility for developing and administering Macedonia's science and innovation system is concentrated in the MES. The minister at the MES has two bodies at his disposal; the Council for Scientific Research and the Commission for Technological Development. In addition, other ministries are also active in the field or research and innovation policies with a focus on their specific sector-oriented responsibilities.

The European Information and Innovation Centre in the FYROM was established in 2008 as a FYROM partner in the Enterprise Europe Network. The Agency for Promotion of Entrepreneurship in the FYROM and the National Agency for European Educational Programmes and Mobility are state owned institutions, established to realise the programmes regarding measures and activities for the promotion of small-business entrepreneurship, and to realise the European educational programmes in the country.

Research performers

Faculties and public research institutes, as units of state universities, are the main actors at the research performer level. The subsequent biggest performer is the FYROM Academy of Sciences and Arts (MASA) through its five departments, which are also considered as a part of the government sector. The R&D units in the industry sector, small and medium enterprises (SMEs) and the different forms of science-industry cooperation like technology parks, business start up centres and incubators, are also a significant R&D performer in the country. The main performers within the business sector are the largest companies.

The role of regions in the governance process

The FYROM has no formal regional research policy, because it is a relatively small country with its research capacity mainly concentrated in the capital, Skopje. Nevertheless, through policies and measures adopted in the last few years, the government is making an attempt to decentralise higher education and the research infrastructures.

2 Structural challenges faced by the national system

The innovation performance in the FYROM is below EU-27, which categorises the country in a group of modest innovators (UNU-MERIT 2010, Innovation Union Scoreboard). The growth performance of the country is also below EU-27. This is a consequence of the marginalised position of RDI system in the country since its independence in 1991. Private companies have failed to show interest for participating in the creation of R&D and innovation policies. Conversely, neither the government nor academia have provided a challenge to the business sector to get involved in R&D and innovation activities and policy developments.

Inefficient governance of the innovation system

The innovation system of the FYROM is highly centralised. It is coordinated by the MES and ME; however a dedicated institution that is clearly responsible for innovation has not been clearly defined. Without proactive involvement of the other stakeholders, the division of responsibilities for support and development of innovation between MES, ME and other ministries creates a strong problem in the governance of innovation. This issue is partially resolved through various inter-ministerial working groups and public

consultations which is far from a systematic solution to governance of innovation problems and also creates additional difficulties such as a mismatch between the supply and demand side for innovation support and disconnection of research and business sectors (Institute Ivo Pilar, 2010; Radosevic S., 2009). This challenge has been recognised by the government and in their election Programme for the period 2011-2015, there is a plan for establishing a Technology and Innovation Agency (TIA). Furthermore, in the governance of the innovation system policy makers have a low recognition of science and R&D as key strategic factors essential for long term economic development. The importance of science and R&D is well established in all national strategic documents, but in the field a very small share of the country's GDP is dedicated for R&D and support of innovation activities. The absence of general governance in the overall system of innovation along with the weaknesses of the systems for financial support of innovation by both public and private sectors are noted in European Innovation Scoreboard (EIS) in the FYROM 2010.

The governance structure of the national innovation system does not provide efficient legal and policy arrangements for a supportive environment in private sector and university–enterprise cooperation. On the performer level, the research and innovation activities are concentrated amongst few actors. The largest actor, UKIM, comprises 65% of the total research and teaching personnel in the state university sector in 2010 (private university sector is mainly dedicated to education). In addition, one private company comprises 100% of the total reported private intramural R&D expenditures in the country (SSORM, 2011). The monitoring system for innovation is not implemented well, both in terms of institutions that monitor innovation activities, and in indicators used to monitor innovation.

A re-organisation of the entire governance structure of the FYROM RDI system which includes all relevant stakeholders and ensures an efficient monitoring system would be a very important prerequisite to increase its system's performances and to reduce the performance gap when compared to other EU countries. An increase of interest in research, development and innovation activities can be maintained through the creation of a proper regulatory framework and financial instruments that stimulate both research and the economic application of the research results.

Lack of quality human resources for RDI

According to the SSORM, the indicators of the FYROM for the human resources dimension are significantly below the EU average. The performance of the country for the indicator new doctorate graduates per 1,000 population aged 25-34 is only 33% of the EU average, and for the indicator population aged 30-34 having completed tertiary education, the country's performance is 51% of the EU average. Also, the total number of employees in R&D on indefinite and definite period in the FYROM was 2,050 in the year 2009, or 0.32% of the total employment in the country, much lower then the EU average of 1.04% for 2010. Additionally, the intellectual assets dimension from Innovation Union Scoreboard 2010 (IUS, 2010) for the FYROM indicates the low quality of the FYROM innovation system with all scores at approximately 3% of EU averages.

The low number of graduates and PhD students in the country had a big impact on the priorities set in the governmental policies and laws on higher education, which until 2008 were focused on education, instead of research and innovation (Josimovski S. & Trenevska K., 2011). Consequently, while the number of candidates who received a PhD diploma and the share of the population aged 30-34 having completed tertiary education were increased by 32% and 20% respectively in 2010 when compared to 2009, the total number of researchers was decreased by 8%. Furthermore, the last

available data for the overall number of scientific publications in the country shows that in 2008 it was decreased by 25% compared to 2007.

Higher education in the FYROM has the biggest impact on the demand of human resources for research and academic career, since the universities (including public institutions that operate under university umbrella) comprise around 90% of the total number of researchers in the country (SSORM, 2011). Regarding the fact that there has been almost no inflow of researchers and university professors from abroad due to the under-developed educational and research system in the country, the domestic HES has been the only supplier of researchers and academic employees at the universities. On the other hand, the international position of the FYROM HES is very weak, and it is listed only on "Webometrics Ranking of World Universities" where in 2011 the "Ss. Cyril and Methodius" university is ranked on 1,468th place and the other universities are ranked after 3,000th place from 12,006 universities. For the same reasons, an outflow of quality researchers and professors was recorded in the period following the independence of the country in 1991. This circumstance additionally decreased the quality of the human resources in the country for research and innovation.

The low quality of human resources for research and innovation is noted in the PGRM 2008-2012, causing several changes to the Law on Higher Education (LHE) in 2010 and 2011. This law now defines stronger criteria for recognition of a higher education institution (HEI) and performance of R&D activities through cooperation with the business community.

Weak science-industry linkages

According to the EIS in the FYROM 2010, one of the main structural challenges of the FYROM innovation system is the weakness of business-university linkages. From the survey conducted in the same study, only 17.3% of the surveyed companies can be classified as product innovators for the period 2007-2009, and only 14.5% of the products are innovated in collaboration with other companies or institutions (universities, research centres, etc.). This percentage for SMEs is 9.6%. This problem is additionally strengthened by: the low number of researchers employed in the private sector (only 1.5% of the total number of researchers), the weak system for financial support of innovation, and the focus of the HES on education rather than research. The most heavily discussed aspect of the national R&D and innovation systems in the FYROM is the lack of know-how and technology transfer to the business community (Polenakovik R. & Pinto R., 2010).

The structure of R&D expenditures in the country for 2009 also shows the weak linkages between the science and business sector. Intramural business expenditures represent 84.5% of the total business R&D funds, whilst only 15.4% is spent by the HES. Additionally, all R&D money spent by the business sector is from its own sources, which means that no funds have been recorded from government or abroad (ERAWATCH Network, 2010).

Universities from the country are still criticised that they struggle with many basic problems, such as old fashioned teaching methods and curricula that are neither in line with the requirements of the Bologna process nor the needs of the industry (R. Polenakovik & R. Pinto, 2010). Nevertheless, in recent years universities have started to restructure their curricula according to the principles of the Bologna declaration. Steps have also been taken by the government to stimulate cooperation with the business sector and to increase the influence of the business sector on the HEI. The urgent need for cooperation between the business sector and the universities in the field of R&D is recognised in the government's Programme 2008-2012 and in the new LHE adopted in 2008. Under this law, the implementation of the principles and the recommendations of

the Bologna declaration are regulated. The need for coordination of the education and the research with the changing needs in the field of labour is also recognised in the National Strategy for the Development of Education in the FYROM 2005-2015.
With assistance from TEMPUS, GTZ and other international donors, several technological centres, centres for technology transfer and business incubators have been established in the country, mainly within universities. Due to their financial problems after international support was finished at the end of 2010 only two centres and two business incubators were active. Additionally, the incubators are more focused on creating employment rather than on innovation (Dall E., 2007). In the country there are two science parks which are in the process of development within private companies.
Therefore, linking education and research with the labour market and establishing and strengthening linkages between universities, businesses and industry is a very important structural challenge for the country and its policy makers. This structural challenge is closely related to the main deficiency of the innovation system in the country, which rests with the production sectors that are mainly low-and medium tech and rarely need cooperation with the research sector.

Low capacity for innovation by the companies

The business sector comprises only 1.5% of the total number of researchers, and performs only 21% of GERD in 2009. According to the EIS in the FYROM 2010, the lack of innovation by the FYROM companies is a strong structural challenge that inhibits its own innovation development. The survey results for the three year period from 2007 to 2009, show that only 17.3% of the surveyed companies had introduced innovative products or services and more than 74% of the enterprises have neither introduced (as completely new or significantly improved) manufacturing, goods-producing, or service-based methods; nor have they introduced new or significantly improved logistics, delivery or distribution methods for supplies, goods or services. In the paper (Polenakovik R. & Pinto R. 2010) the authors note that only few companies have their R&D departments, while firms typically consider R&D expenditure as a cost without due consideration for the long-term effects of innovative products, processes and services resulting from R&D activities.
These facts reflect the small capacity of the private sector to become directly involved in R&D and innovation activities. It also shows its insignificant competitiveness when it comes to inclusion in European research networks and projects. Therefore, encouraging the active role of the private sector to stimulate its own R&D investments and its involvement in research is another big challenge for the research policy in the country.
This could be a persistent problem because of the structure of the FYROM economy. According to the SSORM, the services sector is becoming increasingly important, accounting for more than 60% of GDP in 2010. The industrial sector accounts for less than 30% of GDP in 2010, although it remains as the leading exporting sector. Textiles, iron and steel, power generation, cement, chemicals and pharmaceuticals are the important manufacturing industries of Macedonia. Agriculture is gradually losing its significance in terms of GDP creation, with participation of 10% in the structure. In 2010 out of the 75,497 enterprises, only 212, or 0.3% were large (SSORM, 2011). While the employment in medium-high and high-tech manufacturing and the employment in knowledge-intensive services as a percentages of total workforce were 4% and 4.7% respectively in 2008 (CONTESTI, 2011; EIS 2010), medium and high-tech exports represent only 1% of total exports in the country. Since the majority of the companies don't include any research and development, the cooperation between the industry and

the public research sector could be very promising and useful for achieving the ultimate goals of the policy makers.
Low R&D and innovation figures, along with a low awareness for innovation in the FYROM are illustrated in the comparative analysis of the innovation capacity in the Western Balkan Countries (WBC) (Institute Ivo Pilar, 2010). The same study notes that the low technological competences and absorptive capacity of the companies for new knowledge and for adapting imported and purchased technologies creates a lack of interest for research and innovation. Furthermore, according to the global competitiveness report for 2011-2012 (World Economic Forum, 2011) on the indicators for Company spending on R&D, the FYROM is ranked on the 109th position from 142 countries.
The low capacity for innovation as a structural challenge is recognised in the Industrial Policy of the FYROM 2009-2020 and the Strategy for Intellectual Property of the FYROM 2009-2012. These policies include a few measures as recommendations to increase the companies' capacities for innovation. The Industrial Policy presents an ambitious plan and policy for realising the priorities of development and the creation of a competitive economy that confirms and activates the human, material and natural potentials of the country. However, the low capacity of the private sector to utilise the measures and the small funds dedicated for the measures are the main barriers for the realisation of the policy's goals.

Absence of a national roadmap for building quality research infrastructures
One of the main characteristics of the national R&D system in the FYROM is the modest availability of quality research infrastructures (RIs) when compared to international standards. Research laboratories are primarily located in MASA and at public universities and institutes. Conversely, private universities do not own any research laboratories. In the business sector only a small number of businesses have created research laboratories as a result of the modest investments in research infrastructures during the past decade. Additionally, the country has no official national roadmap for building new RIs.
Poor RIs and low availability of cutting-age RIs influence the finest researchers to leave the country which in turn makes the domestic research market unattractive for foreign researchers. RIs are a key instrument in the creation of new knowledge and in strengthening innovation activities. While most EU countries have begun to identify their national RI needs, the national RIs in the FYROM are in an indigent state. As a result, the country is not seen as an attractive place where domestic and foreign researchers can perform advanced research.
The vague situation regarding RI development in the FYROM results from the lack of an official national roadmap for building new research infrastructures. At this moment, the guiding document for current RI investments is the PGRM for the period 2008-2012. This document neither proposes areas for specialisation nor provides guidelines on how the budget will be allocated. On the other hand, the government is in a process of equipping research laboratories for public universities and institutes with a total value of €60m for a period until 2013. Therefore, the establishment of a national roadmap for quality research infrastructures can be regarded as a structural challenge for the FYROM, since it would influence the brain drain, which is one of the biggest problems in the country and could increase the utilisation of new research infrastructures.
The outdated and inadequate scientific infrastructure and low level of investments is noted in the comparative analysis (Institute Ivo Pilar, 2010). The National Strategy for the Development of Education in the FYROM 2005-2015 also points out the need for

increased participation in international research and innovation networks and for strengthening research infrastructures, along with a balanced and flexible system of cooperation among the stakeholders in R&D and innovation.
The availability and accessibility of research infrastructures are prerequisites for resolving other structural challenges as individual companies cannot create the necessary conditions to generate and/or adopt new knowledge.

3 Assessment of the national innovation strategy

3.1 National research and innovation priorities

The FYROM doesn't have a separate national R&D or innovation strategy. A revision of existing priorities and the establishment of new emerging priorities are expected to be defined through the national R&D and innovation strategies which are currently in their final stage of development.
The MES is in the process of adopting a separate National R&D Strategy for the period 2011-2020. The primary goal of this strategy is to create a knowledge-based society through increased expenditures for research and technological development (1.8% of GDP by 2020), with 50% participation by the private sector. It is expected that the government will adopt this strategy in the second half of 2012. Currently, through cooperation with the MASA, universities and the business sector, and with support from the Organisation for Economic Co-operation and Development (OECD), the ME is preparing the National Innovation Strategy 2012-2020. The main objective of this strategy is to improve the capacity of domestic companies in order to absorb new technologies. The strategy should be released in the second half of 2012. The development of this strategy will answer the challenges arising from missing a clear vision, strategy and policy for development of the national innovation system. It is expected that these two documents will clearly identify the priorities on which the R&D and innovation systems in Macedonia will be focused in the period until 2020.
The priorities and objectives of the strategies are based on: previous analysis of strengths and weaknesses at the national level by the responsible ministries, the level of basic R&D and innovation statistics and indicators compared with the EU and South Eastern European (SEE) countries and conclusions of the broad public discussions by relevant stakeholders. The priorities of the National R&D Strategy 2011-2020 are based mainly on weaknesses in R&D and innovation financing in the country, quantity and quality of human resources, research infrastructures and research in private companies. At this stage, the National R&D Strategy 2011-2020 defines only general thematic priorities which are mainly influenced by the Europe's 2020 agenda. These priorities include:

- Building an open, innovative and knowledge based-society;
- Development of a low carbon society;
- Sustainable society and management with natural resources;
- Health of the citizens; and
- Security of the citizens.

The defined general priorities in the strategy are a follow-up of the thematic priorities defined in the Programme for Technological Development in the FYROM for the period 2002-2006. However, the priorities defined in the National Strategy 2011-2020 are

more citizen-centric as they were subjected to a broad public discussion, whilst in the final stage a definition of specific thematic priorities with a more sector-oriented approach is expected.

The National Strategy 2011-2020 discusses some social challenges like clean energy, security of the citizens, disease prevention, eco-products and organic food. Some of these challenges are defined in the Industrial Policy for the FYROM 2009-2020. Strengthening the know-how and technology transfer to the industry and open innovation concepts are part of the Law on Encouragement and Support of Technological Development (LESTD) adopted in 2011, and the Decree on Norms and Standards for Establishing Higher Education Institutions and performing Higher Education Activities (DNSHE), adopted in 2010. Through the Programme for Technological Development (PTD) the LESTD favours basic research projects with increased co-financing up to 100% of the total projects' expenses. The DNSHE sets out the policy for mandatory involvement of industry professionals in the universities' educational and R&D activities. This policy also includes compulsory internships for students in industry or government institutions. The public sector innovation aspects are discussed in the National Strategy for e-Inclusion 2011-2014, whose goals refer to Internet availability and the availability of other Information and Communication Technologies (ICT) to all citizens.

In absence of a separate national innovation strategy, the Industrial Policy for the FYROM 2009-2020 and the Strategy for Intellectual Property of the FYROM 2009-2012 define the following priorities for development of applied research and innovation in the FYROM industry:

- Rising the awareness for stimulating applied research, development and innovation in industry through a series of seminars, conferences and study visits to countries and regions that are recognised for their best practices in increasing applied research and development and stimulating innovations;
- Special trainings of SMEs for development of quality applications for projects with which they should apply in the EU programmes and other donor programmes and funds;
- Stimulating cooperation among entities for performing scientific-research activity between the universities and the industry by special instruments such as vouchers in order to enable the industry to acquire new knowledge and engage professional consultants;
- Stimulating commercialisation of new products and services in the field of product design by co-financing market research and marketing strategies for new products and services;
- Supporting the industry for employment of researchers to strengthen their competitiveness in technology and innovation;
- Stimulating the transfer of new technologies by eliminating import barriers and co-financing import costs for technology that would increase the introduction of new products and services with higher added value;
- International monitoring of the innovation potentials in the FYROM industry through inclusion of the country in the European Innovation Scoreboard;
- Supporting and protecting the intellectual and industrial property rights by rising awareness of researchers and industry for their value and by financial support for registering patents for new technologies, products and services; and

- The establishment of Technological–Industrial Development Zones (TIDZs) as a nucleus for the development of innovation based industries and development of partnership, strategic connections and joint ventures with international corporations, domestic companies, universities and centres for applied research.

In 2010 and 2011 the government increased its efforts on R&D and innovation strategies in specific business sectors which have been recognised as important sectors for the national economy. The sectors such as textile, ICT, tourism and energy are selected in the Industrial Policy for the FYROM 2009-2020 as the perspective regarding the long-term orientation of the industry towards higher value-added products and services and their international positioning. The ICT sector is considered as a sector that can accelerate the development and growth of other sectors, whilst the textile sector is one of the major industries in Macedonia as it employed 28% of the total number of employees in 2009 and participated in the total country export with 26% in 2009. For these sectors, there are separate policies adopted by the government: Strategy for the Development of the Textile Industry 2008-2020, Strategy for the Development of the Energy Sector 2030, National Strategy for the Development of Tourism 2009-2013, National Strategy for Development of Electronic Communication with Information Technologies 2007-2012 and Export Promotion Strategy for the FYROM Software and IT Services Industry, published in 2011. The main national sector priorities defined in the public call for financing the projects from PTD for 2011 are agriculture and ICT in agriculture. The projects from the prioritised fields comprise 60% of the total available funds for the PTD for 2011.

There is no official evaluation of any research or innovation policy. One reason for this situation is the absence of dedicated national R&D and innovation policies. Consequently, the main R&D and innovation policies are embedded in governmental programmes which don't include ex-ante evaluation criteria. The only document that refers to national innovation policies and has well established the monitoring and evaluation procedures is the Industrial Policy 2009-2020. According to the policy, the main activities for its monitoring and evaluation will be realised every three years through the document "Assessment of the Industrial Policy Influence" by an independent institution. This document measures the performances of the FYROM industry by measuring the basic data, measuring the progress on the overall industry and on sector level. The first major evaluation of the policy should be performed in 2012.

However, the successes and weaknesses of the separate policies are included in the yearly reports of the responsible ministries. Additionally, when a new measure or a policy is in the process of adoption, it is usually preceded by analysis of available statistics and indicators as well as strengths and weaknesses of the existing measures and policies.

EIS in the FYROM 2010 is the most detailed analytical study of R&D and innovation environment in the country and provides a comparative assessment of its innovation performance. The EIS in the FYROM 2010 was published in February 2011. The study confirms that Macedonia is one of the modest innovators in Europe and for the most of the analysed indicators the gaps that FYROM companies have exist especially in the fields of innovation and R&D. In EIS, the weak systems for financial support of innovation, both public and private, are noted. The majority of firms in the country are very small (micro) and the entrepreneurial system is scattered, with very little experience in utilising cooperation. According to the EIS, the reformation of the entire research, development and innovation system is the main way to increase economic competitiveness and to reduce the gaps between Macedonia and other EU countries. The

study projects a set of stimulus actions for research, development and innovation activities in the enterprises through three layers of politics: tax, financial and competition policies. Additionally, increasing enterprise's competitiveness is encouraged through cooperation and internationalisation of research activities.
Partial evaluation of national research and innovation policies can be found in various academic papers. The paper (Polenakovic, R. & Pinto R. 2010) has analysed the policies and its recommendations are very similar with the recommendations proposed by the government in main research and innovation policies: increase investment in R&D, introduce technological and industrial development zones, establish technology/science parks, promote R&D benefits to SMEs, strengthen the science-business linkages, develop R&D human capital and reduce brain drain, intensify international cooperation, increase technology dissemination, strengthen Intellectual Property Rights (IPR) and an introduction of R&D tax incentives.
In order to increase public and private R&D funds, in 2010 the government introduced new measures and increased the funds for several instruments. However, the total R&D budget and the budget for technological development for 2011, was decreased by 20% when compared to 2010. A structural analysis of this budget shows that the government chose to foster the routes for stimulating greater R&D investments in R&D performing companies whilst attracting R&D performing companies (and universities) from abroad, since the budgets for appropriate instruments in the year 2011 when compared to 2010, were increased by 33% and 19% respectively. On the contrary, within the R&D budget, the funds for the instruments that stimulate R&D in the public sector were decreased by 10% in 2011, amounting to €1.37m. This decrease is overcompensated by the government with two new measures introduced in 2010, ELSR, and the obligation of public universities to allocate 40% from tuition fees to R&D activities. The dedicated funds for the measure ELSR were €4.3m for 2010 and €7.33m for 2012. It is very difficult to estimate the direct financial effects of the obligation of public universities to allocate 40% from tuition fees to R&D activities, but it is notable that the self-financing budget segment for the higher education sector with €53.2m in 2011 was 58.2% of its total budget.
The structural challenges are partially addressed by the national policies that include R&D and innovation priorities in the FYROM. The challenges which have a lack of quality human resources for RDI, weak science-industry linkages and low capacity for innovation by the companies are well addressed and consistent with the defined priorities. However, the challenges inefficient governance of the innovation system and absence of a national roadmap for building quality research infrastructures are not consistent with the adopted priorities for the country.

3.2 Trends in R&D funding

The main R&D funding indicators for the FYROM for the period 2008-2010 in comparison with the corresponding EU-27 averages are presented in the following table:

Table 1: Basic indicators for R&D investments in FYROM

	2008	2009	2010	EU average 2010
GDP growth rate*	5.0	-0.9	1.8	2,0
GERD as % of GDP	0.225	0.199	N/A	2.0
GERD per capita	7.46	6.45	N/A	490.2

	2008	2009	2010	EU average 2010
GBAORD (€ million)	6.92	6.68	N/A	92,729.05
GBAORD as % of GDP	0.1	0.1	N/A	0.76
BERD (€ million)	4.3	2.8	N/A	151,125.56
BERD as % of GDP	0.065	0.042	N/A	1.23
GERD financed by abroad as % of total GERD	16.1	24.5	N/A	N/A[1]
R&D performed by HEIs (% of GERD)	31.4	32.5	N/A	24.2
R&D performed by PROs (% of GERD)	40.1	46.4	N/A	13.2
R&D performed by Business Enterprise sector (as % of GERD)	28.5	21.1	N/A	61.5

*GDP at market prices; Percentage change on previous period

The national research system of the FYROM is under-funded, with a dominant role of the public research sector in 2009 both as an R&D funder (50.3% of GERD) and an R&D performer (78.9% of GERD). In 2009, GERD as a percentage of GDP was only 0.199, significantly lagging behind the EU average. The private research sector in the FYROM is still rather weak (21.1% of GERD in 2009), thus rendering research in the country to be dependent on EU and other international funds. The world economic crisis had a modest negative impact on real GDP growth in the country when compared to EU economies (-0.9% for 2009), but this impact decreased the total R&D expenditures in the country. The biggest drop was recorded in the business sector where the economic crisis was mostly felt.

With the Action Plan for 2008, adopted by the MES, the R&D target was to increase the funds for scientific research by approximately 35% per year until the EU target of spending 3% of GDP on R&D was achieved (Dall E., 2008). The target was not achieved. On the contrary, in 2009 GERD as a percentage of GDP was decreased to 0.199% from 0.225% in 2008. In the draft version of the National R&D Strategy 2011-2020 a new target is proposed for the country. According to this target, FYROM's expenditures in R&D as percentage of GDP should be 1.8% in 2020, with 50% of the GERD performed by private businesses.

The total governmental appropriations for R&D in 2009 are €6.68m, a slight decrease of 3.5% when compared to 2008. A closer approximation of the budget outlays for R&D is the budget line for the "science" of the national budget, along with the budget line for MASA. The science budget line comprises two types of funds; the first type is an outlay for direct transfers, i.e. institutional support to horizontal research performing public institutes, and the second type providing funds for the main R&D funding instruments. While a considerable share of the science budget line for 2011 is competitive-based (44%), the budget line for MASA is based on institutional funding. There are separate block budget lines toward state universities which mainly consist of non-direct R&D expenditures for GUF, however here the R&D portion is neglected.

The government of the Republic in Macedonia strengthens the R&D and innovation through tax incentives and subsidies. The emphasis in the period 2008-2011 is on tax incentives, which are proposed as measures in the main national policies that include R&D and innovation. Nevertheless, there is no evidence regarding the financial dimension of these measures in terms of money and implications for R&D activity in the country.

[1] 8.4 (2009), 9.04 (2005)

Collaborative funding is realised through the government PTD which supports science-industry linkages, know-how and technology transfer, and through direct collaboration of the business sector with the public sector. The funds for the PTD are significantly increased in 2011 compared to 2010 (approximately by 35%), while the funds provided for direct collaboration with the public sector dropped by 27% in 2009 when compared to 2007.

According to the latest available data from the State Statistical Office, the most important source of funds for research activities in the country in the period between 2005 and 2009 was the government sector. The government sector share in the funding was 71% in 2005, 51% in 2007, 45.9% in 2008 and 50.3% in 2009.

While the relative share of government funds has significantly decreased in the period 2005-2008, the share of funds from the business sector have an incremental increase. This share in the total R&D funding for the same period increased from 15% to 37.4% and in absolute value more than tripled (€5.65m in 2008). In 2009 the government funds were on the same level as they were in 2008, the business share was decreased to 25.0%, and the business R&D funds in absolute terms were decreased by 41% compared to 2008.

The share of funds from abroad in the period 2005-2009 increased from 14% to 24.5%. The most important international programmes for the country are FP7, CIP, EUREKA, USAID programmes, projects financed by GTZ, and so on. These funds enable the FYROM institutions and organisations to get involved in more advanced R&D. The share of expenditures on R&D from private-non-profit institutions is negligible as this share was in the 0.2%-0.95% range for the period 2005-2009. The private non-profit sector's contribution is insignificant in both research funding and research performance.

Macedonia is not participating in ERDF/ESF and as a result, no regional R&D and innovation funding is co-financed by the ERDF/ESF.

The research programmes from the MES are mainly generic and lack a sectoral or thematic character.

Public-private partnerships are not recognised as value adding criteria in leveraging additional funds from the programmes in Macedonia. For international funds where it is necessary to form a large consortium, public-private partnerships are created and add value in leveraging funds, although this is not always supported with additional funding by the government.

The government of the FYROM encourages the trans-national cooperation and funding through bilateral international cooperation and contributions and fees for participations in international organisations and international programmes. In 2011 the funds provided by the government for bilateral international cooperation and contributions are decreased when compared to 2010 by 16% and 71% respectively.

3.3 Evolution and analysis of the policy mixes

Since 2008, the Government of the FYROM has expressed a high degree of commitment for strengthening R&D and innovation.

The strategic priorities in the four-year governmental programmes 2008-2012 and 2011-2015 are investments in education, science and information technology as the main components of a knowledge-based society. Furthermore, the programmes, along with the National Strategy for Development of the Education 2005-2015, focus on quality higher education through investments in R&D infrastructures, use of information technology, investments in science and innovations, and improving the quality of the curricula. The main innovation priorities proposed in the Industrial Policy of the FYROM for 2009-2020 are collaborative approaches for enhancing competitiveness (business

research, government collaboration, alliances, networks and clusters), SME development and entrepreneurship, human resource development and knowledge creation, internationalisation, commercialisation of new products, investment enhancement and intellectual and industrial property rights. Therefore, the strategic, coherent and integrated policy framework that promotes research and innovation as a key policy instrument to enhance competitiveness can be considered as strength of the national system. However, under-funding of R&D and innovation in the country by both public and private sectors, along with the small number of innovative companies and the lack of quality human resources are serious threats for the leading role of R&D and innovation in the creation of knowledge-based society. Further strengthening of the role of R&D and innovation in the national policy mix is expected by the adoption of the separate R&D and innovation strategies in 2012.

There is a need to improve the innovation governance system in Macedonia, as noted in several policy and analysis documents (Institute Ivo Pilar, 2010; Radosevic S., 2009; CONTESTI, 2011; EIS, 2010). The lack of systematic governance prevents the effective monitoring and review of the policies and subsequently monitoring and review of the implementation of the programmes and measures. This weakness of the national RDI system has been noted in the reports provided by the implementation bodies where the number of financed projects and dedicated funds are stated, but there is a lack of depth analysis for the quality of realisation, achievement of the projects' stated goals and their larger impact in the industry and the country.

The national policy documents define innovation in a broader scope that concerns organisational changes, processes and service improvements, which gives options to institutions and businesses to get funding for different types of innovation and contribute to the overall improvement of innovations in Macedonia. However, the current R&D and innovation policies and measures focus on the supply-side and neglect aspects of demand that might stimulate or enable R&D and innovation in the country. Regarding the demand-side policies, there is a strong shortage of development in type-specific policies and also lacks clear identification of the role of research and innovation in these policies. The most popular tools used within demand-side innovation policy in Macedonia include awareness raising activities, in addition to regulations and standardisations. It can be concluded that there is no consistency of supply and demand-side policy developments which creates an opportunity for improvement of the policies regarding this criteria.

There are no clear financial policies in Macedonia. As education, science and innovation are placed as a strategic priority in the programmes of the government, they too devote funds to these areas. The largest investment in the period 2010-2011 was made to improve the research infrastructures at public universities and institutes. However, it is not clear what leverage affect these investments of the government in research infrastructures and educational institutions have on the private investments in R&D and innovation. In the Programme for 2011-2015, the following R&D and innovation measures that include fiscal incentives or subsidies are envisioned:

- Fiscal incentives offered to foreign investors for investments in new technologies within the Technological Industrial Development Zones (TIDZ);
- Up to 50% financing of the investment for inventions and patents that have the potential to become effective;
- Up to 50,000€ in grants for encouraging technology transfer;
- Scientific subsidies for all scientific workers who will publish scientific papers in an impact factor magazine; and also

- Creative subsidies for creative activities in the field of music, dramaturgy, painting, sculpture, acting, film directing and linguistics.

The provided funding is in sync with the defined priorities, but the focus is still not on excellence in research and education. However, the efforts of the MES on improving the project evaluation for funding, public presentation of the project results, evaluation of the quality of the R&D in the higher education and stronger criteria for promotion of professors through dedicated policies and measures, can be regarded as strength to the country's R&D and innovation systems. The country is missing legal, financial and social frameworks for research careers offering attractive conditions to both men and women. Additionally, there are no clear incentives to attract leading international talent, except for one attempt when the University for Information Science and Technology "St. Paul the Apostle" in Ohrid was opened and foreign professors were employed. Unfortunately, the expected results regarding the attraction of quality international staff were still not achieved. There is also no framework in Macedonia that will enable the portability of the researchers funding. One reason for the absence of a legal solution for this portability might be the lack of migration by researchers between institutions.
By identifying education as a strategic priority and by identifying the need for more graduates and postgraduates, the government opened new universities and dispersed some study programmes from the existing universities to other smaller cities in Macedonia. The emphasis in this measure is on technical sciences, engineering and ICT. This has contributed to an increase of the graduate and postgraduate students in Macedonia, but in the same time there is a weakness on the quality of the generated graduates and postgraduates. The weakness of low quality human resources for research and innovation is noted in the Programme 2008-2012, which caused several changes to the LHE in 2010 and 2011. The universities have restructured their curricula according to the principles of the Bologna declaration, and include courses and modules that focus on innovation and entrepreneurship. Overall, the ability of the education system to produce the right mix of skills could be regarded too, as strength by the national research and innovation systems.
The current policy documents state and promote the development of partnership between various stakeholders in innovation and R&D. The main weakness is the lack of infrastructure and framework for establishment of partnerships between these stakeholders. The partnerships between the industry and the universities are on very low level and the development of university spin-offs or funding provided by business angels is in very early stages of development. The issue on IPR is more complex and not very transparent, as the enforcement of IPR is not well managed. With the development of the Strategy for Intellectual property of the FYROM 2009-2012, several actions are envisioned that will improve the management of IPR. On the other hand, Macedonia is recognised as a country where the procedures for establishment of new business are very fast and transparent, with some improvements necessary in the process of closing the business. Furthermore, there is neither infrastructure nor framework for establishing trans-national partnerships or collaboration. The international funding programmes like FP7 and previously TEMPUS are the main programmes through which these partnerships have been established, but the majority of the partnerships exist only for the duration of the projects.
Policies which promote innovation, entrepreneurship and enhance the quality of the business environment are envisioned in the governmental strategies, but due to the structural weaknesses of the private sector regarding R&D and innovation, they are inefficient and have a very limited impact on the research and innovation systems of the

country. Therefore, promoting private investments in research and innovation can be regarded as a weakness of the national policy mix.
The small number of clearly thematic and sector-oriented programmes might undermine the understanding of the companies and institutions for which programmes to apply or whether their innovation ideas/projects are appropriate for the programme. The majority of measures are not sector specific however; textile companies, educational institutions, SMEs and innovative ICT companies are targeted with specific measures. In addition, the government offers support in establishing a company by co-funding the establishment, but there is no clear focus on innovative start-up companies as the funds are given for any idea. The lack of business angel networks or venture capital funds restricts the development of innovative start-ups. To some extent the business incubators place a requirement on the supported companies to have an innovative component, but this is the only provision. It can be concluded that there is a lack of high quality, simple and easily accessible public support for innovative start-up companies, and this can be considered as another weakness on behalf of the FYROM innovation system.
For the majority of procurements there are no incentives to stimulate innovation neither in the public sector nor in the delivery of public services. The main procurement criterion is price. Furthermore, there is no public procurement of innovative solutions to improve public services, like dedicated budgets and joint procurement. The only exception is the Public Procurement of Innovative ICT based Products and Services in Education, which is an excellent opportunity for the country to experience the benefits of this type of policies.

3.4 Assessment of the policy mix

The policies that have been adopted by the government in the period 2008-2011 are based on the analysis and weaknesses of the R&D and innovation systems, which are mainly presented as a part of the policy documents. The general opinion is that the analysis confirmed the structural challenges of research and innovation systems. The appropriate policies were mainly well defined for the majority of the structural challenges, but the implementation of these policies has been slowed down due to the absence of long-term R&D and innovation strategies, low capabilities of the private sector for performing RDI activities, inefficient governance structure, incoherent policy mix and the unavailability of sufficient funding from both public and private sources. There is no evidence for positive impact of policies regarding research and innovation systems as they were mainly adopted in 2010 and 2011.
Regarding the inefficient governance of the national innovation system, one of the proposed solutions in the Programme 2011-2015 is the establishment of a TIA. The establishment of a dedicated TIA could strongly improve the governance of the innovation system in Macedonia through better coordination, development and implementation of innovation policies. The possible shortcoming of this proposal is that the TIA is viewed as an independent body with its own funds to support technology and innovation projects. There is no information if the TIA will be the main coordinating body. If such is the case the establishment of a TIA would not be sufficient to eliminate the structural challenges in the inefficient governance of innovation system. To eliminate this inefficiency the TIA should have the power to coordinate all important stakeholders in development and implementation of the innovation policies, programmes, and measures. With this power and by having integral and synergistic approach, the TIA would be able to influence the activities that contribute towards elimination of other structural challenges.

In 2011 a new LESTD was adopted. According to this law, the government will establish a new Committee for Technological Development, which will consist of seven members, six ministers from the ministries involved in R&D and innovation and the vice-president of the government of the FYROM for economic affairs who will act as a president of the committee. The committee proposes the four-year PTD and is the main decision-making body for financing large projects from the PTD. The purpose of the establishment of the new committee is to increase the efficiency of the governance in the innovation system of the country and the efficient implementation of large projects of national importance.
The government as a part of its programmes for the periods 2008-2012 and 2011-2015, developed several policies that would affect the quality of human resources for R&D and innovation. The policies defined in the framework of the Programme 2008-2012 aim towards the strategic goal of having 25% of the population with higher education and to enable a larger group of students to enrol at universities. Therefore, in 2008 the government opened new universities and faculties in bigger cities with decreased-to-no tuition fees; a new university in Ohrid designed to include foreign professors and provided international scholarships for students at one of the Top 100 world universities or Top 20 European universities from the Shanghai Jao Tong University ranking. These policies had impacts on the quantitative statistics for human resources, but have not contributed to the qualitative statistics to a satisfactory extent. In direction of improving the quality of human resources, the Programme 2011-2015 proposes new policies, along with changes in the LHE and the DNSHE as adopted in 2010 and 2011. The policies refer to the international ranking of HEIs, stronger scientific criteria for promotion of professors, stronger criteria for establishment of HEIs, stimulating the students to study natural and technical sciences and subsidies for scientific works published in a journal with an impact factor. The lack of human capital for RDI is a strong structural challenge, because it could take a long time to reach the appropriate goal. Hence, it is still too early to evaluate the effects of these measures since their implementation has just started. Furthermore, overcoming this challenge should be considered in combination with the structural challenges; the absence of a national roadmap for building quality research infrastructures and low capacity for innovation by the companies.
The weak science-industry linkages are noted in the main policy documents that refer to this area. The concrete policy actions that affect this challenge are noted in the DNSHE, adopted in 2010. The DNSHE sets out the policy for mandatory involvement of industry professionals in the universities' educational and R&D activities and also includes compulsory internships for students in industry or government institutions. The memoranda for cooperation between the main universities and chambers of commerce can also be considered as a contribution towards mitigation of the weakness. The effects of these actions are not evident for two reasons: the private sector has a very low number of researchers and there are only few companies in the country which consider R&D and innovation as a main driver for achieving competitiveness. Secondly, the linkages are not supported by dedicated measures.
Additional actions from the Programme 2011-2015 that should strengthen the cooperation between science and industry, are the projects "Commercialisation of Knowledge and Science" and "Techno-Starters and Spinouts". The objective of these projects is to encourage the universities to establish companies based on science or technology. Unfortunately, there is still no clear evidence that the universities have started to create companies based on these projects.
The challenge of low capacity for innovation by the companies is addressed by several policies and measures. The newest policies are embedded in the LESTD, adopted in 2011

and realised through the PTD. PTD opens the door for enterprises to apply for government co-financing of up to 50% of industrial research and development project expenses which can include an innovative component. If the project addresses basic research, the government co-financing is up to 100%. Another action which is part of the 2011-2015 Programme, and addresses this challenge is the project "With Science to New Factories". The project aims to enable state co-financing in the process of development of technologies, innovations, ICT, as well as the transfer of know-how. Furthermore, low capacity for innovation as a structural challenge is addressed in the Industrial Policy of the FYROM 2009-2020 and the Strategy for Intellectual Property of the FYROM 2009-2012. The policies are accompanied by measures such as: Programme for Support of the Textile Industry in the FYROM; Innovation Voucher Counselling Scheme; Programme for Competitiveness of the FYROM Products and Services; Programme for Support and Development of Clusters' Associations in the FYROM; Programme for Development of Entrepreneurship, Competitiveness and Innovation of SMEs; and Public Procurement of Innovative ICT based Products and Services in Education – e-content. These measures raise the awareness for stimulating applied research, development and innovation in the industry, at the same time stimulating commercialisation of new products and services in the field of product design and also stimulate transfer of new technologies. However, the inherent shortcomings of the private sector as an R&D performer and innovator, limits the effectiveness of all these actions. Additionally, this structural challenge could be addressed by attracting business angels and venture capitalists.

Through the ELSR, the government has increased the quality of the research infrastructures for public universities and institutions. However, the measure neither proposes areas for specialisation nor does it provide guidelines on how the budget could be allocated. The investment of infrastructure without having a clear roadmap could create a situation of large dispersion of investments in different sectors and themes without achieving the ultimate goals. Therefore, isolated measures can not compensate for the absence of a national roadmap for research infrastructures. The appropriate address to this challenge could mitigate the other challenges, influence the brain drain as one of the biggest problems in the country and too, increase the utilisation of new research infrastructures.

The assessments of the effectiveness of the specific policies to address the structural challenges are presented in the following table:

Table 2: Assessment of policies addressing structural challenges

Challenges	Policy measures/actions[2]	Assessment in terms of appropriateness, efficiency and effectiveness
Inefficient governance of the innovation system	• Establishment of dedicated Technology and Innovation Agency; • New Committee for Technological Development.	These measures could positively affect the governance of the innovation system. Both entities are not yet established, so their efficiency and effectiveness will largely depend on the role and the power these entities will have.

[2] Changes in the legislation and other initiatives not necessarily related with funding are also included

Challenges	Policy measures/actions[2]	Assessment in terms of appropriateness, efficiency and effectiveness
Lack of quality human resources for RDI	• International scholarships for students at one of the top 100 World universities or top 20 European universities from the Shanghai Jao Tong University ranking; • International ranking of higher educational institutions; • Stronger criteria for promotion of professors; • Stronger criteria for establishment of higher educational institutions; • Stimulating the students to study natural and technical sciences; • Subsidies for scientific works published in a journal with an impact factor.	The measures are partially appropriate, since the ultimate goals are well defined, but the way how the goals should be achieved is not clear, and the funding schemes are missing for part of the measures.
Weak science-industry linkages	• Mandatory involvement of industry professionals in the universities' educational and R&D activities; • Includes compulsory internships for students in industry or governmental institutions; • Memoranda for cooperation between the main universities and chambers of commerce; • Project "Commercialisation of Knowledge and Science"; • Project "Techno-Starters and spinouts".	These measures are appropriate for this structural challenge. However the effectiveness and efficiency of these actions are not evident, since the traditional sectors have low absorption capacities for RDI, the SMEs as dominant type of enterprises are the modest innovators, the private sector has a very low number of researchers and there are only few companies in the country which consider R&D and innovation as a main driver for achieving competitiveness. The implementation of the actions is mainly dependable on the proactive role of the universities. Additionally, the measures are not supported by dedicated funding schemes.

Challenges	Policy measures/actions[2]	Assessment in terms of appropriateness, efficiency and effectiveness
Low capacity for innovation by the companies	• Programme for Technological Development; • Project "With Science to New Factories"; • Programme for Support of the Textile Industry in the FYROM; • Innovation Voucher Counselling Scheme; • Programme for Competitiveness of the FYROM Products and Services; • Programme for Support and Development of Clusters' Associations in the FYROM; • Programme for Development of Entrepreneurship, Competitiveness and Innovation of SMEs; • Public Procurement of Innovative ICT based Products and Services in Education – e-content.	These measures support companies in performing R&D and innovative activities and provide additional funding for RDI projects. However, the inherited shortcomings of the private sector as R&D performer and innovator, limit the effectiveness of all these actions. Furthermore, the dedicated funds are very low.
Absence of a national roadmap for building quality research infrastructures	• Equipping Laboratories for Scientific Research and Applicative Activities	The focus of this measure is on providing quality RIs, and doesn't address the absence of a national roadmap for RIs. The absence of this roadmap decreases the effectiveness and efficiency of the measure.

4 National policy and the European perspective

As presented in their programmes and R&D and innovation policies, one of the goals of the Government of the FYROM is economic growth through increasing R&D and innovation expenditures and by providing incentives for innovations and new technologies. Furthermore, the intention of the government is to integrate the national R&D system in the ERA and to align the national R&D targets with the European targets. Opposing this declarative commitment of the government are the available R&D figures which show that public funding is very low both relatively and absolutely. The only exception to this observation is the ongoing investment in laboratories for scientific research and applicative activities in the public institutes and state universities, which was valued at €60m for a four-year period. In addition, the private sector has low absorption capacities for research and innovation, at the same time having a lack of resources for research and also the presence of weak linkages between the science and business sectors. Currently, the majority of FYROM enterprises give special attention to obtaining competitive advantages based on low cost production factors and neglect the competitive strategies sustained by creating products having a high level of added value, that which is obtained by applying the results of research, development and innovation activities (CONTESTI, 2011; EIS, 2010). Also, the effects of scientific and R&D related activities on the national economy are not evident, and it is therefore hard to establish a direct relationship between investment and economic impacts.

The low R&D and innovation intensity in the country is accompanied with several structural weaknesses of the systems. Contrary to the well developed R&D systems, the FYROM public research sector performs and finances most part of the research activities. The scarce budget resources can ensure only the maintenance of the research sector, albeit any significant progress. Additionally, quality was not the dominant criterion in the distribution of the majority of the funds within different measures. Low demand for knowledge from the private sector, low quality of produced knowledge and the presence of brain drain have now become the biggest challenges for policy makers in the country. Conversely, the number of researchers is extremely low, particularly in the business sector where the usage of public funds for innovation and participation in public-private linkages is almost nonexistent.

The ultimate goals of the government on one side, and the available resources along with the structural weaknesses of the R&D and innovation systems on the other, determine the directions for evolving the national policy mix.

The first short-term direction, which should be regarded as crucial, is to increase the funding of the companies through dedicated policies and measures that will efficiently increase their absorptive capacity for R&D, innovation and new technologies. The measures should support establishing linkages with science, employing adequate human resources, internationalising their activities and fostering cross-border cooperation, which are considered as main weaknesses of the private R&D sector. The companies that perform R&D and innovative activities should be also encouraged to invest in new technologies through tax and financial incentives or through FDIs. Since FDI inflow has been mainly achieved through acquiring existing companies that were positioned as a monopoly on the domestic market, the country has not experienced an inflow of new technologies, innovations, new knowledge and increased export through FDIs.

Instead of focusing on the quantity of the produced human resources by higher education, policies should encourage production of quality human resources capable of performing world-class research. This can be regarded as a medium-term direction, as quality education usually requires a longer period of time, therefore it is unlikely that quality human resources can be produced in a short term period.

In order to increase the effectiveness of RDI policies and their monitoring, it is necessary to establish a more efficient governance structure of the RDI system by increasing the role of all important stakeholders. This could be regarded as medium-term direction for evolving the national policy mix. Also the governance structure should increase the coordination between the national R&D system and the ERA.

The ongoing project for equipping laboratories contributes towards higher feasibility of the evolving directions. However, the laboratories should be framed in a broader national roadmap, which could provide efficient use of the available RIs in the country.

Until now the FYROM has not developed a special strategy or action plan on R&D, innovation or technology development based on the assessment of R&D and innovation potentials or foresight exercises. Therefore, the development of R&D and innovation is not based on country-specific science, technology and production framework conditions. As an outcome the country has changed the main R&D targets in the last few years and has shown inconsistency in this domain. This general shortcoming in the national policies should be overcome with two dedicated strategies, National R&D Strategy 2011-2020 and National Innovation Strategy 2012-2020.

The national labour market for researchers in the FYROM is unattractive. Its main negative features for the period 2007-2009 were the drop in the total number of researchers, low salaries and very low inflow of researchers from abroad. On the other side, the equal treatment for women and men in research guaranteed by the law can be

considered as a positive feature of the national labour market. Additionally, the career breaks, like parental leave or political engagements have no formal detrimental effects on female researchers.

For the period 2006-2009, the total number of tertiary-level students versus the overall population in the country was significantly increased from 2.4% to 3.1%, and then decreased in 2010 to 2.8%. The graduates in natural, technical and technological fields in 2010 participated with 20% in the total number of tertiary education graduates in the country and the deficiency of this type of graduate is registered in the labour market. In order to increase this type of graduate, in 2011 the MES announced that during 2012 the number of enrolled students in the state universities will depend on the surpluses or deficiencies of graduates in specific fields.

The FYROM doesn't have a national strategy for international cooperation, which is mainly realised through bilateral agreements and EU research programmes. The National Strategy for the Development of Education in the FYROM 2005-2015 supports public-private R&D partnerships in the form of collaboration between public academic institutes and private companies. This is not limited to SMEs, and includes companies from all sizes through the funding of competitive calls for projects. The main national measure in the FYROM that supports a cross-border co-operation is the Programme for Scientific and Research Activities (PSRA) which includes several sub-measures. The main sub-measure that supports cross-border co-operation is bilateral research international projects. The available funds for these projects for 2011 are €0.14m or 16% of the total funds for the PSRA.

In the Table 3 the assessment of the national policies and measures supporting the strategic ERA objectives are presented.

Table 3: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA dimension	Main challenges at national level	Recent policy changes
1	**Labour Market for Researchers**	• Increased number of researchers; • Improved quality of researchers; • Stimulate brain circulation instead of brain drain.	• The complete costs for students that will enrol into PhD or master studies at one of the top 100 world universities or top 20 European universities from the Shanghai Jao Tong University ranking list are covered; • New state University for Information Science and Technology opened in Ohrid, with foreign professors employed on a permanent base; • The R&D related criteria for promotion of professors, researchers and PhD mentors in HEIs are introduced; • New PhD programme according to the Bologna process.

	ERA dimension	Main challenges at national level	Recent policy changes
2	**Cross-border cooperation**	• Integration in ERA; • Increased participation in EU funding programmes.	• Delegated representatives in European research bodies; • Commitment toward encouraging national organisations to participate in European research programmes and funding schemes, like FP7, COST and EUREKA.
3	**World class research infrastructures**	• Building quality RIs.	• Promotion of MARNet as an independent institution in 2011; • Government signed 50 new contracts for research laboratories in 2011.
4	**Research institutions**	• Improved quality of produced knowledge.	• Mandatory spending on R&D for universities from its own funds; • Increased quality criteria for establishment of HEIs; • Mandatory ranking of the HEIs; • LHE envisions a new PhD concept in accordance with Bologna process.
5	**Public-private partnerships**	• Stimulate know-how and technology transfer.	• Mandatory involvement of professionals from the industry in educational and research activities of the universities.
6	**Knowledge circulation across Europe**	• Increased participation in international projects.	• Support of international projects through the PSRA; • Support of participation in EU research and innovation programmes.
7	**International Cooperation**	• Extended scope and number of bilateral projects.	• New bilateral agreements are signed or are in process of signing; • There are separate funds for bilateral projects within PSRA.

Annex: Alignment of national policies with ERA pillars / objectives

1. *Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers*

1.1 Supply of human resources for research

In absolute terms, Macedonia's R&D sector had 1,254 researchers and 2,050 employees in 2009. Compared to 2007, the number of researchers and R&D employees with a full-time equivalent (FTE) has fallen down considerably by 15.6% and 19.4% respectively. This decrease has been registered in all three sectors, HE, government and business. The number of researchers (FTE) per 1,000 of population in the FYROM was 0.33 in 2009, significantly lagging behind the EU-27 average of 3.17.

The higher education in the country employs the majority of researchers in the country (75.5%), and at the same time is the main supplier of potential researchers. Therefore, the policies that refer to higher education have the biggest influence on the balance of demand and supply. The largest share of the total number of researchers is personnel with a PhD degree, which was 60% in 2009. The supply of new doctorate graduate per 1,000 population aged 25-34 as potential researchers is 0.5 for 2010, relatively low when compared to the EU-27 average of 1.5. The demand for potential researchers with a PhD in the higher education sector has increased, due to the many new higher educational institutions opened by the government and the private sector. The old universities usually recruit the best graduates and then follow their research and educational career.

The inflow of researchers from abroad is very low. The main inflow of researchers in the country comes through the new University for Information Science and Technology in Ohrid, established in 2008. This university is designed to include foreign professors on full time basis. In the academic 2011/12 year there are 12 professors from abroad included in teaching and research activities. At other universities the foreign researchers and academic staff that hold either a permanent or a temporary position are primarily in the foreign language departments. Private universities also have a very low number of temporary foreign professors, as their focus is mostly on teaching and not research.

In order to enhance the trans-national mobility, the Government of the FYROM facilitates the exchange of researchers, familiarises FYROM researchers with EU opportunities and supports the researchers with different instruments. In 2007, the Government established the National Agency for European Educational Programmes and Mobility, through which it promotes educational programmes, encourages researchers' mobility in the EU and stimulates the participation of the universities in the Erasmus Mundus programme. Furthermore, in 2011 the country, as a part of the EURAXESS Jobs Portal, set up its national EURAXESS Portal and Network which will support the mobility of researchers in both directions, to and from the FYROM. The government has 20 bilateral agreements signed with other countries and actively supports participation in EU programmes which enables the mobility of both students and professors. Through more than 50 Actions in the European Cooperation in Science and Technology (COST) programme, 90 researchers have participated in mobility activities. Furthermore, based on the Programme for the period 2008-2012 the MES provides scholarships to cover the complete costs for students that will enrol into PhD or master studies at one of the top 100 world universities or top 20 European universities from the Shanghai Jao Tong University ranking. In 2010, on a public call for scholarships in international master studies, 14 candidates applied and six scholarships were approved.

The information regarding the flow of researchers between Macedonia and other countries is limited because the data is dispersed through various institutions and organisations, thus creating an obstacle for presenting accurate mobility. In addition, there is no detailed study for the mobility of doctoral students and researchers. However, there are several studies that elaborate the brain drain phenomena and give indication to the flow of researchers and skilled persons from the country. In 2005, the World Bank estimated that the emigration rate for tertiary educated citizens is 20.9% in the country, and a 2003 study estimated that between 12,000 and 15,000 young, educated, and highly skilled persons left the country in the decade preceding the year of the study (Vangeli A., Mehmedovic N. & Bakiu B., 2010). According to a survey on the aspirations of young people in Macedonia conducted in 2006 (Taleski, 2006), the majority of young

people expressed a desire for permanent relocation, and 42.6% of these young people who are planning to emigrate would leave the country for good.

1.2 Ensure that researchers across the EU benefit from open recruitment, adequate training, attractive career prospects and working conditions and barriers to cross-border mobility are removed.

The academic and research career progress in higher education is determined by the LHE and the separate rulebook for promotion of academic staff developed by each university. The promotion criteria are divided in three groups: teaching activities, scientific-research activities, and professional and applicative activities. Due to the specifics of the higher education sector in the country, the educational promotional criteria prevailed for the period before 2010. Since 2011, according to the changes of the LHE, the participation in international conferences with the international conference committee and publishing research results in journals with impact factor are mandatory for the promotion of the academic staff in the country and for the mentors of PhD students.

A second time re-elected full-time professor is the only academic and research category at the universities and institutes employed on a permanent base. The other categories have a status of temporary employees, and are elected for a certain time period (three years for teaching and research assistants, five years for assistant professors and associate professors and five or seven years for full-time professors) until they become re-elected full-time professors. The social and health taxes for the whole period are covered for all academic and research staff.

In accordance with the financial autonomy of the universities, the total salaries and other benefits of the academic staff vary between universities and between faculties within the same university. The basic salary for the academic and research staff at the public universities is determined by the government ranging from €350 per month for teaching assistants/junior researchers, up to €700 per month for full time professors. For November 2011, the average salary in Macedonia was €339. However, the faculties have a discretion right to include up to 60% of their own financial sources as an additional part of the salary to its employees. This creates the main differences between incomes at different faculties and universities. For the State University for Information Science and Technology there are special salaries for foreign professors which are determined by the government. The universities have their own policies for the recruitment of teaching and research staff. The general human policy, which is common for all existing older public universities, is the recruitment from university's students who have achieved the best results during the undergraduate and/or post graduate levels of study. In this stage the meritocracy is the dominant system applied. However, during the promotions of the academic and research staff, the dominant system is endogamy. The only exception is the new public University for Information Technologies, where experienced professors from abroad are hired. The private universities have specific human resource policies, which is in line with their strategies. A considerable share of their teaching staff is part-time professors.

Low salaries for researchers, along with the low availability of cutting-edge research infrastructures make the domestic research market unattractive for both domestic and foreign researchers. These circumstances cause the brain drain phenomena in the country, which can be linked to the loss of investments in human capital and creative work force from the country (Vangeli A., Mehmedovic N. & Bakiu B 2010; Taleski, 2006). The government tries to prevent brain drain and repatriate researchers that leave the country through general R&D policies, but specific measures are missing. However, since the main reasons for brain drain still exist, significant effects have yet to be registered.

Career breaks, like parental leave or political engagements have no formal detrimental effects on researchers, since, the same position is guaranteed for researchers by country legislation. The only exceptions are managerial positions.

There is no restriction for non-nationals to apply for permanent research and academic positions. However, one of the main obstacles for the employment of non-nationals at the majority of the universities is the required knowledge of FYROM or Albanian as a teaching language. The issue can be partially transcended with the changes in the LHE from 2011, which obligate the universities to have at least one department with English language curriculum in the academic year of 2012/2013.

The process for recognition of professional qualifications which facilitates the equivalence/validation of foreign academic degrees is regulated with the LHE. The complete process of recognition should be completed within 20 days from application. If the diploma is received from one of the top 500 Universities as

ranked by Institute of Higher Education of Shanghai Jiao Tong University, US News and Report and Times Higher Education Supplement – World University Ranking, the duration of equivalence/validation of foreign academic degrees is eight working days. This is a significant shortening of the process from the previous duration lasted up to one year.
Usually there is no international advertising of research vacancies, except if there is a specific intent to employ foreign researchers.
The researchers that are awarded a research grant are not allowed to transfer their national grants when they obtain other positions in the country or abroad, mainly because there is no regulation on how to manage the transfer to another national or foreign institution.

1.3 Improve young people's scientific education and increase interest in research careers.

The government balances the supply of science, technology, engineering and mathematics graduates and postgraduates through appropriate distribution of scholarships among different scientific fields. Also in 2011 the MES announced that in 2012 the number of enrolled students in the state universities will depend on the surpluses or deficiencies of graduates in specific fields. According to this criterion, the government's intention is to increase the graduates in natural, technical and technological fields, which in 2010 participated with 20% in the total number of tertiary education graduates in the country. The participation of these fields in the total number of new PhD graduates is even lower, only 15%. The estimated share of human resources in science and technology (HRST) from the economically active population in the age group 25-64 in the FYROM is 24.1% for 2010, while the EU average is 40.5%.
The government in 2010 and 2011 launched several campaigns in order to improve specific skills of the population and businesses, like ICT skills. Through the Project 45, the government encourages people older than 45 years to enrol in selected faculties and increase their knowledge and skills.
After the independence in 1991, the educational system in the FYROM was traditional with face-to face learning as the dominant teaching method. The system lacked project-oriented learning, teamwork and an interactive way of teaching. The situation has been completely changed due to measures that support the National Strategy for Development of the Education in the FYROM 2005-2015 and the numerous international educational projects in which FYROM universities have actively participated. The most influential international programme is TEMPUS. The programme was especially important for higher education in the period 1996-2010, when 119 joint European projects and 44 structural and complementary measures were implemented. TEMPUS, which represents the largest input of education projects in the FYROM, has contributed to the harmonisation of higher education in terms of unifying curricula, with 70% of higher education institutions stating that over half their curricula are in line with the Bologna criteria as a result of TEMPUS (EACEA, 2010). After the independence, entrepreneurship skills were also recognised as a critical factor for the private sector. This was an additional motive for the faculties from different fields to include entrepreneurship courses in their curricula. The changes of the LHE from 2011 envision 10% of the courses in a specific curriculum to be elected from the other faculties within the same university. The goal behind this measure is to provide a greater variety of general skills, like entrepreneurship, communication, ICT, etc., to the students.

1.4 Promote equal treatment for women and men in research

In the FYROM the equal treatment for women and men in research is guaranteed by law. Therefore, there is no policy action for promoting equal gender representation in academic and research committees, boards and government bodies. Regarding the gender structure of the total number of researchers, in 2009 the female researchers prevail with 51.7% from the total.
Similar to the career breaks for any researcher, parental leave or political engagements have no formal detrimental effects on female researchers. After maternity leave or political engagements, the same position is guaranteed for female researchers by country legislation. Also, if the female researcher is temporary employed, the contract is automatically extended regarding the promotion of the researcher. The only exceptions are managerial positions. If a researcher is on managerial position before the career break, the position is not guaranteed by the law after the leave.

2. Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding[3].

The only national programme that includes sub-measures where foreign legal entities are legible to compete for funds through a domestic legal entity is the PSRA. The sub-measures are bilateral international research projects and the stay of foreign professors in the country.
The policies at the national level support joint funded activities and programmes, but the measures have no international dimension. The National Strategy for the Development of Education in the FYROM 2005-2015 supports public-private R&D partnerships in the form of collaboration between public academic institutes and private companies from all sizes through the funding of competitive calls for projects. These public – private partnerships are partially supported by the PTD. However, the results from the call in 2009 show that there are no applications for joint research.
The R&D public-private collaboration in the FYROM is also supported by signed Memoranda for Cooperation between the leading chambers of commerce and also by the leading state universities in the FYROM. There is no information on how many joint R&D projects are realised as a result of these memoranda.
A combination of merit-based research funding and mission-oriented research is applied in the framework of the Programme for Technical Culture (PTC). The MES funds projects proposed by Associations of Citizens that are certified by the Ministry.

3. Develop world-class research infrastructures (including e-infrastructures) and ensure access to them

The national RIs in the FYROM are in an indigent state as result of modest investments in the RIs in the past decade. RIs are primarily located in MASA, and at the public universities and institutes. Even more, most of these investments were a result of international projects initially financed through various donor programmes, and then financed through the state budget. In the business sector only a small number of businesses have created research laboratories.
The lack of continuous RI investments in the FYROM created a situation in which the country does not have and is not in the process of developing a large RI in any field or area that can be available for foreign researchers. As a result of this Macedonia is not seen as an attractive place with RIs where foreign researchers can perform advanced research.
There is no available data for the size of national investments in RIs before 2010. In 2010, through the project ELSR, the MES declared a €4.3m budget for equipping 22 laboratories in different research areas at public universities and institutes. In 2011 the government announced that in total, 72 contracts for scientific laboratories were signed with public institutes and state universities. These RI investments are a result of the Programme for the period 2008-2012, where one of the priorities is the strengthening of educational and research infrastructures. This project is the first serious RI investment in the country thus creating a positive trend for RI investments in Macedonia.
In 2011 the FYROM Academic and Research Network, MARNet, which was established in 1995 under the aegis of the biggest and oldest "Ss. Cyril and Methodius" University in Skopje, became an independent public institution in order to connect all universities in the country. In 2010 MARNet implemented the new IPv6 protocol and became a part of the pan-European data network for the research and education community GÉANT. In 2011 MARNet, together with the MISA, had started a promotion of the network as a national public assess point for Internet traffic exchange, in order to increase the opportunities for the users at competitive prices through an entry of international ISPs in the country.
The guiding document for current RI investments is the Programme for the period 2008-2012. The country is missing an official national roadmap for building new research infrastructures. The involvement of Macedonia in ESFRI infrastructures is still in its early stages. The participation support of national

[3] Promote more critical mass and more strategic, focussed, efficient and effective European research via improved cooperation and coordination between public research funding authorities across Europe, including joint programming, jointly funded activities and common foresight.

- Ensure the development of research systems and programmes across the Union in a more simple and coherent manner.
- Promote increased European-wide competition and access of cross-border projects to national projects funding

institutions in European and world-wide RIs is outlined in the Programme for the period 2008-2012. According to the FYROM Progress Report 2011 of the European Commission, the nominations have been made in most governance bodies, such as the European Research Area Committee (ERAC), the Strategy Forum for International Cooperation (SFIC), and the Steering Group on Human Resources and Mobility (SGHRM). However, due to the low administrative capacity, the irregular participation at their meetings is noted.

4. Strengthen research institutions, including notably universities.

In the FYROM the autonomy of HEIs is guaranteed by the Constitution and is defined through the LHE. The university's autonomy includes academic freedom, management autonomy and autonomy inviolability. HEIs play an essential role in providing quality human resources as the main drivers towards smart, sustainable and inclusive growth of the FYROM knowledge based economy. The main focus of the government HE policy in the period before 2008 was education and quantitative aspects of the HES, and instead of research, innovation and qualitative aspects. Since 2008, the government has undertaken a set of very complex measures, with the goal to increase the quality of human resources in the HES and improve their R&D and innovation capacities.

The HES in the country comprises of five state universities, 10 private universities and seven private HEIs. In the academic 2010/11 year, the teaching staff in the HES consisted of 3,861 employees, with 2,940 (76.1%) employed in the public higher education sector. The universities' establishment is regulated with the LHE and DNSHE, and these establishments are supervised by the MES through the Evaluation and Accreditation Board for Higher Education in the FYROM. In the 2009/2010 academic year, HEIs in the country had 57,894 students, out of which 45,765 students (79%) were enrolled in public HEIs. For the period 2006-2009, the total number of tertiary-level students versus the overall population in the country was significantly increased form 2.4% to 3.1%, and then decreased in 2010 to 2.8%.

In 2009 the total R&D expenditures in higher education (HERD), including the business share of €0.51m, (11.8%), were €4.31m. The business share of HERD was decreased when compared to 15.2% in 2008. HERD as a percentage of GDP was significantly decreased from 0.27% in 2000 to 0.065% in 2009. This trend has created obstacles for HEIs regarding the improvement of their R&D performance.

The mechanisms for national academic and research quality assurance are defined by the LHE, the Law on Scientific and Research Activities and the DNSHE. The LHE identifies the following mechanisms for quality assurance:

- External evaluation through the Evaluation and Accreditation Board for Higher Education in the FYROM;
- Internal (self) evaluation;
- Quality evaluation system for academic staff; and
- Bi-annual ranking of all universities and higher education institutions in the country through an open procedure for engagement of a consulting firm.

Except for self evaluation, which is practised in the biggest state universities, there is still no evidence for the rest of the quality assurance mechanisms.

The main government contribution to education and research expenditures of the universities and public institutes was channelled through GUF and competitive funding. Competitive funding represents the only R&D institutional support because the block budget lines toward state universities consists primarily from non-direct R&D expenditures. The allocation of university block funding provided by the state budget was in accordance to the size of the university: number of students, number of study programmes on undergraduate level and size of the teaching staff. The institutional financing of higher education is not linked with the scientific results. In January 2011 the MES announced the development of a new system of institutional financing for higher education based on the cost per student and the demand for graduates in specific scientific fields. Contrary to this announcement, the criteria for project-based competitive funding are based on research results of the leading researcher in the specific project.

5. Facilitate partnerships and productive interactions between research institutions and the private sector.

The creation of efficient linkages between the business community, universities and public research organisations has proven to be a very useful model for encouraging innovations and technological development. In this context, the role of the technological infrastructure which consists of research and development units in the companies, the innovation centres and centres for technology transfers, scientific and technological parks and ICT centres, is particularly important. With the assistance of TEMPUS, GTZ and other international donors, several centres were established in the country until 2010. One of the main problems facing the centres established with international financial support is the financing structure of their activities after international support is finished. Therefore, in 2011, only two centres were active: the Centre for Research, Development and Continual Education at the Faculty of Mechanical Engineering and the Regional Innovation Centre in the Eastern FYROM town of Shtip.
The European Information and Innovation Centre (EIIC) is a another initiative that supports information sharing and communication between universities and the business community and helps companies and research organisations in the process of technology transfer, in establishing business partnerships and provides information about possible sources for financing innovations. The centre is coordinated by UKIM and is a part of the Enterprise Europe Network.
The LHE provides the opportunity for universities to establish technical parks, spin-offs and business start up centres in which the staff and the students can work to create innovations and sell its own scientific results, innovations and/or patents, and at the same time providing services to the business community or to the students. Nevertheless, until now no spin-offs have been created, and the business start-up centres are mainly financed through projects supported by international donors or EU funds, not by universities.
The know-how and technology transfer through linkages with the industry are envisioned in the LESTD adopted in 2011. According to the law, the MES provides co-financing of research and innovative projects for entities of technological development up to 50% for industrial research and up to 100% for basic research. The projects anticipate a procedure for protection with the State Office of Industrial Property prior to the beginning of the procedure for review, selection and co-financing. In 2011, the government obligated the universities and public institutions to open the research laboratories provided through the measure ELSR to the external users.
One part of the government-owned research is freely available, while the other part is available only on request.
There is no administrative framework for inter-sectoral research mobility, so the researchers can not easily move between the institutions from different sectors. There is only an administrative framework adopted by each university for teaching mobility where a professor from one university can teach at another university. The mobility can be performed relatively easy by submitting a request to the faculty management and scientific council at the university to approve its staff to be contracted for teaching at other institutions.
The participation of the private sector in governance bodies of HEIs or PROs is rather inexistent in the FYROM. The involvement is limited to occasional advisory services provided by the private sector. This advisory role is provisionally defined through memoranda for cooperation signed between universities and the private sector. Besides involvement in university governance, the memoranda for cooperation regulate the other aspects of the R&D public-private collaboration. There is no information on how many joint R&D projects are realised as a result of these memoranda.

6. Enhance knowledge circulation across Europe and beyond.

The main national measure in the FYROM that supports cross-border co-operation is the PSRA which includes several sub-measures. The main sub-measure that supports cross-border co-operation is bilateral research international projects. The available funds for these projects for 2011 were €0.14m or 16% of the total funds for the PSRA. The legal bases for the projects are signed agreements for cooperation with 20 EU and non-EU countries in the area of education, science and technological development. Besides research projects, the agreements regulate other forms of cooperation between the countries, such as expert exchanges, scholarships, exchange of information and publications, and so on. The national funding procedures for bilateral research projects are adjusted according to the signed agreements and protocols.
The cross-border knowledge circulation is additionally enhanced through EU research programmes (FP7, EUREKA and COST), and partially through the IPA funding mechanism. Although no research field is explicitly prioritised, the majority of international projects favour the following fields: ICT, Energy, Health,

Environment, Biomedicine and Molecular Biosciences, Chemistry and Molecular Sciences and Technologies, Earth System Science and Environmental Management and Food and Agriculture.
In order to strengthen the cooperation and coordination of research activities carried out at national and international level in 2010, the FYROM appointed representatives to the three main European research bodies: ERAC, SFIC, and SGHRM.
The country participates in ERA NET initiatives through projects such as: WBC INCO NET and SEE ERA NET PLUS, which enhance the integration of the WBC in the ERA.
There is no national measure that supports a European scientific information system. A kind of scientific information system in the country is a library information systems and research information systems network; Co-operational Online Bibliographic System and Services COBISS.Net. COBISS.Net includes over 650 libraries from the Balkan region and connects autonomous (national) COBISS library information systems of different countries and their current research information systems.

7. Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world.

The FYROM doesn't have a national strategy for international cooperation, which is mainly realised through bilateral agreements and EU research programmes. There is no available official evidence on the national level for students and researchers inflow and outflow. The biggest university in the country and the main R&D performer UKIM is part of the following three programmes that provide scholarships for academic exchange between EU and Balkan countries: BASILEUS, JOINEUSEE and ERASMUS Life Long Learning. Starting in 2008/2009, 120 students from the UKIM have studied at EU universities and 27 students from EU universities have studied at UKIM. In the academic year 2009/2010, through the BASILEUS mobility programme, six students from abroad studied at UKIM and a professor from Slovenia stayed at the Faculty of Philology "Blaze Koneski". Through the programme JOINEUSEE, three students from EU had a one semester study stay at the UKIM (Source: The Official Reports of the UKIM).
The activities for bilateral international cooperation are based on the signed agreements for cooperation in the areas of education, science and technological development with nine EU and 11 non-EU countries. The ministry responsible for these agreements is the MES, while the agreements are usually signed by its minister. The FYROM has signed agreements with the following EU countries: Slovenia, Bulgaria, Poland, Hungary, Germany, Italy, France, Austria and Spain. In addition, agreements have been signed with the following non-EU countries: Croatia, the Russian Federation, Turkey, Belarus, USA, China, Egypt, Japan, Israel and Bosnia and Herzegovina and Qatar. The bilateral agreements usually cover expert exchanges, cooperation between institutions from higher education, scholarships, joint scientific research projects, exchange of information and publications and other forms of cooperation as agreed between the parties.
The main areas of international cooperation are: agriculture, biotechnology, food processing, chemistry, pharmaceutical research, and environmental protection. Grand research challenges are addressed through participation in international projects based on these fields. According to the data provided by MES, out of 109 bilateral projects for the period 2006-2010, 40 were implemented with Slovenia, 19 with Bulgaria and 15 with Croatia.
The main form of international cooperation with third countries is also bilateral cooperation, and there are no specifics in this type of cooperation compared with the cooperation with other EU and non-EU countries. The government has signed eight bilateral agreements with third countries through which it enables the mobility of students and professors. One of the major obstacles for mobility is the limited number of courses taught in English in the country.

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List of Abbreviations

BERD	Business Expenditures on Research and Development
CERN	European Organisation for Nuclear Research
CIP	Competitiveness and Innovation Framework Programme
COST	European Cooperation in Science and Technology
DNSHE	Decree on Norms and Standards for Establishing Higher Education Institutions and performing Higher Education Activities
EIIC	European Information and Innovation Centre
EIS	European Innovation Scoreboard
ELSR	Equipping Laboratories for Scientific Research and Applicative Activities
ERA	European Research Area
ERAC	European Research Area Committee
ERA-NET	European Research Area Network
ERDF	European Regional Development Fund
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESF	European Social Fund
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU-27	European Union including 27 Member States
EUREKA	pan-EU Network for Industrial R&D
FDI	Foreign Direct Investments
FP	European Framework Programme for Research and Technology Development
FP	Framework Programme
FP7	7th Framework Programme
FTE	Full Time Equivalent
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GTZ	German Agency for Technical Cooperation
GUF	General University Funds
HE	Higher Education
HEI	Higher Education Institution
HERD	Higher Education Expenditure on R&D
HES	Higher Education Sector
HRST	Human Resources in Science and Technology
ICT	Information and Communication Technologies
IPR	Intellectual Property Rights
ISP	Internet Service Provider
IUS	Innovation Union Scoreboard
LESTD	Law on Encouragement and Support of Technological Development
LHE	Law on Higher Education
MARNet	FYROM Academic and Research Network
MASA	FYROM Academy of Sciences and Arts

ME	Ministry of Economy
MES	Ministry of Education and Science
MISA	Ministry of Information Society and Administration
OECD	Organisation for Economic Co-operation and Development
PGRM	Programme of the Government of the FYROM
PRO	Public Research Organisations
PSRA	Programme for the Scientific and Research Activities
PTC	Programme for Technical Culture
PTD	Programme for Technological Development
R&D	Research and Development
RDI	Research Development and Innovation
RI	Research Infrastructure
S&T	Science and Technology
SEE	South Eastern European
SF	Structural Funds
SFIC	Strategy Forum for International Cooperation
SGHRM	Steering Group on Human Resources and Mobility
SME	Small and Medium Sized Enterprise
SOIP	State Office of Industrial Property of the FYROM
SSORM	State Statistical Office of the FYROM
TIA	Technology and Innovation Agency
TIDZ	Technological–Industrial Development Zone
UKIM	“Ss Cyril and Methodius” University in Skopje
USAID	United States Agency for International Development
VC	Venture Capital
WBC	Western Balkan Countries

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Abstract
The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. EW Country Reports 2011 identify the structural challenges faced by national innovation systems. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. The annex of the reports gives an overview of the latest national policy efforts towards the enhancement of European Research Area and further assess their efficiency to achieve the targets.

These reports were originally produced in November - December 2011, focusing on policy developments over the previous twelve months. The reports were produced by the ERAWATCH Network under contract to JRC-IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl.

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As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

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Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

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