



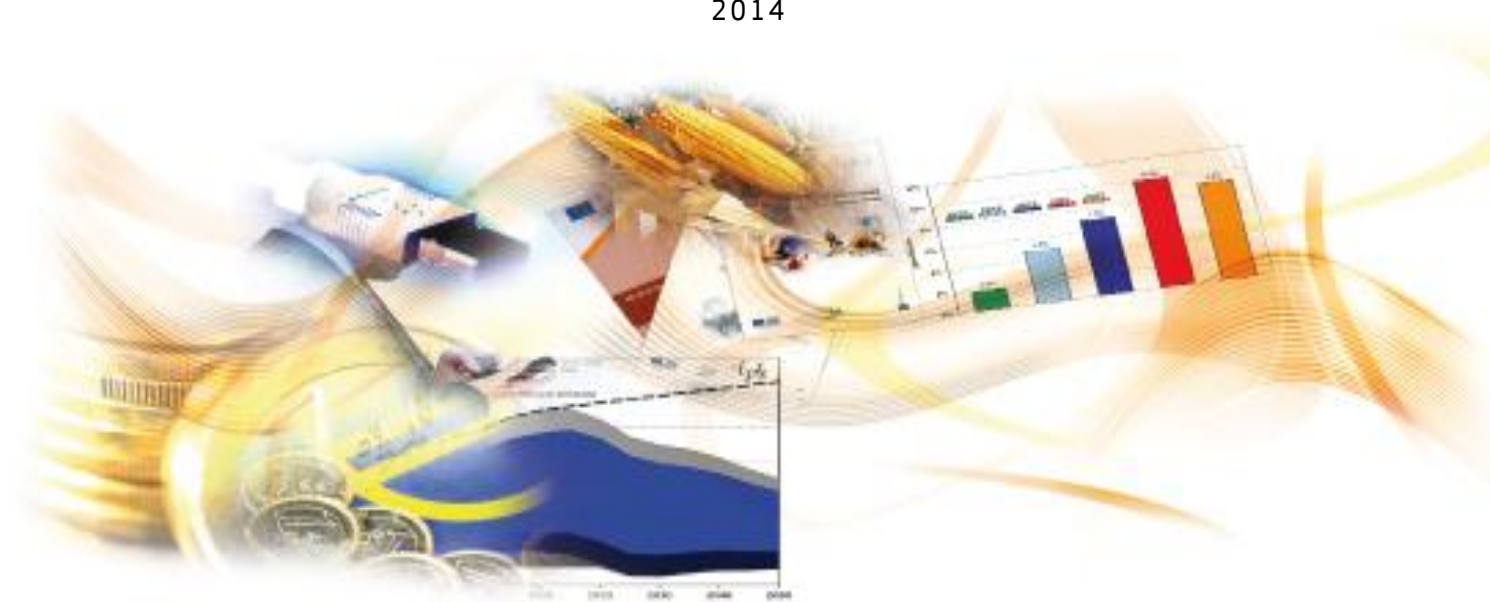
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The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context.

The first draft of this report was produced in December 2012 and was focused on developments taking place in the previous twelve months. In particular, it has benefitted from the comments and suggestions of Patrice dos Santos from JRC-IPTS. The contributions and comments from comments from Dr. Emira Bečić of Ministry of Science, Education and Sports, Croatia are also gratefully acknowledged.

The report is currently only published in electronic format and is available on the [ERWATCH website](#). Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

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EXECUTIVE SUMMARY

The Croatian research and innovation system has evolved over the last decade into a complex system of various institutions and measures directed to build innovation-driven growth. Despite all the efforts, Croatia was hit by the worst economic crisis, the massive loss of jobs, economic exhaustion of the companies and budget deficits. That gives an impression that research and innovation systems, in spite they provides various incentives for innovation, are not efficiently related to the sphere of business development, entrepreneurship or industrial technology progress. On the other hand, there is a common opinion that the upcoming Croatian membership to the EU (expected on 1 July 2013) provides remarkable opportunities for Croatia to address a number of economic and innovation-related challenges and become a competitive and successful economy.

The [Ministry of Science, Education and Sports](#) (MSES) is the pillar institution of the entire research and education policy and innovation policy concerning conditions for economic growth based on knowledge and exploitation of research results. The [Ministry of Entrepreneurship and Crafts](#) and the [Ministry of Economy](#) complement the national innovation policy related to innovation-based entrepreneurship and business infrastructure. The increased role of the [Ministry of Regional Development and European Funds](#) is expected upon the availability of the Structural Funds, in particular the ERDF, after Croatian accession to EU.

Policy formulation and implementation include the [National Council for Science](#) (NCS) and the [National Council for Higher Education](#) (NCHE) which are the highest advisory bodies in their respective fields.

The main funding bodies, in addition to the MSES, are the [Croatian Science Foundation](#) (CSF) (fostering science excellence), [the Business Innovation Agency of Croatia \(BICRO\)](#) (supporting various innovation policy programmes like RAZUM, TECHRO, IRCRO, PoC, etc.), the [Unity through Knowledge Fund](#) (UKF) (supporting cooperation between local researchers and Croatian researchers living abroad) and the [Science and Innovation Investment Fund](#) (SIIF) (fostering technology transfer and commercialisation of universities' research results).

The remaining stakeholders in research and innovation system which do not provide funding are: the [Agency for Science and Higher Education](#) (ASHE) with the task of setting up a national network for quality assurance, and the [Croatian Agency for Mobility and EU Programs](#) (AMPEU) in order to organise programmes for lifelong learning and the EU mobility programmes.

The [Croatian Institute of Technology](#) (HIT) was merged with the [BICRO](#) in February 2012 to ensure the efficient investment of EU structural instruments in areas of research, development and innovation.

The [Second Science and Technology Project](#) (STP II) is launched in 2012 after successfully accomplished STP I with estimated funds of around €24m in the period 2012-2015 for improving the capacity of Croatia's R&D and innovation institutions, adjusting current programs (BICRO and UKF) to EU regulations and preparing submissions to EU Structural and Cohesion funds.

The trends in R&D funding reveal that both private and public investments in research and innovation are fairly small and have worryingly downward trends. Research and innovation are not only constantly under-invested (below 1% of GDP, compared to EU average of 2%) but further budget restrictions and financial crisis threaten the maintenance of the national knowledge base, professional expertise and education.

The public R&D sector, with universities playing a leading role, largely surpasses the technologically weak private sector in terms of research workforce (80% of the total) and R&D performance (54% of R&D in 2011). The public resources for R&D are both low and stagnant in the last couple of years and decreased in comparison to the previous years. They amounted to 0.42% of GDP in both 2010 and 2011 (around €184m) that is a decrease compared to 2009 (€196m) and 2008 (€208m). This is also far from the national target of 1% of GDP of public resources for R&D defined in the Science and Technology Policy 2006-2010.

The volume of business R&D is low (ten times less per capita investments than in EU) and fluctuates between 0.4% in 2004 and 0.34% of GDP in 2011 (€150.4m). This is a significant decrease from 2000 when it was also low but amounted to 0.56% of GDP. Private sector suffers from the substantial lack of critical mass of researches (19% of the total) and investments for technological accumulation and transition to knowledge economy.

An explicit regional research policy does not exist in Croatia mainly due to the insufficient resources that would enable counties or municipalities to take a more active part in the development of education and research institutions and activities. The National Research and Innovation Strategy on Smart Specialization (RIS3) is in the initial phase and its completion is expected in June 2013. The development of the RIS3 is crucial for the future public support to innovation and business competitiveness since it is the pre-conditionality for the use of the ERDF.

The following main structural challenges are identified:

1. The R&D policy is obsolete and lacks visionary, coherent and integrated policy framework

The science and innovation policy remains on periphery of the mainstream development strategies which are mainly focused on economic drawbacks and socio-political obstacles. Policy makers tend to neglect that research and innovation hold the key to boosting productivity and securing long term development. The science policy suffers from the lack of strategic visions that produces disorientation in policy actions. It is reflected in the withdrawal of all the Acts from the parliamentary procedure (four in the period 2011-2012) aimed at reforming science and higher education;

2. Business environment is not conducive to innovation

Overall business environment in Croatia creates disincentives to innovation. Its key features include inefficient state administration (sometimes prone to political voluntarism), financial system dominated by banks (with relatively shallow and illiquid capital market), high costs of utilities and local services, widespread illiquidity and weak linkages between education sector and the labour market. According to the results of the Global Competitiveness Report for 2011-2013 (WEF, 2012) Croatia is positioned in 81th place out of 144 countries, which represents a decline of five places compared to the results for 2010. The most problematic factors for doing business in Croatia include, according to WEF, inefficient government bureaucracy, corruption, access to financing, restrictive labour regulations tax rates, policy instability, tax regulations, etc.

3. Weak interest of private companies for research and development

The volume and investment of private businesses R&D is low (around €30 p/c, while EU invests in average almost 10 times more, around €318.3 p/c). Their interest in cooperation with the public R&D sector is weak. Economy is dominated by the large and un-reformed public companies that are not exposed to market competition which would urge them to innovate. A new layer of SME is composed of sectors which are not based on research and innovation and consists largely of micro companies with less than 10 employees having modest capacities to perform or absorb research. The analyses (MEC, 2012) indicate that, overall, SMEs invested less than 1% of total revenues in research and development, an amount of around €88 million in 2008.

4. Sluggish reforms of research and higher education system

The governance, organisation and the financing of the research and higher education sectors remained largely un-reformed. The current universities are fragmented into a large number of autonomous faculties with considerable individual power which obstruct the legal and financial integration of universities. It also makes strategic development of universities difficult, poorly adaptable to international competition and reduces opportunities to succeed in a wider European and international environment. While the commercialization of education is raising threatening teaching as the basic university mission, there are many obstacles to research commercialisation and efficient science-industry cooperation.

5. Weak regional research and innovation system

Croatia suffers from considerable and long-term regional disparities since the average incomes are three times higher in the richest regions than in the poorest ones. The difference is about 1% to 3.1% of GDP per capita and do not decrease (RCIC, 2011). That calls for strengthening the active regional research and innovation policy which is currently almost non-existent. A boost is expected from the ERDF funds from two financial perspectives 2007-2013 and 2014 -2020 and the National Research and Innovation Strategies on Smart Specialization (R3) which is pre-conditionality for the use of the Fund

The last three years were stagnant regarding policy developments in science and innovation, as well as in strategic visions of future research priorities. One of the reasons is that Croatia has been affected by the worst economic crisis in the last two decades and is faced with many uncertainties and strategic ambiguities to define

secure policies and priorities. However, the “National Strategy for the Croatian innovation development 2013-2020”, is in progress and will be carried out by the Organisation for Economic Co-operation and Development (OECD) in collaboration with local experts. Up to now, the First Draft of the Background Report which provides the basic inputs to the Strategy was publicly presented in October 2012 (OECD, 2012). The Annex to the Draft provides a list of the five strategic pillars for the future development of the innovation system and around 40 guidelines for their implementation. The five pillars include:

1. Enhance business innovation potential and create a regulatory environment in support of innovation;
2. Increase knowledge flows and interactions between industry and academia;
3. Secure a strong science and technology base and strengthen the capacities of research institutions for technology transfer;
4. Strengthen human resources for innovation;
5. Improve governance of the national innovation system.

The identified research and innovation priorities largely correspond to structural challenges, especially in relation to the needs for improving business environment for innovation, governance of research and innovation system and reforming higher education system in order to strengthen human resources for innovation. The Background report emphasises the need for knowledge flows and interactions between industry and academia while the strengthening of the weak interest of companies for R&D is rather neglected although companies' absorption capacities are a pre-condition for efficient science-industry cooperation. The report is fairly deficient in elaborating the needs for regional innovation development and smart specialization strategies.

During the last two years, the national policy mix to stimulate research in innovation has remained quite stable despite some setbacks in implementation of the measures due to the budgetary financial constraints and expiration of the World bank loan that served to co-finance the UKF and selected BICRO's programmes (RAZUM, IRCRO). The three new measures have been launched. The Croatian Science Foundation (CSF) started in 2011 two instruments - [Research projects](#) programme and the [Collaborative research programmes](#) - to strengthen science excellence and internationally competitive research teams. The BICRO started in May 2010 the programme "[Proof of concept](#)" (PoC) to assist entrepreneurs and researchers to verify commercial viability of their ideas.

In fact, the largest change is expecting in the forthcoming period which is related to the transition from the project to programme allocation of the budget funds by the MSES. The legal basis is provided by the new Draft of the law amending the Law on Science and Higher Education from 2003 which was adopted by the Government on 1 February 2013 and sent to the parliamentary procedure. MSES has announced the termination of the Research projects programme (*Z-Projects*) the principal instrument for allocation competition-based research grants that lasts for the 20-years (Jovanović, 2012). It will be replaced with the "Programme contracts", a sort of lump sum or institutional funding for research at the institutional level of PRO and universities while competition based research funding will be transferred to the Croatian Science Foundation (CSF). The main reason for cancelling the programme is its poor competitiveness and contribution to scientific excellence.

Consequently, future developments could include the following suggestions:

- Development of operational /strategic documents for usage of EU funds (operational programmes and Partnership agreement);
- Coordination of national (Innovation strategy, Education, science and technology policy, regional development, SME with EU requirements: OP/PA, 3S/RIS3 – in order to deliver coherent policy framework in the field of R&D&I);
- Carry out the National strategy for smart specialisation (RIS3) based on in-depth and profound analysis of the regional and national technological and research capacities and areas of

competitiveness; strengthen regional innovation strategies; develop an action plan and monitoring for implementation of the strategy on an annual basis

- Design a new strategy of science, innovation and higher education aligned to the National strategy for smart specialisation (RIS3); develop an action plan and monitoring for implementation of the strategy on an annual basis
- Performing regular evaluation of innovation policy (including the work of institutions which are responsible for policy implementation);
- Stop further decline in the public investments in R&D since the further financial constrains threaten the maintenance of the national knowledge base, recruitment of outstanding scientists, professional expertise and education;
- Improve business environment, investment climate and competition policies to boost private business investments in R&D and their need to cooperate with the public R&D sector;
- Support SME investment in R&D through strengthening BICRO's programmes, role of the Bank for Development and Reconstruction, various matching grants for science-industry cooperation or conditional loans, mentoring support, etc;
- Analyse and redefine mechanisms of coordination between different government bodies (ministries, agencies, regional authorities etc.) responsible for socio-economic development in general and innovation policy in particular; develop a platform for dialogue among researchers, policy-makers, business people, media, the general public and others concerned by innovation development.

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1 INTRODUCTION

Croatia is a Central European and Mediterranean country on the Adriatic coastal edge of south-eastern Europe at the crossroads of the Central Europe, the Balkans and the Mediterranean. The country is divided into 21 counties and the city of Zagreb which holds the double status of both town and county. According to the first results of Census in 2011 the Croatian population is 4.29 million inhabitants or 150,000 less than in 2001. It accounts for around 0.9% of the population of the EU-27.

Croatia has signed the accession treaty for the membership in the EU on 9 December, 2011 and it should become 28th member of EU on 1 July, 2013.

The Croatian economy is the most developed in Southeast Europe, reaching €10,427 of GDP per capita in 2011 (€ 45.897 billion) or around 60% of GDP of the EU-27 average. It is characterised as an upper-middle-income country.

The period of high economic growth from 2002 to 2008 with an average annual rate of GDP increase of 5%, was followed by full four years of economic recession that brought economic downturn and cumulative decrease of GDP by 11.8% (CEOQ, 2012). The deep economic downturn coupled with cost-cutting policy and strong financial discipline takes its toll not only on spending and employment but has a negative feedback of R&D financing and future prospects.

The total gross expenditures on R&D (GERD) in 2011 (€336m) remained at the level of 2010 (€335m) when it was 0.75% of GDP. That is the lowest level of investments in research and development since 2006 that marked a persistent decline in R&D funding in Croatia. It is considerably below the average of the EU 27 of 2.03% of GDP for R&D. Per capita investment in R&D achieved only 15% of EU-27 average (€510.5 p/c versus €76.2 p/c).

The public R&D sector, with universities playing a leading role, is the largely dominant sector in both research manpower (80% of total researchers) and performing research activities (54% of R&D in 2011). The public resources for R&D are both low and stagnant in the last couple of years and decreased in comparison to the previous years. Public resources amounted to 0.42% of GDP in both 2010 and 2011 (around €184m) that is a fall compared to 2009 (€196m) and 2008 (€208m). This is also far from the national target of 1% of GDP of public resources for R&D defined in the Science and Technology Policy 2006-2010.

The share of the budget for the Ministry of Science, Education and Sports in the State budget for period 2013-2015 (Official Gazette, 139/2012) is planned to decrease from 9.69% in 2012 to 8.75% in 2015.

The private business sector invested 0.34% of GDP in R&D in 2011 (€150,386m) and employs around 19% of the total researchers. This indicates a substantial lack of critical mass of researches and investments for technological accumulation and transition to knowledge economy.

The Majority of GERD in 2011 (48.2%) is financed by the government while business sector contributed with the 38.2%. Another 12% comes from abroad (mainly for research services of the business companies) and the rest is accounted for by universities (1.7%) and private non-profit sector (0.2%).

According to the Progress report of Croatia's state of preparedness for EU (EC, 2012), in the area of research and innovation policy, Croatia is sufficiently prepared. The Report noticed that there has been no increase in the level of investment in research, which is still rather low (less than 1% of GDP, compared to an EU average of 2%). Conditions for enhanced cooperation between the private and public sectors need to be encouraged. Further measures such as establishing a national roadmap for research infrastructure and transfer of technology management have to be further considered in order to be fully in line with EU standards and targets.

According to the Innovation Union Scoreboard Croatia (IUS, 2011) is a moderate innovator with below EU average performance. Its growth in innovation performance in the last five years has been well above EU average while innovation expenditures in 2010 has increased most in Croatia compared to other countries (IUS,2011). Croatia performs particularly poorly in intellectual assets and license and patent revenues from abroad. Other areas of weakness include the quality of scientific publications (share in the top 10% most cited

publications worldwide) and business investment in R&D. EU countries publish in average around 11% of research papers in the 10% most cited scientific publications while the respective number in Croatia is only about 3%. On the other hand, the country slightly outperforms the EU on a few indicators: youth aged 20-24 with the upper secondary level education (95.3% vs. 79.0%), international scientific co-publications (324 vs. 301), non-R&D innovation expenditure (0.86 vs. 0.71), innovative SMEs collaborating with others (11.88 vs. 11.16) and sales new to market and new to firms innovations (14.41 vs. 13.26).

The number of researchers in Croatia has declined by 25% in less than a decade, from 8,572 (in FTE) in 2002 to 6,434 researchers in 2011. That accounts for 1,458 researchers per million inhabitants or 47% of average in the EU-27 (3,106 researchers per million inhabitants). By contrast, the number of researchers in the EU has grown in the same period for 35% from 1.17 million in 2002 to 1.58 million in 2010 and has doubled in some countries like the Czech Republic or Slovenia.

Croatia both perform relatively better in publishing scientific journal articles than in patenting. In Croatia there are about 100 publications per one registered patent (MSES, 2006). The higher education sector applied for 13 patents in 2010, which was around 23% of all patent applications in Croatia in 2010. However, no patents were granted to Croatian HEIs in 2010. There have been no patent applications or granted patents from HEIs abroad (OECD, 2012).

When looking at publication quality and impact indicators, Croatia performs less successfully. In terms of citations and the H index of the Scimago database which measures both scientific productivity and impact, Croatia is ranked at 43rd place out of 238 countries in the period 1996-2011. It places Croatia behind all the Western European countries, but ahead of most reference countries of Southeast Europe as FYR Macedonia (106), Serbia (108), Bosnia and Herzegovina (132), Albania (147) and Montenegro (205).

Research infrastructure is primarily national in character, rather fragmented and dominated by the small research units and equipment. Croatia is a member of ESFRI since October 2010 but the roadmap for ESFRI is planned to be carried out within the new science and technology strategy for 2012-2014. EU FP has recently appeared as an important resource for procurement of scientific equipment (Institute for Brain Research, Zagreb, Institute Rudjer Boskovic, Zagreb, Medical School of Rijeka).

A share of highly educated population has significantly increased and amounted to 17.2% in 2010, while the share of highly educated employees (aged 15-59 years) is 20%, which is close to the plan of 20% of persons with the tertiary degree by the year 2010 envisaged by the Education Sector Development Plan 2005-2010. Presently, the percentage of population aged 30-34 with tertiary education in Croatia is 24.5% while in the EU 27 is 34.6% (EUROSTAT, 2011). The human resources in science and technology (HRST) as a share of the economically active population in the age group 25-64 in Croatia fluctuate around 30% (e.g. 32.1% in 2010 and 30.9% in 2011) whereas in developed countries it often exceeds 50% (EU 27 – 42.3% in 2011).

In 2010, the number of tertiary graduates (ISCED 5-6) in mathematics, science and technology per 1000 persons aged 20-29 years was 11.6% that is lower than EU 27 average of 14.3%. However, the number of S&T graduates has been doubled from 2003, when the corresponding figure was 5.6%. Majority of university students graduated in social sciences, business, law, and training.

Croatia is a country with the higher number of young persons with at least upper secondary education in Europe, since more than 95% of the population aged 20-24 completed some kind of upper secondary. The number of students increased from 139,100 in 2009 to 149,900 in 2010 or 33 students per thousand inhabitants while EU-27 has in average 39 students per thousand inhabitants. Unfortunately, Croatia is the 3rd country with the highest share of young unemployed persons reaching 36.1% in 2012 (CES, 2012) while the first is Greece with 54% followed by Spain with 53% of young unemployed persons. A share of unemployed persons with higher educational level is 10.4% of the total number of unemployed.

The three largest export industries are textiles, chemicals and electrical and optical equipment, while technology oriented industries are missing. Service sector is very important since it makes 60% of GVA (Gross Value Added) and employs more than 60% of workforce. It is dominated by tourism which also makes a half of total exports. FDI have not brought new technologies since the majority of FDI is realized in wholesale trade and

commission trade followed by financial intermediation trade. R&D in business sector is concentrated in a few large companies like PLIVA and GlaxoSmithKline (pharmaceuticals), Ericsson-Tesla Institute, (telecommunication) Podravka (food industry) and Končar–Electrotechnical Institute. Key enabling technologies are not properly addressed by policy measures and support. The highest potential in commercialization of basic science can be identified in health, biomedicine and life sciences due to the strong medical schools (Zagreb, Rijeka), series of research units in polyclinics and hospitals and independent institutes like the Croatian Institute for brain research, Mediterranean Institute for Life Science (MedILS), etc.

The next most promising field for research and technological specialisation is in the domain of cognitive and robotic systems, cooperative network embedded systems and similar strategic areas developed by the Faculty of Electrical Engineering and Computing of the University of Zagreb.

The number of higher education institutions in the Republic of Croatia has doubled in the last 6-7 years, while the number of academic programmes has tripled (NCHE, 2011). The public research sector consists of 122 higher education institutions of which: 7 public and 3 private universities, 67 faculties and academies, 2 private and 13 public polytechnics, 27 private and 3 public schools of professional higher education and 26 public institutes. It also includes about fifty “other” public research institutions such as the Croatian Academy of Arts and Sciences or research units within health care institutions. The business research sector includes around 13 private scientific institutions, six of which are in-house institutes affiliated with large industrial corporations, while remaining are research institutes that operate independently in the market. The majority of human resources are concentrated at the University of Zagreb (around half of all researchers and university teachers). The University of Zagreb is the first university from Croatia listed at Shanghai ranking in August 2011.

The pillar institutions of the Croatian science and innovation system are the [Ministry of Science, Education and Sports](#) (MSES), [Ministry of Economy](#), [Ministry of Entrepreneurship and Crafts](#) and the [Ministry of Regional Development and European Funds](#). The latter three ministries, together with the Ministry of Labour and Pension System, are new ministries, established in December 2011 with the election of the new government. The Ministry of Science, Education and Sports remained in its previous form and are responsible for the entire research and higher education system, and innovation policy in terms of science-industry cooperation and commercial exploitation of research.

Policy formulation and implementation include the [National Council for Science](#) (NCS) and the [National Council for Higher Education](#) (NCHE) which are the highest advisory bodies in their respective fields. The [Agency for Science and Higher Education](#) (ASHE) is responsible for setting up a national network for quality assurance in science and higher education. The Strategic Council for Science and Technology (SVEZNATE) and the National Innovation System Council of MSES (VNIS) have been established in 2009 to coordinate research and innovation policy but they are not functional.

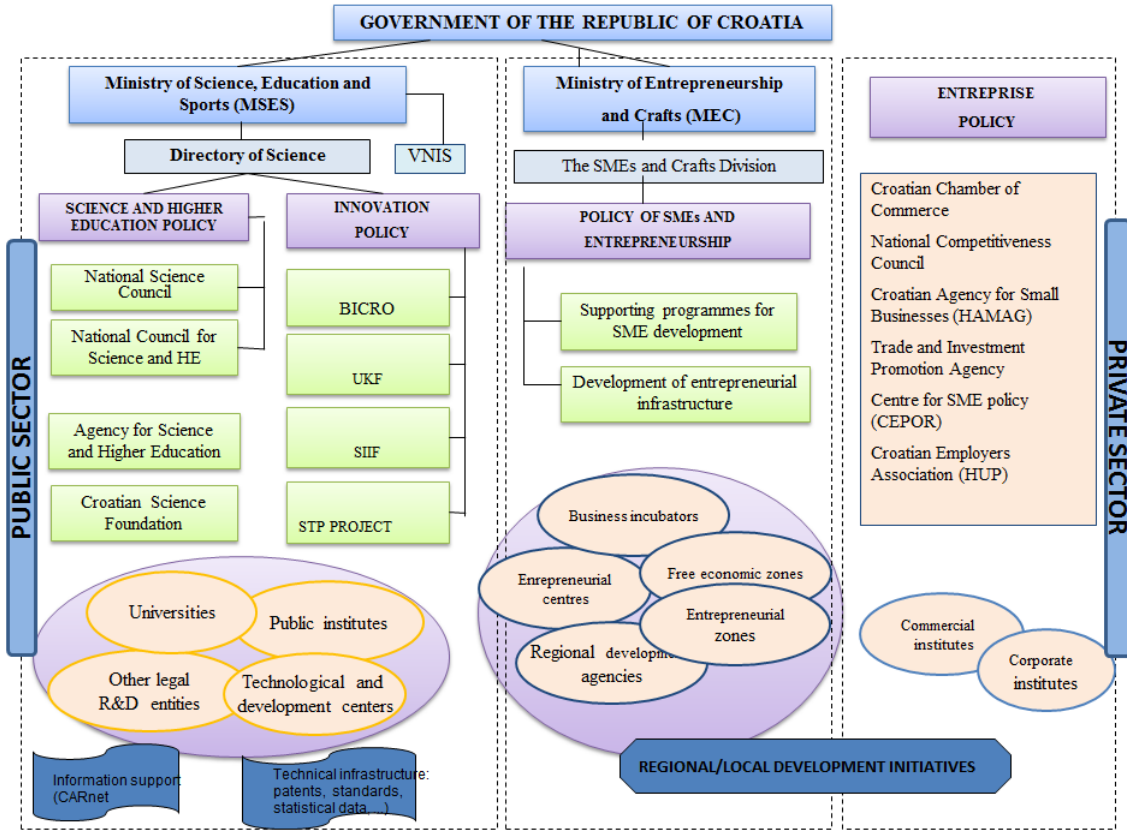
The main financial bodies are the [Croatian Science Foundation](#) (CSF), the [Business Innovation Agency of Croatia](#) (BICRO), the [Unity through Knowledge Fund](#) (UKF) and the [Science and Innovation Investment Fund](#) (SIIF). The Croatian Institute for Technology (HIT) has been merged with BICRO in 2012.

The role of science and research as vehicles of regional development has not been strongly and adequately articulated. However, in 2010 Croatia's Government adopted the [Strategy of Regional Development 2011-2013](#) which also includes policy measures related to the research and innovation policy by NUTS 2 and NUTS 3 level. The greatest impetus to regional development is provided by the Instrument for Pre-Accession assistance programme (IPA), Component IIIc focused on development of entrepreneurship and innovation. According to the Regional Innovation Scoreboard (EC, 2012a) the entire Croatia is moderate innovator while the most developed region is North-West Croatia which is classified as an innovation follower.

The National Research and Innovation Strategy on Smart Specialization (RIS3) is in the initial phase and its completion is expected in June 2013. The development of the RIS3 is crucial for the future public support to

innovation and business competitiveness since it is the pre-conditionality for the use of the ERDF. Croatia will have to access to ERDF upon accession to EU on 1 July 2013.

Figure 1: Overview of the Croatian research and innovation system



2 Recent developments of the research and innovation policy and system

2.1 National economic and political context

Croatia, like many other European states, has been severely affected by the global economic crisis. The period of high economic growth from 2002 to 2008 with an average annual rate of GDP increase of 5%, was followed by full four years of economic recession that brought economic downturn and cumulative decrease of GDP by 11.8% (CEOQ, 2012). After a sharp decline of GDP of -6.9% in 2009 followed by contraction of -1.2% in 2010 and zero per cent rate in 2011, a new decline of -1.2 % of GDP is expected in 2012. The optimistic prognoses of GDP recovery in 2013 with growth of 1.0 % has been revised downwards to modest 0.5%. Since 2009, Croatia has seen its convergence gap with the EU10 and EU15 countries increase.

The Standard & Poor's ratings services lowered on December 14, 2012 sovereign credit ratings on Croatia one step from "BBB-/A-3" to „BB+/B“ ("speculative level" that already is valid in Hungary, Turkey, Portugal and Cyprus) due to the insufficient reforms to eliminate the structural rigidities that hamper the country's growth potential¹. They expect the economy to stagnate, and then recover only gradually to trend growth of 2% by 2015, well below the pre-crisis average. Government believes that Croatia's economy will be able to cope with competitive pressures and market forces within the EU in the short-to-medium term.

The new centre-left Government elected in November 2011 has started significant economic reforms e.g. reducing budget deficits, increase of VAT at 25 %, change of personal income tax, registration of a company with only €1.3 of founding capital, etc. Unfortunately, they failed to reverse the negative economic trends caused by the long-term neglect of structural reforms, particularly slow growth of foreign direct investments and crisis in the Eurozone. There are also opinions that the tight fiscal discipline, new and growing taxes², asset seizures for payment of tax and bank debts, the policy of scarcity and austerity budget for both 2012 and 2013, etc. have a reverse effect on business climate with negative feedback effect on research and innovation. People's dissatisfaction with the economic and social situation is growing as many can often no longer maintain the life standard they are used to or even afford basic goods and services. The deep economic downturn coupled with cost-cutting policy and strong financial discipline takes its toll not only on spending and employment but has a negative feedback of R&D financing and future prospects.

The labour market continued to deteriorate in 2011 and 2012. The registered unemployment rate in September 2012 was 18.3% and in October 2012 unemployment increased by 13.5 per cent as compared to the same month of 2011 (CES, 2012). There has only been little progress in reducing the structural weaknesses of Croatia's labour market, which are reflected in low employment, high inactivity rate (war veterans, retired people) and long-term unemployment. Reduced demand for jobs is coupled with the mismatch between labour demands and offers. The job losses in the last four years of economic downturn (160,000 jobs have been lost)

¹ Additional information available at: <http://daily.tportal.hr/232159/Standard-Poor-s-downgrades-Croatia-s-rating-to-BB-B.html>

² According to the World bank analysis, there is only one state of the EU 27 with higher indirect taxes (World Bank, 2012)

were concentrated in construction and manufacturing which hardly can be absorbed by new sectors needed for economic recovery like service and higher added value sectors.

The most significant problem is the high unemployment of youth (aged 15-24) coupled with lack of perspectives, high demoralization and increased rate of emigration. Croatia is the 3rd country with the highest share of young unemployed persons reaching 36.1% in 2012 (CES, 2012) while the first is Greece with 54% followed by Spain with 53%. A share of unemployed persons with higher educational level in Croatia is 10.4% of the total number of unemployed that certainly challenge the reforms not only of labour market but the higher education sector itself. There is a general challenge to improve the quality for all levels of education, increase participation in lifelong learning and improve the currently low rates of mathematics, engineering, computing and science graduates.

The doctoral students (who are usually perceived as human resources for knowledge economy) with the expiring employment contract in public sector (HEI and PRO) will face the huge difficulties to find job in the private sector after graduation. The budget cuts and recent reforms of research sector do not allow them to stay in the public sector which was previously a regular practice. Therefore, it is important to explore possibilities for job creation, including self-employment and entrepreneurship.

Sluggish economy coupled with the budget cuts for research point to the private sector investment in innovation and research as one of the biggest challenge for efficient innovation policy. Private sector in Croatia invests around 0.34% of GDP in R&D that indicates a substantial lack of critical investments for technological accumulation and global competition based on knowledge and innovation.

One of the reasons for weak business research is a collapse of large state owned enterprises in the manufacturing sector during privatization and their link with research organizations. The second adverse factor is structure SME dominated by sectors which are not based on research and innovation. 92.5% of SMEs employ in average around 1.9 employees having, thus, modest capacities to perform or absorb research. The amount spent on development activity is very small; SMEs invested less than 1% of total revenues in research and development (€88 million) in 2008. These investments were almost nil in the year 2010 (MEC, 2012) (See Section 3 - Structural challenges). There is a strong concentration of R&D expenditure on relatively few companies while innovation and R&D occupy a marginal role in the development strategies of the most of Croatian companies. Croatia is slowly closing its competitiveness gaps with the EU10 and EU15 on labour market, productivity, rule of law but the gaps are largest on innovation, technological readiness and business sophistication.

The important factor for private investments in R&D is well-functioning business environment which is still discouraging to innovation. Research sector could not lead to innovation by itself but requires wider supporting socio-economic environment like absorption/technological capacities of companies, macroeconomic fundamentals, competition policies, transparency, overcoming corruption and similar factors which are progressing but still are not properly in place.

The political elites lack the strategic development visions which would promote research and innovation as the pillars of development. Pushing scientific research on the margins of the development agendas makes a significant drawback to prospects of R&D sector. The "new industrial policy" which would provide a framework for the future of science and technology is not a matter of policy debates. Although all the governments since 2000 emphasize R&D as the key prosperity factor and promise to catch up with research investments at least to the average level of the EU, this goal is practically dropped out. Lack of funding is justified in the past by other priorities like large capital non-productive investments (e.g. sports arenas), subsidies to failed industries (shipyards, railways) and agriculture (five-fold of the EU15). The scarcity of resources for R&D in 2013 is justified by the new subsidies to shipyards, EU membership fee, interest on state loans, increase of pension funds, salaries in the public sectors and other factors.

Anyway, the trends in R&D funding reveal that both public and private investments in research and innovation are fairly small and have worryingly downward trends. Research and innovation are not only constantly under-invested (below 1% of GDP) but further budget restrictions and financial crisis threaten the maintenance of the national knowledge base, professional expertise and education.

An important factor which would certainly influence future evolvement of research and innovation and provide a new momentum for economic development and financial stability is perspective of Croatia to become a new member state of the European Union on 1 July 2013. Since then, Croatia will have access to the Structural Funds including ERDF that is the key instrument for regional development, competitiveness and innovation. There is awareness that the availability of funds will not ensure prosperity by itself. Therefore, a major concern of the development and innovation policy in the coming years will be to implement further reforms to create absorption capacities for EU funds and avoid being a net contributor to the EU.

2.2 Funding trends

	2009	2010	2011	EU27
GDP growth rate	- 6.9	- 1.4	- 1.9 (2012)	- 0.3 (2012)
GERD (% of GDP)	0.85	0.75	0.75	2.03s (2011)
GERD (euro per capita)	85.8	75.7	76.2	510.5s (2011)
GBAORD - Total R&D appropriations (€ million)	312,446	423,603	334,206	91,277.1 (EU27 total 2011)
R&D funded by Business Enterprise Sector (% of GDP)	0.34	0.33	0.34	1.26 (2011)
R&D performed by HEIs (% of GERD)	32.3	28.2	27.8	24% (2011)
R&D performed by Government Sector (% of GERD)	27.5	27.5	27.4	12.7% (2011)
R&D performed by Business Enterprise Sector (% of GERD)	40.4	44.1	44.7	62.4% (2011)
Share of competitive vs institutional public funding for R&D	n / a	n / a	n / a	n/a

s - EUROSTAT estimate

Data Source: EUROSTAT, March 2013

The trends in R&D funding reveal that public investments in research and innovation are fairly small and have worryingly downward trends. Research and innovation are not only constantly under-invested (below 1% of GDP) but further budget restrictions and financial crisis threaten the maintenance of the national knowledge base, professional expertise and education.

The availability of budgetary resources for many research and innovation programmes remains uncertain in the context of currently severe fiscal constraints. The austerity budget for R&D can be mitigated by the EU Structural and Cohesion Funds which will be available to Croatia upon EU accession on 1 July 2013. By the World Bank estimation (World Bank 2012) Croatia will have an annual amount of approximately €150m available for R&D from EU funds in the period 2014-2020.

The total gross expenditures on R&D (GERD) in 2011 (€336m) remained at the level of 2010 (€335m) when it stood at 0.75% of GDP. That is the lowest national level of investments in R&D since 2006 when it was also 0.75% of GDP, and considerably below the average of the EU 27 of 2.03% of GDP.

The majority of GERD in 2011 (48.2%) is financed by the government while business sector contributed with the 38.2%. Another 12% comes from abroad (mainly for research services of the business companies) and the rest is accounted for by universities (1.7%) and private non-profit sector (0.2%). The share of resources from abroad significantly increased from 6.9% of GERD in 2009 to 11.6% of GERD 2011.

The public R&D sector, with universities playing a leading role, is the largely dominant sector in both research manpower (80% of total researchers) and performing research activities (54% of R&D in 2011). The public resources for R&D are both low and stagnant in the last couple of years and decreased in comparison to the previous years. Public resources amounted to 0.42% of GDP in both 2010 and 2011 (around €184m) that is a decrease compared to 2009 (€196m) and 2008 (€208m). This is also far from the national target of 1% of GDP of public resources for R&D defined in the Science and Technology Policy 2006-2010.

Private sector performs 45% of GERD in 2011 compared to 44% of GERD in 2010 and 40.4% in 2009. The ratio of private and public expenditures of 40:50 is almost constant since 2000. Private sector investments fluctuate between 0.4% in 2004 and 0.34% of GDP in 2011 (€150.4m). This is a significant decrease from 2000 when it amounted to 0.56% of GDP. In the last three years the business sector employs a modest 19% of total researchers. This indicates a substantial lack of critical mass of researches and investments for technological accumulation and transition to knowledge economy.

As reported in 2011, the government finances more than 85% of research at public institutes and 78% at universities, while the business sector finances a small portion of university research (9.8%) and that of public institutes (3.4%).

The majority of business research is financed by business companies themselves but their share decline from 86% in 2009 to 77% in 2011. The government contributes to the business sector with the modest 3.1% in 2011. However, the share of foreign investments in the business sector increased from 7% in 2009 to 17.2% in 2010 and 19.6% in 2011. The investments are mainly intended for licenses, contract research and joint ventures.

The largest part of science in Croatia is financed by the State budget allocated by the MSES that usually make 80% to 85% of total research funding at public research institutes and universities, as well. Due to the lack of data, it is difficult to calculate the ratio between institutional and competition-based project funding especially at universities which co-finance their activities through scholarships. Generally speaking 70% of the allocated budget resources are spent on salaries, 10% on direct institutional funding (overheads, phone, energy, etc.),

10% on research grants (material and operational costs) and remaining 10% is spend on other research-supporting activities (conferences, publishing, etc.)

The distribution of the MSES budget for R&D is rather stable over years. Around 27% is spent on institutional funding for public institutes (out of which 83% is spent for salaries of researchers) and another 27% is spent on rejuvenation of the research community through the Junior Researchers Programme. Around 11% is spent for competition-based grants for research projects (*Zprojects*) while remaining resources are spend on different supporting programmes (e.g. research associations, publishing, conferences, etc.) that are also carried out on a competition basis.

As reported by EUROSTAT, GBAORD has slightly increased in 2011 compared to 2010. It amounted to €334m (€324m in 2010) and reached 0.74% of GDP (0.72% in 2010). The largest part of GBAORD is regularly allocated for the institutional funding that includes salaries of researchers at PRO and HEI as well as the salaries for research novices. In 2011 the institutional funding amounted to 73% of the GBAORD which is consistent with the previous years. Resources are mainly provided by the MSES .The reaming resources are allocated for the various research activities (research project grants, equipment, IPA programmes, etc.) Only about 5.7% is allocated for the competitive grants of scientific projects and 1.4% for technological projects.

The MSES is also responsible for carrying out the mission-oriented programme – the Science and Innovation Investment Fund (SIIF) co-funded by IPA (€10.3m for the period 2009-2013).

There are three specialised intermediary/funding institutions that provide the competition-based grants for research and innovation projects, as follows:

- [The Croatian Science Foundation](#) (CSF);
- [The Business Innovation Agency of the Republic of Croatia](#) (BICRO);
- [The Unity through Knowledge Fund](#) (UKF).

There are no specialized analysis of the share provided by these different funding sources and the national public budget. However, their contribution to the direct funding of research and innovation activities is significant if we take into account that the MSES spends only about 11% of its funds for direct funding for competition-based research projects (€19.6m in 2011). By contrast, the Croatian Science Foundation invested in 2011 a total of €5.2m of the State budget for highly-competitive projects within 7 different programmes. However, it should be borne in mind that sources provided by other funders seem generous because MSES covers operating expenses, the cost of basic functioning of the scientific system (wages and overheads). BICRO spent €2.6m in 2011 on the four different programmes and €19.2m in the period 2007-2011 for the RAZUM and TECHRO programme. UKF spent from its beginning in December 2007 until June 2011 an amount of €7.8m for 91 scientific and technological projects.

The significant resources for restructuring R&D sector and innovation-based programmes administered by BICRO are provided by the World Bank loan for the Science and Technology Project (STP). The first phase involved €30m loan (with an additional national component of €5.7m).[The Second Science and Technology Project](#) (STP II) is launched in 2012 after successfully accomplished STP I. Estimated funds are about €24m in the period 2012-2015 for improving the capacity of Croatia's R&D and innovation institutions, adjusting current programs (BICRO and UKF) to EU regulations and preparing submissions to EU Structural and Cohesion funds (World Bank, 2012). CSF's programmes are fully funded by the State budget while programmes of BICRO and UKF are co-financed by the World Bank loan in the framework of the [Science and Technology project \(STP\)](#). Yet, the MSES, acting as holder of the UKF, ensured nearly €5.1m, i.e. 65 % of the total funds.

According to the World Bank analysis (World Bank, 2012) the volume of business R&D is low, despite generous tax breaks. Croatia has a very generous system of tax breaks for R&D compared to OECD countries,

corresponding to a subsidy of about 35% for US\$1 of R&D, second only to France (42% in 2008). The recent analysis (Aralica et al., 2011) reveals that tax incentives are more generous form of state aid for R&D than subsidies. Namely, several large business R&D performers claim tax incentives that exceed the overall public R&D subsidies. Evidence can be found in corporate financial reports. For example, in 2009 subsidies amounted to less than a third of aid granted by the tax incentives. Although over 270 companies used of tax incentives, 90% of the total tax incentives is realized by a small number of companies: 9 in 2008 and 27 in 2009. This indicates that the a few companies conduct large research projects and the concentration of tax incentives into the small number of users is present. It is estimated that the “tax breaks tend to be irrelevant to SMEs and to favour incumbent firms to the detriment of entrants” (World Bank, 2012a). However, tax incentives prove to be of large assistance to companies and have the effects of additionality (increase the investment of companies in R&D). It is estimated that each forgone HRK generates 1.19 HRK of R&D investments but a significant number of potential beneficiaries do not use it due to concerns about excessive red tape.

Sectorial R&D policies or support for specific thematic areas are not common policy practice. The main policy instrument for financing scientific research is the *Research Projects* programme (*Z-projects*) which follows a horizontal approach to assure the balanced

2.3 New policy measures

The most important change in research policy measures that will surely influence the entire future organisation and performing of research activities is the termination of the Research projects programme (*Z-Projects*). The legal basis is provided by the new Draft of the law amending the Law on Science and Higher Education from 2003 which was adopted by the Government on 1 February 2013 and sent to the parliamentary procedure. The change is anticipated for 1 July 2013. *Z-projects* programme was the main instrument of the MSES for the allocation of competition-based research grants from the State budget with a long tradition of more than 20 years. The *Z-Projects* programme that allotted funds to research teams should be substituted with the “Programme contracts”, a sort of lump sum for research at the institutional level of PRO and HEI for performing research activities agreed between the MSES and research institutions at the three years basis (Jovanović, 2012). There are estimates that the funds for these contracts will be very scarce (about €670 per researcher per annum) while criteria for allocation of the programme funds and their distribution within institutions are yet not defined. The main reason for cancelling the *Z-projects* programme is its poor competitiveness and contribution to scientific excellence. The programme funds a large number of small scientific projects with high acceptance rate (more than 80% of proposed projects) that favour scientific mediocrity instead of excellence. The allocation of the competition based research project grants will be transferred to the [Croatian Science Foundation](#) (CSF) and assumes a rigid evaluation process that should end up with a small number of high quality research projects. The conditions for this transition are already set with the two new CSF’s programmes - [Research projects](#) programme and [Collaborative research programmes](#) which have been launched in 2011. They will support only highly-competitive research projects and groups (around 20% of proposals) and will become the principal tools for allocation of budget resources instead of *Z-projects*.

Research projects supports research groups that deal with scientific issues of international interest and whose leaders have recognized scientific achievements so far. The ultimate goal is to create a critical mass of research groups that will be competitive at the international level. *Collaborative research programmes* are proposed and conducted by universities, university departments and public institutes. They should involve at least three research groups from which at least two must be from different institutions. The ultimate goal is to

encourage networking of research groups for internationally competitive programmes and to pave the way for the centres of excellence.

In 2011 the financial means for *Research projects* and *Collaborative research programmes* amounted to € 2.1m and € 2 respectively. Both the programmes have funded so far very few projects that caused dissatisfaction of researchers. Due to the announced serious budget cuts in 2013, there are worries that the practice to fund only a very small number of projects will be continued while the majority of the scientific community will remain without operational cost for research that would deteriorate national scientific base in the long run.

The financial and budgetary constraints coupled with the expirations of the World Bank loan for Science and Technology project in 2010 which was a principal co-financer of the UKF's and BICRO's programmes have a negate feedback on the sustainability of these programmes. Although UKF was proved as a very successful and gained international reward for its achievements, it was forced to stop the activities and close their programmes (e.g. "Gaining Experience", "Visit to the homeland", "Research in industry and academia") in 2011. The realisation of the BICRO's programmes like RAZUM, TECHRO or IRCRO was slowed down. The projects of the BICRO's beneficiary companies have been stalled by waiting for allocation of already approved funds that influence their business plans and financial flows. BICRO's pipeline of projects was large, exceeding many times the amount of annually available funding (World Bank, 2012a).

The continuation of programmes is enabled by launching the [Second Science and Technology Project](#) (STP II) in 2012. The UKF has announced the new public calls for the two programmes: "Gaining experience" and "Industry and Academia Grant".

In early May 2010, the BICRO has launched a new programme - [Proof of Concept](#) - (PoC) in collaboration with partners - recognized technology centres like the Office of Technology Transfer at the University of Zagreb, Science & Technology Park, University of Rijeka - StePRi, Tera Technopolis, Osijek, etc. The aim of the programme is to ensure pre-commercial funding for technical and commercial testing of innovation concepts. The programme has achieved significant results in terms of the growing number of applications and the quality of applied projects. Due to this high interest six new centres have been included in the programme (the Istrian Development Agency - IDA, Zagreb Development Agency - TPZ, Pakrac Entrepreneurial Centre, Zadar County Development Agency - ZADAR, The Rudjer Boskovic Institute and BIOS Entrepreneurial Incubator) that ensure the regional coverage and regional character of the programme.

The TEST programme - the very first innovation policy programme for fostering new technologies based on scientific research launched in 2001 by MSES has been transferred from the Croatian Institute of Technology (HIT) to the Business Innovation Agency of the Republic of Croatia (BICRO) and is active within its "Service for R&D Programmes".

2.4 Recent policy documents

Since 2010 the Government was rather active in proposing new laws in order to reform the science and higher education systems. The most recent document is the new Draft of the law amending the Law on Science and Higher Education from 2003 which was adopted by the Government on 1 February 2013 and sent to the

parliamentary procedure. This Draft of the Law comes after the four previous proposals of laws³ have been withdrawn from the parliamentary procedure since they encountered strong criticism in the academic community. The new Draft of the law brings many changes to increase the efficiency of the R&D system and, envisages, among others, a new model of institutional funding through “programme contracts” between the Ministry of Science, Education and Sports (MSES) and PRO/HEI.

The next document with a great impact on scientific community is the new Regulation on conditions for obtaining scientific titles (Official Gazette 26/2013) which was adopted by the National Science Council on 19 February 2013. The Regulation tightens criteria for promotion of scientists into higher scientific grades in order to foster scientific merits.

The "National Strategy for the Croatian innovation development 2013-2020" is in progress and will be carried out by the Organisation for Economic Co-operation and Development (OECD) in collaboration with local experts. Up to now, the Draft of the Background Report which should provide the basic inputs to the Innovation Strategy was publicly presented in October 2012. The Draft entails a list of 5 main strategic goals for reforming research system and around 40 guidelines for their implementation.

The Government adopted in February 2013 a new [Action plan to Increase Absorption Capacity for Participation in the Framework Programmes \(FP7\) of the European Union 2013-2015](#).

On December 20, 2012 MSES presented the [Action plan "Science and Society"](#), a first such document for Croatia. The Action plan is based on four interconnected, but still somewhat different thematic circles: Socially responsible science, Scientific culture and education, Scientific policy and the citizens, and Science and the media.

The new Government elected in November 2011 initiated the [Guidelines for strategy of teaching, education, science and technology](#) which was carried out by the MSES in collaboration with the Croatian Academy of Science and Arts in April 2012.

Croatia participates in developing the [Regional Strategy for R&D and Innovation of the Western Balkan Countries](#) (WBC) which is initiated by the [Regional Cooperation Council](#) (RCC) and coordinated by the World Bank and European Commission. The Commission committed funds for the Strategy in 2011. The proposed initiatives for regional cooperation consist of four components: regional research fund, regional centres of excellence, technology transfer facility and regional platform for monitoring implementation of the actions (RCC, 2012). The Strategy should be accomplished in spring 2013 which will challenge the potential funding sources to provide budget for the proposed programmes of around €100m.

2.5 Research and innovation system changes

In the last few years there were not significant changes in the landscape of research institutions, funding agencies and research legalisation. However, since 2010, there were strong efforts of policy makers to reform R&D and higher education sector in terms of achieving scientific excellence, international visibility and better scientific productivity. The legal framework for reforms was provided by the new Draft of the law amending the Law on Science and Higher Education from 2003 which was adopted by the Government on 1 February 2013 and sent to the parliamentary procedure. This Draft was preceded by the proposal of three laws from October

³ They include three laws from October 2010: the Law on Science, the Law on Universities and the Law on Higher Education and one from April 2012 – the Draft of the law amending the Law on Science and Higher Education from 2003

2010 and the Draft law amending the 2003 Law on Science and Higher Education from May 2012. These proposals have been withdrawn from the parliamentary procedure because of the many criticism.

Based on the Draft law the MSES aims to bring significant changes in organization and financing of scientific activities to achieve scientific excellence. The most noteworthy is a shift from project to programme financing. It assumes complete or partial abolition of research grants allocated by the MSES through the Research projects programme (*Z-Projects*). The *Z-Projects programme* should be substituted by the “Programme contracts”, a sort of lump sum for research programmes at the institutional level of PRO and HEI. The main intention is to terminate the current practice of funding a large number of small scientific projects and high acceptance rate (more than 80% of proposed projects). This request is justified from two points: /1/ to reach a critical mass of researchers and resources that would have yielded significant scientific results within the national research priorities and /2/ to provide internal responsibilities of PRO and universities for delivering research results and outcomes with the impact on socio-economic potentials.

The allocation of the competition based research project grants is planned to be transferred to the Croatian Science Foundation and assumes a rigid evaluation process that should end up with a small number of high quality research projects.

However, these reforms should be carried out with a lot of thoughtfulness because they can endanger a relatively small science base in Croatia (about 6,400 researchers in FTE or 47% of average in the EU-27). It is often forgotten that Croatia has a relatively narrow financial base for scientific research and a lack of diversified resources for competitive research funding. With the exception of the Croatian Science Foundation, MSES used to be a single financer and consumer of R&D, and literally preserves and develops a “national science base”. This base rely mainly on public R&D sector which nowadays employs 85% of the Croatian research labour force and makes a ground for overall research-based development.

The Draft law plans the foundation of the new National Council for Science, Education and Technology Development. The new Council should integrate the current National Science Council and the National Council for Higher Education. The aim of this merging is to harmonize development, planning and monitoring of higher education, science and innovation systems in order to prevail the current fragmentation of the research and education systems and to strengthen integration between the sectors.

The next important change is related to the Business Innovation Centre of Croatia (BICRO) a leading public company with limited liability established in 1998 to develop financial incentives and support innovation and technology-based businesses in Croatia. The legal status of BICRO has been changed in 2010 when BICRO was transformed from company with limited liability into an innovation agency with the status of public institution by the Government directive (Official Gazette, 129/2010). This Directive was amended in 2012 by the new Government directive (Official Gazette, 31/2012) by merging BICRO and the Croatian Institute of Technology (founded in March 2006) into a new Business Innovation Agency of the Republic of Croatia – BICRO. The HIT was implementing programme TEST (pre-commercial technology oriented research activities). It was in charge of developing national technology foresight platform and for provision of administrative structure for Framework Programmes. The main reason for merger was to ensure the efficient investment of EU structural instruments in areas of research, development and innovation.

According to the World Bank (World Bank, 2012a) the BICRO’s transition from a liability company to a government agency is likely to have at least two negative implications: /1/ salary cuts of up to 40%, which create a severe risk of losing the cadre of highly trained professionals, and /2/ a more restrained capacity to manage multiyear budgets, which increases BICRO’s dependence to the State budget cycle and contributing to the volatility of public financing for business R&D.

2.6 Regional and/or National Research and Innovation Strategies on Smart Specialisation (RIS3)

Although the idea of smart specialization is a new concept in regional and innovation policy, the preparations for the development of the National Research and Innovation Strategy on Smart Specialization (RIS3) are in a full swing. The Strategy is crucial for the future development of Croatia since smart specialization is considered as an ex-ante conditionality for the withdrawal of the financial means from the European Regional Development Fund (ERDF) (EC, 2012b). Croatia will have the access to ERDF upon accession to EU on 1 July 2013. An expert group for carrying out the Strategy is appointed by the Ministry of economy which will coordinate the activities. The expert group will include the representatives of other relevant ministries and public bodies and most importantly the representatives of the regional and local authorities. Regional authorities include mostly the [regional development agencies](#) established in each of the 21 counties which will provide their inputs into the Strategy. There are a total of 29 regional and local development agencies at the level of 21 counties and several cities that want autonomously initiate structural reforms, attract private investment, EU funds, create new jobs, etc. The Strategy will be based on sectorial approach and the strategies in the three sectors are already in progress: wood processing, food processing and automotive industry. The drafting of the Strategy should start in January 2013 and ended in June 2013.

The RIS3 strategy is closely related to regional development which receives an increasingly important role in the overall national development. A proactive regional policy based on convergence and competitiveness is very important because Croatia suffers from considerable and long-term regional disparities. There is a widening gap of the socioeconomic differences and development opportunities in different parts of the country and among various social groups. The average incomes are three times higher in the richest regions than in the poorest ones (RCCI, 2010). As the result, the Law on Regional Development was adopted in December 2009 (Official Gazette 153/2009) as well as the Strategy of Regional Development 2011 - 2013 that was adopted in June 2010. An important component of regional development is the Strategy of cluster development in Croatia 2011 - 2020 carried out by the Ministry of Economy, Labour and Entrepreneurship in 2011. Clusters' development makes a good starting point for smart specialisation. In Croatia there are around 50 clusters initiatives on different level of maturity and success.

None of aforementioned strategic documents dealt specifically with regional research capacities, specific innovation competences or cooperation between universities and businesses. The regional innovation and research policies are rather weak due to the insufficient resources, coming from the small tax base, that would enable counties or municipalities to take a more active part in the development of research and innovation activities. A crucial role in stimulating regional development in the period 2007-2012 was provided by the IPA IIIc programme based on the [Regional Competitiveness Operational Programme 2007-2009](#). The IPA programme is also more focused on the development of business infrastructure, business climate and competitiveness that can help less developed regions to catch up with more developed ones, than to research competencies and technology transfer.

Nevertheless, addressing the issue of specialisation in research, innovation and industry is of particular importance for countries that are not leaders in any of the major science or technology domains, like Croatia. In the absence of strong industries that have been deteriorated during the transition to market economy, Croatian economic structure is rather diverse and follows the natural assets of particular regions. Economic activities range from organic farming to advanced manufacturing and from software design and development to financial services and logistics (Bečić and Švarc, 2010). The structure of the economy in the most developed

regions (Zagreb region and North-West Croatia) is characterised by a high share of services⁴. In recent years, the coastal regions, Adriatic North and Adriatic South, have experienced strong growth of gross value added (GVA) from increased tourism. Central Croatia and, in particular, Eastern Croatia have a quite unfavourable economic structure, with a relatively large share of agriculture.

This is maybe the reason that the majority of policy measures aimed at supporting research, innovation and entrepreneurship are not sector specific and are not selective in terms of prioritisation of certain technological, business or research areas (Bečić and Švarc, 2010). Although horizontal approach has certain advantages (maintenance of a national scientific diversity, what appears as duplication very often generates new opportunities or scientific breakthroughs with their various applications).

On the other hand, the horizontal approach alone could be perceived as opposing the national interest for accelerating faster economic growth since the shortage of priorities could lead to disorientation of strategic development and confusion of goals in the long run coupled with the waste of resources and efforts.

The sectorial approach and support of the selected technology or research areas are rather neglected. The entire strategy of economic and technological development remains rather undefined and vague, illustrating that political and economic elites have not yet succeeded in defining priority areas and sectors that could be key drivers of progress. It also produces vagueness in science and innovation policies, which tend to define their own priorities and direction of development, mainly following the European strategies and recommendations. However, they are rarely related to the national down-to-earth needs of the 'real' production/service sector. The present economic situation in Croatia urgently requires structural adjustment to meet the challenges of international competition (exports) and integration with the EU that make policies with regard to technological specialisation crucially important. At the same time, it is evident that both the high tech industries and related scientific disciplines have not really become new growth areas in Croatia.

Talking about specialization in scientific research, it should be noted that the bio-medical and bio-technical research, such as biochemical engineering, molecular biology, medicine, pharmacy and related fields have the highest potential to bridge the existing gap in technology transfer and the commercialisation of science. Croatia has a solid platform for cutting-edge research in these fields and a critical mass of researchers located all over the country in institutions such as the Medical School of Zagreb, Medical School of Rijeka, the Institute of Immunology, The Croatian Institute for brain research, Mediterranean Institute for Life Science (MedILS) and a series of research units in polyclinics and hospitals (25 research units). The Medical School of Rijeka and the Croatian Institute for brain research have already proven its expertise by gaining millions of Euros from the EU FP for funding their research. Besides, the construction works on the incubation centre for the companies based on the biomedical and biotechnological research ([BIOCentre](#)) has started in November 2012. This is a green-field investment of over €18m of which 85% will be financed from the IPA programme.

The next most promising field for research and technological specialisation is in the domain of cognitive and robotic systems, cooperative network embedded systems and similar strategic areas developed by the Faculty of Electrical Engineering and Computing of the University of Zagreb.

In addition to bio-medicine and robotics, traditional bio-technological research in the food and agriculture industry, forestry, energy (bio-fuels) and the environment (waste and water treatment) is of special interest for Croatia since it has a long tradition and significant research resources in these fields.

⁴ The Croatian economy is a service-oriented economy, i.e., services account for more than 60% of gross value added (GVA). Comparing the GVA structure in 1995 and 2006, one can see a decrease in the share of the agriculture, hunting and forestry sector from 10.7% to 7.4% and manufacturing from 24.3% to 20.3%, whilst there is a noticeable trend of increase in the share of services from 60.9% to 68.1%. In this process the following sectors are important: financial intermediation, wholesale and retail trade and transport, storage and communications (Bečić and Švarc, 2010).

2.7 Evaluations, consultations

The two important evaluation studies of the innovation supporting programmes were carried out in 2011 and 2012, as follows:

- The evaluation study of the [Science and Technology Project](#) (STP), a common project of the MSES and World Bank to modernise the Croatian research system was carried out in February 2012 (World Bank, 2012a);
- Evaluation of the BICRO's innovation programmes - RAZUM and IRCRO and UKF Fund which are co-financed by the World Bank in Croatia within the Science and Technology Project, carried out by the Institute of Economics in May 2011 (Radas et al, 2011).

The value of these studies is even greater because they are the first professional and independent evaluation studies of innovation policy programmes since launching the HITRA programme in 2001 which marked the beginning of innovation policy in Croatia.

According to the evaluation, the Science and Technology Project (STP) aimed to help Croatia establish and develop the institutions and programmes inherent to modern R&D and innovation systems. The project development objective remains highly relevant for Croatia's economic development and is central to the Europe 2020 Strategy and the Innovation Union flagship. The study tried to provide an answer to the interesting question – should Croatia's government prioritise public expenditures in R&D on the expenses of some other sectors. In order to provide the answer, the estimates of the rate of return on R&D compared with possible public investments in education and infrastructure is carried out. The estimated rates of returns on R&D (73%) are at least double the value of returns on infrastructure and seven times higher than on education. Yet Croatia's aggregate R&D investments are at a relatively low level (0.9% of GDP in 2011, as compared to 3-5% in innovation-driven economies such as Finland, Sweden and Israel). It is concluded that R&D and innovation continues to hold the key to boosting productivity and securing long term development in Croatia.

The STP project enabled R&D institutions to commercialize research outputs. It also increased the ability of enterprises to develop, use and adapt technology by addressing and correcting the market failures of programmes focusing on R&D financing for enterprises (RAZUM and SPREAD). Key achievements included: /1/ more research outputs and research capacity commercialized by RTIs; /2/ improved scientific and technological cooperation; and /3/ more firms investing in R&D activities, as illustrated below by the following results:

- 69 new research contracts (target was 55) with industry were concluded by Brodarski Institute and UKF, with a total value of €10.9m (against the target of €9.8m);
- Rudjer Innovations (TTO at the Rudjer Boskovic Institute) established five spillover companies (two new companies to be completed within the next 12-24 months). Total value of the five spillovers amounts to €3.1m (target was €2.9m for eight spillovers);
- Rudjer Innovations signed 12 licensing agreements (exceeding the target of eight agreements), including with the Massachusetts Institute of Technology and Brown University, reaching about € 800,000 (falling short of the target €1.0m);
- UKF's cooperation program established collaboration with 133 foreign research institutions including Mack-Planck Institute, Swiss Federal Institute of Technology, and Johns Hopkins University;
- Increased volume of private funding for R&D activities mobilized by firms: €13.7m, 30% higher than the initially envisaged target of €9.2m.

After successfully accomplished STP I, the Second Science and Technology Project (STP II) is launched in 2012.

The main conclusion of the evaluation of the RAZUM programme carried out by the Institute of Economics (Radas et al, 2011) is that the programme had a significant impact on the development of innovation, new export oriented products, science-industry collaboration and the promotion of research and innovation capabilities of the enterprises. A potential danger is the difficulty of finding funds for the commercialization of prototypes. It is, therefore, suggested to develop additional programmes that would assist companies in commercialization their new products.

According to the results of the evaluation of the IRCRO programme, the main benefits for companies consist in strengthening the connection between business and science, saving costs of in-house research and development, and shortening the cycle time of companies' research and development projects. It is recommended to conduct rigorous testing in the planning phase of the project in order to minimize the possibilities that the planned resources are not sufficient to complete the project.

UKF projects have resulted in a number of scientific papers published in international journals, or presented at international conferences. They also produced new international project cooperation and submissions to EU FP funds. It should be noted that without UKF funding Croatian scientists would have achieved less scientific results, lower levels of quality of outputs, and would not have access to modern technology. The opportunities to educate young researchers abroad by contemporary world standards would be much lower.

3 Structural challenges facing the national system

HUMAN RESOURCES	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	0.9
Percentage population aged 25-64 having completed tertiary education	24.5
Open, excellent and attractive research systems	
International scientific co-publications per million population	324
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	3.07
Finance and support	
R&D expenditure in the public sector as % of GDP	0.41
FIRM ACTIVITIES	
R&D expenditure in the business sector as % of GDP	0.34
Linkages & entrepreneurship	
Public-private co-publications per million population	17.7
Intellectual assets	
PCT patents applications per billion GDP (in PPSE)	0.66
PCT patents applications in societal challenges per billion GDP (in PPSE) (climate change mitigation; health)	0.03
OUTPUTS	
Economic effects	

Medium and high-tech product exports as % total product exports	45.7
Knowledge-intensive services exports as % total service exports	14.01
License and patent revenues from abroad as % of GDP	0.06

Data Source: [Innovation Union Scoreboard 2011](#)

Following the national research and innovation performance trends as well as strategic documents dealing with research, innovation and economic development, the following main structural challenges can be identified:

1. The R&D policy is obsolete and lacks visionary, coherent and integrated policy framework

Under the present financial constraints, the science policy actions are focused on two goals: rationalisation of public research sector in order to achieve savings of the state budget and establishing better quality of scientific research at the same time. Ambitious agendas that aim to provide some entirely new possibilities for science in economic recovery and socio-cultural changes are not a subject of the current policy. The new industrial policy that could provide a framework for science and technology strategic role is not devised. Policy makers tend to neglect that research and innovation hold the key to boosting productivity and securing long term development⁵. The science (and innovation) policy is overlooked in favour of other politically and socially accepted priorities, such as macroeconomic stabilisation, privatisation, declined industries, public debts, etc. By contrast to popular narratives since 2000 that celebrate “Croatia as a country of knowledge”, science does not play a significant role in development. It is separated from productive use of knowledge and its market realisation through innovation. The present research policy is rather myopic based on day-to-day problems instead of analytical studies of national/regional competences or technology foresight exercise for directing future development (Švarc, 2011). The latter have never been produced for any of Croatian business, technology or research sector. Some progress can be expected from the Strategy of smart specialisation (S3) which is expected to be accomplished in June 2013.

The lack of long-term visions is best illustrated by the lack of strategic documents since the last one - the Science and Technology Policy of the Republic of Croatia 2006–2010 expired three years ago, with most of its objectives remaining unfulfilled. The [Guidelines for strategy of teaching, education, science and technology](#) carried out in May 2012 by the Ministry of Science, Education and Sports (MSES) in collaboration with the Croatian Academy of Science and Arts has not brought much strategic recommendations. The “National Strategy for the Croatian innovation development 2013-2020”, initiated in May 2012 and carried out by the Organisation for Economic Co-operation and Development (OECD) experts in collaboration with local experts has so far produced only a draft of the Background report (OECD, 2012) with majority of analytical data and diagnoses already known. The strategic goals are currently composed of a list of the six main pillars and around 40 guidelines for their implementation which made an annex to the Background report.

The science policy suffers from the lack of strategic visions that produces disorientation in policy actions. It is reflected in the withdrawal from the parliamentary procedure of all Acts (four in the period 2011-2012) aimed at reforming science and higher education due to the disagreements regarding the crucial issues of science organization and regulation. One of the reasons is perceived in the missing overall strategic framework and

⁵ According to the World Bank calculations (World Bank, 2012), the social rate of return on R&D investments in Croatia is estimated to 73%, more than twice, for instance, the rate of return for infrastructure. Yet Croatia’s aggregate R&D investments are at a relatively low level (0.9% of GDP in 2011, as compared to 3-5% in innovation-driven economies such as Finland, Sweden and Israel.

visions which would explain and justify the implementation of the reforms and harmonize interests of different stakeholders in research and higher education systems. Currently, a new Draft of the law amending the Law on Science and Higher Education from 2003 which was adopted by the Government on 1 February 2013 has been sent to the parliamentary procedure.

The present science policy suffers also from the lack of coordination between different government bodies responsible for innovation policy, as well as an inadequate planning and evaluation processes which are either underdeveloped or missing. After election of the new Government in December 2011, there are three ministries in addition to MSES which are responsible for different aspects of fostering innovation and should have, thus, the impact on research and higher education. These are: the Ministry of Economy (MoE), Ministry of Entrepreneurship and Crafts (MoEC) and Ministry of regional development and EU funds (MRFEEU). However, the policies and supporting measures of these ministries are not harmonised and related in such a way to produce a synergy in innovation and technological development. Therefore, it is necessary to increase consultation and communication between the relevant ministries and funding/implementing agencies like the BICRO and CSF and ASHE.

2. Business environment is not conducive to innovation

One of the most critical parts of overall strategy to create more efficient scientific research is creation of a sound business environment to encourage innovation capacities of firms and business demand for research. The government often understand the relationship between scientific research, innovation and economic growth in a simplified way and assumes that the reform of the public research sector by itself would lead to innovation. By contrast, the policies to enhance the productive use of science should be part of an overall strategy addressing the business sector's demand for the results of public research.

Overall business environment in Croatia creates disincentives to innovation. Its key features include inefficient state administration (sometimes prone to political voluntarism) at central and local levels, financial system dominated by banks (with relatively shallow and illiquid capital market), high costs of utilities and local services, widespread illiquidity, limited state support to innovation and weak linkages between education sector and the labour market.

Consequently, enterprises with more ambitious business strategies based on innovation and higher governance and competitiveness standards are likely to be burdened by high risks and costs. The current trends are likely to have negative effects on innovation activities in the medium term, as companies struggle with low demand and liquidity problems and are forced to cut costs and lay workers off. Unemployment is growing daily and has reached almost 18% in September 2012. Therefore, the main structural challenge is to ensure the socio-economic factors that provide fundamental economic and social stability for business/technology development. In Croatia such factors include primarily: fiscal discipline, removing obstructive and time-consuming bureaucracy, elimination of corruption and political voluntarism, openness to FDI, incentive tax system, solving insolvency, re-distribution of subventions (agriculture, shipyards), improving management of state-owned enterprises, promotion of the value system that appreciate work and knowledge instead of political privileges⁶.

Weak response of the former government to the economic and financial crisis also entailed postponement of structural reforms that has further decreased the quality of the business environment. The current Government elected in November 2011 has initiated many reforms in order to improve the overall business environment,

⁶ The recommendations of the World Bank include for, example: improvement of fiscal sustainability, enhancing competitiveness, reducing bureaucratic red tape and strengthening the rule of law, reducing the economic dominance of the state and state-owned enterprises (World Bank, 2012).

such as: reducing budget deficits, rise of VAT to 25 %, change of personal income tax, registration of so-called simple company with limited liability with only €1.3 of founding capital, etc. The reforms, however, have not produced the expected benefits for business climate due to the long-term neglect of structural reforms, particularly slow growth of foreign direct investments and crisis in the Eurozone. There are also opinions that the tight fiscal discipline and unusual control methods like the “List of shame” (the Internet available list of tax debtors’ names), announcement of forthcoming property tax, asset seizures for payment of tax debt and bank credits, etc. have a reverse effect on business climate with negative feedback effect on research and innovation.

3. Weak interest of private companies for research and development

One of the main structural problems is that the volume and investment of private business R&D is low and their interest in cooperation with the public R&D sector is weak. The public R&D sector largely surpasses the technologically weak private sector in terms of research workforce and R&D expenditures. Business sector invest about modest €30 per capita in R&D (34.1 in 2011) while EU invests in average almost 10 times more (€318.3 p/c). One reason is disappearance of large state owned enterprises in the manufacturing sector during privatization and their link with research organizations. The second adverse factor is structure of a new layer of small and medium sized companies (SME) dominated by sectors which are not based on research and innovation. The wholesale and retail trade sector, construction, accommodation and restaurants make nearly 50% of all SMES (MEC, 2012). Besides, 92.5% of total SMEs are micro companies with less than 10 employees (1.9 in average) having modest capacities to perform or absorb research⁷. Finally, the third reason is the large share of un-reformed public companies in economy structure that are not exposed to market competition which would urge them to innovate.

There is a strong concentration of R&D expenditure on relatively few companies while innovation and R&D occupy a marginal role in the development strategies of the most of Croatian companies. Innovations are mainly incremental and forced by survival on the domestic market rather than a result of meaningful and long lasting strategy for competition on international markets.

On the other hand, small businesses are the core drivers of the Croatian economy in the recent period, playing an important role in industrial restructuring, competitiveness and innovation and in generating new employment. They make 99.5% of the total number of companies and account for 66.3% of the total number of employed persons in Croatia with significant growing trends in employments. However, their research and innovation capabilities are rather weak.

The analyses (MEC, 2012) indicate that, overall, SMEs invested less than 1% of total revenues in research and development, an amount of around €88 million in 2008. For the year 2010, the situation was worse since the expenditures for R&D were cut by half. The broader measure of expenditure in R&D tracked by the level of intangible assets has shown the similar results. Overall, it could be said that the amount spent on development activity is very small, almost nil in the year 2010.

The SME sector must find the means to increase the level of investment in research and innovation especially if it wants to keep its competitiveness after joining EU single market. An important task is to create conditions for the further development of today’s small businesses and their growth into large and medium-sized enterprises that are able to develop a research function and research-based innovation

⁷ The total enterprise sector in Croatia is composed of 168,931 productive units. Within this enterprise universe, the SME sector (1 to 249 persons) comprises 168,443 productive units. There are 155, 828 micro-enterprises which account for 92.5% of total SMEs (76.665 legal entities (including cooperatives) and 79.163 crafts); 10,599 small companies or 6.3% of all SMEs, comprise of 8791 enterprises and 1808 crafts, and 2015 (0.2%) are medium sized enterprises, comprising 1954 enterprises and 61 crafts (MEC, 2012)

Although innovation may be performed even with low R&D budgets (especially in the case of incremental and process innovations), this is often difficult to achieve, as the data on innovation performance demonstrate. Based on its average innovation performance, Croatia is one of the moderate innovators with a below average performance compared to EU (IUS, 2011). The exception is a region of Northwest Croatia which is an innovation follower (EC, 2012a) mainly due to the city of Zagreb, a capital of Croatia whose GDP is well above Croatian average.

On the other hand, it is estimated that Croatia's growth in innovation performance in the last five years has been well above EU average while innovation expenditures has increased most in Croatia in 2010 (IUS, 2011). Regarding knowledge capacity and economic structure Croatia is low knowledge capacity country with a specialisation in low knowledge intensive sector (similar to Bulgaria, Romania, Poland and Turkey) (EC, 2011a).

Croatia's ranking in the Global Competitiveness Report (WEF, 2012) continue to decline from 2008 to 2012. Its ranking in 2012 dropped by five places compared to 2011 and puts Croatia in the 81st place out of 144 countries. This finding should serve as a call to action and a stimulus to policy debate on how to improve innovation- based competitiveness.

The challenge is, therefore, to re-vitalise research and innovation activities in both industrial (manufacturing) and service sector with a view of upgrading technological capabilities of companies towards higher technological capacities. Knowledge production and circulation need to be significantly improved, in order to create preconditions to more effective innovation processes. A new national technological and industrial policy based on ecological ("green") sectors should be envisaged taking into account production and skills abilities of the workforce.

Government support should focus not only on low and medium innovations which is now the case but also on areas with high social and economic benefits that push out the technological frontiers. The establishment of the national technology platforms should be encouraged to enable Croatia to participate in the European technology platforms (ETP). Currently, Croatia does not participate in ETP due to the weak interest of private sector. The aim is to overcome deficits in R&D concerning a low number of research conducting enterprises, strong concentration of R&D expenditure on relatively few companies, low start-up and growth dynamics of innovative enterprises

4. Sluggish reforms of research and higher education system

The quality of research and higher education system and the need for their reforms has been frequently discussed since 2000. The four milestones can be, at least, identified: /1/ beginning of the Bologna process in 2001, /2/ Science and Higher Education Act from 2003, /3/ proposals of the Law on Science, the Law on Universities and the Law on Higher Education, in October 2011, /4/ introduction of the quality assurance system of PRO and universities in 2007 by the Agency for Science and Higher Education (ASHE) and /5/ Draft law amending the Law on Science and Higher Education from 2003, in May 2012.

None of these actions have achieved the expected changes. The governance, organization and the financing of the research and higher education sectors remained largely un-reformed. The need for reforms is again emphasized in the [Programme of the Croatian Government for the mandate the 2011 - 2015](#) adopted in December 2012. A new Draft of the law amending the Law on Science and Higher Education from 2003 which was adopted by the Government on 1 February 2013 and sent to the parliamentary procedure and the new Regulation on conditions for obtaining scientific titles (Official Gazette 26/2013) which was adopted by the National Science Council on 19 February 2013 provide a framework for larger reforms of research system.

The current universities are fragmented into a large number of autonomous faculties with considerable individual power which obstruct the legal and financial integration of universities. It also makes strategic

development of universities difficult, poorly adaptable to international competition and reduces opportunities to succeed in a wider European and international environment.

The lack of strategic coordination is best illustrated by the fact that the number of higher education institutions has doubled in the last 6-7 years, while the number of academic programmes has tripled (NCHE, 2011). Shortly before 2005, during which the study programmes were aligned with the Bologna principles, it was just over 400 programmes, while now there are nearly 1,300. The commercialization of education threatens the mission of the universities.

By contrast, there are many obstacles to research commercialisation, efficient science-industry cooperation and meaningful role of universities in economic development. On the business side there is a weak demand for research service due to the low innovation capacities. On the science side, the career progression of researchers is determined by academic achievements, an approach which favours Current Content publications and basic research rather than applied research and collaboration with the private sector. In addition, the predominance of institutional over competitive funding has discouraged the diversification of revenues; however, these revenues can be rather limited due to the current economic crisis and low technology capabilities of companies. Universities play the leading role in the production of research works and publications. According to the Central Bureau of Statistics they published regularly around 60-65% of all research works produced in Croatia (63% in 2011).

Research community as well as HEI perform much better in publishing scientific journal articles than in patenting: there are about 100 publications per one registered patent (MSES, 2006). According to the background report of the National Innovation Strategy (OECD, 2012, the higher education sector applied for 13 patents in 2010, which was around 23% of all patent applications in Croatia in 2010. However, no patents were granted to Croatian HEIs in 2010.

In terms of scientific production, Croatia's researchers outperform those of comparative countries: in 2009, researchers published on average 0.17 articles in Croatia against 0.12 in Finland, 0.17 in Slovenia and 0.08 in Slovakia. Nevertheless, when looking at publication quality and impact indicators, Croatia performs less successfully. In terms of citations and the H index of the Scimago database which measures both scientific productivity and impact, Croatia is ranked at 43rd place out of 238 countries in the period 1996-2011. It places Croatia behind all the Western European countries, but ahead of most reference countries of Southeast Europe as FYR Macedonia (54), Serbia (53), Bosnia and Herzegovina (40), Alban (35) and Montenegro (12).

The share of scientific publications among the top 10% most cited publications worldwide is rather low. While EU countries publish in average around 11% of research papers in the 10% most cited scientific publications respective number in Croatia is only about 3% (IUS, 2011). It means that overall productivity of Croatian scientists (mainly concentrated in universities) was beyond the average productivity in the world

It threatens not only the research excellence and the international recognition of the Croatian PRO and universities but also decreases the technological and commercial application of science. These trends call for reforms of the universities, especially in terms of financial and functional integration and new models of institutional funding of both universities and public research organisations based on objective and independent evaluations.

5. Weak regional research and innovation system

An explicit regional research policy does not exist in Croatia. Regional development policy exists mainly at the county level (NUTS 3) and is related to affairs of regional significance such as regional economic development, traffic infrastructure, pre-university education, health services and other social and cultural institutions. The lack of regional research policy stems primarily from the insufficient resources (small tax base) that would enable

counties or municipalities to take a more active part in the development of education and research institutions and activities.

The majority of research potentials is located in the city of Zagreb and is related to the largest university – University of Zagreb which employs more than 50% of all academic staff and educates almost 50% of all students in Croatia.

The development of the regional network of tertiary education institutions (universities and polytechnics) is a first step towards implementation of regional research policies. In addition to established universities in Zagreb, Split, Rijeka and Osijek, and due to the growing educational needs of the regions, the three new universities in Dalmatia (Dubrovnik, Zadar and Pula) were established. For the same reason, a range of new public and private colleges and polytechnics were established in Karlovac, Požega, Šibenik, Petrinja, Knin, etc., but their research capabilities remain low. Universities are increasingly perceived not only as the main suppliers of an educated workforce but also as the potential centres of research excellence and technological advancement needed for regional development.

During the accession process to the European Union, the three statistical regions according to the NUTS methodology are identified (Official Gazette 35/2007): East (Panonian) Croatia with 8 counties, Adriatic Croatia with 7 counties and the North-West Croatia with six counties. The regions were last revised in August 2012 when the three NUTS regions are substituted by only two regions: the Continental and the Adriatic Croatia. This new division will apply from 1 January 2013 in order to use efficiently the structural and cohesion fund of the EU. Croatia will have access to these funds since 1st July 2013.

According to the Regional Innovation Scoreboard (EC, 2012a) the entire Croatia is moderate innovator while the most developed region is North-West Croatia which is classified as an innovation follower mainly due to the city of Zagreb which is financial, commercial, production and educational centre.

By the Regional Competitiveness Index of Croatia (RCIC, 2011) the North-West Croatia is followed by Adriatic Croatia in second place, and then by the Central and Eastern Croatia in third. Croatia suffers from considerable and long-term regional disparities since the average incomes are three times higher in the richest regions than in the poorest ones. The difference is about 1 to 3.1 of GDP per capita and do not decrease that calls for strengthening the active regional policy and regional innovation systems. Regional development strategies (at NUTS 3 level) for the period 2011 - 2013 include measures related to research and innovation - usually through enterprise development, science-industry cooperation and the development of technology infrastructure.

This crucial role in stimulating regional development in the period 2007-2012 had the IPA programme (component IIIc – regional development) which was more focused on the development of business infrastructure, climate and competitiveness that can help less developed regions to catch up with more developed ones, than to research competencies and technology transfer. In the period 2007- 2010, the regional development agencies have been established within each of the 21 counties. They are the central authority of local governments to carry out tasks of regional development, international cooperation as well as the creation of projects for national and EU funds.

After entering into full membership of EU, Croatia will be eligible to use ERDF funds from two financial perspectives: 2007-2013 and 2014 -2020. Therefore for the first period the funds will be available for the short period of six months. In that respect the Operational programme is in its final stage and is expected to be approved by the EC in short period. For the financial perspective 2014 -2020, the programming process started in April 2012, and it is expected that it will deliver programme documents for use of EU structural funds. These documents required for use of EU funds (Operational programmes and Partnership agreement)

and S3 (smart specialization strategy) / RIS3 (regional) have to be in line with each other in order to avoid overlapping. Moreover other national strategic documents that have been drafted have to be in compliance with these strategic and operational documents for use of EU funds. Therefore an additional effort for the coordination and harmonization has to be respected in order to have clear strategic position for effective implementation of the policy.

The National Research and Innovation Strategies on Smart Specialization (R3) is in the initial phase meaning that an expert group for carrying out the Strategy is appointed by the Ministry of economy which will coordinate the activities. It is expected that ERDF will significantly contribute to the regional development and reducing regional disparities.

4 Assessment of the national innovation strategy

4.1 National research and innovation priorities

The mid-term policy documents like “Strategic Development Framework 2006–2013” (SDF) and the “Strategic Coherence Framework 2007-2013” (SCF) remains the main strategic documents for the overall development. The documents emphasise the knowledge, education, science and information technologies to have a prominent role in the forthcoming period. Due to the process of European integration, the Pre-accession Economic Programme (PEP)⁸ is produced each year to assess the economic progress and needs for improvements. These documents replace the “Multi-annual Research and Innovation Strategy” which has not yet been developed. The PEP 2012 defines nine key areas of structural reforms including the “Development of a Knowledge-based Society”. This area assumes three main reforms: /1/ improve quality of primary and secondary education, /2/ implementation of the Bologna process and /3/ strengthening the connection between science and industry in the service of economic development. The reforms should be accomplished on the continuous basis.

Despite the expiration of the “Science and Technology Policy 2006 – 2010” and related documents (“Action Plan for the Implementation of the Science and Technology policy 2007-2010” and the “Action Plan to Encourage Investments in Science and Research”), no new strategic documents have been developed to replace them. The exception is the [Guidelines for strategy of teaching, education, science and technology](#) initiated by the new Government elected in December 2011 and carried out by the MSES in collaboration with the Croatian Academy of Science and Arts. The Guidelines are outlined in a rather general way and are not sufficiently specific to start concrete steps in order improve the research and higher education systems. Therefore, the main goals of research policy formulated in the Science and Technology Policy 2006-2010 are still valid, particularly because many of them are not yet fulfilled. They include the following goals:

1. Increase investment in research and development towards the "3% target".
2. Reform the Croatian science system in order to build the synergy of the research potentials and implement functional and financial integration of the universities;
3. Strengthen cooperation among science, government and industry when creating new knowledge and goods in order to capitalise scientific research;
4. Increase participation of Croatian scientists in EU framework programmes.

⁸ The PEP for 2012 is available at the following address: <http://www.sabor.hr/Default.aspx?sec=745>

Although the investment plan for R&D (e.g. 3% of GDP) is mainly understood as the motivational factor than realistic strategic goal, its implementation turned out to be as distant today as six years ago, in 2006 when GERD reached 0.75% of GDP, the same as in 2010 and 2011. The investments of business sector (BERD) reveals a constant downsizing trends from 0.4% in the middle of this decade to 0.34% of GDP in 2011. Some additional targets defined by the “Action Plan to encourage investments in science and research” such as 10% annual increase for GERD, 15% annual increase of BERD, 20% annual increase of value of R&D contracts between science and industry, have also not been accomplished.

The high expectations regarding new and comprehensive strategy of innovation are related to the “National Strategy for the Croatian innovation development 2013-2020”, which is in progress and will be carried out by the Organisation for Economic Co-operation and Development (OECD) in collaboration with local experts. Up to now, the First Draft of the Background Report which provides the basic inputs to the Strategy was publicly presented in October 2012 (OECD, 2012). The Annex to the Draft provides a list of the five strategic pillars for the future development of the innovation system and around 40 guidelines for their implementation. The five pillars include:

1. Enhance business innovation potential and create a regulatory environment in support of innovation;
2. Increase knowledge flows and interactions between industry and academia;
3. Secure a strong science and technology base and strengthen the capacities of research institutions for technology transfer;
4. Strengthen human resources for innovation;
5. Improve governance of the national innovation system.

The identified pillars largely correspond to structural challenges (see the Chapter 3), especially in relation to the needs for improving business environment for innovation, governance of research and innovation system and reforming higher education system in order to strengthen human resources for innovation. The Background report emphasises the need for knowledge flows and interactions between industry and academia while the strengthening of the weak interest of companies for R&D is rather neglected although companies’ absorption capacities are a pre-condition for efficient science-industry cooperation. The report is fairly deficient in elaborating the needs for regional innovation development and smart specialization strategies.

The main challenges of policy making in the period 2009-2012 were focused on international mobility of researchers and their participation in the EU Framework programmes since it was estimated as rather low and unsatisfying. Several action plans are adopted within this framework: Action plan for overcoming obstacles and enhancing international mobility in education for the period 2010-2012⁹, Action plan for mobility of researchers 2009 – 2010 and Action plan for mobility of researchers 2011 – 2012¹⁰. The main goals are twofold: (1) removing the obstacles for inward and outward mobility of researchers and (2) increasing the international and inter-sectorial mobility. Measures within these two goals include: (1) Employment of foreign researchers on science and science-educational working places; (2) Enhancement of working conditions for researchers; (3) Regulation of residence for the purpose of scientific research; (4) Further development of infrastructure for mobility of researchers; (5) Encouraging inter-sectorial mobility of researchers, and (6) Strengthening the researchers’ competences.

The most recent document in this domain is the [Action plan to Increase Absorption Capacity for Participation in the Framework Programmes \(FP7\) of the European Union 2013-2015](#) adopted in February, 2013. The main aims of the Action plan are, as follows:

1. Strengthening the legal framework for participation in the FP;

⁹ <http://public.mzos.hr/Default.aspx?sec=2510>

¹⁰ <http://public.mzos.hr/Default.aspx?sec=2127>

2. Strengthen the administrative capacity at national and institutional level for facilitating the application and project management;
3. Increase the number of projects and their contracted value and reward the best performers;
4. Linking scientific careers and participation in international competitive projects;
5. Strengthening participation of SMEs in the FP.

During 2011 and 2012, in the context of growing economic crisis and budget austerity, the focus of science policy debates has been shifted towards reforming science and higher education sectors. The most important topics involve improvement of scientific excellence and internationally more visible scientific outputs. There are growing demands for rationalisations and restructuring of the entire science and higher education systems in order to increase social accountability, economic responsibility and budget savings. However, all reforming laws, four in the period 2011-2012, aimed at reforming science and higher education were withdrawn from parliamentary procedure (the last one on 3 October 2012). The Government adopted on 1 February 2013 a New Draft of the law amending the Law on Science and Higher Education from 2003 and sent to the parliamentary procedure. The Draft of the law brings many changes to increase the efficiency of the R&D system and, envisages, among others, a new model of institutional funding through “programme contracts” between the Ministry of Science, Education and Sports (MSES) and PRO/HEI.. The Government priority is to put an end on the long term practice of funding small-scale and low-competitive projects. This decision will surely have long term effects on the organization of future scientific work (see Chapter 2.3 – New policy measures).

In addition, the National Science Council adopted on 19 February 2013 the new Regulation on conditions for obtaining scientific titles (Official Gazette 26/2013) which tightens criteria for promotion of scientists into higher scientific grades. It prefers the scientific papers published in the journals which are indexed only in the Web of Knowledge and books published by the foreign publishers listed in the [SENSE Ranking of Academic Publishers](#).

The “Science and Technology policy 2006-2010” recognises the research priorities in biotechnology, new synthetic materials and nanotechnologies as well as in the nation-specific research themes such as understanding of humanity and national identity or preservation of natural wealth and cultural heritage. However, no calls for thematic priorities have been launched since science policy is still focused on horizontal measures in order to support harmonised development of all scientific disciplines. The global and societal challenges related to the fresh and sea waters, soil, agriculture, air and climate change are addressed in Croatia by Croatian Environment Agency. The ageing of the society is a topic of many projects related to demographic studies and reforms of pension system. The new Energy Strategy of Croatia adopted in June 2009 fully recognised the EU climate and energy targets by 2020, known as the “20-20-20” targets. Generally, there is lack of specialised research programmes aimed at major national and global societal changes and the enabling key technologies (KETs). However, within the SEE-ERA.NET PLUS programme the two societal challenges - ICT and food – are selected for financing by the Joint call for European research projects in the period 2009-2013. It could be expected that more attention will be addressed to KETs within the national strategy for smart specialisation which is an ex-ante conditionality for ERDF (EC, 2012b).

The two important evaluation studies of the innovation supporting programmes were carried out in 2011 and 2012: The evaluation study of the [Science and Technology Project](#) (STP) (World Bank, 2012) and the Evaluation of the BICRO’s innovation programmes - RAZUM and IRCRO and UKF Fund (Radas et al, 2011) (see Chapter 2.7. Evaluations, consultations).

The evaluation studies as well as the downsizing trends in R&D investments indicate that the policy mix routes chosen to foster public and private R&D investment are diverse but not sufficiently effective. The policy mix should be upgrade by the measures which correspondents to the current needs of business sector. A good

example is the BICRO's programme "Proof of concept" which attracted many attentions and whose priority is to verify commercial viability of research results and establish an appropriate strategy for commercialisation.

4.2 Evolution and analysis of the policy mixes

During the last three years, from December 2009 to December 2012, the national policy mix to stimulate research in innovation has remained quite stable despite some setbacks in implementation of the measures due to the austerity budget and expiration of the World Bank loan that served to co-finance the UKF and selected BICRO's programmes (RAZUM, IRCRO).

The three new measures have been launched. The Croatian Science Foundation (CSF) started in 2011 two instruments - [Research projects](#) programme and the [Collaborative research programmes](#) - to strengthen science excellence and internationally competitive research teams. The BICRO started in May 2010 the programme "[Proof of concept](#)" (PoC) to assist entrepreneurs and researchers to verify commercial viability of their ideas. The programme has recorded considerable success in a number of applications and user satisfaction.

In fact, the largest change is expecting in the forthcoming period, foreseeable from December 2012. The change is related to the transition from the project to programme allocation of the budget funds by the MSES. As pointed out in the Chapter 2.3 - New policy measures the MSES has announced the termination of the Research projects programme (*Z-Projects*) the principal instrument for allocation competition-based research grants that lasts for the 20-years. It will be replaced with the "Programme contracts", a sort of lump sum or institutional funding for research at the institutional level of PRO and universities while competition based research funding will be transferred to the Croatian Science Foundation (CSF). The main reason for cancelling the programme is its poor competitiveness and contribution to scientific excellence. The results of this change remain to be seen since there are estimates that the funds for the programme funding will be very scarce (about €670 per researcher per annum) while CSF will support only highly-competitive research projects and groups (around 20% of proposals). It could endanger broader scientific base needed to recruit outstanding scientists and excellent research teams.

Since 2001 the Croatian government has introduced a plethora of new policy instruments that complements standard science policy and today presents a policy mix to stimulate research in innovation. It can be divided in the following categories:

- Policy measures for national scientific excellence which include public programmes for competitive research grants, institutional funding, support for young researchers (PhD students), introduction of a quality assurance system and accreditation of RTOs and university departments, etc.;
- Policy measures for mobility that addresses the international inward and outward mobility of researchers (e.g. "Brain Gain" programme of CSF, EUROAXESS portal) and attracting Croatian scientific Diaspora while the inter-sectorial mobility between science and industry is quite deficient;
- Science – industry cooperation measures include different programmes like Technology oriented projects (TEST), Collaborative research development (IRCRO) managed by the BICRO, newly established "Science and Innovation Investment Fund" developed under the IPA;
- Fiscal measures encourage private companies to invest in R&D following the Law on profit tax based on eligible project costs. Since 2007 it turned out to be an important incentive instrument for companies and total amount greatly exceeds subsidies for R&D to invest;
- Measures aimed at the innovation-based companies involve mainly BICRO's programmes, like RAZUM (Development of the knowledge-based companies), KONCRO programme (Competitiveness and technology process advancement) and Proof of Concept (PoC);

- Measures aimed at technology and innovation infrastructure include the TECHRO programme of BICRO aimed at development the infrastructure for science – industry cooperation like technology parks, transfer centres, etc. and the supporting programmes of the Ministry Entrepreneurship and Crafts for innovation infrastructure like of entrepreneurial zones, business incubation centres, development agencies, clusters, etc.;
- Measures for the development of the venture capital include a single programme “VENCRO” run by the BICRO which is still not in a full function.

Unfortunately, the effects of these measures on innovation and socio-economic development remain fairly modest, probably due to the overall framework conditions which do not favour research and innovation for development and growth. Besides, the aforementioned five structural challenges (Chapter 3) which hinder innovation are not appropriately addressed within the policy mix (Chapter 4.3).

If we take into account the Self-assessment tool of the Innovation Union Flagship initiative (EC, 2010) that consist of the ten features for well-functioning of the national innovation system, the performance of the Croatian Innovation system is largely unsatisfactory.

Research and innovation are not considered as key drivers of the competitiveness and job creation. They are pushed to the margins of other priorities such as budget deficits, wage insurance and pensions, European integration, agricultural policy, fight against corruption, etc. The policy debates about the role of innovation are underestimated in policy circles and often restricted to academic and professional communities. This is due to the low awareness of political and business elites about the critical role of innovation and insufficient communication among key innovation stakeholders about knowledge-based strategic development and visions. Many administrative burdens and pointless regulation hinder innovation in the companies.

The public sector itself is not a driver of innovation while the public demand and procurement policies are not usual practice for fostering innovation and advanced technologies. The biggest progress was made by establishing the e-healthcare system which has simplified various administrative and medical procedures.

Based on its average innovation performance, Croatia is one of the moderate innovators with a below average performance compared to EU (IUS, 2011). The exception is a region of Northwest Croatia which is an innovation follower (EC, 2012) mainly due to the city of Zagreb, a capital of Croatia whose GDP is well above Croatian average.

On the other hand, it is estimated that Croatia’s growth in innovation performance in the last five years has been well above EU average while innovation expenditures has increased most in Croatia in 2010 (IUS, 2011). Regarding knowledge capacity and economic structure Croatia is low knowledge capacity country with a specialisation in low knowledge intensive sector (similar to Bulgaria, Romania, Poland and Turkey) (European Commission, 2011a).

The trends in R&D funding (Chapter 2.2) reveals that public investments in research and innovation is fairly small and have worryingly downward trends. Research and innovation are not only constantly under-invested (below 1% of GDP) but further budget restrictions and financial crisis threaten the maintenance of the national knowledge base, professional expertise and education. The out dated economic model based on defensive inter-sectorial restructuring, imports of goods, domestic market consumption, low-tech/cost FDI and long-term state borrowing, does not provide incentive framework for private investments in R&D and innovation. Private sector investment in innovation is probably the biggest challenge for efficient innovation policy in addition to the lack of strategic development visions. Public support to research and business is difficult to gain. Despite, there is a thin layer of export oriented companies to which innovation is a critical factor for survival and expansion that should serve as a model for innovation development.

It is commonly perceived that the needs of the labour market are not systematically assessed by the university education. There is large inertia in setting up enrolment quotas for programmes with higher employability rates, especially with respect to the portion of students financed by public resources.

Proportion of people with a postsecondary education degree in the active labour force (age 25-65) is rather low (15.2%). By contrast, over 95% of youth in Croatia (aged 20-24) completed some kind of upper secondary school (EU-27 average is 79%) and need incentives for higher education and perspectives for employment. Fostering the excellence of RTOs and higher education has officially come into force by introduction of the quality assurance system managed by the Agency for science and higher education in 2007. Unfortunately, due to the scarce financial resources which allows primarily operational funding of organisations (per capita investment in research achieved only 15% of EU-27 average (510.5 vs. 76.2 euro per inhabitant) and the lack of diversified research funds the results of evaluation are not yet used as an instrument for fostering scientific excellence (e.g. via institutional funding).

4.3 Assessment of the policy mix

Since 2000 Croatia has developed a complex innovation system with multiple supporting institutions and measures directed to build innovation-driven growth in Croatia. Although many of these measures and institutions have been developed with the assistance of international organisations (e.g. STP programme of the World Bank, IPA programmes, CARDS programmes) their impact on structural challenges of the innovation system and economic recovery were rather modest.

Research and innovation systems, in spite they provides various incentives for innovation, are not efficiently related to the sphere of business development, entrepreneurship or industrial technology progress (Švarc, 2011). The obstacles to efficient research and innovation system are formulated in the 5 main structural challenges of which some are beyond the standard research and innovation polices. One of the most important obstacles to research and innovation is the inadequate business environment, inefficient administration, still high corruption, etc.). Besides, business environment is affected by the large state-owned firms insulated from market competition and thus are unlikely to invest in R&D and innovation. The result is a low volume of business R&D (0.34% of GDP or about €30 per capita) despite generous tax breaks for R&D (see Chapter 2.2 Financial trends). On the other side, the sector of SMEs which emerges in the last 20 years is simply not able to conduct or invest in innovation and research. SMES sector, although it is the core driver of the economy, is dominated by the micro companies (1-2 of employees) or consist of the companies which are engaged in low-tech activities that do not need research for growth (wholesale, retail, construction, accommodation and restaurants). According to some estimations (MEC, 2012), the investments of SMEs in R&D were almost nil in the year 2010. The measures which would enable and encourage knowledge flow, technology transfer and mobility of experts between the science and industry sectors are not in place.

These and similar factors reduce the effects of conceptually well designed measures. Very probably they are the reasons why government-funded technologies (e.g. TEST), university spin-offs and technology-based companies (e.g. RAZUM), science- industry cooperation and science commercialisation (e.g. IRCO, Partnerships in research, Research in industry and academia, SIIF), etc. have been rather limited in their achievements. On the other hand, the evaluation studies of the selected programmes (see Chapter 2.7. – Evaluations, Consultations) revealed that evaluated programmes resulted with many measurable outputs and have a significant positive influence on their beneficiaries. The evaluation study of IRCO and RAZUM undertaken by the Institute of Economics indicates that these measures contribute to increases in R&D activities.

A special problem is a lack of strategic visions of development, a presence of rather myopic policy instead of analytical studies and technology foresight exercise for directing future development. The new industrial policy is not a matter of the current policy agendas.

The high profits in recently privatised service sectors like banks, telecommunications, real estate and commerce, strong state support to declining sectors like shipbuilding or agricultural sector provide the impression that

relationship between innovation-technology-production-education is not the key development factor. A general conclusion is that there is a complex set of mutually interrelated factors that produce deficits in research and innovation systems and their weak role in strategic development.

Challenges	Policy measures/actions ¹¹	Assessment in terms of appropriateness, efficiency and effectiveness
<p>1. 1. The R&D policy is obsolete and lacks visionary, coherent and integrated policy framework</p>	<p>New science and technology policy is being planned.</p> <p>The national strategy on smart specialisation (S3) is in progress.</p> <p>The Guidelines for strategy of teaching, education, science and technology is carried out by the MSES in collaboration with the Croatian Academy of Science and Arts in April 2012.</p> <p>The Draft of the Background Report on the Innovation system of Croatia was presented in November 2012.</p> <p>The Programme of the new government for the mandate 2011 - 2015 emphasizes education and science as the key elements in the development of economy and society.</p>	<p>The former Science and Technology Policy 2006 – 2010 was not implemented in an adequate way, despite its expiration in 2010.</p> <p>The new government elected in December 2011 has initiated the development of new strategic documents - the Guidelines for strategy of teaching, education, science and technology and the National Strategy for the Croatian innovation development 2013-2020”.</p> <p>The “National Strategy for the Croatian innovation development 2013-2020” is in progress. Up to now, the Draft of the Background Report on the Innovation system of Croatia was presented in November 2012. The Draft entails a list of strategic goals for reforming research system which currently consist of the five main pillars and around 40 guidelines for their implementation;</p> <p>Neither the Guidelines nor the Draft of the Background Report have brought up to now some important new insights that could serve to define a radically new approach to fostering innovation and productive use of knowledge.</p> <p>Although all the governments since 2000 emphasize R&D as the key prosperity factor and promise to catch up with research investments at least to the average level of the EU, this goal is practically dropped out. Lack of funding is justified by investments in other priorities like large capital (usually non-productive) investments, subsidies to failed industries (shipyards, railways) and agriculture, payment of interest on state loans, etc.</p>

¹¹ Changes in the legislation and other initiatives not necessarily related with funding are also included.

Challenges	Policy measures/actions ¹¹	Assessment in terms of appropriateness, efficiency and effectiveness
<p>Business environment is not conducive to innovation</p>	<p>State administration reform has been initiated but it has progressed very slowly. Anti-corruption activities have improved the quality of business environment. Government attempted to fill in the gaps in the availability of credit and equity financing (through programmes of the Croatian Bank for Reconstruction and Development and co-financing of equity Funds for Economic Cooperation). EU accession and implementation of regional (NUTS 3) development strategies for the period 2011 - 2013 provide some stimuli to innovation policy development.</p>	<p>Government elected in 2011 started many reforms in order to improve business climate, but reforms have so far been insufficient to eliminate the structural rigidities that hamper the country's growth potential.</p> <p>Due to the complexity of business environment, policy response needs to be comprehensive and coordinated. In the case of Croatia, policy response has been fragmented and partial. Consequently, it has not reached the required level of appropriateness, effectiveness and efficiency.</p> <p>State administration reform and further anti-corruption efforts remain as important task for the new government.</p> <p>The availability of credit and equity financing for innovation is still insufficient.</p> <p>Policy inertia and opposition from vested interests have contributed to the current stalemate in restructuring process of economy and needed reforms</p>
<p>3. Weak interest of private companies for research and development</p>	<p>The Croatian SME Observatory Report 2012, was carried u for the first time (MEC 2012)</p> <p>Key innovation policy measures (e.g. Proof of Concept, IRCRO, and RAZUM) aim to increase R&D and technology capability.</p> <p>Tax exemptions have been introduced in order to facilitate R&D expenditures in companies.</p>	<p>The Croatian SME Observatory Report 2012 (MEC, 2012) presented many important features of SME sector in Croatia including very modest investments in innovation and R&D.</p> <p>The Ministry of Entrepreneurship and Crafts carry out important programme - Entrepreneurial impulse - to upgrade business infrastructures, foster uniform regional development, develop SMEs and clusters, encouraging the implementation of innovations and new technologies, etc. These efforts are not coordinated very much with the efforts of the Ministry of Science, Education and Sports (MSES).</p> <p>The policy measures for fostering R&D in SMEs under the responsibility of MSES have been appropriately designed. Evaluation studies of related to RAZUM and IRCRO undertaken by the Institute of Economics indicates that these measures contribute to increases in R&D activities. Proof of concept has proved as very successful programme. Effectiveness of policy measures is constrained by their limited budgets.</p>

Challenges	Policy measures/actions ¹¹	Assessment in terms of appropriateness, efficiency and effectiveness
		<p>Government's growth program which is based mainly on increasing investment by state-owned enterprises can be offset by weak private demand, given high unemployment and unfavourable credit conditions.</p> <p>Tax exemptions are mostly claimed by medium-sized and larger companies, as it has been elaborated by the Institute of Economics. This measure is appropriate, efficient and effective. It been particularly important for international competitiveness of several Croatian subsidiaries of transnational corporations. Tax exemptions are conducive to their parent companies allocating their R&D budgets to Croatia.</p>
<p>4. Sluggish reforms of research and higher education system</p>	<p>The Draft law amending the Law on Science and Higher Education from 2003 was adopted by the Government on 1 February 2013 to reform the science and higher education sectors.</p> <p>The transition from projects to programme financing is expected to be introduced in 2013.</p> <p>The <i>Research projects programme</i> and the <i>Cooperative research programmes</i> were launched in 2011 by CSF to substitute budget allocations by the MSES for research project grants. Internal and external quality assurance mechanisms are being developed through activities of the Agency for Science and Higher Education. Increases in available resources are constrained by budgetary issues.</p> <p>The guidelines for establishing centres of excellence are in progress</p> <p>The guidelines for establishing criteria for accreditations of research institutions are in progress.</p> <p>Technology transfer institutions and mechanisms are being facilitated through Science and Innovation Investment Fund. Intellectual property rights regime at</p>	<p>Reform of science and higher education sectors has not been adequately prepared and discussed. All the Acts aimed at reforming science and higher education (four in the period 2011-2012) were withdrawn from the parliamentary procedure due to the fundamental disagreements between the main stakeholders about proposed science organization and financing. The key areas of disagreement were university legal and financial integration, replacement of project funding with the programme funding (a sort of new institutional funding for research) at both universities and public research organisations, retirement age of researchers, etc.</p> <p>The new programmes for encouraging research excellence introduced by CSF finance a very small number of projects which is not sufficient to maintain the national science base needed for recruitment of the outstanding researchers. Increases in available resources needed for the implementation of the programmes on a wider basis are constrained by budgetary issues. Croatia is missing other different sources for funding R&D.</p> <p>Science and Innovation Investment Fund is the only one mechanism for the facilitation of the Technology Transfer institutions and mechanisms. Technology transfer Institutions and mechanisms have been facilitated through variety of sources (both international and domestic). However, their level of funding is inadequate to achieve satisfactory results. Underdeveloped intellectual property rights regime and fragmented support to technology transfer through Science and Innovation Investment Fund are unlikely to bring about efficient improvements.</p>

Challenges	Policy measures/actions ¹¹	Assessment in terms of appropriateness, efficiency and effectiveness
	<p>universities is not sufficiently regulated.</p>	<p>Internal and external quality assurance mechanisms are being developed through activities of the Agency for Science and Higher Education.</p> <p>The new Regulation on conditions for obtaining scientific titles (Official Gazette 26/2013) which was adopted by the National Science Council on 19 February 2013. The regulation seriously tightens criteria for promotion of scientists into higher scientific grades in order to foster scientific merits.</p> <p>Examples of financial sources for technology transfer are World Bank S&T project (Rudjer Innovations), IPA (Science and Innovation Investment Fund), European Enterprise Network (Former Component B – Technology Transfer (BICRO), state budget (BICRO, HIT), internal funds of Universities etc.</p> <p>Labour Act on the national level established a basic set of rules for dealing with employee inventions and technical advancements, while Copyright and Related Rights Act establish rules for dealing with employee copyright issues. These rules consequently apply to all University employees.</p>
<p>5. Weak regional innovation systems</p>	<p>The Law on Regional Development was adopted in December 2009 – the first act that systematically address the issues of regional development in the whole national territory</p> <p>The Strategy of Regional Development 2011 - 2013 that was adopted in June 2010.</p> <p>The Strategy of cluster development in Croatia 2011 – 2020 is adopted in 2011.</p> <p>The National Research and Innovation Strategy on Smart Specialization (RIS3) is in the initial phase.</p> <p>Regional development strategies (at NUTS 3 level) for the period 2011 - 2013 include measures related to research and innovation – usually through enterprise development, science-industry cooperation and development of technology infrastructure.</p>	<p>None of these documents dealt specifically with research policy since it is coordinated by the MSES at the central state level. Local communities and regions do not have sufficient resources for R&D.</p> <p>The improvements in regional development policies and EU accession have had a beneficial effect on policy framework. Due to IPA, a total of 29 regional and local development agencies at the level of all the counties and several cities are established. They want to attract private investment, EU funds, create new jobs, etc. Regional innovation actors have become more coordinated than in the past. However, it is too early to assess efficiency and effectiveness of these developments.</p> <p>An expert group for carrying out the National strategy on smart specialisation is appointed by the Ministry of economy. The realization of the strategy should attain a high priority since it is a condition for the withdrawal of funds from ERDF. Croatia will have access to ERDF from 1 July 2013.</p> <p>The NUTS regions were last revised in August 2012 when the three NUTS regions are substituted by only two regions: the Continental and the Adriatic Croatia. This new division will apply from 1 January 2013 in order to use efficiently the structural and cohesion funds of the EU. Croatia will have access to these funds since 1st</p>

Challenges	Policy measures/actions ¹¹	Assessment in terms of appropriateness, efficiency and effectiveness
		July 1013.

5 National policy and the European perspective

National policy mix is becoming increasingly aligned with ERA pillars and ERA Communication objectives. According to the Progress report of Croatia's state of preparedness for EU (EC, 2012), in the area of research and innovation policy, Croatia is sufficiently prepared. However, more efforts need to be taken in order to achieve further alignment with the ERA and to address the strategic challenges outlined by the ERA Communication.

Regarding the first ERA communication priority – **more effective national research systems** – it should be stressed that there has been no increase in the level of investment in research, which is still rather low (less than 1% of GDP, compared to an EU average of 2%; only 15% of the EU average per capita). Despite financial constraints, the reforms of research and higher education have already started through new funding mechanisms, quality assurance system and mechanisms for stronger competition. New legislations, policies and programmes are in preparation or have been launched to increase competition within the national scientific community. One of such mechanisms is a transition from project to programme financing and allocation of research grants by CSF instead of MSES.

In the area of institutional assessment Croatia is at the forefront in the application of the European standards and guidelines since they were introduced in Croatia in 2009 by the adoption of the Law on Quality Assurance in Science and Higher Education (Official Gazette No. 45/2009). Based on the Law, the Agency for Science and Higher Education (ASHE) is carrying out the evaluation procedures (initial accreditation, re-accreditation and thematic evaluations).

In the domain of - **transnational cooperation and competition** – it should be stressed that Croatia has continued to participate successfully in the FP. It has a good level of administrative capacity and a good knowledge of cooperation with EU partners and the region (EC, 2012).

Croatian participants have been active in Marie Curie grants scheme. Out of 218 contracted FP7 projects with Croatian participants, 20 were Marie Curie. That placed Marie Curie the fourth most successful program for Croatian participants, after SME Actions with 30 projects, Food, Agriculture, Fisheries and Biotechnology with 23 projects and ICT with 22 projects. Out of 218 FP7 projects contracted until October 2012 with Croatian participants approximately 95 (or 43%) have been profit organizations. Over the time number of contracts from profit sector has been increased significantly.

Participants in programme Actions for the Benefit of SME's have been most successful, where Croatian participants have signed 30 projects, significantly more than the next most successful ones, Food, Agriculture, Fisheries and Biotechnology with 23 projects and ICT with 22 projects. Moreover, Croatian participants in

Actions for the benefit of SME's have had the highest success rate out of Croatian participants in other programs.

Therefore, there are strong indices that Croatian profit (private) sector is active and successful in FP7 and that it is realistic to expect that during Horizon2020 it over perform public sector both in the number of projects and amount of grants

When comes to the ERA-NET type of projects Croatia participates in several ERA-NET initiatives such as [ERACOBUILD](#), [SmartGrids ERA-NET](#), [HERA ERA-NET](#), [ERA-NET ASPERA-2](#) and the [SEE-ERA.NET PLUS](#). The Croatian Bureau of Statistics (CBS) collects the data about the national public funding allocated to the transnationally coordinated R&D that amounted in 2011 around 11% of GBAORD

The grand challenges are still not addressed properly as well as the research infrastructures. In the domain of grand challenges Croatia has the best prospects in health and biomedical research. In this context it is worth mentioning the Faculty of Medicine, University of Rijeka which is the first institution that won in December 2012 a prestigious research grant of €1.8m for biomedical research in the field of immunology from the European Research Council (ERC). Further measures such as establishing a national roadmap for research infrastructure and transfer of technology management have to be further considered in order to be fully in line with EU standards and targets. Croatia intends to make a roadmap for ESFRI within the new science and technology strategy for 2012-2014. Projects proposals for the EU Structural Funds in the period 2014-2020 that includes funding possibilities for new large-scale national research infrastructures are in progress.

A major priority for the coming two to three years will be to create capacities to absorb EU funds and avoid being a net contributor to the EU. This requires a lot of preparatory work to get projects ready for the time when EU Structural and Cohesion Funds can be accessed (1 July 2013) and challenge the research community to properly prepare project applications.

In the area of – **an open labour market for researchers** – Croatia has made a big progress in implementation of the Action Plan for Mobility of Researchers 2009-2010 and 2011-2012 (EC, 2012). It has continued steps that have been taken to host foreign researchers in Croatia. Croatia actively participates in EURAXESS network. The transparency of employment of foreign researchers have been improved through advertising job positions at the EUROAXSES portal of the European Commission. In October 2010 on this website were registered 46 Croatian institutions that were 113 listings for vacancies.

Since 2008 the three Ordinance on Determining the Requirements for Granting Temporary Residence to Foreigners for the Purpose of Scientific Research (Official Gazette 42/08; Official Gazette 92/12; Official Gazette 22/13) were adopted which significantly simplified the participation of foreign scientists in research activities in Croatia and receiving the work posts.

In Croatia, publicly funded grants or fellowships are not portable to other EU countries. However, all the programmes of the Unity Through Knowledge Fund (UKF) and majority of programmes of the Croatian Science Foundation are open to researchers from all around the world and no nationality restrictions are included. The only obligation is that the research activities and host research centres are located in Croatia.

Conditions for enhanced cooperation between the private and public sectors need to be encouraged. Further measure should be undertaken in order to increase inward and outward mobility of researchers. It assumes that the universities and research institutes should adopt and implement effective strategies of internationalization, which would include opening academic market to foreigners and introducing international standards of academic performance.

Male and female students are equally represented at all levels of education. 50% of persons employed in the research and development sector are women. From this point of view, Croatia has reached **gender equality** and made significant progress. However, the number of women holding leading positions in higher education institutions is rather modest since only 14% of women hold rector, and 17% dean positions. The number of women holding leading positions in public research institutes is notably better, where 40% of directors are women.

A 2011 study of Croatian academic libraries (Hebrang-Grgić, 2011) showed that Croatian scientific community and librarians are aware of the importance of launching institutional **open access (OA)** repositories **to enlarge optimal circulation, access to and transfer of scientific knowledge**. The [Croatian declaration of open access](#) has been signed by more than 500 researchers in a couple of months. The state encourages all the results of publicly funded research to be publicly available. Therefore, one of the criteria when deciding on grant applications is journals' free availability on the internet. The most important tool for OP is the very successful Croatian national Open Access journal platform [Hrčak](#) (meaning *hamster*). By October 2010 it provided access to 222 journals, 4121 issues and 54163 full text articles. Another open source is based on the research projects, such as [Croatian Scientific Bibliography](#) (CROSBI) which consists of publication resulted from the research projects financed by the MSES. Both the sources – CROSBI and Hrčak are part the [Croatian scientific portal](#).

A further evolvement of the national policy mix to overcome the national structural challenges and achieve better alignment with the strategic challenges outlined by the ERA Communication could go in the three directions, as follows:

1. Strategic policy development

- Reaffirm the role of scientific research and innovation in national development;
- Carry out a new and ambitious strategy of science with a visionary role of science and technology in the socio-economic development and put it into a coherent and integrated policy framework;
- Align the strategy of science with the national Research and innovation strategies for smart specialisation (S3)
- Perform continuous evaluation of innovation and research programmes in order to provide inputs for strategic policy learning (formative evaluation).

2. Scientific excellence, knowledge circulation and higher education

- Provide financial security and increased funding for public scientific research with clear link to more competitive funding environment ;
- Define and implement common research agendas on grand-challenges;
- Accelerate reforms of RTO and HEI in terms of scientific excellence and international visibility;
- Base institutional funding of RTO/HEI on standardized and objective quality assessment and peer review;
- Connect scientific careers with participations in EU projects and projects for local/regional development;
- Provide incentives for establishment of the centres of excellence;
- Reform higher education curricula by enhancing STEM disciplines;
- Remove barriers to non-nationals/non-residents access to national grants and scientific posts;
- Establish open access to scientific publications at national level with a view of reciprocity form other countries/publishers;
- Carry out the national ESFRI roadmap and stimulate integration with the EU research infrastructures.

3. Regional business development for R&D

- Build up capacities for using Structural funds for research and innovation development;
- Match R&D potential with business needs and capacities and develop links between sectors, especially on the regional level;
- Make business environment more conducive to innovation;
- Encouraging development of the national technology platforms:
- Encouraging development of the key enabling technologies;

- Stimulate private business investments in R&D through common inter-sectoral programmes, tax reliefs, etc.
- Stimulate private business for new employments of researchers, especially young researchers and youth with higher education;
- Match higher education curricula with the labour market;
- Rewarding and public promotion of successful results of innovation activities.

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LIST OF ABBREVIATIONS

ASHE	Agency for Science and Higher Education
BERD	Business Expenditures for Research and Development
BICRO	Business Innovation Agency of Croatia
CASA	Croatian Academy of Sciences and Arts
CERN	European Organisation for Nuclear Research
COST	European Cooperation in Science and Technology
CSF	Croatian Science Foundation
CSIPO	Croatian State Intellectual Property Office
EHEA	European Higher Education Area
ERA	European Research Area
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
FDI	Foreign Direct Investments
FP	European Framework Programme for Research and Technology Development
FP7	Seventh Framework Programme
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
GUF	General University Funds
HEI	Higher education institutions
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
HIT	Croatian Institute of Technology
IP	Intellectual Property
IPR	Intellectual property rights
IRCRO	Collaborative research development Programme
KONCRO	Competitiveness and technology process advancement Programme
MEC	Ministry of Entrepreneurship and Crafts
MELE	Ministry of Economy, Labour and Entrepreneurship
MLPS	Minister of Labour and Pension System
MRDEF	Ministry of Regional Development and European Funds
MoE	Ministry of Economy
MSES	Ministry of Science, Education and Sports
NCHE	National Council for Higher Education

NCS	National Council for Science
OECD	Organisation for Economic Co-operation and Development
PRO	Public Research Organisations
R&D	Research and development
RAZUM	Development of the knowledge-based companies Programme
RI	Research Infrastructures
RTDI	Research Technological Development and Innovation
RTO	Research and Technology Organisation
S&T	Science and technology
SCF	Strategic Coherence Framework 2007-2013
SDF	Strategic Development Framework 2006-2013
SF	Structural Funds
SIIF	Science and Innovation Investment Fund
SME	Small and Medium Sized Enterprise
SVEZNATE	Strategic Council for Science and Technology
TEST	Technology oriented projects Programme
UKF	Unity through Knowledge Fund
VC	Venture Capital
VNIS	National Innovation System Council of Ministry of Science, Education and Sports

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Abstract

This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). 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.

The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. These reports were originally produced in December 2012, focusing on policy developments over the previous twelve months.

The reports were produced by independent experts under direct contract with 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 external experts.

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.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

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.

