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Innovation Policy and Sectoral Competitiveness

Representation of the
European Commission in Bulgaria

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enterprise europe network

European Commission
Enterprise and Industry

cip competitiveness and innovation framework programme 2007–2013

ISSN: 1313-1060

CONTENTS

LIST OF ABBREVIATIONS

AA	– Agricultural Academy
AD	– Bulgarian Abbreviation for a Joint Stock Company
ADSL	– Asymmetric Digital Subscriber Line
AES	– Adult Education Survey
ARC Fund	– Applied Research and Communications Fund
BAS	– Bulgarian Academy of Sciences
BNB	– Bulgarian National Bank
BPO	– Bulgarian Paten Office
BSMEPA	– Bulgarian Small and Medium Enterprises Promotion Agency
CIP	– Competitiveness and Innovation Framework Program
CIS	– Community Innovation Survey
COST	– European Cooperation in Science and Technology
CR	– Commercial Registry
CRM	– Customer Relationship Management
EB	– Eurobarometer
EBRD	– European Bank for Reconstruction and Development
EC	– European Commission
EEA	– European Economic Area
EIF	– European Investment Fund
ERP	– Enterprise Resource Planning
EU	– European Union
FDI	– Foreign Direct Investment
FIEC	– European Construction Industry Federation
FP	– Framework Program
GDP	– Gross Domestic Product
GVA	– Gross Value Added
HSCE	– Higher School of Civil Engineering
ICT	– Information and Communication Technologies
INA	– Survey of Innovation activity of Bulgarian Business Conducted by the Applied Research and Communications Fund
IP	– Intellectual Property
IPC	– International Patent Classification
ISPA	– Instrument for Structural Policies for Pre-Accession
IT	– Information Technologies
JEREMIE	– Joint European Resources for Micro to Medium Enterprises
LAN	– Local Area Network
LLC	– Limited Liability Company
MEET	– Ministry of Economy, Energy and Tourism
MEYS	– Ministry of Education, Youth and Science
MV	– Medium Voltage
NEC	– National Electricity Company
NACE	– Classification of Economic Activities
NGO	– Non-Governmental Organization
NIF	– National Innovation Fund
NRA	– National Revenue Agency
NSF	– National Science Fund
NSI	– National Statistical Institute
OECD	– Organisation for Economic Cooperation and Development
OP	– Operational Program
OPHRD	– Operational Program Human Resources Development
RES	– Renewable Energy Sources
R&D	– Research and Development
SCI	– Science Citation Index
SITC	– Standard International Trade Classification
SMEs	– Small and Medium-Sized Enterprises
SU	– Sofia University
TPP	– Thermal Power Plant
UACEG	– University of Architecture, Civil Engineering and Geodesy
UCTM	– University of Chemical Technology and Metallurgy
UNDP	– United Nations Development Program
UT	– University of Transport
VAT	– Value Added Tax

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EXECUTIVE SUMMARY

National innovation policy

Bulgaria entered the second decade of the 21st century at one of the lowest levels of its innovation potential and competitiveness in Europe. In 2011, there are conditions which, provided they are used efficiently, can transform the innovation weaknesses into opportunity. Europe is developing its new long-term economic strategy Europe 2020 and requires member states to adopt at national level ideas, priorities and instruments to achieve the objective of a competitive, sustainable, green and social European economy. The main principles, which will guide the next 2014 – 2020 programming period in the management of EU funds are in the process of development.

Figure 1. STAGES OF DEVELOPMENT OF THE NATIONAL POLICY IN SCIENCE, TECHNOLOGY AND INNOVATION

Source: ARC Fund, 2011.

There are several principles that have been proven to work in developed economies and which Bulgaria should adapt and introduce in its national practice in developing the national policy in science, technology and innovation:

- Establishing a **coordinating unit for innovation policy** with significant administrative capacity will provide the necessary basis for a more effective implementation of policies. This could be achieved by merging the

numerous agencies at the Ministry of Economy, Energy and Tourism in one body – **Innovation Bulgaria.**

- **Introducing rules for annual assessment of the scientific results of research organizations funded by the government** (Bulgarian Academy of Sciences (BAS), Agricultural Academy (AA), universities) at individual and institutional level and directing public funding to scientists and units with the greatest potential for development. These rules should be based on internationally recognized indicators, such as number of publications in journals with an impact factor, number of registered patents, share of co-funding attracted from private and international sources, and others.
- Support for the integration of Bulgarian research into the European Research Area (framework programs, technological platforms) through **co-funding for the projects of Bulgarian research organizations** which have received EU funding (e.g. from the framework programs for research and innovation, competitiveness, justice and home affairs, etc.).
- **Piloting and subsequent adaptation of the variety of tools existing in international practice in support of science and innovation** as constituent elements of a comprehensive financial portfolio – European and national funds, credit and guarantee lines, voucher schemes, risk capital, tax relief and public procurement, etc.

Innovation potential of the Bulgarian economy

There are some positive trends in Bulgaria's R&D indicators, although these are not particularly dynamic and are the result of market forces and not of a targeted scientific, technological and innovation policy. These could be cancelled by the economic crisis if measures for improving public innovation policy are not undertaken. Along with the constant increase of funds for R&D in all institutional sectors, the following structural changes can also be noted:

- **Increasing share of the business and higher education in R&D expenditure** at the expense of the state sector;
- **R&D expenditure distribution is spread out more evenly** by planning regions in the country.

The main challenges are related to the chaotic nature of the changes in public policy, inconsistency in the funding of individual scientific fields, as well as the weak institutionalization of policy measures. Since funding reflects the location of human resources, the indicators of staff engaged in R&D demonstrate the same positive structural changes in respect to the institutional sectors and the regions in the country.

Funding for science and innovation remains below the level required to improve the innovation potential of the national economy, which could result in lower growth in the future.

Innovation aspects of sectoral competitiveness

This year's *Innovation.bg* report provides two analyses of sectoral innovation systems and the results of the innovation activity of companies there – **construction** and **energy.**

- The two sectors and the activities related to them along the global value added chain **provide considerable employment, attract a lot of foreign**

direct investment and contribute to the formation of an essential portion of the country's GDP.

- Both sectors are **key for the long-term competitiveness of the national economy** – by means of defining the living and working environment; transport and energy infrastructure, as well as environmental impact, in the case of construction, and through energy efficiency, energy balance and the country's energy security in the case of the energy sector.

Construction and energy depend on a diversified set of technologies which are at different stages of development. Although companies in the two sectors do not conduct formal research activities, they have a considerable potential to absorb technological knowledge generated in other fields and to introduce it in practice.

The results of the sectoral analyses suggest recommendations for the national innovation policy along several main lines:

- Innovation policy and the financial instruments which make its implementation possible (the National Innovation Fund, the National Science Fund, the operational programs, venture and guarantee funds through the JEREMIE initiative, among others) should be tailored to the characteristics of innovation at the sector level and the specific factors in Bulgaria. **Sector development policies should be based on in-depth knowledge of sectoral innovation systems,** the capacity, needs and specific expertise of the stakeholders in the sector.
- Prioritizing high-tech services while disregarding traditional low-tech sectors leads to ignoring factors critical for economic growth and competitiveness of national and regional economies, as well as to missing opportunities for spreading know-how and new technologies created in the country. **Encouraging innovation in the traditional sectors creates higher demand for innovation solutions generated by the economic activities related to them.** This intensifies the interaction in support of open innovation within the national innovation system.
- **The business environment is of key importance for the development of the innovation potential of traditional industries,** which are a smaller source of new knowledge but a big absorber of the latter. Basic (transport and communications) and advanced infrastructure (universities and research units) act as a medium for disseminating existing and new technologies, in conjunction with other factors such as patent law, protection of competition, tax relief and established business practices.

INTRODUCTION

Bulgaria's membership in the European Union was accompanied by high expectations for improvement of the business climate and the living standards in the country. The global financial and economic crisis of 2009 – 2010, however, dealt a severe blow to economic growth, increased unemployment and reduced private and public capacity for investment. Bulgaria remained one of the few stable EU member-states financially and fiscally, but this did not change the position of the Bulgarian economy as the poorest in the EU and requires bold measures for overcoming the slowdown. The first year of the new decade provides a unique opportunity in that respect.

In 2011, the European Union started the implementation of its new policy of intelligent growth Europe 2020 and preparation for the next budget period 2014 – 2020. For the first time, Bulgaria faced the challenge and the opportunity to define its new national innovation policy, participate in the formation of the EU innovation policy and determine the programs and priorities of financial support from the EU for the next decade – all at the same time. The decisions and actions of the Bulgarian government in the development of the new EU financial prospects will determine whether in 2020 Bulgaria would continue to be the poorest member state or will become a model to emulate.

The annual *Innovation.bg* report provides a reliable assessment of the innovation potential of the Bulgarian economy and the state and development capacity of the Bulgarian innovation system. It puts forward recommendations for an improved public policy on innovation in Bulgaria and EU drawing on the latest international theoretical and empirical research while taking into account the specific economic, political, cultural, and institutional framework in which the country's innovation system is operating. For a seventh consecutive year the report raises the awareness of the importance of innovation as a factor for setting national priorities in the implementation of the new EU 2020 Strategy.

The report is intended for decision-makers in the public and private sectors. Following the methodology established by the four preceding editions, *Inno-*

vation.bg 2011 analyzes the state and development capacity of the national innovation system based on five groups of indicators:

- overall innovation product;
- entrepreneurship;
- investment and financing of innovation;
- human capital for innovation;
- information and communication technologies.

In addition, the *Innovation.bg 2011* report for the first time analyzes the innovation potential of two economic sectors (construction and energy), taking into account the characteristics of the value added chains and the interaction within the sectoral innovation systems. To achieve an impact on the speed and effect of innovation through national and sector policies (by means of well-considered regulation, educational and scientific technological priorities, fiscal and tax framework, and rules of public-private partnership) it is necessary to understand the mechanism of innovations at company and sectoral level.

The analysis of sectoral innovation systems provides evidence of the essence and significance of innovation activity at the companies, thereby supporting the establishment of sector-based innovation-oriented policies and measures. Devising mechanisms of impact – ones that have not been imposed from without but are instead the result of and have been indicated by the transformation processes in the relevant sectors – ensures a healthier environment for the functioning of the innovation ecosystem as a whole.

For several years now *Innovation.bg* has refuted a number of myths related to the standard system of indicators for measuring innovation as a linear process and a result mainly of R&D. Shifting the focus to sectoral innovation systems and the value added chains is more closely related to the concept of open innovation. For this reason, in addition to the familiar indicators of R&D intensity, the present report also uses indicators which:

- measure the contribution of the individual sectors to the development of the national economy;
- help define the specific factors that drive sectoral innovation activity;
- understand the mechanisms of innovation and the varied forms of manifestation of its expected effect.

Challenges for Bulgaria's Innovation Policy

Bulgarian innovation policy in the context of the Europe 2020 Strategy for Growth and Jobs of the European Union

Innovation has been placed at the heart of the new EU strategy for competitiveness and growth – Europe 2020.[1] **The Innovation Union is the leading initiative of the strategy,** aimed at reducing the gap between the EU and its main competitors (the United States, Japan and China) in respect to the potential for the development of science and innovations, as well as the barriers to innovation.

Innovation Union differentiates the sources for promoting productivity in EU countries. For the "laggards" these are technology transfers by means of equipment, licenses and know-how acquired by purchasing them or through foreign investments. For the highly-developed strong performers which are close to or have reached the "technological limit", it is decisive to activate their inner innovation potential and to promote innovation in services and the public sector.[2]

Nevertheless, Innovation Union continues to consider the European Union as a homogenous whole in respect to the policies and financial instruments applied at the EU level. In practice, the research and innovation framework programs enhance the differences in the innovation potential of EU member-states instead of aiming to boost the capacity of the economies lagging behind. The conditions for participation and the requirements in respect to research units, educational institutions, business and individual researchers in the European framework programs – Seventh Framework program (FP7) and the Competitiveness and Innovation Framework program (CIP) – or the European Cooperation in Science and Technology program (COST) are the same for representatives of the innovation leader countries and for those that are catching up. The specific environment

[1] *Europe 2020 Flagship Initiative. Innovation Union,* Communication from the Commission to the European Parliament, the Council, the European Social and Economic Committee and the Committee of the Regions, SEC(2010) 1161.

[2] Tilford, S., Ph. Whyte, *The Lisbon Scorecard X, The Road to 2020,* http://www.cer.org.uk/pdf/rp_967.pdf

in which they develop and interact, however, as well as the different obstacles they face, place them on a different basis and largely condition their success and effectiveness in absorbing funds under these programs. The new financial perspective of the EU for 2014 – 2020 should **provide more European financial instruments to ensure approximation internally in the EU. The fact that the new European strategy does not focus on the EU economies lagging behind in innovation** makes it necessary, particularly for countries like Bulgaria, to mobilize much more efforts in designing and systematically applying a policy for the development of science, education, technology and innovation in order to overcome the trend of continuing lower performance.

Innovation Union shifts the focus of European policy from innovation in industry alone **to innovation in the services, the public sector and social processes.** In relation to this, there are provisions for the introduction of more complex indicators for measuring innovation activity which the Lisbon Strategy largely boiled down to the share of R&D spending in GDP. The proposed **Innovation Union Index** of 25 indicators, which should reflect the need of wider measurement of innovation processes, **still does not provide opportunities to measure the hidden forms of innovation typical of low technology sectors.** In their case, the lack of formalized R&D combines with a high degree of innovation activity (as the sector analyses in the present report also find), based on organizational and marketing innovation and the introduction of technological innovations of external to these sectors origin. The application of these indicators, oriented mainly towards measuring the intensity of research (costs and staff engaged in R&D, patents), leaves a blind spot in European policy-making which distorts the innovative economy national profiles and gives grounds for wrong conclusions.

The existing European instruments for comparative measurement of innovation in EU member-states have two essential shortcomings:

- In the first place, R&D data produced by the national statistics offices are provided with too large a time lag (one to two years for the basic data and up to five-six years for input-output data). In this way, they can hardly serve as a basis for developing successful policies, particularly in times of more dynamic changes such as the crisis of 2008 – 2009. For Bulgaria, as a catching-up country these delays are even more critical because they do not allow prompt detection of where there is real approximation and where the situation is deteriorating and quick reaction is called for.
- Second, in terms of methodology, the instruments frequently report only the reality of the older member-states which shows the new member states, and Bulgaria in particular, in an unfavorable light and even informs wrong policy actions. As a rule, the instruments give results which are not adjusted to the structure of the economy and the population and do not take into consideration local characteristics.
    - For a long time, the European Commission provided only cable modem and ADSL as technical options for the measurement of broadband internet, while the most widespread technology in Bulgaria – LAN – practically could not be covered. As a result, Bulgaria stood at the bottom of the rankings for distribution and access to broadband internet. After the methodology was changed, Bulgaria climbed to one of the top places in speed, but for methodological reasons there still is an underestimated share of internet users (mainly because of the unfavorable demographic structure). Senior experts from the European Commission still recommend support for the promotion of broadband internet through ADSL and the development of inter-city/inter-village infrastructure based on

wrong assumptions in the measurement methods, while the real needs of the public and business in Bulgaria are quite different.

- Another illusion in the understanding of innovations is that if there is low patent activity in a country there is also low innovation. The United States and Japan had 47 % of all patent applications[3] in the world in 2008, and the top five ranking states (the US, Japan, Korea and Taiwan) held a total of 77 % – the same countries also being leaders in awarded patents[4] – 84 % of all.[5] Furthermore, even in Europe differences are essential – Germany, United Kingdom and France rely more heavily on formal patenting than Italy, Greece or Portugal. In this sense, it cannot be expected that there will be higher patent activity in Bulgaria, but this should not necessarily be interpreted as lack of innovation. For many Bulgarian companies the cost of a full patent maintenance fee is too high which makes it economically more viable to protect a trade secret rather than register a patent.

Innovation Union recommends that member-states apply an integrated approach, according to which the introduction of innovations should be a priority for all sectoral and horizontal policies. Innovation should also be implemented by coordinating national, regional and European initiatives and encouraged by various mechanisms. **State aid and public procurement** are important elements of the mechanism of promotion of research and innovation, as is the so-called pre-commercial procurement through which the development of competitive R&D solutions to public sector issues are commissioned. This kind of procurement can promote innovation in energy, water supply, health care, public transport and education, and improve the quality of services in the public sector. These aims would also be furthered by an accelerated and modernized standardization. One of the commitments in the establishment of the Innovation Union was that starting in 2011 member states would begin to set aside budget funds **for procurement of innovative products and services.**[6]

The restrictions in state budgets, the level of economic development and national regulations will determine the varying readiness of the EU countries to carry out the activities included in the Innovation Union. The planned procedures of monitoring and self-evaluation are aimed **to support the process of "intelligent specialization" of the countries and the regions** on the basis of their strengths, covering R&D and university education and supported by the operational programs under the structural funds after 2013. Member states **have their say in the process of determining national priorities and objectives for innovative development.** The preparation of the framework conditions for the next programming period 2014 – 2020 and the specific set of financial instruments, which will make the achievement of Europe 2020 goals possible, is an appropriate time for Bulgaria to make a strong bid for participation in the European initiatives for competitive and sustainable growth.

[3] Applications by local and foreign persons.

[4] The basis are patents awarded to local persons.

[5] Data from the World Intellectual Property Organization, quoted through IMD World Competitiveness Yearbook, 2010.

[6] By the introduction of pre-commercial procurement.

Bulgaria and European innovation policy

Analysis of the various stages through which the Bulgarian economy passed over the last 20 years shows that **Bulgarian policy makers do not understand the role of innovation as a factor for sustainable growth and national competitiveness, and ignore the sources of innovation potential.** Instead of a coherent scientific, technological and innovation policy, there are haphazard measures and instruments in Bulgaria. These are shaped by the level of expertise in the administration which develops them and depend on critically low public funding. The Bulgarian government does not have a clear vision in the sphere of science and innovation. It has abdicated from the governance of public research organizations and does not propose concrete measures and actions for implementation of the documents adopted at national and European level. The lack of a system of monitoring and control, as well evaluating the impact of the few measures undertaken additionally hinders as implementation.

The government declared its intention to close the innovation gap by setting an ambitious goal in the National Reform Program (2010 – 2013) – to achieve **investments in R&D amounting to 1.5 % of GDP in 2020,** combined with a good business environment. Inasmuch as it remains unclear, however, how the objectives of the country's innovation development would be achieved by 2020, the findings and recommendations of the Applied Research and Communication Fund in the last six editions of the *Innovation.bg* report are still applicable. Bulgaria's outdated National Innovation Strategy, adopted in 2004, has not been implemented in the last few years and there is no funding provided for the operation of the main instrument for its implementation – the National Innovation Fund. R&D spending as a share of GDP in 2010 was well below the target in the Strategy and was about three times less than the 2020 target.

Against this backdrop, there are indications that the **national innovation policy is still being developed piecemeal:**

- The reform in higher education and scientific institutions is short-sighted, lacks professionalism and goodwill for coordinating the interests of stakeholders;
- The various drafts of a National Research Strategy proposed in the last five years did not put forward common measures and impact fields in respect to integration of science and innovation;
- There are no in-depth analyses to outline clear priority economic policies and measures.

The reforms of BAS, AA and the higher education sector are, on the one hand, just an imitation of activity without a clear vision of the desired and expected result and, on the other, a delay of structural, thematic and staff reforms. As the main source of public funding for science and research, **the government should clearly advise** academia in Bulgaria of the needs of national economic policy **and introduce a regular assessment of the progress achieved,** including by applying indicators such as the number of published articles in impact factor journals, number of patented innovations, funds raised from the private sector and abroad, etc. A number of the research institutes within BAS, the AA and the higher education establishments have good innovative practices, internationally recognized results, effective partnerships with Bulgarian and foreign scientists. This experience should be studied, encouraged and popularized.

A policy in support of innovation is a costly and risky undertaking which requires the application of transparent rules of funding and combining the effect of using specific financial instruments.

Investments in science and innovation in Bulgaria in recent years has been below the potential of the national economy, at incomparably lower levels compared to average European indicators, and does not help the closing of the gap with other member states. In 2011, the National Science Fund is practically the only working state financial instrument, in spite of the fluctuations in its funding and the delay of procedures. The funding of innovation and R&D in Bulgaria is not guided by any considerations of long-term sustainability. The ministries and other agencies lack good management, capacity and initiative, internal and interdepartmental coordination of innovation activity.

The work of the public administration responsible for the allocation and oversight of funds under Operational Program Competitiveness – the main instrument of the European funds in support of innovation in the country – is not sufficiently effective. Bulgaria is one of the four EU member-states which has not suggested measures and has not availed itself of the **Temporary Union framework for state aid measures to support access to finance in the current financial and economic crisis.** The framework allows member states to adopt additional measures for state aid – not exceeding €500,000 per undertaking instead of the existing restriction of not exceeding €200,000 for a period of five years. The action of the temporary framework expired on December 31, 2010. Twenty-three schemes in 23 states managed to avail themselves of the temporary measures, albeit with different intensity (78 % of the extended funds are concentrated in Germany, while the share of Italy and United Kingdom was respectively 8 % and 1.1 %).[7] The public administration in Bulgaria has not made an effort to offer this instrument to the potential beneficiaries of the Operational Program.[8]

The missed opportunities and, above all, Bulgaria's low positions in the field of research and innovation compared to the rest of the EU member states, necessitate a well-reasoned and integrated policy for the development of science, technology, education and innovation. To implement such a policy it is equally important to have ensured funding, as well as political will, aimed at implementing the following measures:

- Establishment of an **Integrated National Strategy for Innovation and Technological Development** of the Bulgarian economy. The new innovation strategy should reflect the science-education-innovation interaction and should provide incentives for research units, universities and businesses to work together in the generation and transfer of new knowledge, technologies and innovations. For example, the definition of reference purchase prices for green energy, which presupposes considerable preferential public investment in these fields, should be combined with the development of a scientific and technological base in the country which would allow a larger portion of added value to remain in the national economy. The measures of the draft national scientific strategy should be integrated with the innovation strategy.

[7] *Temporary Union framework for State aid measures to support access to finance in the current financial and economic crisis,* Communication from the Commission, (OJ 2011/C 6/05, 11.1.2011.)

[8] The integrated efforts of the European Commission during the economic crisis were combined with a number of national measures for enhanced support of research and innovation. On the contrary, Bulgarian governments involved business in a chain of domestic indebtedness – the conclusion of unsecured public procurement contracts and subsequent substantial delays in the payment of dues to companies.

- Bulgarian representatives in the various EU institutions should participate more actively in the forging of European policy and in the making of decisions and recommendations. Numerous guidelines and decisions in the field of innovation have been published in the EU in recent years. Some of them restate ideas and recommendations from previous years without making any analysis, report or evaluation of their implementation and impact. There should be essential improvement in the programming of European funds for 2014 – 2020, with a stress on setting aside more means to fund R&D, technology and innovation. In this respect, the set of themes should be restructured and new rules should be adopted for more effective procedures of application, reporting and control.
- Establishment of a strong and capable **administrative body overseeing the application of Bulgaria's innovation development strategy** which would reflect the political will for implementing the research and innovation policy. The body could be constituted by merging and restructuring the existing executive agencies within the Ministry of Economy, Energy and Tourism. The new body should coordinate the work of the ministries and agencies which are involved in promoting research and innovation and exercise comprehensive monitoring and control of the achievement of the national innovation development objectives. An alternative would be to establish a new Ministry of High Technology and Innovation which would integrate the respective directorates from the Ministry of Economy, Energy and Tourism, the Ministry of Education, Youth and Science and the Ministry of Transport, Information Technology and Communications.
- **Increasing public and private funding of research and innovation** by:
    - Providing instruments for **national co-funding** of projects approved for funding by EU programs. The state should support its best scientists, research units, business and NGOs that have succeeded in attracting external funding for the development of their research potential not only from FP7 but also from the other programs which have a direct impact on the innovation potential (e.g. CIP).
    - **Coordinated public funding** – through the National Innovation Fund, the National Science Fund, the operational programs, the venture capital funds – with the objective of prioritized channeling of funds to the implementation of innovation projects. In an environment of still shrinking markets, OP Competitiveness should offer more flexible mechanisms for funding, ones that are less oriented towards investment in new technological equipment (low demand does not motivate companies to expand production capacity) but to a larger degree towards the development of new products, including on the basis of joint research, as well as participation in technological transfer networks.
    - **Utilization of public-private partnerships** as a tool for the implementation of projects with a significant public outcome. The central government and the municipalities should apply new technological knowledge in public procurement as a main consideration instead of simply the lowest cost bid.

The national innovation system needs new models and mechanisms of management which would provide not only faster reform of its individual elements – scientific organizations, universities, intermediary units, innovative firms, administrative and financial institutions – but would also boost creative interaction

and integration between them. The successful implementation of such measures requires a developed **innovation culture.** Awareness of the potential of innovations and understanding their significance at individual and community level takes time but gives results – a good reason to place it at the foundation of contemporary policy for the development of Bulgarian education and life-long learning.

Innovation Potential of the Bulgarian Economy

Gross Innovation Product

The Gross Innovation Product of an economy or its innovativeness is assessed by the new products and services introduced, the new technologies created and the scientific targets achieved. It results from the interaction of the innovation, technological and scientific products of the country. It is a major benchmark for innovation policy because it allows decision-makers to compare the outcome of the innovation system in temporal and geographical terms, as well as to estimate the needs for changes in the organization and resources of the innovation process.

Innovation Product

The innovation product results from new and significantly improved processes, products and services based on new and/or adapted knowledge and know-how. It is determined by the innovation activity of enterprises in the country and is the most important indicator for assessing the national innovation system. The innovation activity of business, along with the factors which determine it, comprise the innovation potential of the economy – its capacity to develop on the basis of new knowledge.

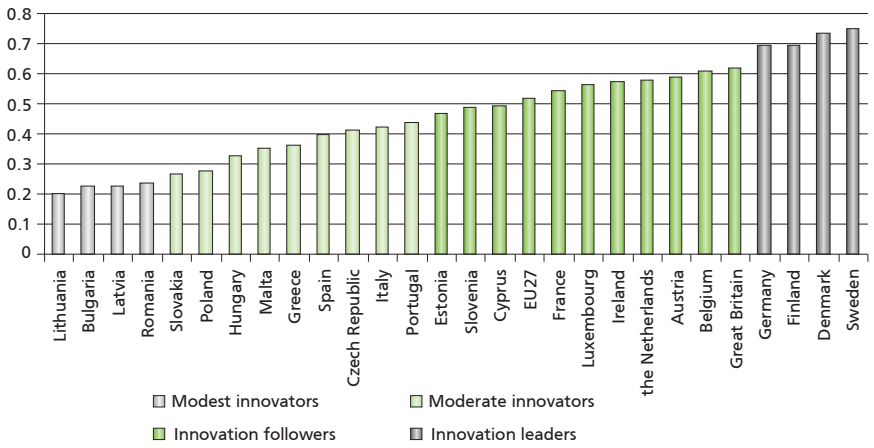
Bulgaria is still among the most modest innovators in the EU, according to the newly-introduced methodology of the European Commission to assess the innovation potential of member states to implement the flagship of the Europe 2020 Strategy – the Innovation Union[9].

The performance of innovation leaders is 20 % or more above that of the average European level. At the other end of the scale, of modest innovators it is below 50 % that of the EU27 average.

The general trend in the EU for 2006 – 2010 is one of convergence of the innovation performance of member states. Bulgaria is no exception, being in the group of countries with the highest growth rate of the Gross Innovation Product – a composite indicator of the country's innovation performance. These high values of the index are entirely due to the country's economic growth by 2008, the year to which the bulk of the data forming the index refer. The economic crisis and recession helped boost competition between market players, expressed in an essential increase in marketing and organizational innovations in 2009 and 2010.[11] The recovery and essential growth of exports in the second half of 2010 and the beginning of 2011 are indicative of the increased company innovation competitiveness over the past five years. The average monthly growth of the physical volume of Bulgarian exports on an annual basis for 2010 was 28.7 % – nearly twice higher than the average for EU27. The considerable decline in the investment by Bulgarian companies and foreign direct investment in the country in 2010 could indicate that the improvement of the national innovation performance and potential could falter.

The latest **Community Innovation Survey** (CIS) of enterprises in EU member states established that over half of the companies in Europe define themselves as innovative.[12] In Bulgaria, the innovative enterprises

Figure 2. INNOVATION UNION 2010: THE INNOVATION PERFORMANCE OF EU MEMBER STATES[10]



Source: Innovation Union Scoreboard 2010.

[9] Innovation Union Scoreboard 2010: The Innovation Union's performance scoreboard for Research and Innovation, February 1, 2011.

[10] Average performance, according to which EU27 are ranked, is measured using a composite indicator building on data for 24 indicators going from a lowest possible performance of 0 to a maximum possible performance of 1. Average performance in 2010 reflects performance in 2008/2009 due to a lag in data availability.

[11] See more details in *Innovation.bg 2010*, pp. 18-23.

[12] http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database

in this period were less than one-third. At the same time, applying the same methodology, the INA-4 survey of innovation activity of Bulgarian business, conducted by the Applied Research and Communications Fund, revealed a distinctive growth in 2009 and reached the average European self-assessment level. Germany (80 % of enterprises), Luxembourg (65 %), Belgium and Portugal (58 % each), and Ireland (57 %) are Europe's innovation leaders. Bulgaria (31 %) is followed by Lithuania (30 %), Hungary (29 %), Poland (28 %) and Latvia (24 %).

Bulgaria's competitiveness and growth in the first decade of the 21st century were based on structural changes in the economy and low prices. Bulgaria and Romania are the only EU member states at the so-called second stage of development, based on improving the efficiency of the economy, after the growth period defined as the first stage. The majority of member states rely on new knowledge and technologies as a source of high added value and better quality of life.

The implementation of an inconsistent scientific, technological innovation policy in Bulgaria without the necessary funding reflects in the low innovation activity of business. The adoption of documents under European pressure alone, faking action through legislative measures without making any effort to enforce them, failing to identify priorities for the development of the national economy (and the science and education supporting it) cannot but result in a permanent lagging behind of Bulgarian enterprises in comparison with their European and international partners. Truly innovative companies which exist through innovation and compete on the basis of new knowledge are a rarity in Bulgaria. A large portion of Bulgarian business does not engage in innovation

Table 1. STAGE OF DEVELOPMENT OF EU MEMBER STATES

Efficiency driven	Transition from group 2 to 3	Innovation driven	
Bulgaria	Estonia	Austria	Italy
Romania	Hungary	Belgium	Ireland
	Latvia	Cyprus	Luxembourg
	Lithuania	Czech Republic	Malta
	Poland	Denmark	The Netherlands
	Slovakia	Finland	Portugal
		France	Slovenia
		Germany	Spain
		Greece	Sweden
		United Kingdom	

Source: The Global Competitiveness Report 2010 – 2011, World Economic Forum, Geneva, Switzerland 2010.

activity or introduces new processes and products at an exceptionally low level of novelty, without any essential impact for the company or the economy.

Technological Product

The technological product (protected and unprotected new technological knowledge) is a result of the creative efforts of the participants in the innovation process. Its unique characteristics and economic significance make it attractive as an object of transfer. The analysis of applicant and patent activity, as well as the attitudes of Bulgarian and foreign persons in this field make it possible to assess an essential aspect of innovation system operation and to find ways for improving it.

After its accession to the EU, Bulgaria is becoming an increasingly attractive place for the protection of inventions. The trend of increasing patent activity was observed first in the case of foreign patent holders in 2004/2005. The increase in the number of patents annually varies from 85 % in the beginning of the period to 10 % in 2010. A positive change, albeit on a much lower basis, is also observed in the case of Bulgarian patent holders. In the last two years, the number of patents issued to Bulgarian persons has increased by over 40 % annually. The main dynamics of patent activity is related not to a boost of technological activity in the country but to regulatory changes.

In the period 1994 – 2010 there had been two peak moments related to reforms in patent legislation:

- A Patent Act was adopted in Bulgaria in 1993 which radically changed the Bulgarian patent law system, including its harmonization with the practice of European countries. This was followed by several years in which the existing inventor certificates were transformed into patents, which determined the high degree of patent activity of Bulgarian persons over the period. This was also the period of redistribution of the existing patent wealth inherited from the centrally planned economy.
- In 2002, Bulgaria became part of the European patent system which expands the territory of application of European patents. This was followed by a

process of validation of European patents so that they could be valid on the territory of Bulgaria, a process which received an additional boost after the country became a fully-fledged member of the EU in 2007.

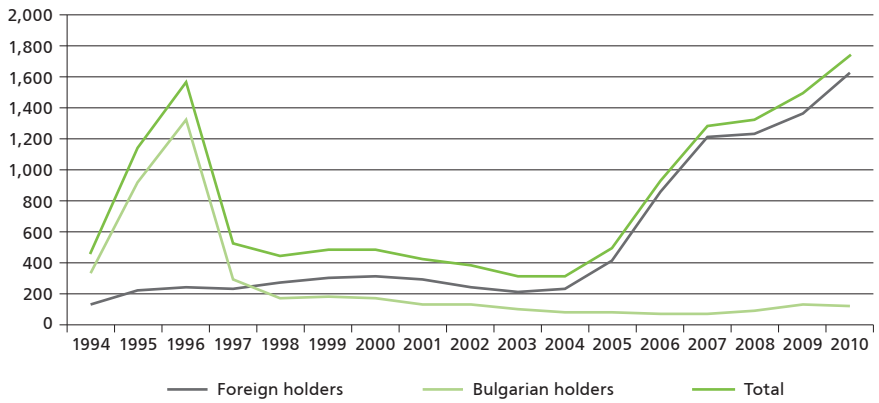
As regards the protection of new technological knowledge, **Bulgaria is of interest mainly for European enterprises.** Of all patents granted for inventions to foreign patent holders, 72 % went to representatives of European countries. The share of the United States in foreign patent activity stands at 21 % and the rest of some 7 % foreign patents are distributed among 36 countries outside Europe.

The interest of foreign companies in protecting new technologies on the territory of Bulgaria results from strategic plans to enter the Bulgarian market. Ten countries – Germany, the US, the United Kingdom, China, Italy, Belgium, Luxembourg, the Netherlands, Austria, Hungary and Spain – share the top 15 ranking of foreign investments and the top 15 in protected invention patents in Bulgaria. **Nine percent of the countries investing in Bulgaria, which account for 85 % of all foreign direct investments, hold 76 % of the foreign patents.**

Along with this, **foreign applicants seek protection for new technologies in scientific fields and economic sectors which are well-developed in the country.** The Bulgarian organizations in these sectors have the necessary facilities, qualified staff and knowledge, to absorb and put into practical operation the new technologies transferred from abroad. This requirement by foreign investors determines the overlapping in the fields of largest applicant activity by Bulgarian and foreign patent holders.

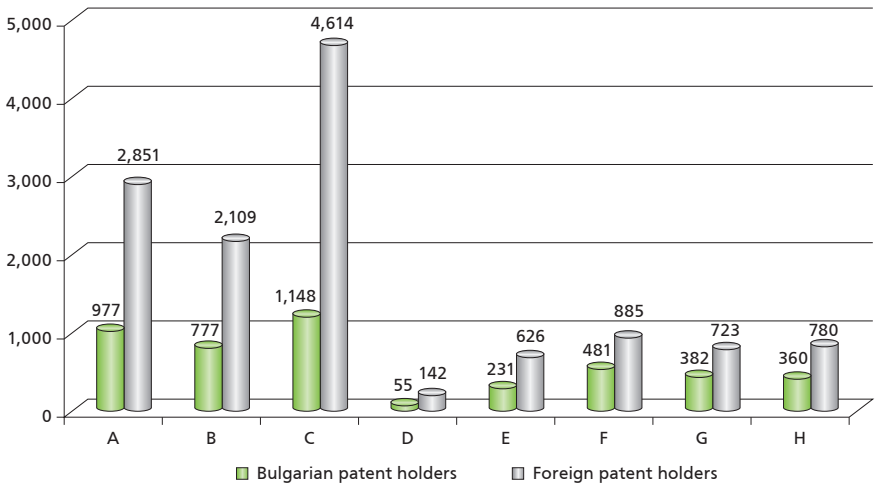
As previous editions of *Innovation.bg* have also found,[13] **individuals are the majority of patent applicants** – they hold 70.5 % of the total number of granted patents and their share has continued to increase over recent years. **There is also a positive change in respect to numbers and the share of business** – in 2010 the patents granted to Bulgarian companies were 2.5 times those in 2007.

Figure 3. NUMBER OF INVENTION PATENTS ISSUED IN BULGARIA



Source: Data from the Official Journal of the Bulgarian Patent Office.

Figure 4. NUMBER OF PATENTS GRANTED FOR INVENTIONS BY IPC SECTION, 1994 – 2010[14]



Source: Data from the Official Journal of the Bulgarian Patent Office.

The higher education sector is on a par with BAS. **Considering that academic staff at higher educational establishments devote a lot of their time to teaching,[15] the sector is doing much better than BAS in one of its three functions – the creation of new knowledge.** Just 11 of all 52

[13] *Innovation.bg 2010: Bulgarian Innovation Policy: Options for the Next Decade;* Applied Research and Communications Fund, 2010.

[14] The sections in the International Patent Classification are as follows: A-Human Necessities; B-Performing Operations, Transporting; C-Chemistry, Metallurgy; D-Textiles, Paper; E-Fixed Constructions; F-Mechanical Engineering, Lighting, Heating, Weapons, Blasting; G-Physics; H-Electricity.

[15] According to OECD data, the ratio between teaching and research of the academic staff at universities is 2:1.

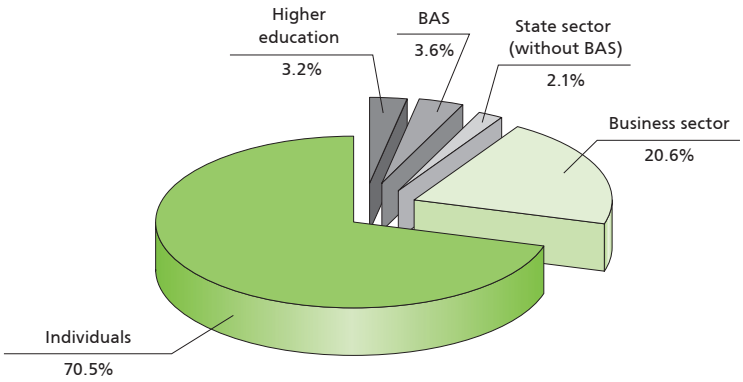
accredited higher educational establishments have registered patents in the last 16 years.

Comparison of the data about relevant staff and protected patents between state sector (including BAS), higher education and business, show that the state sector has the highest share in respect to relevant staff (65 %) and accounts for 6.8 % of patent activity. In the higher education sector 20 % of the staff account for 3.2 % of the patents. **The largest patent productivity is registered with the business sector – with 15 % of the research staff, business holds 20 % of the patents.** The picture is the same in terms of R&D/patent funding. One should bear in mind the outflow of patents (and the related funding and human resources) of which higher education and BAS are most frequently the source. The institutional structure of patent holders shows that there are practically no internal links in the Bulgarian innovation system in the most critical field – pre-commercial protection of new ideas and products.

Distributed by economic sectors, patent activity is greatest in the pharmaceutical industry (28 %) and the manufacture of chemical products (16 %). Against this backdrop, there is a relatively small share of the sectors of construction (4 %) and energy (2 %), which have a far more tangible part in the formation of GDP. Next come the manufacture of metal products, then foods and the production of computer, communication and electrical equipment.

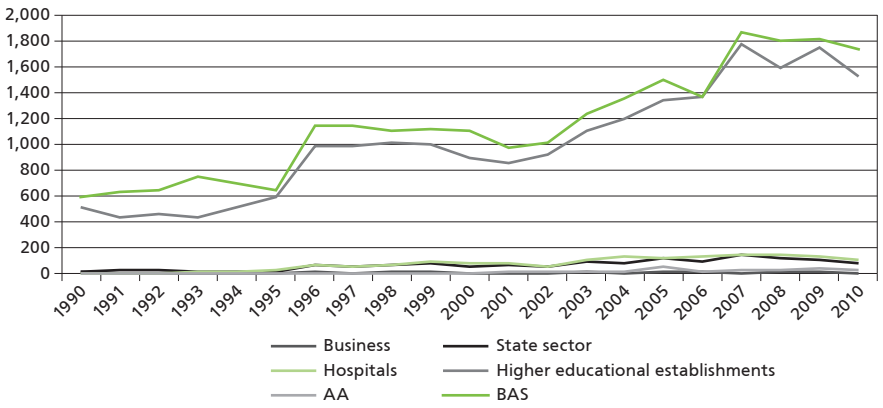
The present condition of low institutionalization of patent activity limits the opportunities for transfer of the protected technological solutions and expansion on foreign markets because of the restricted access of their holders to useful information, possible partners and production capacity for introduction. Appropriate

Figure 5. INSTITUTIONAL DISTRIBUTION OF PATENTS WITH BULGARIAN HOLDERS, 1994 – 2010



Source: Compiled from data published in the Official Journal of the Bulgarian Patent Office.

Figure 6. NUMBER OF SCIENTIFIC PUBLICATIONS BY BULGARIAN AUTHORS IN SCOPUS REFERENCED JOURNALS, 1990 – 2010



Source: Scopus, 2011.

stimuli have to be generated for better utilization of the national patent wealth, including by:

- Reducing to a symbolic figure the amount of SME fees for pre-patent research and upon application, award and maintenance of patents (including to the European Patent Office);
- Promotion of patent activity of universities and BAS and setting indicative goals for patent activity of state-funded organizations;
- Devising a scheme under the operational programs covering the period of transition from research to production as a specific stage in the overall innovation cycle within which protection of the new technologies invented has to be sought.

Just as the activities involving the invention, protection and utilization of new technologies are an important part of the innovation life-cycle and innovation systems, the Bulgarian Patent Office, which should participate in the formation of the national vision in the field of intellectual property, should support the

government's sectoral policies. **At national level, there are no analyses of the potential invested in protected technological knowledge; no assessments are made of the institutional picture of application, of the effectiveness and the opportunities of individual groups of patent holders for optimum participation in technology transfer.** The Ministry of Economy, Energy and Tourism, as a principal of BPO, has not indicated a need for such analyses, nor has it taken the initiative to engage in such a role. When such information is lacking, this knowledge can neither be managed nor adequately supported.

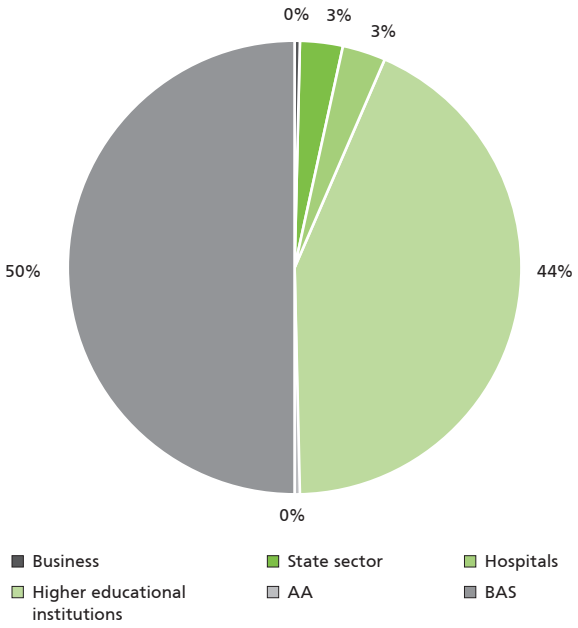
Research Product

An important precondition for enhancing the country's innovation activity is the new knowledge created by its scientific organizations and scientists. An analysis of the dynamics and structure of this process reveals Bulgaria's potential to enter international research networks, its relative advantages in different spheres of knowledge and its ability to compete on the market of intellectual products.

Until 2007, the number of papers of Bulgarian scientists in publications referenced by Scopus[16] had steadily increased. **Figures for the last three years have varied but have mainly declined and in 2010 reached the level of 23 % compared to the peak of 2007.**

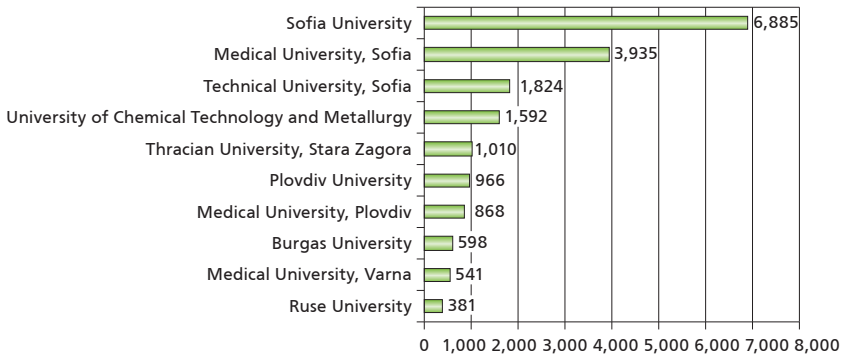
The indexing of Bulgarian scientific publications in databases like Scopus has a tangible influence on the assessments of the quality of Bulgarian science and its presentation before the international scientific community. This is the reason to include quantitative targets about the number of publications in international referenced databases in the National Scientific Research Strategy by 2020, as well as at the lower-level strategies for the development of the academic units and higher educational establishments in the country. **Although the indicators of number of scientific publications and the index of citation are a standard part of international comparative assessments of the innovation potential of national economies, they remain beyond the vision and the strategic framework for the development of science in Bulgaria.** Half of the 18 indicators for monitoring put for-

Figure 7. NUMBER OF SCIENTIFIC PUBLICATIONS IN SCOPUS REFERENCED JOURNALS, 1990 – 2010



Source: Scopus, 2011.

Figure 8. TOP 10 BULGARIAN HIGHER EDUCATIONAL INSTITUTIONS WITH SCIENTIFIC PUBLICATIONS IN SCOPUS REFERENCED JOURNALS, NUMBER, 1990 – 2010



Source: Scopus, 2011.

[16] Since its establishment in 2004, Scopus has become the largest database with nearly 18,000 titles from more than 5,000 publishers. The main requirements for inclusion of scientific publications in the database include that these or their abstracts should be in English, should be referenced by an editorial board and the relevant publication should abide by a regular schedule of release. Scopus features the contents of 54 Bulgarian publications of 25 publishers for a different period of time, 28 of which are active to date.

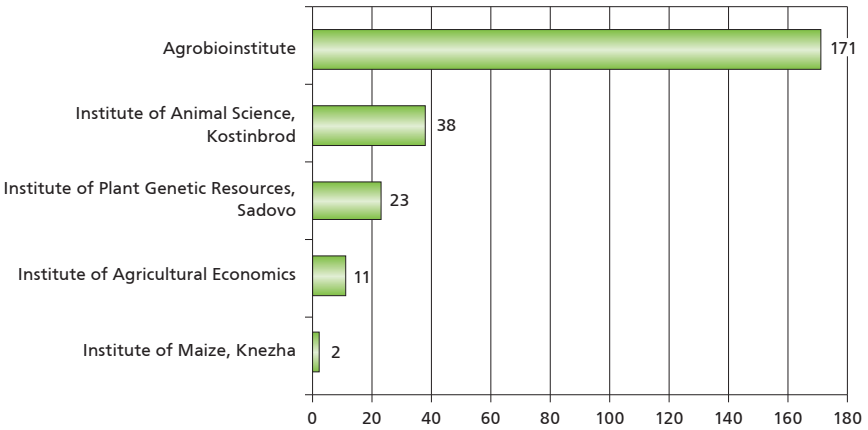
ward in the draft National Scientific Research Strategy are related to the funding of science and the use of other types of measures is forgotten (for example, the number of indexed journals in databases or rate of reference), although these have potentially much larger impact as a factor for the integration of Bulgarian scientists in European and international networks.

The institutional structure of referenced scientific publications is dominated by BAS (24,271) and the higher educational establishments (21,258), with almost equal shares for 1990 – 2010. This group includes 28 of all 52 higher educational establishments in Bulgaria. Measured in this way, the scientific achievements of the two sectors indicate comparable participation in research and make the controversies concerning which of the two types of institutions is more appropriate as a recipient of purposeful public funding for science pointless. The additional value higher educational establishments add to their research is related to direct contact with students and the opportunity for direct dissemination of research results in the process of education.

The Agricultural Academy has 245 publications for the 20-year period, with only 5 of the academy's 20 regional units having publications included in the database. The participation of business is nearly twice below that number (133). Hospitals (1,560) are almost on a par with other state sector units (1,363) – research centers, institutes, secondary schools and ministries.

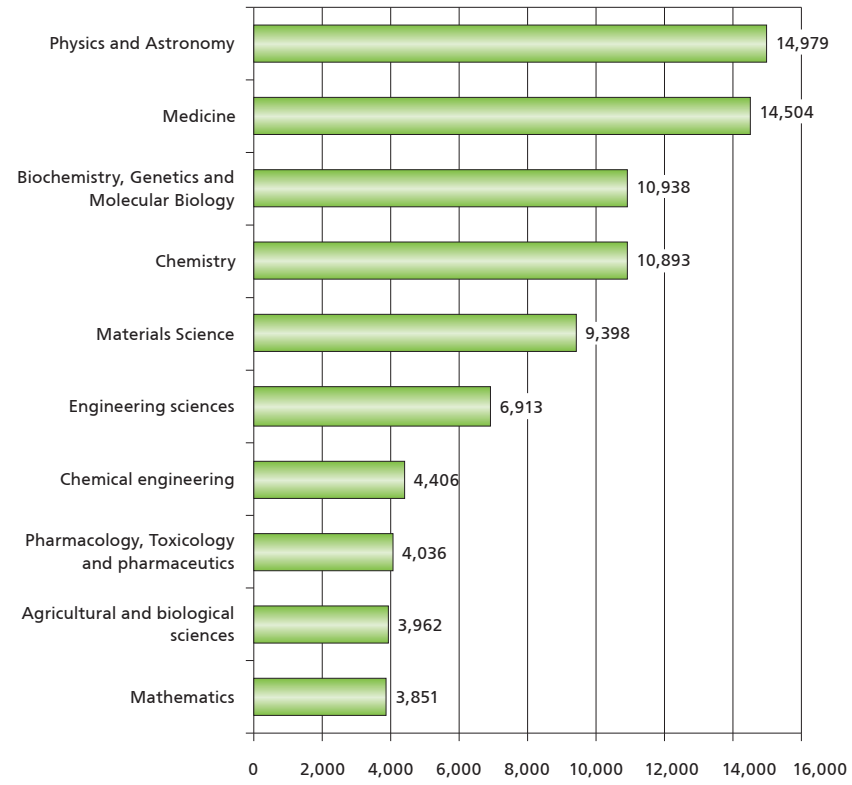
Bulgaria is represented in all 26 scientific fields in which Scopus classifies publications. Most prominent among these is participation in the fields of Physics and astronomy; Medicine; Biochemistry, genetics and molecular biology; Chemistry and Materials sciences.

Figure 9. NUMBER OF SCIENTIFIC PUBLICATIONS OF THE AGRICULTURAL ACADEMY IN SCOPUS REFERENCED JOURNALS, 1990 – 2010



Source: Scopus, 2011.

Figure 10. TOP 10 FIELDS OF BULGARIAN SCIENTIFIC PUBLICATIONS REFERENCED IN SCOPUS, NUMBER, 1990 – 2010



Source: Scopus, 2011.

The transformation of the research product into a technological one (although such a conversion is conditional) in the form of patents awarded in Bulgaria happened in 11 higher educational establishments. These hold a total of 136 patents which, as in the case of scientific articles, is slightly less than the patents awarded to BAS – 154. Within AA, 8 of the

research units hold 30 patents which, along with the protected new plant varieties and animal breeds, accounts for the largest share of applied introduction of research.

Comparison between the scientific fields classified by Scopus, the technological sectors according to the International Patent Classification and the distribution of patents at the Bulgarian Patent Office according to sectors of the National Classification of Economic Activities 2008, shows that **natural sciences – and above all chemistry and biology, along with their sub-sectors and border interdisciplinary fields,** and medicine, pharmaceutics and agriculture related to them, **are traditionally strong and definitive for the national research and innovation potential.**

Entrepreneurship

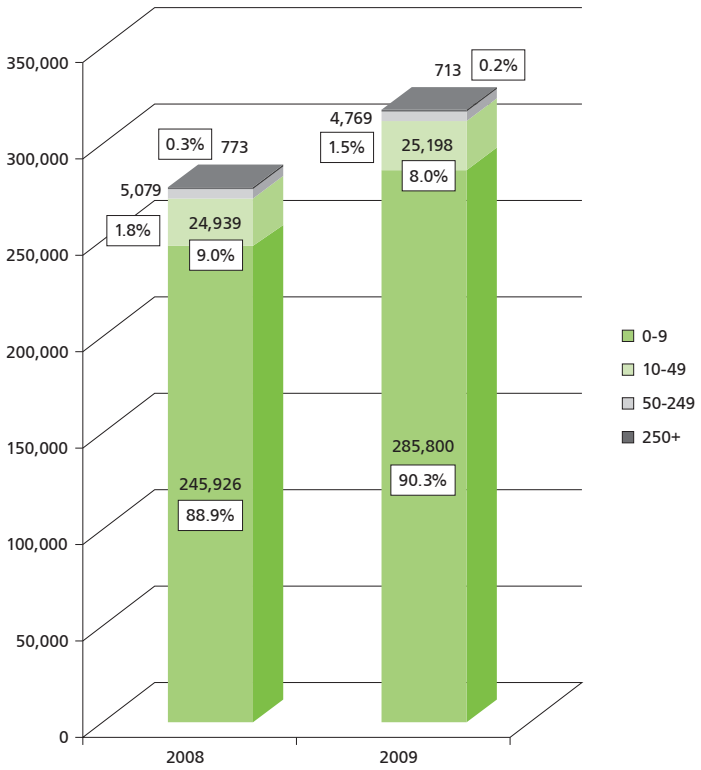
Entrepreneurship is one of the binding elements in the national innovation system. It is embodied in the newly-established companies and the means of interaction and exchange of information, know-how and technologies among the stakeholders in the innovation economy. Entrepreneurship is crucial for both the robustness and adaptability of the national innovation system. A spirit of enterprise and innovation culture should underlie the objectives of national innovation policy.

Judging by the number, structure and dynamics of registered legal persons (companies and NGOs) in the non-financial sector the trend of a steady **increase of the number of micro and small enterprises continued** in 2009,[17] with their number exceeding 300,000 for the first time after 1996. **This trend has a rather negative effect on the potential of the national economy to generate technological innovation.**

With the exception of high-tech micro start-ups, enterprises with less than 10 employed have a low innovation rate and as a whole reproduce the existing business practices in the economy,[18] with the potential to produce mainly marketing and organizational innovations.

Registry Agency data for 2008 – 2010 show that, in spite of the considerable increase of re-registrations of legal persons in 2010, which can be explained by the initial deadline stipulated by the law for entry into the Commercial Register,[19] the decline of the share of newly-registered companies in 2009 and 2010 remained within 13-15 % compared to the preceding year. The extension of the deadline for mandatory re-registration could have negative consequences for the planning and implementation of economic policies, as it postpones the time when the Commercial Register will present up-to-date and reliable information about the structure and dynamics of enterprises for the first time in the last twenty years.

Figure 11. LEGAL PERSONS IN THE NON-FINANCIAL SECTOR BY THE NUMBER OF EMPLOYED, 2011



Source: NSI, 2011, Statistical Yearbook 2009.

The numbers of newly-registered compared to re-registered companies in terms of **type of ownership** show that the entrepreneurs are using mainly limited-liability companies (LLCs) – 44.8 % new as compared to re-registered single-member limited liability companies and 32.3 % new as compared to re-registered limited liability companies – while the shares of the new sole traders and joint-stock companies compared to their re-registered equivalents are some 15 %. Although the increase is related to the changes in the regulatory framework and easier registration, **the larger share of newly-registered limited-liability companies is a positive factor for innovative entrepreneurship** because of the relatively

[17] *Innovation.bg 2010,* Applied Research and Communications Fund, 2010.

[18] The European Commission's Innobarometer survey covers enterprises with 20 and more employees.

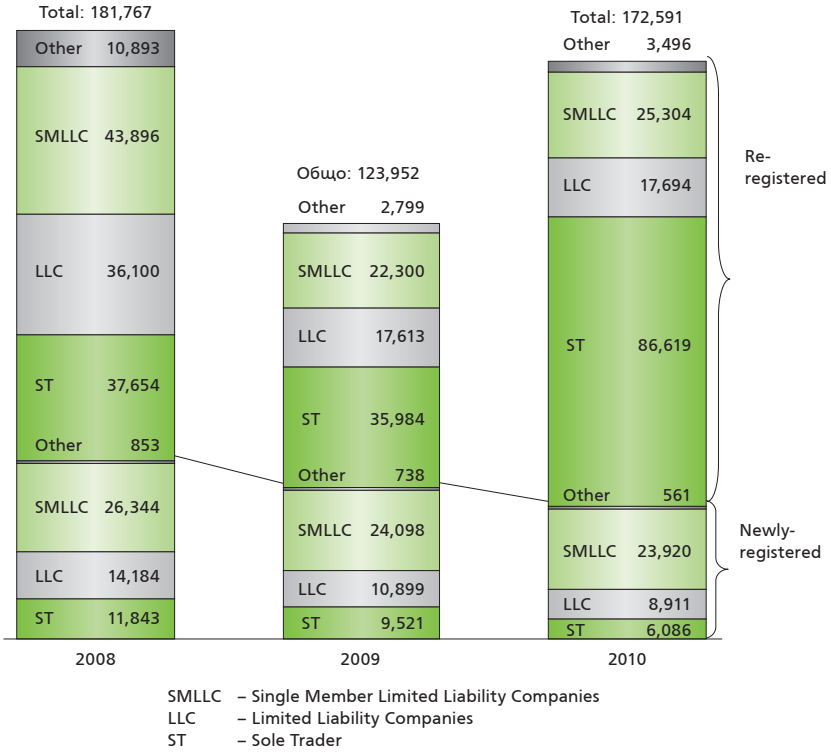
[19] The deadline was extended once until June 2011 and, in the last days of 2010 – until December 31, 2011.

higher innovation potential LLCs have in comparison with sole traders.[20]

With respect to their life-cycle (start-up, survival and death) shows that **the number of active enterprises**[21] **increases in all economic sectors, two of which – power generation and distribution, and real estate transactions – registered the highest growth** – by 2.3 and 1.9-fold respectively.[22] **The power generation and distribution sector is the only one in the national economy which had an increase of start-up enterprises,** while all other sectors showed a growth of start-up enterprises in 2007, followed by a decline in the following year. In 2004 – 2008, some 19 % of the enterprises active in the period were born, i.e. **one-fifth of the active enterprises every year were newly-born.**[23]

The mining and quarrying industry has the highest share of surviving enterprises – 91 %, while the lowest is in real estate (which, according to the new classification, also includes construction) – approximately 65 %. The latter also have the lowest survival rate for a longer period of time. The enterprises with the highest survival rate are those from the financial and insurance sector, where the relative share of surviving enterprises is about 13 %.[24] This share is nearly 4 times less than the EU average (about 50 %).[25] Although explained by greater dynamics and competitive pressures, **the short life-cycle of business enterprises is perceived as an obstacle to sustainable development at company and sector level, and as a barrier to innovation, which requires long-term planning and stability.** Thus, for the policy in the field of promotion of entrepreneurship and innovation it is also necessary to help increase the average life-span of the active enterprises in the Bulgarian economy.

Figure 12. LEGAL PERSONS REGISTERED IN THE COMMERCIAL REGISTER



Source: Registry Agency, 2011.

Box 1. NEW METHODS OF STUDYING ENTREPRENEURSHIP IN BULGARIA ARE REQUIRED

Surveys of entrepreneurship in Bulgaria and practically all comparative studies have one essential shortcoming – they focus on the existing commercial corporations, use sample approaches and interview mainly owners of micro-enterprises and managers of the larger ones, leaving out of their analysis the real entrepreneurs, particularly those with innovation potential and even more – serial enterprise. Early signals are registered by quality surveys of changes in entrepreneurship from one sector to another through new companies. This mostly happened by means of entrepreneurs from all other sectors getting into construction. The second most frequently encountered migration is vertical or horizontal integration. For example, from importers entrepreneurs become distributors and after that producers (or these three roles in some other sequence). In fact, most of the entrepreneurs in Bulgaria who have average-sized companies have several more enterprises which provide the legal services for their business, but also at least one more enterprise,

[20] *Innovation.bg 2010,* Applied Research and Communications Fund, 2010.

[21] An active enterprise is one that has a turnover or employed/hired persons within the reference period, even over a limited period of time (at least one month).

[22] The latest updated data about enterprise demography, published in July 2010, cover the period until 2008.

[23] Business Demography at December 31, 2008, NSI, published July 30, 2010.

[24] Business Demography at December 31, 2008, NSI, 2010; own calculations.

[25] According to the data about the life-cycle of EU enterprises started up in 2001 and surviving until 2006. Business demography: employment and survival. Eurostat, Statistics in focus, No 70/2009.

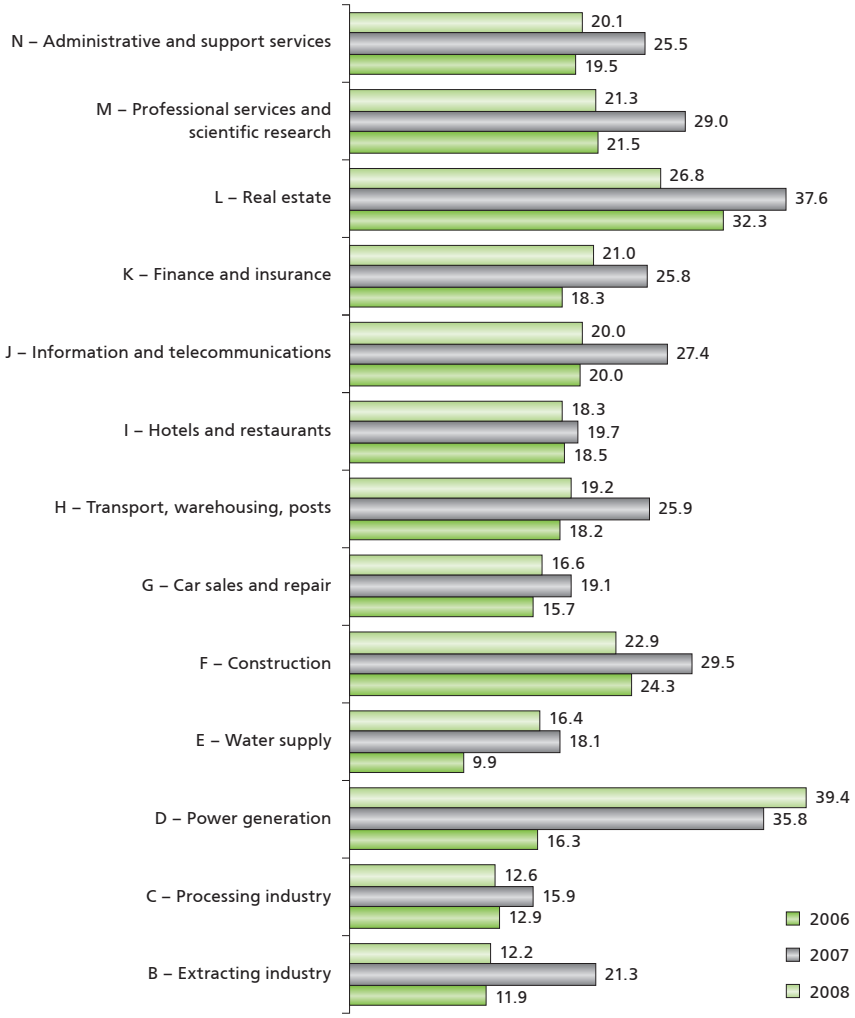
Box 1. NEW METHODS OF STUDYING ENTREPRENEURSHIP IN BULGARIA ARE REQUIRED (CONTINUATION)

either independently or in partnership. Sector-specific analyses of serial and network entrepreneurship are still lacking, but there are many cases in which high-tech entrepreneurs combine with subsequent investment in low-tech sectors. Analyzing innovation is hampered by the existence of complex webs of ownership and different markets of a network of companies.

If analyses of innovation focused on the controlling entrepreneur (or network of entrepreneurs) rather than on the legal form of the enterprise, the picture would be quite different. For policy purposes, therefore, a change is needed in the approach to research commissioned by the state, as well as through the National Science Fund which could fund alternative new methods of studying business, entrepreneurship and innovation.

Source: ARC Fund, 2011.

Figure 13. NEWLY BORN ENTERPRISES AS SHARE OF ALL ACTIVE ENTERPRISES



Source: NSI, 2010.

Funding and Investing in Innovation

Spending on R&D and innovation is a measure of the investment in the creation, use and dissemination of new knowledge in the public and business sectors. They are an indirect indicator of the innovation capacity of national economies. High R&D intensity as proportion of GDP is a factor fostering dynamic economic growth and competitiveness.

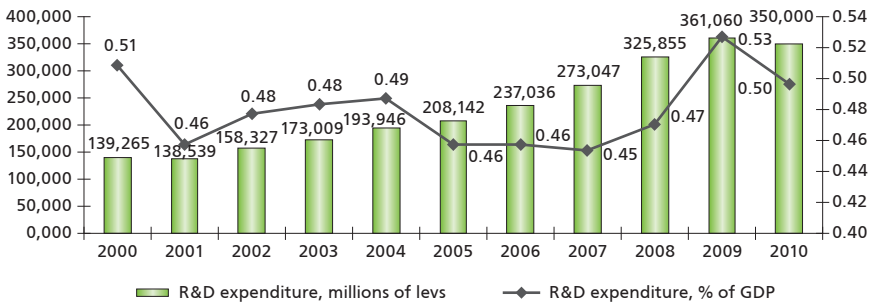
In 2010, the EU adopted the Europe 2020 Strategy[26] and **reiterated its intention to achieve the target of an average 3 % of GDP invested in R&D and innovation, with an emphasis on the efficient use of these resources.** The share of total R&D expenditure set by the Bulgarian government in its position on Europe 2020 and the National Reform Program (2010 – 2013)[27] is 1.5 % of GDP, or three times that of 2009. This ambitious objective should be an essential boost of the national economy's competitiveness, but its implementation requires significant efforts by the public and private sectors. At the same time, there are still considerable doubts as to the capacity of the public administration to achieve that. The disparity in the actions and priorities of the two ministries which are the driving force behind it – the Ministry of Economy, Science and Tourism and the Ministry of Education, Youth and Science – is particularly worrying.

This objective seems more easily achievable in absolute terms. R&D funding for 2009 increased 2.6-fold compared to 2000. However, the task becomes more complicated when this is compared to the potential of the national economy to invest in long-term competitiveness, measured as a share of R&D expenditure in GDP. **The increase of R&D expenditure should essentially exceed GDP growth** which has rarely happened in the last decade.

Funding for R&D in Bulgaria has been increasing constantly in absolute terms in all sectors over the past ten years. R&D expenditure in the sectors of higher education and enterprises has increased by an identical rate (slightly over 3.6-fold) and merely twice larger sums have been distributed for the state sector (publicly funded research units, BAS, AA).

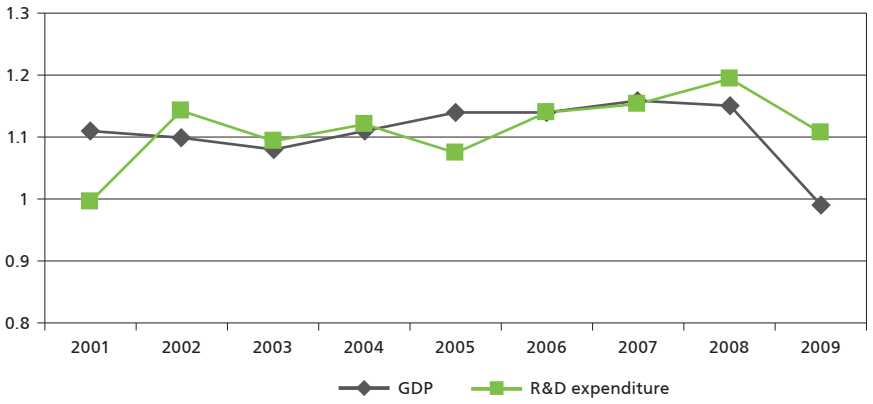
Over the ten-year period, there has been a relative increase of the share of higher education, enterprises and non-profit organizations at the expense of the state sector. However, the share of enterprises in R&D

Figure 14. R&D EXPENDITURE IN BULGARIA[28]



Source: Own calculations based on NSI data, 2011.

Figure 15. GDP AND R&D EXPENDITURE GROWTH RATE, % Y/Y



Source: Own calculations based on NSI data, 2011.

[26] *Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth,* European Commission, Brussels, 3.3.2010 COM(2010) 2020 final.

[27] National Reform Program (2010 – 2013) implementing the Europe 2020 Strategy, Sofia, November 12, 2010.

[28] The figures for 2010 were determined on the basis of preliminary NSI data about 2010 GDP at 70,474 million levs at current prices and expected reduction of R&D expenditure.

expenditure in Bulgaria still remains half of that in EU27.

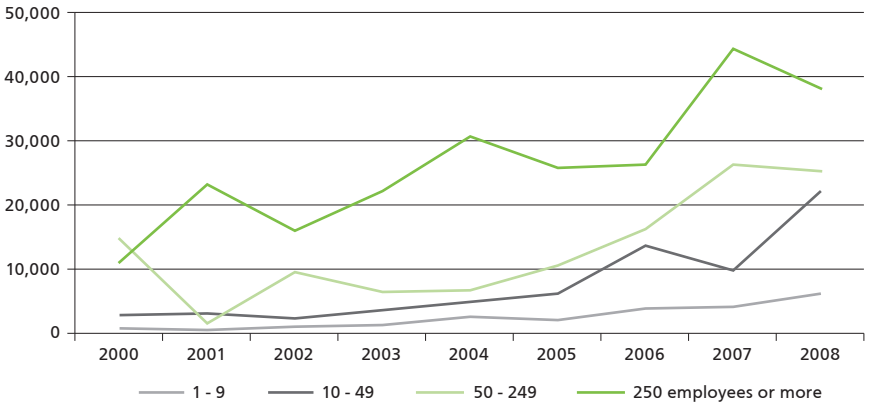
The relatively low interaction within the innovation system is also confirmed by the intensity of financial flows between the institutional sectors.

Given the limited capacity of enterprises to support research infrastructure and staff they refrain from declaring interest in R&D projects in the other sectors. A mere 5 % of the R&D expenditure of enterprises goes into the sector of higher education. The intensive informal contacts between universities and business, evidence of which previous editions of *Innovation.bg* has provided, cannot provide the necessary maturity of relations on which the new knowledge transferred could be commercialized. On the one hand, they are restricted by the governance mechanisms at universities and academies, and on the other – business finds it much cheaper to buy knowledge directly from individual scientists or teams rather than deal with public bureaucracies.

The government target for research activity in higher education is exceedingly low, although this is a basic source of R&D funding for the sector mainly through the university budgets for their typical research activity and the funds under the National Science Fund.

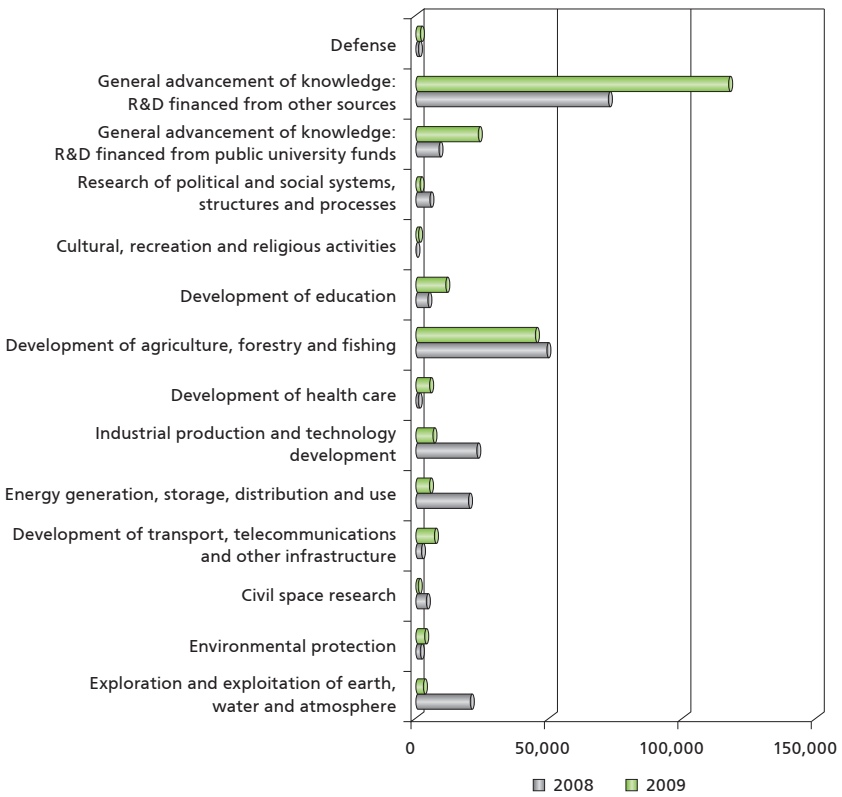
Public funds for R&D are invested mainly in state-financed structures (research institutes, BAS and AA) and very little (13 %) is channeled into promoting R&D in the rest of the sectors.

Figure 16. R&D EXPENDITURE IN THE BUSINESS SECTOR BY ENTERPRISE SIZE



Source: NSI, 2011.

Figure 17. GOVERNMENT BUDGET OUTLAYS ON R&D BY SECTOR, THOUSANDS OF LEVS



Source: NSI, 2011.

In the business sector, albeit with certain fluctuations, R&D costs are on the rise among all groups of enterprises. The greatest dynamics over the period was registered with micro-enterprises with an over 9-fold growth of R&D expenditure, followed by small enterprises with a nearly eight-fold increase of annual expenses for research and development. The smallest change was among medium-sized enterprises (1.7-fold) which come after the large companies with R&D expenditure growth of 3.4-fold.

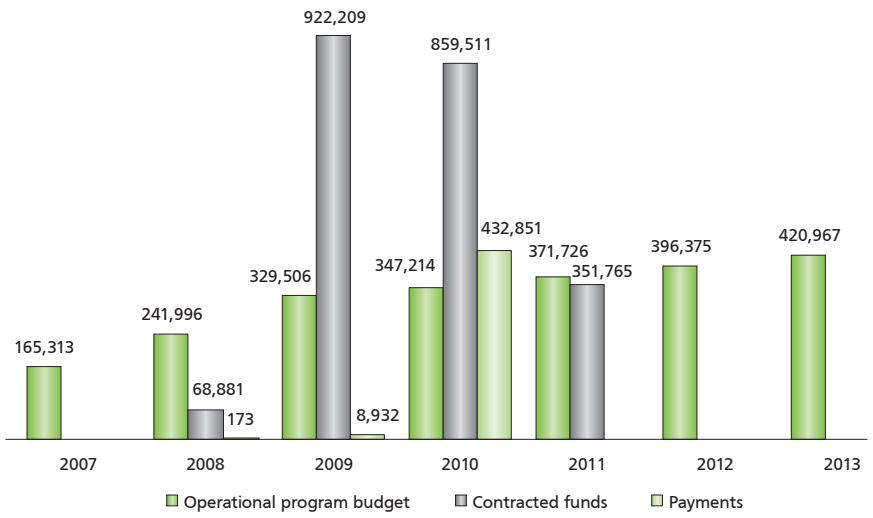
Another example of positive change is the more even distribution of

R&D expenditure among planning regions after 2000. The influence of the Southwestern Region declined by nearly 10 % to the benefit of the South Central Region (an almost fourfold increase) and the Northeastern Region. The share of the North Central Region also decreased.

Due to the powerful presence of the state sector in the Southwestern Planning Region, there the share of the business sector in R&D expenditure is a mere 24 %, ranking the region last by this indicator. The South Central Region is the leader, with business participating with over 71 % in investments made in research and innovation. The Southeastern and North Central Region share the second place, with 48 % share of enterprises in R&D expenditure.

In the years before the economic crisis, there were essential changes in the distribution of public funds for R&D by social and economic targets. At one end is health care, with a nearly 6-fold increase in R&D expenditure, as well as transport and telecommunications with a 3.3-fold growth. At the other, are exploration of the earth, water and atmosphere; space; energy production and use; industrial production and technologies, with a decline in public funding of between 70 % and 80 %. Inasmuch as such critical for the respective scientific field changes are not part of the application of a deliberate government policy, their effect could hardly be expected to be positive. It is quite probable that they may cause fierce lobbying pressure. In this sense, such an approach taken by public funding could introduce contradiction and confusion rather than create conditions for sustainable development – **increased funding is not related to reform and improvement of work efficiency, while reduced funding leads to problems with the implementation of already launched long-term projects.**

Figure 18. FUNDING BY OP COMPETITIVENESS, THOUSANDS OF LEVS



Source: Unified Management Information System for the management and monitoring of EU structural instruments in Bulgaria, January 2011.

Innovation financing through the operational programs

In 2009 and 2010, the financial instruments for development and promotion of entrepreneurship and innovation in Bulgaria remained either non-operational (National Innovation Fund [NIF]) or at an initial stage (the JEREMIE initiative), with only Operational Program Competitiveness providing a financial mechanism for business, albeit difficult to access. Although the activity of NIF has practically been terminated, its functions should be restored in the form of an independent legal entity (not a program scheme, such as it is now) as part of the update of the national innovation strategy and/or the passage of a law on innovation. The idea of combining NIF and the National Science Fund into a single instrument in support of the entire life-cycle of innovation – from research to commercialization of the end-product – which was publicly discussed in 2010, is another alternative in this respect.

In May 2010, the National Assembly ratified the renegotiation of the agreement between Bulgaria and the European Investment Fund. This provides for the extension of more funds for venture financing at the expense of standard credit lines for business enterprises. According to the decision, three private equity investment funds are to be established:

- For venture funding of start-up enterprises – with a capital of €30 million, including €21 million from JEREMIE and the rest – from external sources;
- For growth capital for micro through medium-sized enterprises;
- For mixed equity and loan funding – the so-called mezzanine fund (each of the latter two funds will have €60 million – half from JEREMIE and half – from external sources).

With the exception of JEREMIE[29] which increased the reported absorption of funds under the entire OP Competitiveness from 2.8 % to

[29] Financed under Priority – 3 – Financial Resources for Developing Enterprises (FREDE) of OP Competitiveness.

19.4 % – without, however, these sums having yet reached the companies – the other priorities are lagging in the implementation of the projects and the payment of financial aid to the beneficiaries.

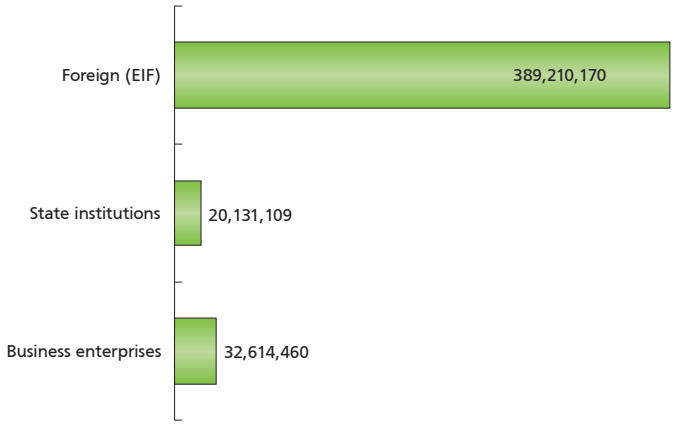
The main criticism business and a large portion of the independent experts level at the functioning of OP Competitiveness is aimed at the complicated, laborious, incomplete and ambiguous requirements of the application procedures, non-abidance by deadlines or lack of such for the individual stages of evaluation and implementation of the projects by the public administration.[30]

Another problem is the lack of clear-cut criteria for prioritization of the supported sectors or the choice of minimum thresholds of the aid requested which are not the result of analyses based on empirical data.[31] The inability of the administration to speed up the processing of projects and to make the participation of business in this OP easier does not justify the spending of 98 % (5,253,553 levs) of the funding under Priority 5 (Technical Assistance) for capacity building and technical and resource support of the Intermediate Body (the Bulgarian Small and Medium-sized Enterprises Promotion Agency – BSMEPA), including slightly over 65 % spent on direct payments of remunerations of officials from BSMEPA and the Ministry of Economy, Energy and Tourism (MEET) for their work involving management of the OP.[32] At this point, this ranks BSMEPA first among the beneficiaries of OP Competitiveness according to actually received funds, with over twice the sum received by the next beneficiary (Bulgarian Investment Agency, MEET) and more than four-fold the funds received by the largest beneficiary among private business enterprises.

The implementation of the operational program to date shows that, besides the noted weaknesses in its management, the inefficiency of target-setting of the program itself has a potentially greater negative influence on entrepreneurship. Priority 1.1. Support for the creation and commercialization of innovations in enterprises and protection of industrial property rights[33] is aimed directly in support of innovative entrepreneurship in Bulgaria. Of the total of 40 approved projects, seven also include academic institutions as contractors (5 universities, Interior Ministry Academy and four BAS institutes), all projects with the participation of academic institutions being part of the procedure for "Support for the creation and development of innovative start-up companies". The lack of a specific requirement for such cooperation in the criteria for evaluation of this procedure gives grounds to assume that these partnerships are oriented towards the implementation of the respective innovation and are not the result of compliance with the administrative requirements.

Besides direct interaction in the process of innovation, there is a more intensive cooperation (an average of two-thirds of the projects) between the business sector and scientific institutions within the Operational Program Development of Human Resources, the academic organizations having a primarily educational role in the process of raising professional qualifications. These results show that, in this form operational programs fail to promote the establishment of innovation-oriented institutional relations between science and business. The absence of a research spin-off in which part of the formal ownership would be held by an academic institution among the submit-

Figure 19. DISTRIBUTION OF FUNDING BY OP COMPETITIVENESS BY BENEFICIARY TYPE (by January 15, 2011; in Bulgarian levs)



Source: Unified Management Information System, January 2011.

[30] Nearly 59 % (371 of a total of 630) of the projects submitted under the procedure for internationally recognized quality standards, the result of which became public in the beginning of 2011, were declared ineligible at the stage of administrative compliance of documents.

[31] The lack of preliminary analysis is indicative of the procedure of call of proposals under 2.1.09 "Provision of consulting services for firms in difficulty", closed at the end of 2010, at which the four applicants were rejected as not corresponding to the definition of "firms in difficulty" in spite of the criticism levelled by the media at the conditions for application.

[32] Unified Management Information System, at January 15, 2011.

[33] To date, projects of this priority axis have been approved under two procedures – 1.1.01. "Support for the creation and development of innovative start-up companies" (30 projects) and 1.1.02. "Support for the introduction into production of innovative products, processes and provision of innovative services" (10 projects).

ted applications is additional proof in this respect.

In spite of these shortcomings, OP Competitiveness is and will continue to be an important source of funding of Bulgarian enterprises in the current and in the preparation of the future EU budget framework. In addition to improving the management of the program and a better focus on the practical problems of the economy, in order to become a successful financial instrument it needs the following:

- Bulgarian enterprises are much smaller than their European partners in terms of their assets. This also means a lower average capacity for formal R&D, need of less funds and concentration mainly on the implementation of marketing and organizational innovation. Projects of over €1 million are too large for the majority of Bulgarian companies. Therefore, the rules of the program have to be adapted to the conditions of the Bulgarian economy. For example, it doesn't make sense to require patent registration in order to recognize the implementation of an innovation project. In practice, exceedingly risky activities such as innovations are funded by a cumbersome administrative program which will hardly lead to greater progress from what has been achieved to date.
- The lack of a significant number of fast-growing medium-sized and small enterprises in Bulgaria makes it difficult to find appropriate projects for funding which correspond to the generally accepted volumes of venture funding in the EU. Therefore, in this first budget period of the program, it would be more reasonable to direct the funds at the development of soft infrastructure (intermediary organizations) and at the restoration of technological and research capacity (BAS, universities, etc.).

Human Capital for Innovation

The personnel engaged in R&D, including academic and technological activity, is indicative of the available human resources directly responsible for the creation, application and dissemination of new knowledge in the field of technologies. The indicator of employment in high-tech sectors characterizes the country's specialization in areas with a high level of innovation activity.

Most of the challenges to which Europe will seek a solution over the next ten years are related to human resources – ageing of the population, discrepancies in the labor market, continuing brain-drain towards third countries, lagging behind by the indicators of employment and efficiency. The dynamic economic changes require new and specific skills which educational policies could hardly predict. Along with the growing influence of highly-qualified workers,[34] the EU anticipates the need of further increase of the number of students and post-graduate students in technical subjects, researchers and employed in high-tech sectors of the economy.[35]

Against the backdrop of the positive changes in dynamic and structural terms as regards R&D staff, Bulgaria continues to lag behind the rest of the European countries which should make the direction and the speed of changes in the field of education and science a key issue of debate.

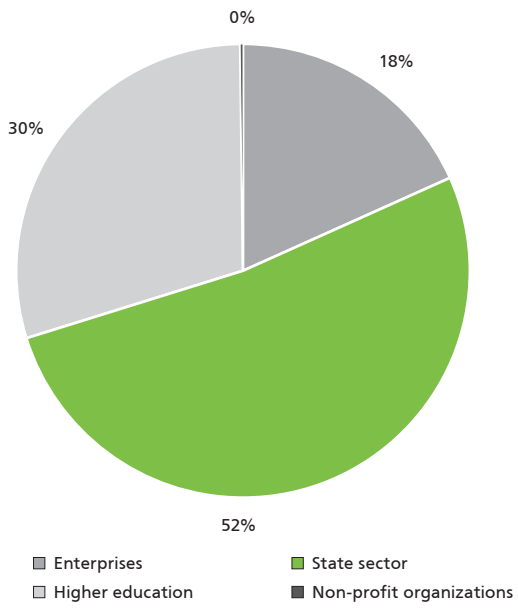
The staff engaged in R&D has increased by 20 % in the last ten years. The rate of change is slightly higher in the case of research personnel who in 2009 had a 66 % share in the total number of R&D-employed compared to 62 % in 2000. **Nevertheless, in terms of the share of personnel engaged in R&D within the general employment rate in the national economy Bulgaria remains at one of the lowest levels in Europe** – 0.48 % which is nearly three times below the European average (EU27 – 1.3 %). Only Poland (0.44), Cyprus (0.33) and Romania (0.31) rank after Bulgaria.

The situation with the funding for R&D personnel is the same. In spite of the increase of expenses per person engaged in R&D by over two-fold in the first decade of the 21st century, **Bulgaria ranks last in the EU with slightly over €8,000 per person engaged in the R&D sector compared to the average EU27 level of €68,000.** Compared to the standard of living in the country, however, the remuneration of research staff is more than twice the average salary in the economy (nearly €3,800 for the same period).

Romania has double the budget per person engaged in R&D. As a whole, all countries in Central and Eastern Europe remain below the average European level by this indicator – from €13,000 for Latvia to €43,000 for Slovenia.

As a large portion of the total R&D expenditure is used to cover overheads and above all for salaries of

Figure 20. R&D STAFF BY SECTOR, 2009



Source: NSI, 2011.

[34] *Skills Supply and Demand in Europe, Medium-term Forecast up to 2020*, CEDEFOP, European Centre for the Development of Vocational Training, Luxembourg: Publication Office of the European Union, 2010.

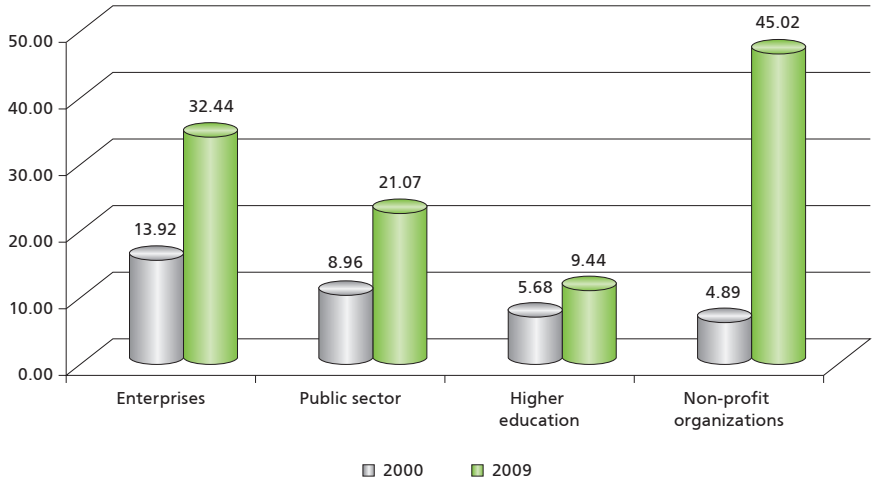
[35] European Innovation Scoreboard (EIS) 2009, European Commission, Enterprise and Industry, PRO INNO EUROPE PAPER N15P 2010.

the research and related staff (85 % in 2008), the trend in the sector distribution of R&D-engaged staff follows the change in the structure of spent funds. Between 2000 and 2009, R&D-engaged staff in the state sector declined by 25 % while it increased by 88 % in higher education.

The faster increase of personnel engaged in R&D at universities (2.2-fold) leads to a cap on the increase of remuneration and to a relative reduction of the price of labor of academics – **9.44 thousand levs per employee at universities.** R&D personnel receive much higher remuneration in the business sector (32.44 thousand levs per employee). The greatest increase is registered with non-profit organizations where the 30 % increase of staff is accompanied by over 12 times higher salaries. The main sources of R&D expenditure for non-profit organizations are the state budget, which accounts for some 65 % of their budget, as well as enterprises, which provide another 29 %. It should be noted, however, that because of the small number of reporting organizations these increases should be interpreted carefully as they could be real but they could also be due to increased reporting. The division of the sectors is conditional too – for example, a sizeable portion of the R&D activity at non-profit organizations is carried out by staff of the higher educational establishments and the academies. The bulk of R&D funding on non-profit organizations comes from other sources, not from the state sector, but because of problems in accounting they are accounted as funding from the state.

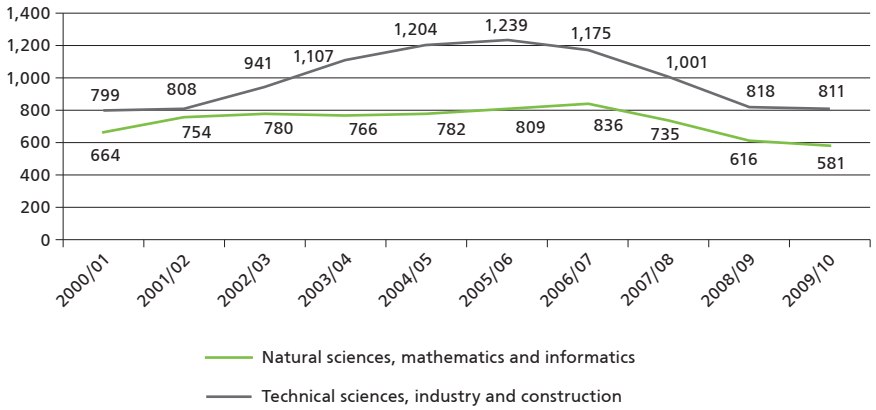
In 2009, the **high-tech sector** in Bulgaria provided employment to 95,000, or 2.92 % of the employed in the national economy. The EU27 average level is 3.73 % and Romania with 1.84 % has the lowest ranking by this indicator.

Figure 21. EXPENDITURE PER R&D-ENGAGED STAFF, THOUSANDS OF LEVS



Source: Own calculations from NSI data, 2011.

Figure 22. NUMBER OF PhD STUDENTS



Source: NSI, 2011.

After 2000, the number of people employed in the high-tech sector increased constantly until a change in 2009, when the number of employed in the sector returned to 2005 levels, i.e. had a 6 % year-on-year decline. Compared to the total number of employed in the economy this decline has been present since 2005 which means that the trend is a persistent one. **Even in the period of intensive growth before the crisis, employment and the growth of the sector were below the potential of the economy as a whole.**

Although the leading high-tech companies hire doctoral students and researchers, studying for a doctoral degree still has not become an effective instrument for improving business competitiveness, but is rather one for personal development. **The combination of significantly reduced funding and chaotic reforms without a clear vision is not the best recipe**

for the development of science and education.[36]

In spite of the chaotic revisions to the legislation regulating the institutions of higher education, the shortage of funds and low degree of transparency of the financial management in universities, there is a desire to use the potential and to apply European practices in education as a basis for attracting students. **A number of problems remain on the agenda,** but their solution would be difficult to achieve without an adequately implemented state policy at national level:

- **Gaps in the quality of educational service** accumulated and deepened over the years and by education and qualification degrees.
- **Deteriorating age structure of the academic staff** combined with lack of competition among young people for a scientific career.
- **Lack of vision and strategic moves** for the development of higher education at different scenarios of change in factors like demographic situation, increasing competition on the European education market or failure in the quality of secondary education.
- **Lack of priorities for development** of the economy, which makes it impossible to plan the supply of specialists with specific, new or advanced skills and qualification. An additional problem is the system of funding education which does not manage properly the linkages between higher education and business. The trend of an increasing stream of Bulgarian students studying abroad (who can hardly be convinced later to make careers in a Bulgarian environment) is combined with a higher demand for specialists in a broad range of economic activities (from construction to science), ones that are well-trained and have advanced professional skills.

Along with this, the **attempts to position Bulgarian higher education on the international market of educational services** are too fragmented (individual programs and universities) compared to the well-developed and aggressively applied strategies of foreign universities to attract students from countries of peripheral and developing economies, including Bulgaria.[37] Such positioning is further hampered by insufficient preparedness for a mass transition to education in internationally recognized languages or such of European standing.

[36] "Scientists in Romania and Bulgaria are having the best and the worst of times", *Nature* 469, 131-132 (January 13, 2011), Published online January 12, 2011, http://www.nature.com/nature/journal/v469/n7329/full/469131b.html

[37] See *Analysing the Future Market – Target Countries for German HEIs,* Centre for Higher Education Development GmbH, Working paper No. 107, May 2008.

Information and Communication Technologies

The ICT sector: production, exports and innovativeness

Against the backdrop of the 2010 negative signals from Lausanne[38] and Davos[39] about the deteriorating competitiveness of the Bulgarian economy as a whole, the positive news from the various sources on ICT in this country provide grounds for optimism that this sector could serve as the basis for the faster development of the entire economy. Bulgaria ranks 53rd in general competitiveness,[40] but it is 3rd in investments in ICT, 6th in average internet user speed, 8th in mobile telephony distribution, 10th in broadband internet relative price (1st by nominal mbps price)[41] and 12th by the export of services (mainly ICT). Using different methodologies, in 2010 Gartner and ATKearny positioned Bulgaria as a leader in outsourcing on a global scale (top 30 in the world according to Gartner, 1st in Central and Eastern Europe and 13th in the world – according to ATKearny).

The reason for this success are both the major international ICT companies with a permanent presence in Bulgaria – HP (2,100 employees expected to hire an additional 2,000 in 2011), IBM (500 employees), SAP Labs (500 employees), Siemens (500 employees), Johnson Controls (500 employees), VMWare with its second-largest R&D center in the world (250 employees), Computer Sciences Corporation (600 employees), Sitel (400 employees) – as well as the smaller Bulgarian branches of Codix (260 employees), Thumbleweed/Axway (160 employees), Software AG (90 employees), Adastra (70 employees) and some smaller companies to which IT hardware and software development and maintenance services of other global leaders have been outsourced (for example, sectors like operating systems, robotics and machine-building, oil extraction and processing, e-trade and finance).

Six to eight years were needed from the appearance of the first faint signals (SAP Labs and Tumbleweed)[42] for Bulgaria's establishment as a place where not only outsourced cheap software or electronics were made, but also as one where innovations, including global, occurred in the field of ICT. Bulgaria is the country which has the largest contribution to SAP patents in the US after Germany (9 % of the SAP patents in 2010 had a Bulgarian co-inventor, 12 % in 2009 and a total of 7 % since the establishment of SAP Labs in Bulgaria in 2002), while SAP patents with Bulgarian co-inventors accounting for two-thirds of all patents awarded in the US in 2009 and 2010. Unlike SAP Labs, the other R&D-intensive local offices of global companies (like VMWare, Johnson Controls, Software AG) do not submit patent applications in the US with the names of their Bulgarian employees, even if these engage in certain development work here.

ICT innovations in Bulgaria occur not only in foreign companies. A new model of innovation in the ICT sector has appeared which combines characteristics of outsourcing and corporate enterprise – the development activities are outsourced in the country, but the rights/trademark remains for the foreign company in return for rights to be used in Bulgaria or neighboring markets (the Balkans or Eastern Europe and Central Asia) or on the part of the innovation developer company.[43] This is an intermediary model between 100 % FDI of established global innovative companies and purely Bulgarian companies established on the international market. This model has the most serious potential for growth and positive externality for the economy because of the stronger ties between the development unit in Bulgaria and the company launching the innovation on the international market (which is both a barrier to subsequent relocation of activity to new destinations and an opportunity for growth based on the partners of the initial client). Usually, companies in this medium group are connected in a capital network of joint-ventures with foreign companies and those that result from Bulgarian individual or corporate serial entrepreneurship.[44] Work on new technologies (which still have not been released on the global market) and the relations of software engineers very quickly lead to alternative solutions which are offered under a Bulgarian brand.[45]

Most interesting are the companies which have managed to establish

[38] 2010 World Competitiveness Yearbook, IMD, Lausanne.

[39] The Global Competitiveness Report 2010-2011, World Economic Forum, Davos.

[40] According to 2010 World Competitiveness Yearbook, IMD, Lausanne.

[41] More detailed comparisons on different indicators related to internet usage can be found at netindex.com

[42] See also "Forget India, Let's go to Bulgaria" *in Businessweek*, March 1, 2004.

[43] One example in this respect is the partnership between Event Games (a Bulgarian start-up) and ikinema.com (an academic spin-off of a Bulgarian from the university in Surrey, UK). The partnership between a Bulgarian development company with a leading global hardware supplier for Georgia's e-government is another such example.

[44] One of the most distinctive examples in this respect are the Sirma Group companies (a total of some 320-350 employed), as well as AMK – Gabrovo.

[45] For example the development of bipper (Norway) by Sirma and a similar own product of Bianor.

their own Bulgarian brand or product on international markets such as Telerik (300 employees), Fadata (160 employees), Chaos Software/Group (60 employees),[46] Bianor (40 employees), Datex (60 employees), Daisy Technology (80 employees), ORAK Engineering (50 employees), as well as others. They are forced to innovate on a regular basis in order to keep and expand their market shares.

Electronics[47] was one of the few sectors which continued to grow during the economic crisis, albeit by a little in 2009 (3.8 % compared to 2008), and in 2010 already demonstrated that it had come out of the crisis. In January – November the growth of exports of office machines and automatic data-processing machines (SITC[48] 75) on an annual basis stood at 34 %, and of electrical machinery, apparatuses and appliances, and electrical parts thereof (SITC 77) – 24 %, at an average 23 % growth of exports for the same period. These data are even more optimistic if compared to average EU levels (January – November 2010/2009) – the total annual growth of exports was 6 %, the growth in the SITC 77 group was 9 %, and in the SITC 75 group there was a 4 % decline.[49] **For the first time, Bulgaria exported more electronics to Germany than it imported from that country in the first quarter of 2010.**

The scale in electronics is guaranteed by companies like Epic Electronics (over 2,000 employed in the largest enterprise of the group in the world, nearly thrice that in China and accounting for a total of 64 % of the employed in the group), Sparky Elstos (800 employees), Opticoelectron (over 700 employees in the holding's enterprises), and the smaller but highly innovative[50] Samel-90, Saturn Engineering, Optics, Datex, Daisy Technology, Elta-R which are leaders in Eastern Europe and export their products all over the world.

Table 2. DEGREE OF COMPANY INDEPENDENCE AND OWNERSHIP OF INNOVATIONS/DEGREE OF INNOVATIVENESS

<table>
<tr><td rowspan="2">IT services and support (Bulgarian companies or joint ventures). SW. HW assembly. Many, mainly small, but there are also some with over 100 employees. Introducers of IT solutions in non-IT companies.</td><td>Innovative companies mainly for the Bulgarian market with a potential for growth. Excellent contacts with academic institutions. Fields: SW, HW, avionics.</td><td>Local companies with own products/brands on the international market or on regional markets. Few in number with 40 to 100 employees. Field: SW/HW</td></tr>
<tr><td colspan="2">Export of innovation in Bulgarian companies or joint ventures but retaining the brand/ ownership. Sometimes the local company is free to find new (global) clients or holds rights on geographical markets. Good relations with academic institutions. Fields: SW/HW.</td></tr>
<tr><td>Global Delivery Services/ Call centers/ IT support

Almost no innovation. High concentration. Mostly no relations with academic institutions, and if there are – rather PR and strategy for recruitment of staff. From 200 to 2,000 employees. Field: Services.</td><td>Code writing and testing of relatively new/innovative technologies/products. QA, (requirements engineering usually done at the parent company). Field: SW</td><td>Outsourced R&D centers of global companies. Continuous innovation. High concentration. Almost standard 150-250 employees. Usually have doctoral students as employees. Field: SW</td></tr>
</table>

Note: SW = software, HW = hardware, QA = quality assessment
Source: Applied Research and Communications Fund, 2011.

A number of companies, which are not involved in the narrow field of electronics but in the related field of industrial automation and robotics (such as Spesima, Vaniko, Mechatronica), drive technology (AMK drive and control equipment) or partially operate in the field of avionics (Telesys,[51] Armstechno[52]), also contribute to both the stable exports and the innovativeness of the sector. The companies in this group have very good relations with academic institutions (including because their own-

[46] A leading company in the world in the field of rendering technologies (for example, its main product – V-Ray – was used in the making of award winning movie *Avatar*).

[47] The role of electronics for the Bulgarian economy was discussed in *Innovation.bg 2009*. In terms of growth in this sector Bulgaria was among the 10 fastest growing countries according to OECD data.

[48] Standard International Trade Classification.

[49] http://bulgaria.world-countries.net/archives/11862.

[50] Most of them bearers of ARC Fund's Innovative Enterprise of the Year award (2004 – 2009).

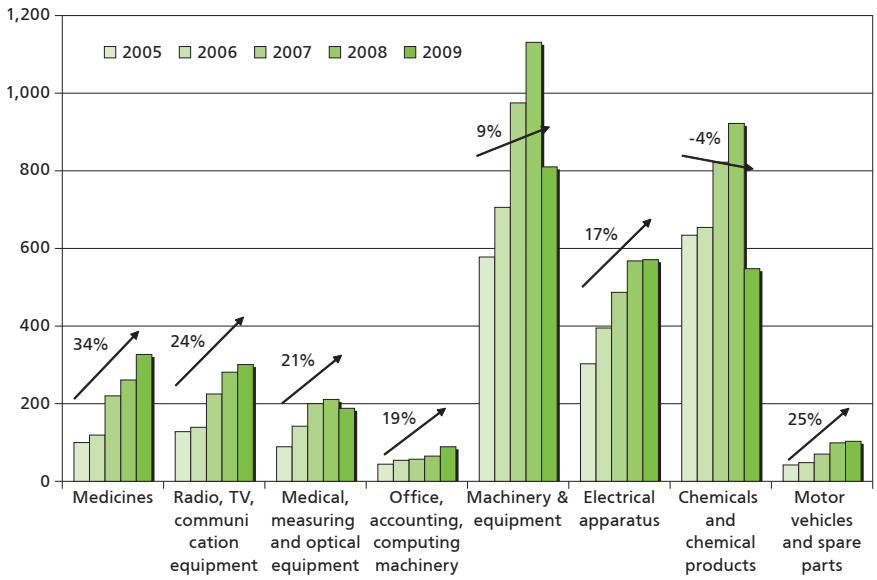
[51] Telesys is a company of a serial academic spin-off operating in the field of ICT, electronics and avionics, and even in aircraft manufacturing.

[52] Producers of a Bulgarian unmanned aerial vehicle NITI with own avionics, certified and exported to NATO countries.

ers and managers were once or still are part of them) – both informally and formally (clusters, joint projects and so on) – and act as innovation integrators since by their activity they introduce or trigger innovations with nearly every contract in nearly all other fields (e.g. machine-building, light industry). These companies are either entirely Bulgarian or joint ventures which, however, have R&D departments and relatively large freedom of action. Through their networks of clients[53] they can become multipliers for innovations and the placement of more Bulgarian companies on foreign markets.

The Ministry of Economy, Energy and Tourism defined the ICT sector as a priority for development because of the sustainable growth in the last five years, the relatively higher value added in the sector and the opportunity for easier migration from one sub-sector to another in the quest for higher growth. In this sector, R&D is probably most intensive. For example, RaySat had a comparable number of patent applications with SAP in 2009, and Sirma Group's Ontotext had a comparable number of publications in journals with an impact factor to those of the BAS Institute of Mathematics and Informatics per number of employees. According to a study of the Applied Research and Communications Fund, data about R&D in ICT are considerably underestimated by the NSI (three to tenfold on average).[54] The policies of the two main ministries responsible for R&D and innovations – the Ministry of Economy, Energy and Tourism and the Ministry of Education, Youth and Science – do not support these positive developments in the ICT sector in Bulgaria. For example, unlike the Ministry of Economy, Energy and Tourism, the Ministry of Education, Youth and Science produced different policy solutions (a research strategy and roadmap) which excluded ICT from their priorities, in spite of the tangible strengths (publications, patents, R&D units, evaluations by independent international sources and so on) in ICT, including the numerous projects of ICT companies funded by the National Innovation Fund and OP Competitiveness.

Figure 23. EXPORTS BY GROUPS OF GOODS IN MILLION EURO AND AVERAGE ANNUAL GROWTH FOR 2005 – 2009



Source: Ministry of Economy, Energy and Tourism, 2010.

ICT: use and innovation effects

Innovation in enterprises, particularly the use of ICT, followed two different models in 2009 and 2010. On the one hand, most cases are of late adopters – about 1-2 % of the companies which have constructed their website for the first time, about 6 % of the companies which have broadband access to internet, and as many (6 %), which have begun to use electronic banking in 2009, between 2 and 12 % of the companies which have connected their computers in intranet for the first time, as well as others. These enterprises are from the cluster of "optimizers".[55] On the other, early adopters in Bulgaria are companies which: continue to develop their websites to receive online orders (by 1 percentage point more in 2009 than in 2008), and the online order and delivery companies have increased by 2 percentage points, while some 5 % partially automated their relations and business processes with suppliers and/or clients. This is mostly the group of catch-up companies.

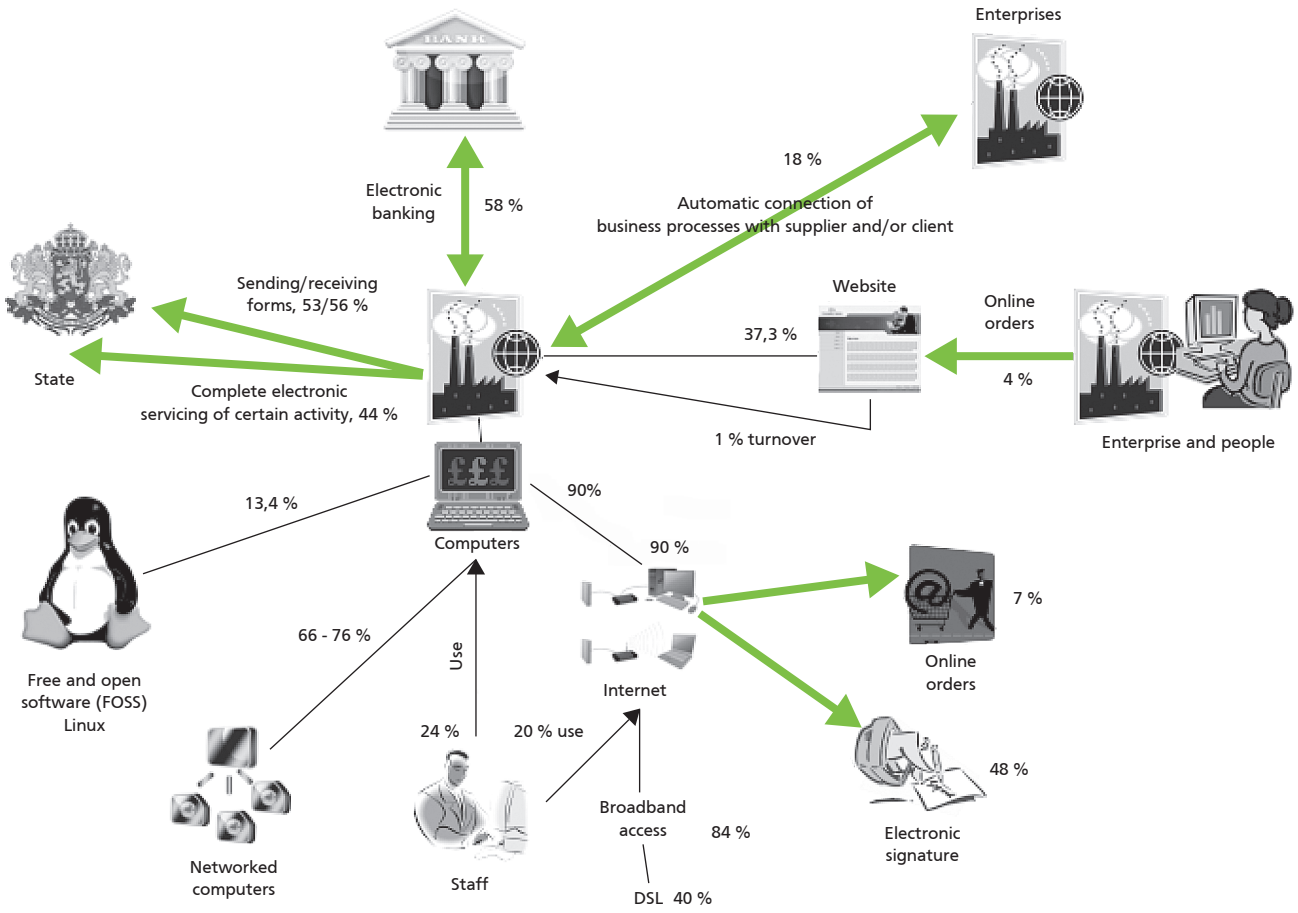
About 3 – 4 % of the employees routinely used computers and internet at their workplace for the first time in 2009, reaching respectively to a total of 24 % and 20 % degree of distribution among the employed in the first quarter of 2010. An ever increasing number of open job positions are announced on the websites of enterprises (15.5 % of the enterprises have such advertisements) or in the specialized recruitment sites (jobs.

[53] Practically all important markets with a potential for enormous growth, including China, India and the CIS countries.

[54] For more details about the typology of cluster analysis-based companies see Innovation.bg 2009 and *Innovation.bg 2010*.

[55] See *Innovation.bg 2010*, p. 21.

Figure 24. USE OF ICT BY ENTERPRISES IN BULGARIA



Source: ARC Fund and Eurostat, 2011.

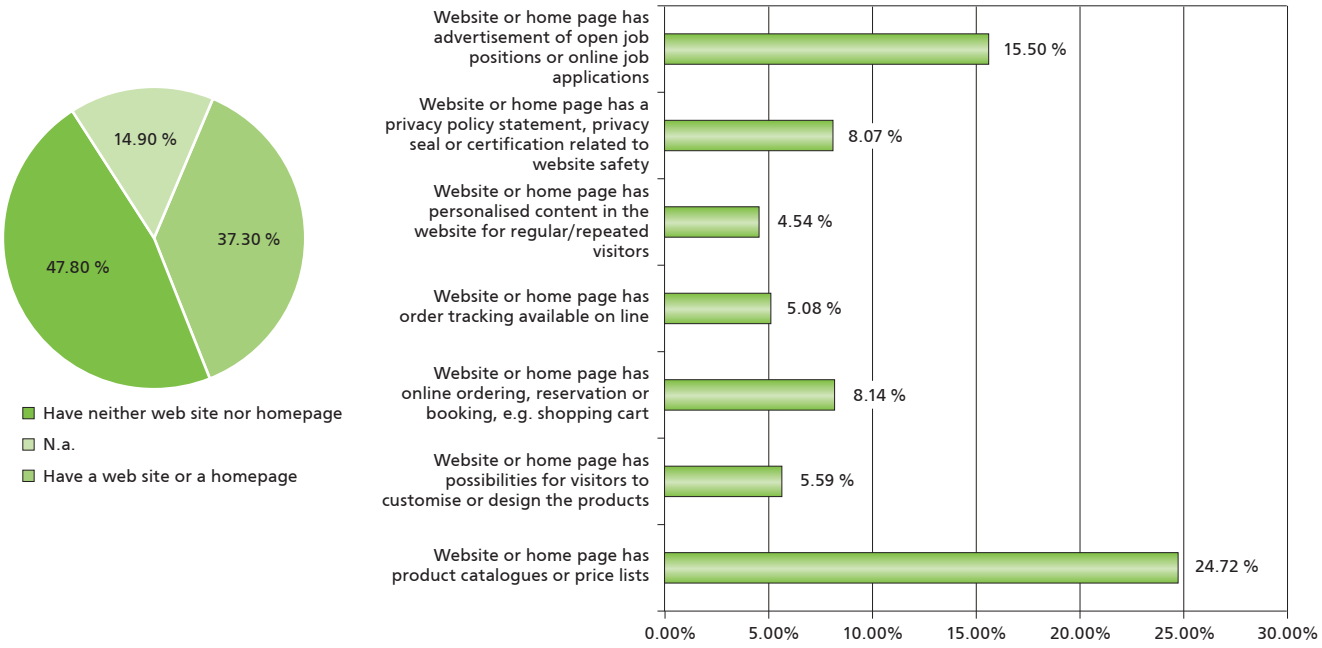
bg, karieri.bg, itjobs.bg and others), while employers (particularly in the knowledge-based industries) carry out online searches about the job applicants to find more information that would held them in decision-making. With the fast spread of mobile internet and smart phones, more people (and companies) can be online through their phones while they are at work than by means of their office computers. This trend was detected by some innovative companies which developed easier ways for mobile payment than the existing mobile banking and launched the service in the beginning of 2011. Again, because of the smart phones (and tablets) with broadband internet access at acceptable prices (practically the price of accessible home internet) the group on innovation leaders developed special applications for their early adopter clients, to enable them to use those precisely through their phones and tablets.

According to official data, the use of websites in Bulgaria is somewhere in the beginning of the "early majority."[56] However, if one takes into account that some 43 % of the active companies in Bulgaria, according to NSI, are practically a form of self-employment (without a single employee), and the non-respondents are re-calculated, then it turns out that the country is rather in the stage when the last 15-20 % (late majority and lagging behind) of the companies construct their own website.

Eight per cent of the company sites offered some opportunity for online trade (bookings, orders and payment) in 2010. Merely half of them, however, achieved more than 1 % of their turnover online. In the last year there was a slight increase of both this share (by 1 percentage point) and the average turnover from e-trade. Interestingly, 6 % of the enterprises have declared that their sites provide the opportunity for tailoring the products according to client desires or to design themselves. Although this functionality is more of an intention than a reality, in 2011 there will be a number of such innovations, particularly along the chain for adding value in construction (and the connection with other sectors – for example, trade in furnishings – software for interior design). The collec-

[56] See *Innovation.bg 2009*, p. 104.

Figure 25. AVAILABILITY AND FUNCTIONALITY OF WEBSITES (Q1 2010)



Source: Eurostat, 2011.

tive shopping sites (about 20 specially targeted at Bulgarian buyers), which are in themselves a social innovation, will continue to become established in 2011 and will practically lead to a number of organizational and process innovations in the companies related to them.

A special type of innovation occurring in public organizations, related to e-governance and electronic public services is expected to continue in 2011. The National Revenue Agency (NRA) practically imposed electronic communication between itself and businesses (including by obligatory e-mails for those registered under VAT, a connection between NRA and petrol filling stations, successful absorption of the e-audit service, etc.). More than half of businesses claim that they use comprehensive electronic services. NSI also achieved considerable progress in reducing cumbersome administration by introducing ICT services at the receipt of company reports, the census and so forth. There are considerable problems in the practice of the Registry Agency which restrict the usage of its electronic services. The software for the establishment and maintenance of geographic information systems (GIS) became a sought after and value adding component in many municipalities. The design of e-government, however, is still not based on business logic but on administrative logic – which service will be easiest to provide, regardless of the interest in it. In this case, the government can have a powerfully innovative role through the mechanism of pre-commercial procurement, so that radically new services could be developed (from the point of business and consumers, not from the point of view of the administration) and provided through public-private partnerships. Government expenditure in this sphere is and is expected to be higher than the expenditure for R&D in ICT and it is absolutely necessary for them to have comparable – if not higher – efficiency in the private sector. Therefore an entirely new coordination is required between the various institutional partners for the development of ICT – the Ministry of Economy, Energy and Tourism, the Ministry of Education, Youth and Science, the Ministry of Transport, Information Technology and Communications, the National Science Fund, the National Innovation Fund, the Public Procurement Agency and the Bulgarian Small and Medium Enterprises Promotion Agency.

Innovation Aspects of Sectoral Competitiveness

Bulgaria's government has repeatedly declared intentions to focus innovation policies and economic development priorities on high-tech sectors, but this has never led – not even on paper – to synchronization of the various policies. Policy instruments are usually directed at the low and medium technology sectors – the least qualified strata of the existing workforce. Even from the period of the EU pre-accession programs, support for sectors like agriculture and tourism did not presuppose that these would be aimed at more knowledge-intensive and technologically saturated industries and services. For five years in a row, for example, the Tobacco Fund gave more money in support of tobacco production than the National Innovation Fund and the National Science Fund together gave for research and innovation (from 35 % to 700 %). For many years, with the tacit support of the government, the construction sector guaranteed higher return on investment at the same or lower risk than in the high-tech sectors mainly through regulatory non-compliance. This even led to the transfer of capital from high-tech branches to construction before the crisis, which in turn led to problems for numerous companies and the economy in 2009 and 2010.

Without any clear plans for the restructuring of the national economy, the discrepancy between declared priorities and real policy leads to channeling efforts (human resources, finance, administrative capacity, public expectations) in fields which cannot provide a sufficiently wide economic and social impact. The well-known innovative enterprises from the high-tech sector serve mainly for state PR and to balance the current account through the increase of exports, rather than for sustainable development and integration with low and medium technology sectors inside Bulgaria. High-tech branches account for a

mere 8 % of exports, while medium and high-tech together account for 27 % and 5 % of the workforce, and practically function independently of the rest of the economy. With the same share in employment, Romanian medium and high-tech branches account for over 44 % of exports.[57]

Innovation.bg 2011 focuses on two sectors – energy and construction which generally show lower than average results in respect to the standard indicators for research and innovation, but which have an important position in the Bulgarian economy. The purpose of the analysis is to identify fields and means of support for research and innovation in these sectors in order to guarantee their long-term competitiveness, and from there of the entire economy.

Regardless of low investment in R&D and patent activity, **the low-tech sectors demonstrate a potential for the introduction of know-how and new technologies generated by them, a strong involvement along the value added chain and considerable organizational and marketing innovations.**

Medium and low-tech sectors are a field for the application of technological projects from other sectors and thereby act as a driving force behind the research and innovation activity of high-tech activities and science intensive services. In some of the cases, they **have a sectoral innovation eco-system with a high intensity of interaction which guarantees the fast dissemination and diffusion of (un)protected and (un)codified new knowledge.**

[57] European Innovation Scoreboard, 2009.

Construction

Structure and importance

An evaluation of the innovation potential of construction companies and the possible impact of the policies for increasing their innovation activity is needed for at least two reasons: 1) the sector is structurally significant for the country and raising the efficiency and productivity of the companies there has a multiplying effect in the economy as a whole; 2) at the beginning and the end of the value added chain the sector is linked to high-tech activities and science-intensive services (architecture and design, production of new materials, production of machines and equipment, real estate operations) which increases the pressure on construction companies to introduce new technological solutions and offer products meeting high quality standards. These arguments acquired additional weight with the adoption of ambitious priorities by the European Commission and member states to improve the energy efficiency of housing and use the energy from renewable energy sources in the EU.

The significance of the construction sector for the Bulgarian economy is evident in a number of facts:

- Construction generates 7 % of the country's GDP.
- Construction provides official employment of more than 8 % of the economically active population and those employed in the sector amount to 13 % of all employed in the economy.
- Taking into account the informal economy, both in employment and in respect to added value, the share of construction in GDP is even larger – up to 10 % by expert estimates.
- The sector got nearly 10 % of FDI in the national economy (in the period of economic growth) and was a factor in the attraction of another 30 % of the foreign investments through the services involving the sale, rental and management of real estate.
- Over 40 % of the investments in fixed capital are in construction.
- The sector is critical in overcoming the effects of global climate change through the measures for increasing energy efficiency and limiting pollution.
- By creating housing, retail and office space the sector determines the quality of living and working environment.
- Given the government priorities for investing in infrastructure (motorways, roads, the underground railway) through European funds, in the next three years construction will continue to have a structurally significant role, even after the decline of housing and office construction following the crisis.

Furthermore, the sector has a strong impact on the national competitiveness and the attraction of foreign investments through the development and maintenance of transport infrastructure and influences decisions in other key sectors by means of the quality and reliability of the power grid and hydro-technical facilities. Construction has a considerable influence on public life as a result of the disbursement of funds by national and European programs and its share in public procurement. The sector is also related to the development of creative services such as interior and exterior architectural design, among others.

Because of the nature of its products, the sector does not participate actively in the formation of the country's foreign trade balance. However, construction, as well as the extraction and production of construction materials and equipment, at one end, and transactions with real estate and operation of infrastructure, at the other, attract serious interest from foreign investors.

The construction sector includes **varied activities:** construction of housing and non-housing buildings; development of transport infrastructure, hydro-technical facilities, the power grid and distribution networks, specialized construction services. The specific profile of the clients (the government, business and end-users) and the mechanisms for selecting contractors determine the variations in the degree to which each of the construction activities reacts to the crisis.

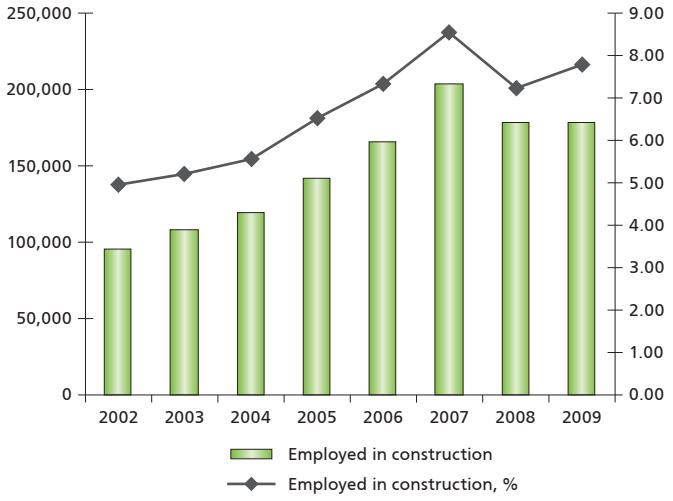
The limited purchasing power of end-users combined with the restrictive lending policy of banks and diminished foreign investment interest led to the greatest decline in the sales of residential buildings and vacation properties in the past two years. On the other hand, through the procurement for infrastructure sites the government sustains the construction companies with considerable production capacity. In fact, companies specialized in or reoriented towards the development of infrastructure reported a growth for the 2008 – 2009 period.

In this way, the economic crisis rearranges the agents in the sector and causes sectoral restructuring and, finally, has a remedial effect – it necessitates streamlining and improv-

Figure 26. VALUE ADDED IN CONSTRUCTION, MLN LEVS, AT 2001 CONSTANT PRICES AND % OF GROSS VALUE ADDED

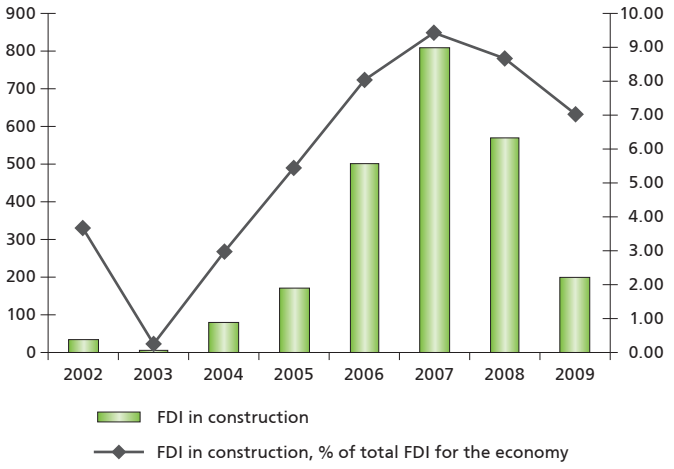
Source: NSI, 2011.

Figure 27. EMPLOYED IN CONSTRUCTION, NUMBER AND % OF ALL EMPLOYED



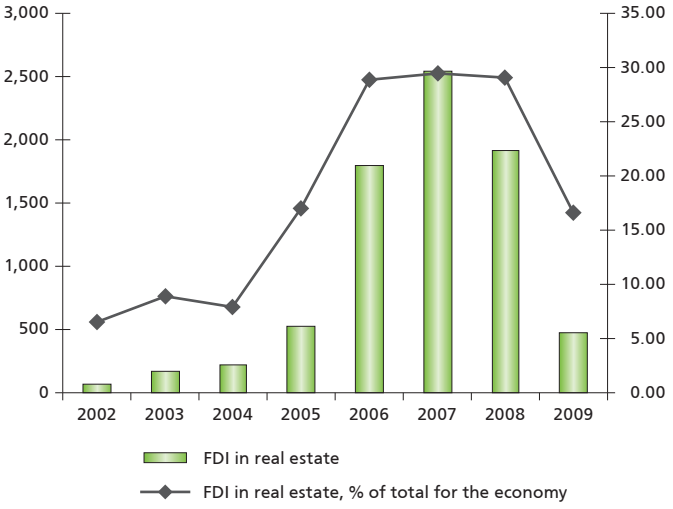
Source: NSI, 2011.

Figure 28. FOREIGN DIRECT INVESTMENTS IN CONSTRUCTION, € MLN AND % OF TOTAL FDI FOR THE ECONOMY



Source: BNB, 2011.

Figure 29. FOREIGN DIRECT INVESTMENTS IN REAL ESTATE, € MLN AND % OF TOTAL FDI FOR THE ECONOMY



Source: BNB, 2011.

ing effectiveness. Companies which do not comply with the construction standards are forced out of business. Most of the bankruptcies are due to poor judgment of the market as well as failed attempts at fraud. Construction is among the sectors with the shortest life-cycle making it even more difficult to measure R&D and company innovativeness. Small construction entrepreneurs – not only in Bulgaria – are not very keen on participating in various types of consolidations based on the market (e.g. joining consortia at application for public procurement and implementation of large infrastructure projects is decided on different grounds).

Construction is an **exceedingly fragmented sector.** In 2008, 96 % of the construction companies in the country are micro and small enterprises (up to 50 employees), which is largely due to the local nature of construction activities. By this indicator, construction in Bulgaria is within the average indicators for Europe. These statistics should be further analyzed (particularly from the point of view of local competition and control of market players) since the contractors frequently cre-

ate separate companies for each individual project or site in order to minimize risk, both with respect to checks from the labor inspectorate and market risks. There are sites (for example, Rosalitsa, a luxury residential community close to Varna) with over 50 firms for one project alone, while individual buyers sign complicated network contracts with up to 7 companies from the preliminary agreement to the real transfer of ownership. These companies obviously stop functioning, even if they continue to exist legally after the completion of project. In this sense, a realistic analysis of the sector requires a study of the actual entrepreneurs and the end users/owners.

Most micro and small enterprises provide a limited number of services intended mainly for the local market. The limited potential and orientation towards small short-term projects do not allow for pricing advantages and competitiveness on this basis. These enterprises have less capacity to introduce innovation – they do not have the resources, they have no impact on the value added chain, do not generate long-term integration and are frequently plagued by poor managerial judgment in long term decision making.

Medium-sized and large construction companies have a widely diversified portfolio of activities, products and services. The capacity to shift assets, financial and human resources makes them adaptive and stable in periods of economic crisis. The small share (less than 4 %) of the medium-sized and large enterprises provides 48 % of the total employment and 54 % of the added value in the sector.

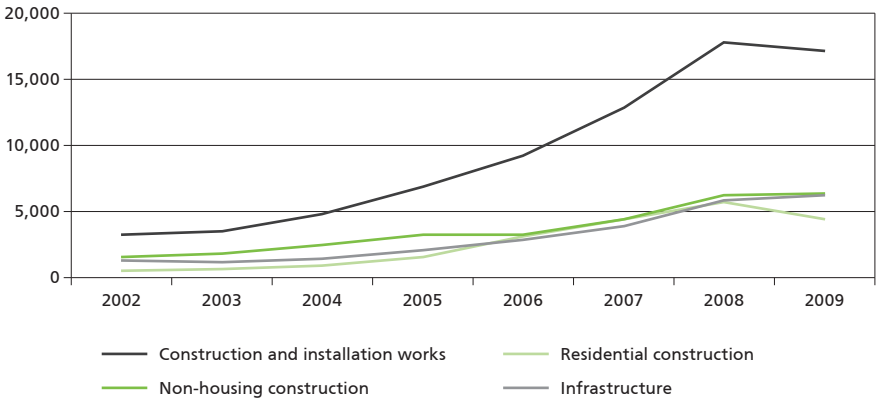
Over two-thirds of the construction output is formed on the basis of intermediate consumption. Construction is not among the sectors where high added value is created (merely 25 %), including because of the cost of the low-qualified workforce.

Table 3. TOP 5 LEADING CONSTRUCTION COMPANIES IN BULGARIA BY BASIC FINANCIAL INDICATORS, 2008 – 2009

Construction company	Profit growth, %	Net revenue growth, %
PSI AD	2,050	133
Vodstroy 98 AD	1,334	2,052
Trace Group Hold AD	556	96
Comfort Ltd.	315	16
Markan Ltd.	254	57

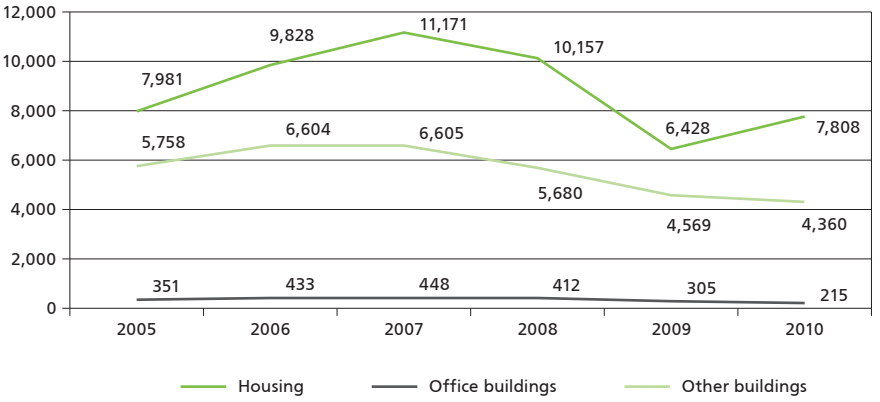
Source: Bulgarian Construction Chamber, 2010.

Figure 30. CONSTRUCTION COMPANY REVENUE BY CONSTRUCTION TYPE, MLN LEVS



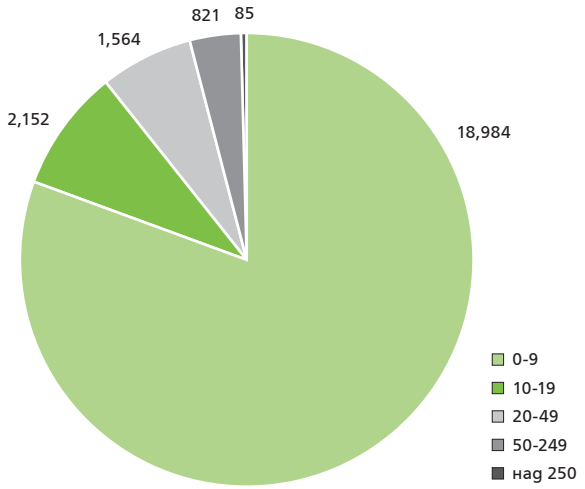
Source: NSI, 2010.

Figure 31. NUMBER OF BUILDING PERMITS ISSUED



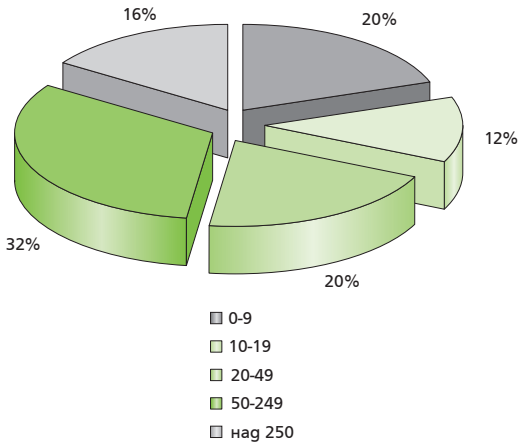
Source: NSI, 2010.

Figure 32. CONSTRUCTION COMPANIES BY THE NUMBER OF THEIR EMPLOYEES, 2009



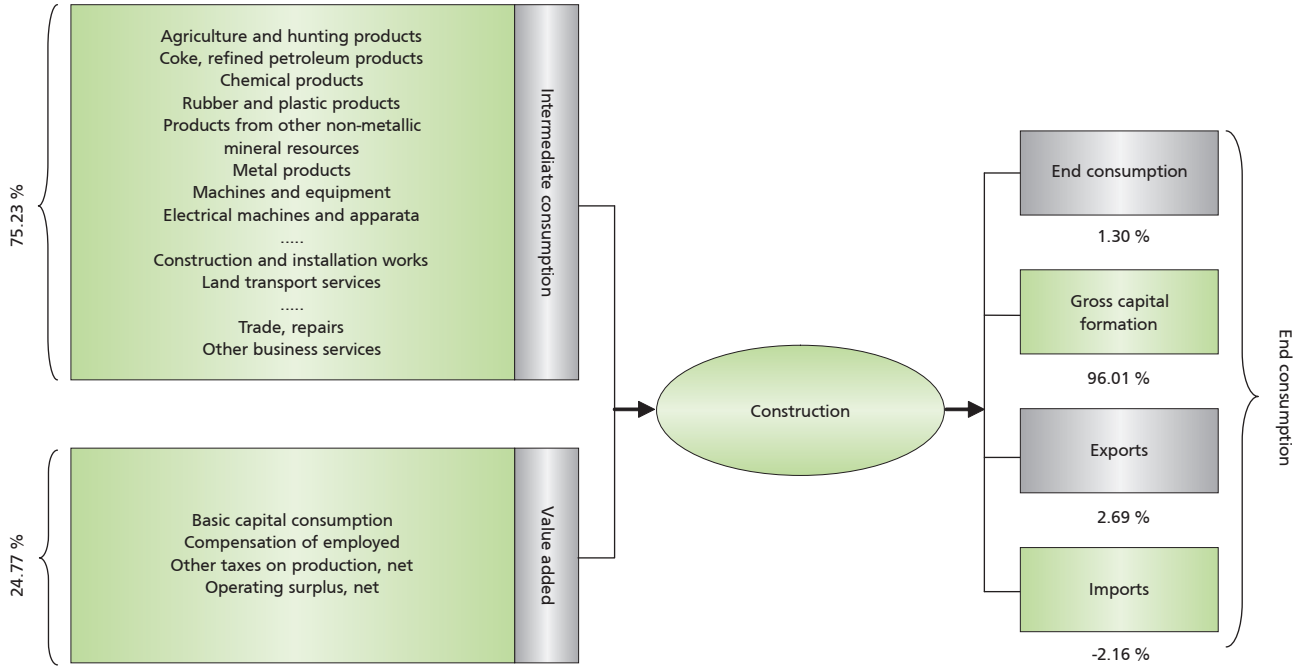
Source: NSI, 2011.

Figure 33. SHARE OF EMPLOYMENT IN THE SECTOR PROVIDED BY CONSTRUCTION COMPANIES BY SIZE, 2009



Source: NSI, 2011.

Figure 34. INPUT-OUTPUT ANALYSIS OF THE CONSTRUCTION SECTOR, 2005[58]



Source: NSI, 2011. Balance of inter-sector relations 2005, based on Wu, X. and Z. Zhang, "Input-Output Analysis of the Chinese Construction Sector," *Construction Management and Economics* (November 2005) 23, 905-912.

Sector innovation potential

The analysis of research and innovation of construction companies reveals a number of features of their innovation policies, interactions along the value added chain and the effect of innovation. On the one hand, this explains the relatively weak positions of the sector according to the standard indicators for measuring innovative capacity and, on the other, it suggests approaches and measures

[58] The enormous delay of input-output data, although they can be very useful for policy design, makes them practically inapplicable as a feedback mechanism for corrective action in support of innovation with a greater impact on the economy.

to boost the competitiveness of the sector.

Construction is one of the sectors where the so-called **"hidden" innovations**[59] occur – innovations which are not overt in character, are embodied in the end-product of the production process or concern the processes and business practices used. **Hidden innovation is mainly the product of knowledge generated outside the respective sector.** In this sense the intensity and direction of innovation more frequently than in other sectors depends on the access to new ideas in related industries and the potential for their adoption.

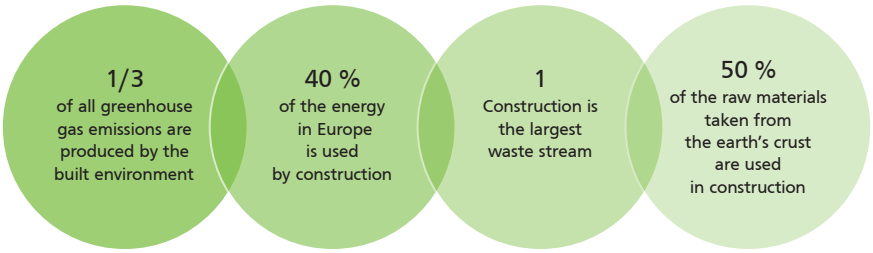
Innovation in the construction sector is implemented **on a project basis.** Activities such as the introduction of new materials and technologies, and the creation of products embodying new knowledge are separate and project-oriented – corresponding to the way resources in the sector as a whole are organized on a project basis – and less so on the basis of annual or strategic innovation plans. Participation in, the launch of and the implementation of a large part of the projects is determined by factors outside the industry – requirements for bidding in public procurement after national or European funding has been received, lobbying interests and corruption schemes, etc. This is a hindrance to the formation of organizational knowledge and its transfer from one project to another.

Within the specific projects there is coordination and integration of the efforts of different experts – architects, designers, civil engineers, machine engineers and others. The effect accumulated over time from the consistently implemented incremental innovations can be considerable at company or sectoral level, but still remains intangible, invisible to official statistics.

[59] Roper, S. et al., *Measuring Sectoral Innovation Capability in Nine Areas of the UK Economy,* Report for NESTA Innovation Index project, Index Report: November 2009.

Box 2. SUSTAINABLE CONSTRUCTION

The construction industry in Europe accounts for 10 % of EU GDP and 7 % of employment in the European economy. The sector covers the operation of 3.1 million enterprises, of which 95 % with fewer than 20 employees.



Recognizing the impact of the construction sector on the environment and its significance for the European economy, the European Construction Industry Federation (FIEC) initiated **ten principles of sustainable construction in three fundamental spheres – environment, economy and social pillar** – for implementation by construction enterprises on a voluntary basis and oriented towards:

1. Promoting improved relationships with stakeholders throughout the supply chain.
2. Promoting a high level of quality management of products and processes.
3. Promoting a solid economic basis for the purposes of raising productivity and improving economic, social and environmental performance through making use of improved risk management techniques, as well as taking into account whenever possible, the total life cycle costs of construction projects including their maintenance and operation.
4. **Promoting investment in research and development and dissemination of innovation.**
5. Promoting freedom of association and the right to collective bargaining.
6. Promoting and continually improving health and safety procedures.
7. Promoting training and continuous professional development of employees.
8. Promoting responsible community relations wherever construction activities take place.
9. Promoting more environmental management strategies, notably through eco-design and the reduction of the environmental impact, energy efficient techniques, reducing water and energy use, re-using and recycling surplus or residual materials, as well as preserving both biodiversity and Europe's cultural heritage.
10. Promoting progressively reporting mechanisms in order to measure and communicate sustainability performance and to put in place policies for on-going improvements.

Source: http://www.fiec.eu

Nearly 77 % of the construction companies are **micro-enterprises** with up to 9 employees. They provide a small set of services, carry out projects limited in scope which are

intended for the local market. Their potential to offer new technological solutions encounters shortage of financial resources and qualified knowledge. Application of new ideas occurs at a stage when the latter become basic for the sector, mandatory as part of the sectoral standardization and can be applied at a relatively low price.

Companies in the construction sector practically do not invest in R&D. Over the 2002 – 2006 period, business expenses for R&D were practically zero (less than €50,000 for the entire economy), and in 2007 they were €100,000. In comparison, in 1995 – 1999 the expenses officially reported to the NSI were between €400,000 and €2 million (1996). More detailed studies are necessary in order to determine whether in the low technology sectors, as in the high-tech ones, there is a problem with reporting,[60] but there are sufficient grounds to believe that that is so, at least from the point of view of the indirect data coming from patent activity of enterprises in the construction and energy sectors.

As a low-technology sector, construction **does not create its own research projects.** The factors and conditions motivating innovation come from outside construction companies, e.g. from the producers of construction materials and construction equipment at the beginning of the value added – end client chain. What is implemented is mainly incremental, lower-degree product and process innovation not based on own R&D.

Innovations in the sector should be considered against the backdrop of their impact on sustainable development, environment protection and the quality of life, and in this sense as a **condition for significant social changes.** Construction is influenced directly by the changes in legislation and regulations (as well as by the effectiveness of their application) which in turn reflect the challenges of globalization and the growing civic awareness.

Considered together with its related services and industries, the construction sector has **considerable research potential** (research infrastructure, patent activity), **as well as a specific innovation profile** (orientation towards organizational and marketing innovation).

The sources of new technological knowledge, part of the sectoral innovation system, include BAS institutes which do research in the field of nanotechnologies and new materials and technologies (representatives mainly of physical, chemical, engineering sciences and earth sciences), the University of Architecture, Civil Engineering and Geodesy (UACEG) and the other higher educational institutions providing training in construction subjects and engaging in research projects in the respective fields of science and education.

Of all the 51 accredited higher schools in Bulgaria, three state and two private universities provide education in construction and related fields – the University of Architecture, Civil Engineering and Geodesy (UACEG) and the Higher School of Civil Engineering (HSCE), as well as the University of Transport (UT), and

Box 3. EUROPEAN TECHNOLOGY PLATFORMS

The idea for the establishment of European Technology Platforms was first launched by the European Commission at the end of 2002[61] in response to the need of **uniting and coordinating the efforts of all stakeholders** – state and local authorities, industry, research institutions and the academic community, financial institutions and the representatives of civic society, **in scientific and technological fields, determining in the long term the future of the EU and its competitive positions.**

A total of **36 technology platforms** have been established, which cover the development of the main scientific and technological fields and sectors of the European economy, including:

- seven in the field of **energy** – bio fuel, wind energy, nuclear energy, energy from renewable resources, photovoltaic energy, intelligent networks, zero greenhouse gas emissions.
- one in the field of **construction** – uniting 230 organizations from 23 European countries, including 10 universities, SMEs and large companies engaged in: underground construction, cities and construction, quality of life, materials, networks, cultural heritage, processes and ICT.

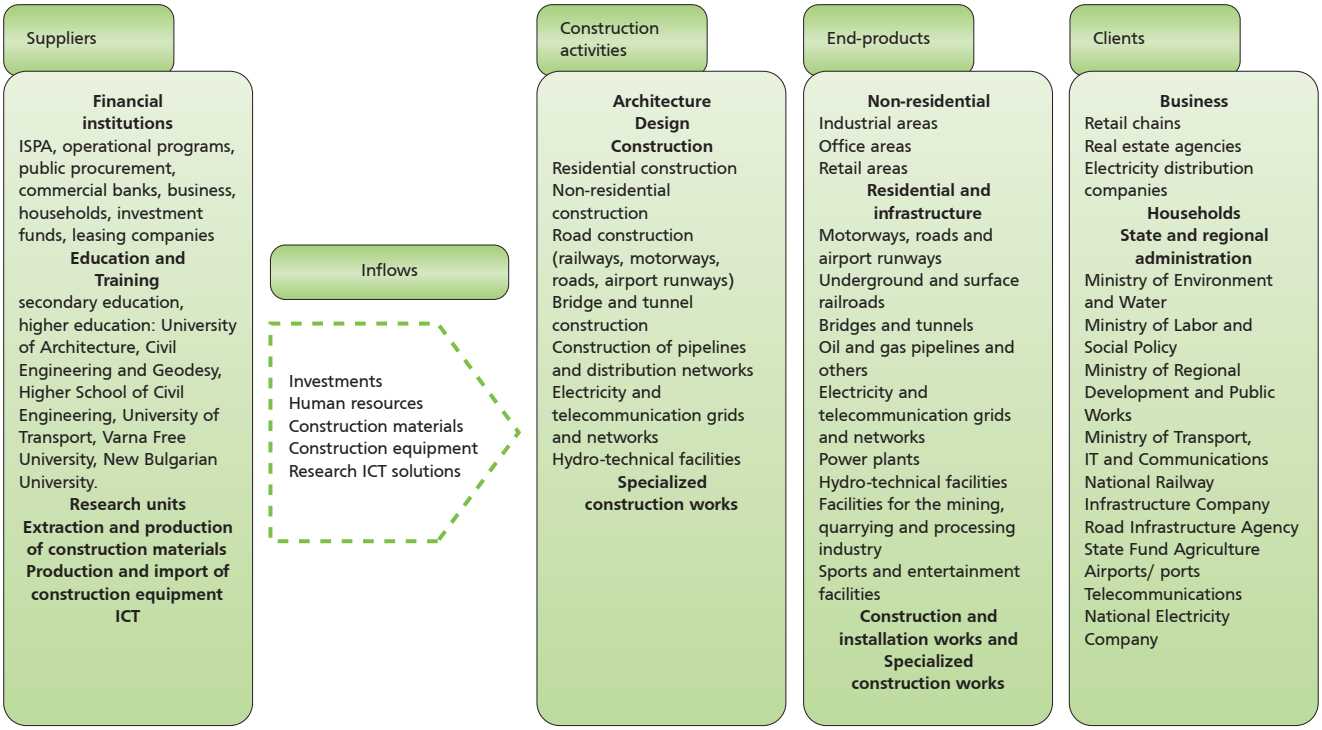
Although the first European technology platforms have been functioning for nearly ten years, Bulgarian participation has not been registered in any one of them. Neither have national technology platforms been established in the country (the so-called National Mirror Group, as is the practice in a number of European countries) as links to the policies and strategies at European level. In the field of construction, 17 states participating in the European Technology Platform have developed their own mirror groups.

Source: http://cordis.europa.eu/technology–platforms/home_en.html

[60] Additional analysis is needed to verify whether the reported business expenses for R&D are as they were given, as well as whether all state-commissioned R&D was reported as such.

[61] *Industrial Policy in an Enlarged Europe,* Communication from the Commission, COM/2002/0714 final.

Figure 35. VALUE ADDED CHAIN IN THE CONSTRUCTION SECTOR



Source: ARC Fund, 2011.

Varna Free University and New Bulgarian University.

The research staff in the three state higher educational establishments is mostly middle-aged as are researchers in the country as a whole. The three universities have research staff mainly in the 35-54 year old range. Only 13 % of the lecturers and researchers are below 35, while 11 % of the scholars in the same category are over 65.

The ratio of assistant professors (364) to associate professors (267) to professors (54) **seems appropriate only at first glance.** Just 1 % of the assistant professors are below 25, another 24 % are in the 25-34 years age bracket. Most assistant professors are aged between 45 and 54 which is a late rather than an appropriate stage for launching a scientific career.

In spite of the trend for a decline of the number of enrolling students, the increasing interest in studying abroad and the competition between universities and education fields, **the number of students at the three higher educational establishments is increasing.** Enrolment at the UT in the field of technical sciences remains invariable.

The three state higher educational establishments **are becoming increasingly dependent on public funding.** The increase of state budget funding for research (by an average 50 % for HSCE and UT and nearly nine-fold for UACEG) and education (by an average 40 %) is accompanied by a decline of the funds attracted from all other external sources – national funds, private donors, international programs. There is a positive change only in respect to financing received from European funds.

Over the entire period in which Bulgarian journals were referenced in the Scopus database, including until 2010, only UACEG has such articles registered. **In the past 15 years some 4 % of all patents issued by the Bulgarian Patent Office were targeted at application in the construction sector,** including building construction (223 patents), civil engineering (147 patents) and specialized construction activities (108 patents). The ratio between Bulgarian and foreign patent holders is 40:60. The positions are almost level in the case of patents with application in the construction of buildings, while the greatest disparity (27 % Bulgarian and 73 % foreign patent holders) exists in the case of patents with application in specialized construction services.

Patenting patterns in the field of construction in Bulgaria reflects the general trends for the economy as a whole:

- High patent activity in the period after 1994 was largely the result of transformation of the existing inventor certificates into

patents in compliance with the revisions in patent legislation;

- Since 1997, foreign patent applicants have accounted for the prevalent portion of patent activity. In the field of construction this trend began later – in 2003;
- Starting in 2000, the number of Bulgarian patents in the field of construction has been declining constantly, reaching its lowest values (5 patents) in 2010. The trend with foreign patent holders is quite the opposite – they had a 20 % to 80 % year-on-year growth, reaching the maximum of 65 patents in 2009.

In 1994 – 2010, only ten universities had patents awarded by the Bulgarian Patent Office. The Higher School of Civil Engineering ranked second after the Medical University in Sofia with 25 patents (or 18.7 % of all patents of the institutional sector). The University of Architecture, Civil Engineering and Geodesy has one patent, awarded in 1997. In BAS, the highest patent activity was registered by the Institute of Metal Science – 29 patents (21.3 % of BAS patent activity), the Institute of Engineering Chemistry and the Institute of Solid State Physics with 17 patents each (11 %).

The interest of foreign applicants in acquiring protection of their intellectual property rights on the territory of the country is driven, on the one hand, by strategic intentions for the implementation of business projects in Bulgaria and, on the other, results from their assessment of the potential of the respective sector to absorb and use effectively the new technological knowledge. The trend in local patent applications gives grounds for such a conclusion. **For this reason, the fields in which there is higher interest of foreign applicants are also fields of higher activity of Bulgarian patent holders.**

There are relatively few cases of submitted applications for patenting and awarded patents in the field of construction where the invention has an application in more than one field. Such are the **inventions which can also be introduced in the field of green technologies and/or energy.**

Although there is a lag between the submission of an application and the award of a patent and a precise comparison is not possible, the data show that a relatively smaller portion of the Bulgarian applications lead to the award of a patent compared to the situation with foreign applicants. This is indicative of the relatively lower quality (degree of novelty, invention step, practical applicability) of the applications submitted by Bulgarian persons.

Innovation activity in the construction sector is in two main directions: **research,** which leads to the creation of a new product and process inno-

Table 4. RESEARCH AND INNOVATION POTENTIAL OF HIGHER EDUCATIONAL INSTITUTIONS IN BULGARIA TEACHING COURSES IN CONSTRUCTION SUBJECTS*

Indicators		UACEG	HSCE	UT
Lecturers and researchers, 2009*	number	339	107	123
Trained students, 2009*	number	4,423	1,298	2,083
Students involved in R&D %	%	1.49	1.17	2.59
Budget subsidy for R&D, 2009	€ thousands	245	96	97
Budget subsidy for education and training, 2009	€ thousands	4,671	1,160	1,402
Financing from national funds, 2009	€ thousands	-	11	11
National private funding, 2009	€ thousands	5	15	1
Financing from European funds, 2009	€ thousands	146	-	65
Funds from international programs, 2009	€ thousands	152	-	53
Trained doctoral students, 2009*	number	25	1	7
Doctoral degree graduates, 2007 – 2009*	number	21	4	2
Publications in national referenced journals, 2007 – 2009*	number	116	45	62
Publications in international referenced journals, 2005 – 2009* (Scopus)	number	18	7	1
Citations, 2005 – 2009* (Scopus)	number	222	160	-
Habilitations, 2007 – 2009*	number	24	8	-
Applications for protection of intellectual property rights, 2007 – 2009	number	2	5	33
License agreements, 2007 – 2009	number	14	6	33

* The data refer to the technical fields according to the Classification of Education and Training Fields – 2008.

Source: MEYS, 2010.

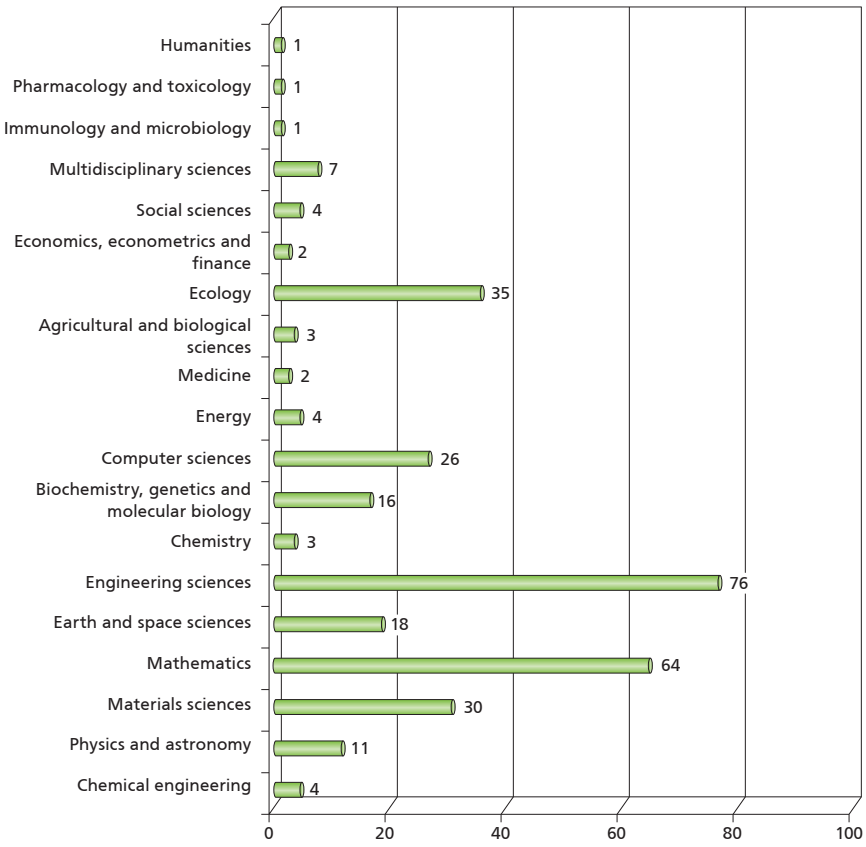
vations; and **organizational innovations,** related to combining new and existing construction, architectural and engineering practices, new business models, organizational forms and approaches to contracting and interaction with suppliers and clients. Organizational innovations are important both in themselves and as a basis for the implementation of product and process innovations.

The first type is applicable in the conditions of large diversified construction companies which have the necessary financial resources and qualified staff, as well as a comprehensive production base and where the new technologies can find application. The majority of construction companies in Bulgaria (not only from the group of micro and small enterprises) engage mainly in organizational innovations and, along with that, form a medium for the introduction of new technological solutions, created in related fields – production of construction materials, production of construction equipment and ICT. As a whole, **innovations in construction are not based on high cost research and are not related to the introduction of radically new technologies.**

The new innovative solutions embodied in the end-products of construction are rarely visible (novelties in architecture and design, or incorporation in the environment) and frequently remain hidden for the end-users. They are the result of the use of:

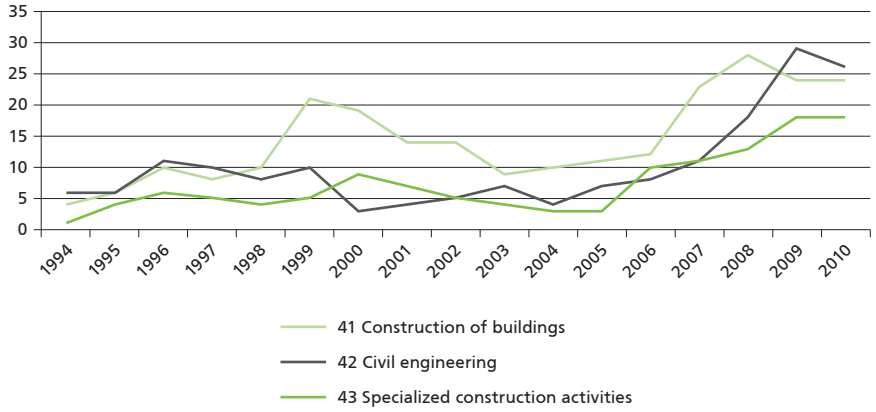
- New materials which are lighter and more effective, are easily maintained and repaired and can meet contemporary energy efficiency and fire safety requirements (for example plasterboard);
- New methods which provide a higher degree of effectiveness of process implementation, higher productivity, better quality (retention of heat, moisture-proof qualities, period of wear, energy efficiency, permissible defects), as well as shortening the time for execution of the individual stages of the technological process (for example, dry construc-

Figure 36. NUMBER OF ARTICLES BY UACEG STAFF IN SCOPUS CITED JOURNALS FOR THE PERIOD UNTIL 2010 INCLUDED, BY SCIENTIFIC FIELD



Source: Scopus, 2011.

Figure 37. NUMBER OF PATENTS AWARDED IN BULGARIA BY CONSTRUCTION SECTOR DIVISIONS (NACE.BG-2008)



Source: Compiled from data published in the Official Journal of the BPO.

tion, modular technologies of assembly).

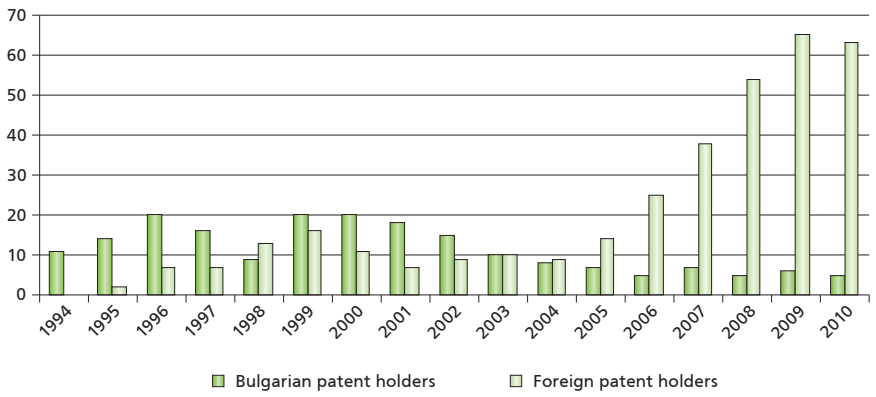
Innovations based on expertise external to the sector reduce the cost of the end-product up to 30 % in comparison to the use of conventional construction methods, provide independence from climate conditions, with up to 50 % lower costs for the supply of materials and ensure considerable reduction of the environment pollution accompanying the development and operation of construction sites. In this sense, **the innovation potential of the construction sector depends on the full-blooded functioning of the sectoral innovation system and the interaction between the participants along the value added chain.**[62]

Regulations (in respect to end-products of construction and the processes for their implementation) **and consumer demand can be additional motors of innovation activity in the sector.** Construction companies usually follow the requirements of consumers, while early involvement of end-users in the implementation is considered a peculiarity of the sector.

Beyond the impact of these factors (suppliers at the start of the value added chain, consumers, regulatory framework), **construction companies rarely develop internal incentives for the introduction of innovations.** In spite of the unquestionable advantages of the so-called "contemporary methods of construction", they are actually used very little in the sector (about 4 % of the construction companies in the United Kingdom use such methods) which indicates the need of applying a well-considered policy for the development of the sector.

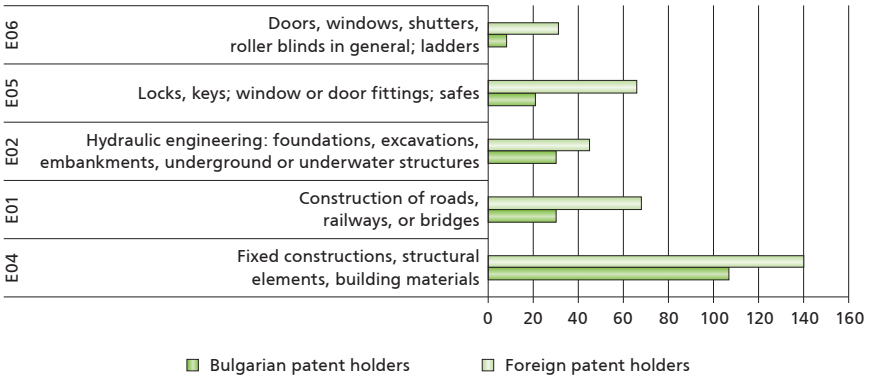
[62] *Hidden Innovation. How Innovation Happens in Six "Low Innovation" Sectors,* NESTA, Research report: June 2007.

Figure 38. NUMBER OF PATENTS AWARDED IN BULGARIA TO BULGARIAN AND FOREIGN PATENT HOLDERS, CONSTRUCTION SECTOR



Source: Compiled from data published in the Official Journal of the BPO.

Figure 39. NUMBER OF PATENTS IN CONSTRUCTION AND MINING AWARDED IN BULGARIA TO BULGARIAN AND FOREIGN HOLDERS, BY IPC SECTIONS AND CLASS LEVEL, 1994 – 2010



Source: Compiled from data published in the Official Journal of the BPO.

Policies encouraging innovation in the construction sector

In the years before the economic crisis, construction became a factor of growth through the influence of market forces (favorable credit policy, interest from foreign investors), reflected in the growing demand and supply of housing, vacation properties and office space. In the post-crisis period, given the so-called "new economic reality" and the reiterated intentions to pursue the objectives of sustainable development (higher energy efficiency, limiting the harmful impact on the environment) national policy can find **the future drivers of the development of the construction branch** along several lines:

- A rearranging of the sector – **infrastructure (transport, water supply, power distribution) is key for Bulgaria and it is where investment will go.** Both the potential – large Bulgarian companies with experience, funding from European funds and programs – and the need – the poor state of the infrastructure – are

there. The result – restored inflow of foreign investment, new jobs, establishment of a modern business environment – would bring Bulgaria closer to the European standards of quality of life and will support the achievement of the national objectives under Europe 2020.

- **Implementation of environmental projects.** Sites for waste storage and processing, rehabilitation of the existing buildings or the introduction of modern green technologies in the construction of new ones would have equally high economic effect.
- **Making a priority of the education and qualification** of the people employed in the sector and in related activities. Construction is a platform for the introduction of technological solutions generated elsewhere in the economy. The existence of competent management and experienced staff is an important condition for this to happen. Shifting from housing to infrastructure – or vice versa – requires considerable effort from construction companies and familiarity with the peculiarities of the technological processes.

In the short term **the measures for the promotion of sectoral competitiveness** include:

- Regulatory compliance

Construction is a highly regulated sector. In spite of that, most regulatory standards – the issuance of building permits, the quality of materials used, energy efficiency requirements, insulation and so on – are routinely disregarded.

Some of the statutory instruments in the sector were drafted in the middle of the past century. They do not reflect the requirements of the contemporary construction methods, the characteristics of new construction materials or the capabilities of modern construction equipment. This creates confusion in the preparation of project documentation and building permits, particularly for foreign investors.

It is necessary to supplement the requirements of the Energy Efficiency Act to achieve the broader scope of the standards for construction of sustainable buildings. Undertaking such measures will ensure commitment of the government not only to a key economic sector but also towards fulfillment of the energy strategy objectives.

- A change in the rules of the government-to-business relations

Simplifying and standardizing the requirements for bidding in public procurement tenders, as well as the introduction of priorities, not only about prices and time-limits, but also of the quality of execution of construction sites would make the work of the administration more transparent, support business and limit future risks of non-compliance with contract commitments.

Easier procedures for applying to the EU-funded operational programs and clear and transparent rules of evaluation and payment to business are needed. In a situation in which delayed payments lead to poor liquidity and inter-company indebtedness, the suppliers and construction companies practically finance the

Table 5. BULGARIAN COMPANIES WITH BPO REGISTERED PATENTS BY IPC CLASSES CORRESPONDING TO NACE CLASS "CONSTRUCTION", 1994 – 2010

Company	Location	Patent number
KOZLODUY N-PLANT EAD	Kozloduy	1
ANTIBIOTIC AD	Razgrad	1
A.S.S. ENGINEERING OOD	Loukovit	1
B+K OOD	Sofia	1
BT ENGINEERING EOOD	Sofia	1
DENDRIT OOD	Sofia	1
DENEL AD	Sofia	1
MAUER LOCKING SYSTEMS OOD	Varna	1
NEC AD, KOZLODUY N-PLANT BRANCH	Kozloduy	2
POLIMERI AD	Devnya	1
POLINOR OOD	Sofia	1
SOLID-55 OOD	Sofia	2
SOPHARMA AD	Sofia	2
TRANSREMONTSTROY AD	Sofia	1
HYDROISOMAT AD	Sofia	1
ANDIS EXPORT-IMPORT	Sofia	2
JERICHO	Sofia	1
MICHAEL DESIGN – DESIGNER BUREAU	Sofia	2
DEVNYAINVEST OOD	Devnya	1
EVGENYI ROUSSEV	Sofia	1

Source: Compiled from data published in the Official Journal of the BPO.

completed sites for a period of up to 18 months without a guarantee for the reimbursement of expenses. Such artificially created insecurity of the market is not a good signal for either Bulgarian or foreign investors.

- Development of the innovation potential of construction companies

Funding from the operational programs should prioritize various forms of collaboration between the key stakeholders, including research teams – informal or on a formal basis through industry associations, cluster policy and requirements for the establishment of temporary consortia for applying for large public procurement contracts. The practice of contracting suppliers with no experience in project implementation but with political support who then sub-contract companies disqualified because not eligible must be avoided. A methodology for the assessment of the innovation potential of low-tech sectors, such as construction, should be developed.

- A change in oversight policies

Investments in improvements to buildings and the use of modern technologies at the construction of new buildings increase the property value but also result in higher local property taxes. In this way **government policy punishes investors for their innovation.** Instead of being considered a luxury, improvements should be facilitated and encouraged. Extending more favorable terms for the use of credits or covering part of the investment through different financial instruments are possible solutions for that. At the same time, oversight mechanisms should be devised ensuring that the relief options benefit the intended target group – innovative companies or end-users. The former practice of subsidizing interest payments on loans for environment-friendly window framing, for example, had a rather negative effect as it in effect increased the cost for the end-user. There was no oversight because the scheme was executed through commercial banks which were not interested in contractors providing higher quality. Bad administrative services for business keep resulting in unfair competition and lower construction standards.

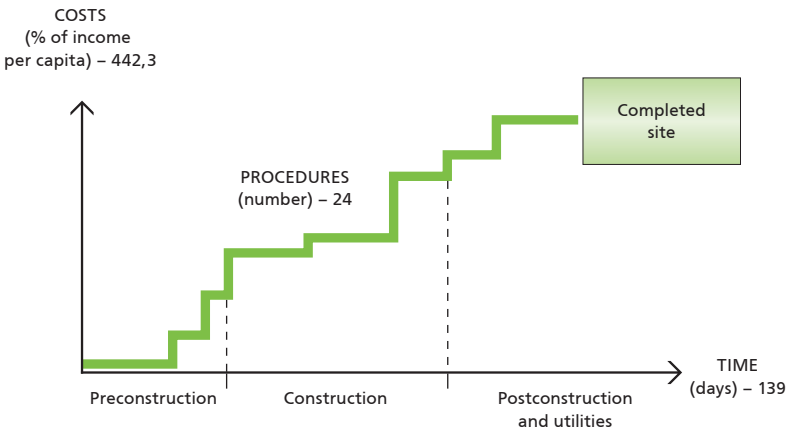
- Promotion of good business models which are not lacking among Bulgarian companies or the foreign companies in the country.

Taking up the role of regulator, client and investor, the government has multifaceted influence on the development of the construction sector. In all three cases clarification of interests should be achieved, as well as agreement on the mechanisms of interaction so that the effect, too, could be many-sided.

Box 4. THE BUSINESS ENVIRONMENT OF THE CONSTRUCTION SECTOR

A World Bank study of the business environment covering the factors and barriers before the development of business in 183 countries came up with the following results about the general rules for construction in Bulgaria:

Obtaining the various construction permits, index	**119**
Procedures (number)	24
Time (days)	139
Costs, % of income per capita	442.3
Registration of property, index	**62**
Procedures (number)	8
Time (days)	15
Costs, % of property value	3.0



The same study for 2005 identified 20 procedures requiring 127 days. Apparently, in the past five years the environment in which the construction business in Bulgaria is operating has become more complicated, contrary to the trends in the majority of other economies. In 2007, the country ranked 85th out of 175 states and has since dropped to 119th.

Source: *Doing Business 2011: Making a Difference for Entrepreneurs,* The International Bank for Reconstruction and Development/The World Bank, 2010.

Energy

Structure and importance

The energy sector is of key importance to the Bulgarian economy and the country's international standing. The sector provides 4 % of GDP and 1 % of the people employed in the national economy. Along with this, the enterprises which generate and distribute energy provide a tangible part of foreign direct investments (8 % for 2009). The share of the sector in the country's exports and imports is respectively 14 % and 22 % for 2010.[63] Beyond the direct economic effect, energy has a strategic role in meeting a number of challenges, which in turn shape the country's competitiveness:

1. **The Bulgarian economy has very low energy efficiency** as a result of losses during transmission, the outdated production technologies of industrial consumers, the lack of incentives for energy saving and the high share of electricity consumption for household heating because of lack of options.
   In spite of some positive trends, **Bulgaria has an extremely energy intensive economy[64] which, although it reflects a reduction of over 30 % compared to 2000, remains the highest in the EU – 6 times higher than the average European level and 1.5 times that of the next country, Romania.**
2. **The energy market remains uncompetitive and non-transparent** – mostly state-owned, not managed efficiently and vulnerable to corruption and lobbyist pressures.[65]
3. **Bulgaria has undertaken considerable political and economic commitments for the implementation of strategic energy projects** aimed at reducing energy dependence, diversification of energy sources, linking the country's energy network to those of the neighboring states and ensuring sustainability and stability of supplies, not only for the national economy but also for Europe as a whole.
4. **Bulgaria has clear obligations in support of the Europe 2020 objectives** – a 16 % share of renewable energy sources (RES) in gross domestic electricity consumption, including a 5.6 % share of biofuels. The requirement for 10 % RES in transport energy consumption is mandatory. Achieving the goal of 50 % reduction of the economy's energy intensity (equal to the 25 % rise in energy efficiency) compared to 2005 levels will require considerable effort.

Increased investment in R&D and promotion of the sector's innovativeness, as well as entrepreneurship in the RES market, could help overcome most of these problems and challenges.[66] Science fields engaged in promoting low-carbon technologies – RES energy production, eco-vehicles and the infrastructure they need, intelligent networks, green cities, carbon capture and storage technologies, technologies for promotion of energy efficiency, co-generation, etc. – are also crucial and growing on a global scale.

In structural terms, the energy sector has been undergoing dynamic changes in the past few years. According to NSI data, **there are two opposing trends within the sector – an increase in the number of enterprises (more than fivefold since 2002) and a reduction of the number of employed (by more than 40 % over the same period).** The reasons for this can be sought in both the streamlined operation of the existing production units (including new company spin-offs) as a result of privatization and the cuts of Kozloduy nuclear plant output after 2006, as well as in the relative increase of the number of micro and small enterprises following new regulations of the development of RES energy generation.

As a result of these changes, in recent years the structure of the sector according to the number of employees in energy companies has reflected that of the economy as a whole, unlike 2002 when the share of micro (29 %), small (26 %) and large enterprises (27 %) was nearly the same. The sector includes services – generation, transmission, distribution of electricity and heating from different sources – which are relatively separate and in which companies develop high degrees of specialization.

Medium-sized and large companies prevail in the generation and distribution of energy from conventional sources, while micro and small enterprises are mainly engaged in using alternative energy sources. In the former case, the industry is at the stage of maturity and the enterprises have basic technologies and consider-

[63] According to NSI data, www.nsi.bg

[64] 944.16 kg of oil equivalent per €1000 of the country's GDP in 2008, according to Eurostat.

[65] A detailed analysis of the management practices applied in the energy sector can be found in *Energy and Good Governance in Bulgaria: Trends and Policy Options,* Center for the Study of Democracy, 2011.

[66] *The UK Innovation Systems for New and Renewable Energy Technologies,* Final Report, Imperial College London Centre for Energy Policy and Technology and E4tech Consulting, June 2003.

able experience and know-how which are shared throughout the sector thus reducing the potential of considerable competitive advantages. They also require considerable investment for entering the market. In the latter case, the new technologies form a specific business segment with high entrepreneurship and innovation. The relatively large share of highly-qualified specialists with vocational and higher education degrees is an important part of the intellectual capital of both types of enterprises.

The innovation potential of the sector

Globally, investments of energy companies in R&D are continuing to grow and the forecasts for 2011 are the same,[67] developing countries are catching up with the leading economies investing in energy technologies,[68] the portfolio of research projects of large energy companies is being diversified, with new projects in the field of RES being added along with research in the previous large business sectors of fossil fuels and nuclear energy.[69] In spite of the plans for increasing public and private R&D budgets, these expenses remain relatively low against the backdrop of R&D investments in other sectors and scientific fields, the return on the introduction of new energy technologies being still far from economically viable.

The considerable disparity among the technologies for the generation of energy from various sources – fossil fuels, nuclear energy and RES – is a specific feature of innovation in the sector. These technologies have different motors of growth, are at different stages of their technological life-cycle and market penetration and are subject to specific regulation. The varying profile and specialization of the enterprises in the energy sector determines different approaches to their research and innovation. As for the Bulgarian energy sector, there is low level of participation of local scientific and technological expertise in the development of national solutions in the various types of energy, with the exception of lignite mining. The result is that a smaller portion of added value remains in the country in the form of profit, salaries and license payments. For example, unlike the Czech Republic, which has the technological opportunity to compete on the market of construction of nuclear reactors, Bulgaria can participate mainly in activities with low added value – early construction stages such as concrete laying.

Table 6. POTENTIAL EFFECT OF PROMOTING ENERGY SECTOR INNOVATION

Economic impact
Reducing energy intensity. Saving energy and control of peak load by developing intelligent networks.
Increased energy efficiency as a result of the introduction of modern production technologies by industrial users and increased co-generation capacity.
New jobs in regions with low employment as a result of implementation of local RES projects.
Increased economic value of the land on which RES facilities are located and preserving employment in the agricultural sector.
Reducing the risk of having to purchase RES energy from abroad and payment of fines in case of non-compliance of the intermediate objectives under the European Energy Strategy.
Reducing the overall end-consumer energy price, including fossil fuel harmful emission costs and radioactive waste transport and storage costs in nuclear energy.
Promoting entrepreneurship and innovativeness.
Attracting foreign direct investment.
Creating conditions for the introduction of innovative Bulgarian energy production projects.
Environmental impact
Reducing harmful emissions in the environment, including from transport.
Recycling of waste which – in the standard energy model relying mainly on fossil fuel – remains unutilized and pollutes the environment.
Impact on the security of the country
Diversification of energy sources by introducing RES technologies.
Security and sustainability of supplies and reduction of the risk for the economy.
Reducing dependence on energy resource imports.

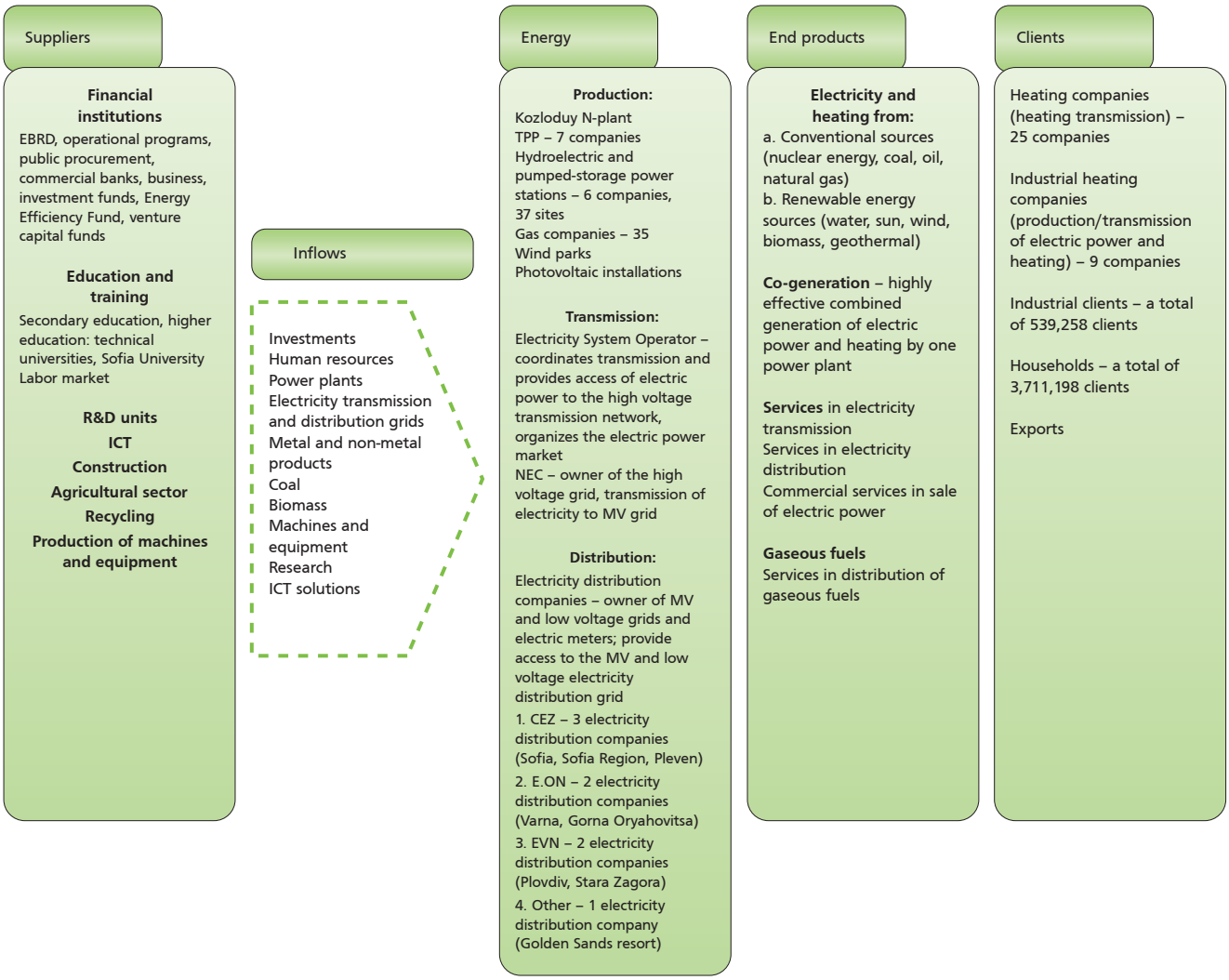
Source: ARC Fund, 2011.

[67] *2011 Global R&D Funding Forecast,* Battelle, December 2010.

[68] GE Global Innovation Barometer, 2011.

[69] Such is the case with the Czech company CEZ which owns 3 electricity distribution companies and Varna TPP. On January 3, 2011 the company registered a subsidiary for investments in renewable energy sources, CEZ Bulgarian Investments. A day later, the company was registered in the Dutch Trade Register with a capital of €30,000.

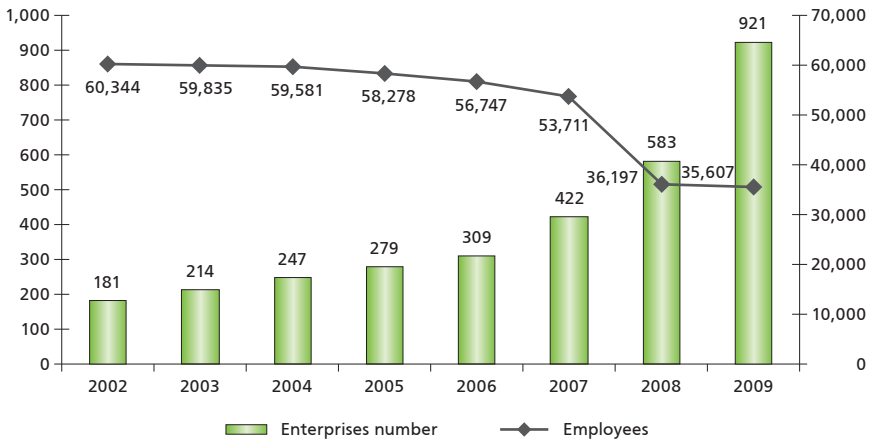
FIGURE 40. ENERGY SECTOR TECHNOLOGICAL AND VALUE ADDED CHAIN



Source: ARC Fund, 2011.

Such, too, is the problem with the new green technologies. The introduction of high reference prices should be linked with the search for solutions to create local technological and research capacity so that the country would be a fully-fledged participant in the international value added chain in this energy sub-sector. Local conditions and traditions have determined different scale and development of the use of energy from renewable sources (wind, water, sun, biomass, geothermal energy). For some of them there is a high degree of efficiency and considerable economic impact (biofuels, remote wind farms, wave and cur-

FIGURE 41. STRUCTURAL CHANGES IN THE ENERGY SECTOR



Source: NSI, 2011.

rent energy, new generation photovoltaic facilities).

Although the factors driving development and market penetration of each of the technologies is specific, they can be summed up in several groups:

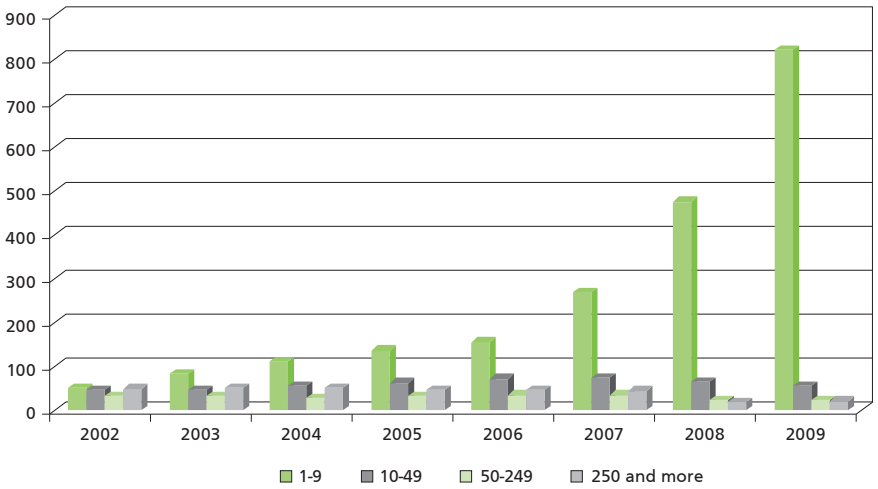
- **Factors providing the so-called technology push** – public and private investment in R&D, accrued technological knowledge, inter-company networks, highly qualified staff, patent and licensing activity, enterprising business conduct.
- **Factors conditioning market pull** – expectations for growth of low carbon technology market are optimistic. The reasons for this are varied – preferential terms for supplying and using RES energy, high degree of awareness of households and evolving environment-friendly consumer behavior, the requirements for increasing energy efficiency towards industrial consumers – but they act in concert.
- **Macro-environment factors** – the European and national strategic framework and promotion mechanisms; political commitments for overcoming the harmful impact on the environment and climate change.

Under the influence of such factors and a favorable energy policy companies in the sector can be innovative above the average levels for the economy. Supporting measures help overcome the natural barriers to the introduction of new technologies and technological standards (financial and market risk, high price, high investment requirements, lack of supporting infrastructure), and are important for the establishment of a clear regulatory framework, good business practices and transparent public-private partnerships.

In 1994 – 2010, a mere 2 % of the patents in Bulgaria were from the energy sector. Bulgarian (48 %) and foreign (42 %) patent holders are almost on a par. After a peak in the beginning of the period, driven by the transformation of inventor certificates into patents following the revisions of the patent law, foreign persons have more patent applications approved by the Bulgarian Patent Office.

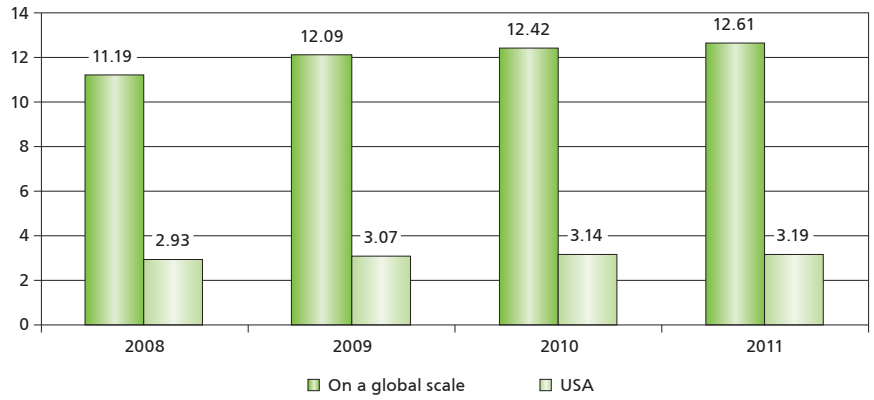
In the last three years, nearly 18 % of the patent applications concerned technologies with application in other economic sectors besides energy, most frequently green technologies – a considerable prevalence of technologies with possible subsequent inter-sector diffusion compared to patent applications made in other economic activities. The distribution of the patents in the sector by sections of the International Patent Classification includes three classes in section F – Mechanical Engineering, Lighting, Heating, Weapons; one in section G – Physics and one in section H – Electricity.

Figure 42. ENTERPRISES IN THE ENERGY SECTOR ACCORDING TO THE NUMBER OF EMPLOYEES



Source: NSI, 2011.

Figure 43. R&D BUSINESS EXPENSES IN ENERGY, $ BLN



Source: http://www.rdmag.com/Feature-Articles/2010/12/Policy-And-Industry-Government-Funding-2011-Global-RD-Funding-Forecast-Industrial-RD-Energy/

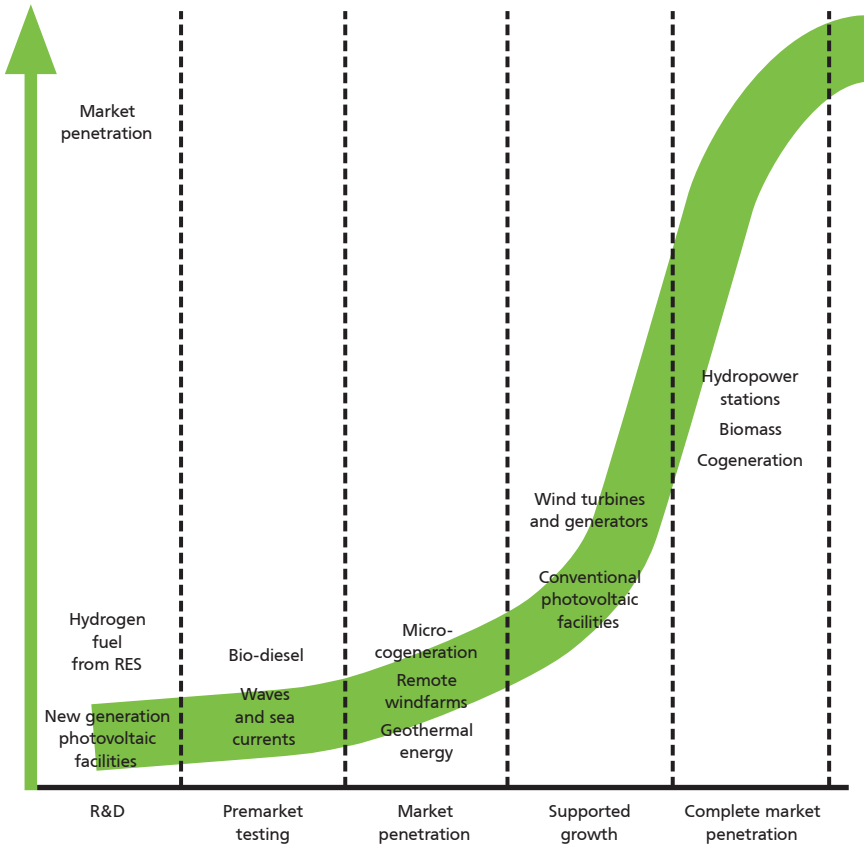
Besides 16 patents of the technical universities (not all in the energy sector) and 22 patents of BAS institutes in the field of energy, **the public sector in Bulgaria does not have any other protected technological knowledge in this field.**

In this respect, small enterprises whose share in the field of RES in Bulgaria is the largest and which have highly specialized technological knowledge are in the most unfavorable position. They do not have the capacity of the large companies to engage in R&D and maintain numerous patents in broad technological fields. SMEs refrain from patenting in order to withhold confidential information and avoid cooperation, including with BAS and the universities, because of the lack of clearly defined procedures and rules for handling intellectual capital created on the basis of joint research work.

In such highly regulated and capital-intensive sector as energy, which is loaded with considerable public expectations, the role of the state and public funding increases constantly. In 2007 – 2009, the government budget for R&D in the field of energy in Bulgaria varied widely – in 2007 it was at the European average level; funding peaked in 2008 (matched only by Finland at that year); and declined by 76 % in 2009 to levels lower than the European average. It is very difficult to judge the effectiveness of these costs for R&D. Probably, a substantial portion of them are expenses for consultancy services involving the preparation of large energy infrastructure projects which used the Public Procurement Act to avoid competition at commissioning R&D contracts. Additional micro-analysis of these expenses is necessary in order for them to be evaluated more accurately.

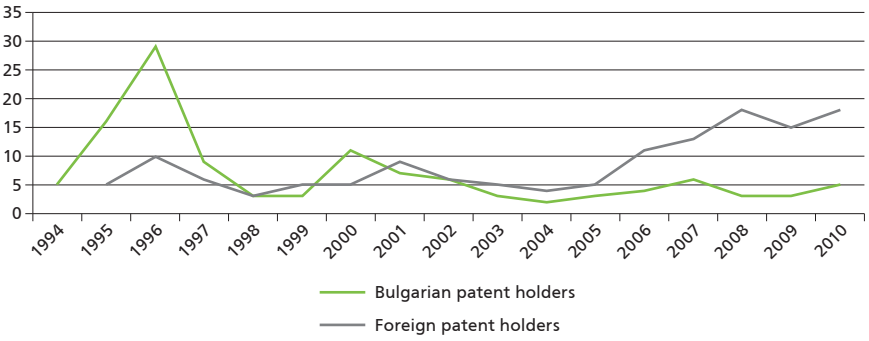
In Bulgaria, public funding of research, technological development and innovation in the field of energy started only recently. The main objectives pursued by the financial instruments are related to resolving the most critical problems of the Bulgarian economy – increasing energy efficiency, including of buildings; reducing the energy intensity of production; increasing the share of RES in energy generation and consumption. In addition to funding from the financial instruments of the national

Figure 44. LOW-CARBON TECHNOLOGY LIFE-CYCLE



Source: Based on: *The UK Innovation Systems for New and Renewable Energy Technologies*, Report for the UK Department of Trade and Industry, June 2003.

Figure 45. ENERGY SECTOR PATENTS AWARDED IN BULGARIA



Source: Compiled from data published in the Official Journal of the BPO.

energy policy, enterprises can seek support for their innovation projects from sources which cover broader fields.

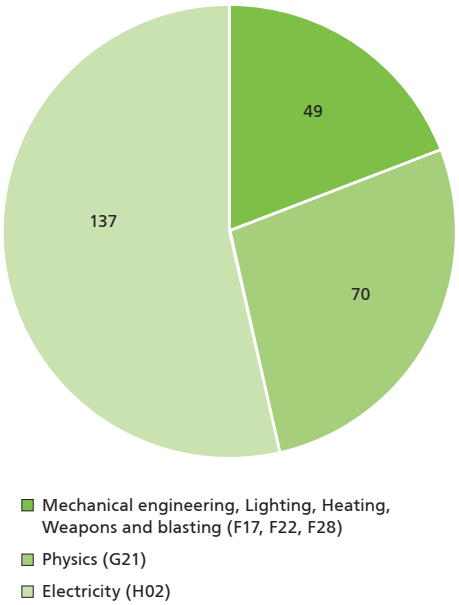
Some of the funds extended within the five sessions of the National Innovation Fund have been channeled into the implementation of projects in the field of energy and new energy resources. Their share in the total number of funded projects, however, is not large given that nuclear energy, energy-saving technologies, eco-innovations and RES have been priorities for the fourth and fifth session of the Fund. Sessions of the Fund were not held in 2009 or 2010 and funding was provided only for covering expenses on already concluded contracts from previous sessions.

Funding for R&D in the field of energy technologies is insufficient to fully use the potential of academic and company research in the country. This research could develop Bulgarian solutions which would bring the country closer to its European partners in using low carbon technologies and help reduce the gap in the achievement of the objectives of the European Energy Strategy. **Public funding is provided by public institutions without mutual coordination and synchronization of efforts.** This and the lack of understanding of the overall technological chain and innovation system of the sector prevents public funding from generating the greatest effect for the stakeholders and the economy.

National policy supporting the innovation potential of the energy sector

Energy is doubtless one of the top priority sectors for the Bulgarian economy. Bulgaria has undertaken a serious commitment in support of the European Energy Strategy and would be liable if it fails to achieve the medium-term and final objectives by 2020. Since the technologies underlying these objectives have not proved their full potential in practice, and are still unattractive

Figure 46. NUMBER OF ENERGY SECTOR PATENTS AWARDED IN BULGARIA BY IPC SECTIONS AND CLASSES, 1994 – 2010



Source: Compiled from data published in the Official Journal of the BPO.

Table 7. PATENTS REGISTERED IN BULGARIA BY IPC SECTIONS AND CLASSES, 1994 – 2010

IPC	Name	Bulgarian patent holders		Foreign patent holders	
		number	%	number	%
F17	Storing or distributing gases or liquids	0	0.00	8	3.13
F22	Methods of steam generation, steam boilers	4	1.56	8	3.13
F28	Heat exchange, steam condensers, cleaning of surfaces of heat-exchange or heat-transfer conduits	14	5.47	15	5.86
G21	Nuclear physics, nuclear engineering	21	8.20	49	19.14
H02	Generation, conversion or distribution of electric power, electric machines, generators, motors, control or regulation	79	30.86	58	22.66
	Total:	**118**	**46.09**	**138**	**53.91**

Source: Compiled from data published in the Official Journal of the BPO.

to business since they generate a high degree of financial and market risk, they need the active support of the government. This support, however, is adversely conditioned by the very low purchasing power of the Bulgarian public and the existence of a currency board which requires strict financial discipline. That is why prioritizing individual technologies is particularly difficult and should be made after careful analysis of costs and benefits.

The existing strategic framework for the development of the energy sector in Bulgaria is not based on an in-depth analysis of the existing technological base generated by research units and business. There is no oversight of public spending, results achieved or the guidelines for their application. The sectoral value added chain is not in the focus of the energy policy. Rather the stages of generation and distribution of energy, creation and application of new technologies are considered in opposition to each other.

There is no shared vision among the government, science and business of the future development of the energy sector and technological competencies. Scientific institutions and business should receive a clear signal from the government that financial and non-financial support of low carbon technologies is a long term priority. Some changes to the mechanisms and financial instruments is necessitated by the dynamics of the competitive environment and markets, but the commitment should remain a long-term one.

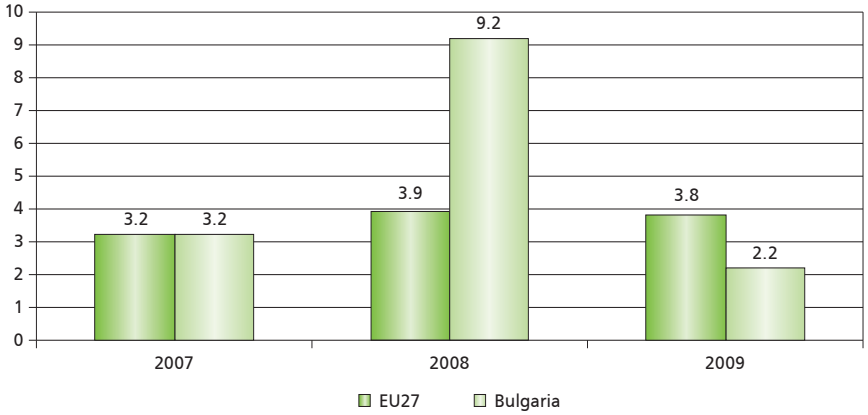
International commitments and objectives of the national energy policy could only be achieved on the basis of complex measures for transition to a low carbon economy, while at the same time maintaining a balance of technological and production capacities in respect to the other types of energy. Bulgaria's energy agenda

Table 8. BULGARIAN COMPANIES WITH REGISTERED PATENTS IN IPC CLASSES CORRESPONDING TO NACE CLASS "ENERGY", 1994 – 2010

Company		Patent number
AGROBIOCHIM	Stara Zagora	1
KOZLODUY N-PLANT	Kozloduy	2
DICS INTERTRADE	Sofia	1
ELMA	Troyan	1
ELPROM ZEM	Sofia	1
ENEMONA	Kozloduy	1
ZEOREX INTERNATIONAL	Sofia	1
INCOMS RECTIFIERS	Pernik	1
YORDAN KOLEV-INTEGRAL FORKLIFT	Sofia	1
NEOCHIM, Research Institute for Low-Tonnage Chemical Products	Dimitrov-grad	3
NEFTOCHIM	Bourgas	2
PODEMCRANE	Gabrovo	1
SOPHARMA	Sofia	1
TESPOM	Gabrovo	1
UNICOM MICROSYSTEMS	Sofia	1
PHARMA	Doupnitsa	2
FICOSOTA	Shoumen	1
HYUNDAI	Sofia	1
BALBOK – ZHELYAZKOVA & CO	Sofia	1
CHEMICAL PHARMACEUTICAL RESEARCH INSTITUTE	Sofia	2
OCTO-7-TSOLEV &CO	Botevgrad	2
TESY	Shoumen	1
	Total number:	**29**

Source: Compiled from data published in the Official Journal of the BPO.

Figure 47. GOVERNMENT BUDGET EXPENSES FOR R&D IN ENERGY, % OF ALL BUDGET EXPENSES FOR R&D



Source: Eurostat, 2011.

TABLE 9. FINANCIAL INSTRUMENTS FOR PROMOTING INNOVATION IN THE FIELD OF ENERGY

Main objectives	Total budget	Launch of operation
Bulgarian Energy Efficiency Fund http://www.bgeef.com/displaybg.aspx		
Increasing energy efficiency of Bulgarian municipalities, industrial enterprises and housing. Use of RES and co-generation, provided the projects are accompanied by energy efficiency promotion measures.	32.2 mln levs at December 31, 2009 under 77 projects	2004 pursuant to the Energy Efficiency Act
Operational Program Competitiveness http://www.opcompetitiveness.bg/bg/index.html		
Priority 2: Increasing efficiency of enterprises and promoting supportive business environment, thematic group of interventions 2.3. Promotion of business networking and clustering, Operation 2.3.1. Introducing energy-saving technologies in enterprises, and Operation 2.3.2. Introduction of renewable energy resources Objective – Reduction of energy intensity and diversification of energy sources.	210,953,218.63 levs 191,630,486.62 levs	Q2 2011
Operational Program Regional Development http://www.bgregio.eu/		
Priority Axis 2: Regional and Local Accessibility, Operation 2.3: Access to Sustainable and Efficient Energy Resources, under grant scheme BG161PO001/2.3-01/2010 Support for preparation, designing and studies for the construction of a gas distribution pipeline connecting Bulgaria and Serbia. Priority Axis 4: Local development and co-operation, Operation 4.1: Small-Scale Local Investments, grant scheme BG161PO001/4.1-03/2010 – Support for the implementation of energy efficiency measures in municipal educational infrastructure of 178 small communities.	11,734,980 levs 27,265,087.74 levs	2010
Energy efficiency and RES credit line of EBRD and Kozloduy International Decommissioning Support Fund http://www.ebrd.com/pages/homepage.shtml		
Co-generation of heat and electricity; Steam boiler rehabilitation; Transition to heating from electricity to heating based on other fuels; Installment of new electric motors and electric equipment; Reconstruction of electric power transmission and transformation systems; Introduction of energy management systems.	€20 mln	2004
EEA Grants and Norway Grants http://www.eufunds.bg/bg/page/22		
Energy efficiency. Use of RES. Reduction and prevention of greenhouse gas emissions. Nuclear safety.	€12 mln	2008
GEF Small Grants Program, UNDP http://www.sgp-bulgaria.org/index.php?option=com_frontpage&Itemid=1&lang=bg		
Energy efficiency; RES; reducing greenhouse gas generation as a result of agricultural practices; promotion of new approaches in technical design of products and choice of materials (including in construction), as a means of reducing energy intensity.	$200,000 for 2011	2005

Source: ARC Fund, 2011.

should encompass a wide set of financial instruments and non-financial incentives influencing energy producers, industrial and end-users, as well as the financial sector.

The introduction of financial incentives should encourage competition between the types of technology instead of leading to prioritization of a certain energy source (wind or solar energy, for example). Overlapping of these instruments should be avoided and they should seek multiplication of effect by combining them with non-financial support schemes. There is a rich international experience in such measures:[70]

- Introduction of energy efficiency standards for vehicles, residential housing and office buildings;
- Introduction of a standard classification of vehicles and making the relevant taxes and fees conditional on the harmful emissions released in the air;
- Mandatory requirements for increasing energy efficiency when urban, inter-city and railway transport is being modernized and replaced;
- Certification of buildings and vehicles by accredited organizations in order to reduce taxes;
- Development of databases for energy generation and consumption as a basis for introducing intelligent energy systems management and control grids;
- Use of behavioral effect – introduction of e-energy balances in households to encourage use of energy-effective appliances and reduction of energy consumption;
- Regionalization of measures a large portion of which are local as regards stakeholders, resources and intended effect. This requires greater participation and initiative at the local level and could be achieved by relying on the unused potential of regional innovation strategies.

Table 10. PROJECTS APPROVED FOR FUNDING BY THE NATIONAL INNOVATION FUND, BY SESSIONS

Field	2005 Session I and II		2006 Session III		2007 Session IV		2008 Session V		Total	
	number	%	number	%	number	%	number	%	number	%
New energy sources	5	4.5	3	2.8	5	4.9	3	4.8	16	4.2
Energy	2	1.8	6	5.5	5	4.9	2	3.2	15	3.9

Source: MEET, 2011.

Table 11. BAS RESEARCH AND INNOVATION POTENTIAL IN THE FIELD OF ENERGY AND NEW ENERGY SOURCES

	Patents	Scientific publications		Funding, 2009, levs	Doctoral students, 31.12.2009, number	External evaluation*
		2009, number	2006, number			
Physical sciences						
Institute for Nuclear Research and Nuclear Energy	1	315	220	4,184,789	23	B A B
Central Laboratory of Solar Energy and New Energy Sources	5	43	50	432,006	1	B B C
Chemical sciences						
Institute of Electrochemistry and Energy Systems	-	41	70	818,272	7	A A A
Institute of Chemical Engineering	16	84	71	386,734	5	B B A

* *Research at the Bulgarian Academy of Sciences,* Report, European Science Foundation, 2009. The grades were assigned according to a four-grade system (A, B, C, D) and refer to 1). Quality and Productivity; 2). Relevance; 3). Prospects.

Source: *Annual Report 2009,* BAS, 2010.

[70] *Global Gaps in Clean Energy RD&D,* International Energy Agency Report for the Clean Energy Ministerial, 2010.

Table 12. POSSIBLE FINANCIAL INSTRUMENTS IN SUPPORT OF CLEAN-TECH INVESTMENTS

Mechanism	Description
Credit lines	Financial instrument of national financial institutions which provide share capital in the implementation of energy projects.
Guarantees	Sharing market and financial risk with local financial institutions when funding energy projects and companies.
Venture capital funds	Venture capital invested in technological innovation.
Carbon funding	Capitalization of the share of reduced greenhouse gas emissions achieved.
Grants	Covering R&D and innovation costs in the field of energy.
Programs for easier loan terms	Mobilization of national capital resources.
Preferential prices in purchasing energy	Promotion of innovation activity in the sector and acceleration of return on investment.
Tax credits	Aimed at different stages of technological maturity without favoring some technologies at the detriment of others.
Public procurement	Initiation of new technological solutions in the development of public infrastructure.
Concessions	Provide long-term incentives for maintaining low prices and/or introducing new technological solutions, particularly in large-scale infrastructure projects.
Voucher schemes	Support of the cooperation between business and science by covering research expenses in the implementation of practical technological innovation projects.
Tax relief	Promotes achievement of the Energy Strategy objectives, including boosting energy efficiency: – for construction companies implementing passive building projects and high energy efficient building projects; – for households and companies implementing energy efficiency projects in residential housing, office and industrial buildings; – for transport companies (taxis, second-hand car sales, importers and distributors of new vehicles, bus transport companies) at offering low or zero emission motor vehicles; – for municipalities at the implementation of urban transport modernization and development projects.
Direct subsidy	Promotion of entrepreneurship and innovation in the sector.

Source: ARC Fund, 2011.

Drafting a program promoting the energy efficiency of sectors with the worst results in respect to electricity and heating used per end-production item could be a specific measure aimed at reducing the energy intensity of the economy.

Bulgaria's energy system is in the process of transformation from a standard energy model based on using fossil fuels to a balanced energy mix based on RES and energy efficiency. Its successful implementation requires the application of an intelligent energy policy with strict requirements for the stakeholders on the energy market, a clear regulatory framework and transparent rules of interaction between the government and business.

6 CONCLUSION

In the last three crisis years Bulgarian governments failed to react adequately to the impact of the crisis – signals of forthcoming economic difficulties were disregarded, public payments were delayed, the regulatory practice was haphazard and unpredictable – thus creating additional difficulties for businesses in Bulgaria. While the crisis was not seen as "a good period to invest in innovation", now it is expected that the promotion of new knowledge will become a focal point of national policy. In addition, the definition of the EU priorities, as well as coordination of the instruments to achieve them, for the next period of 2014 – 2020 is on the agenda – a process in which Bulgaria should take a more active part to establish a favorable business environment and a working innovation eco-system.

The analysis of the national economy's innovation potential made by this report highlights some positive changes:

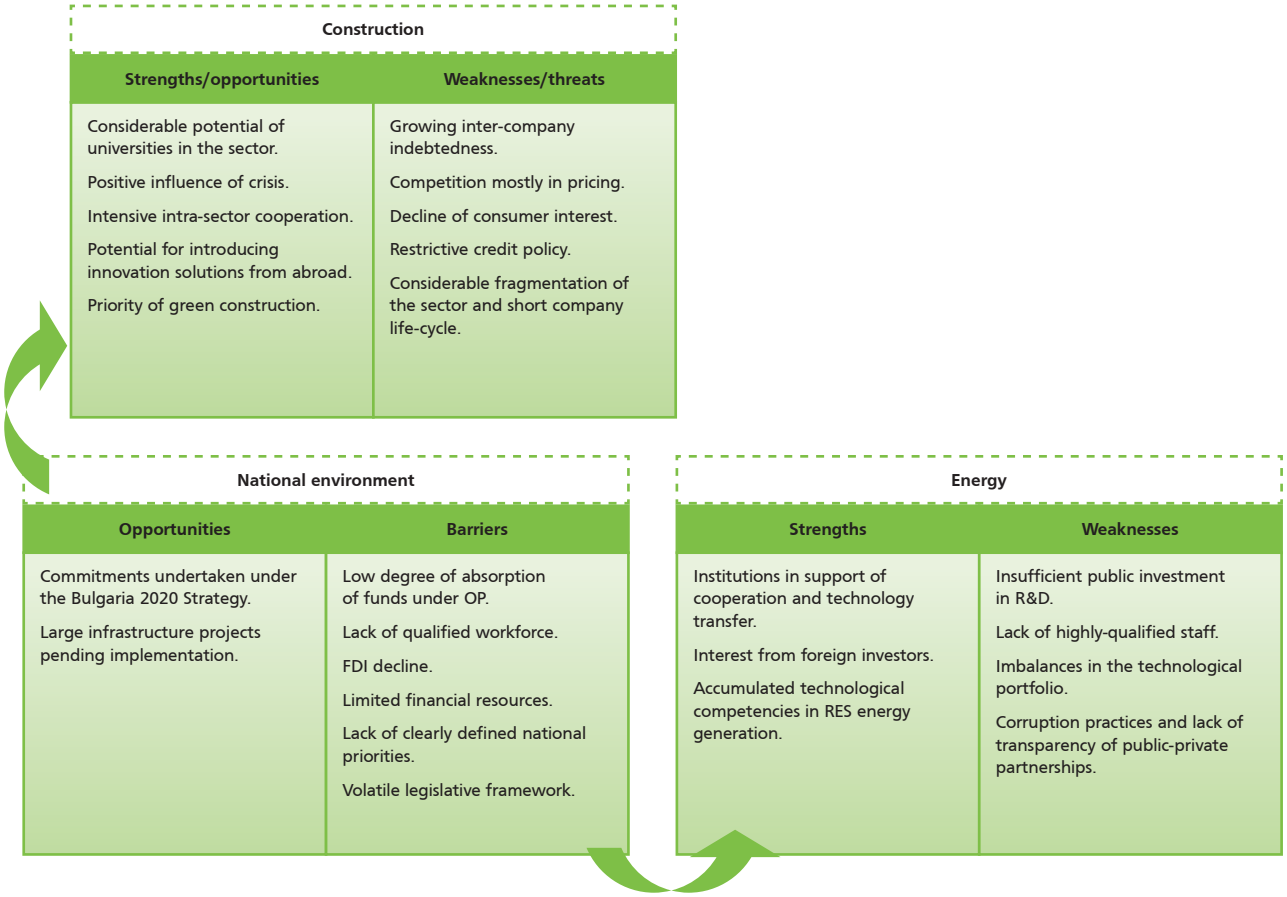
- A stronger involvement in R&D – in terms of expenses and people – of business and higher education;
- A reduction of regional imbalances in R&D investment;
- More patent applications and higher patent productivity of business;
- A positive correlation between the research and innovation potential at sectoral level and the interest of foreign investors.

The outlined positive changes are not the result of a well-considered innovation policy but are rather the random effect of the action of various bodies directly or indirectly involved in innovation.

This report has found that in spite of relatively fast progress, Bulgaria continues to stand at the bottom of European innovation and competitiveness rankings, which implies that the economy has a potential for innovation growth. Well researched and comprehensive policies founded on an understanding of the significance of innovation, including at regional and sectoral level, are still very much needed. These should be supported by an effective use of the variety of financial and other instruments. The stakeholders in the sectoral innovation sys-

tems have to start "speaking the same language" in choosing priorities and in the implementation of measures to achieve them.

Figure 48. SWOT ANALYSIS OF SECTORAL INNOVATION SYSTEMS



Source: ARC Fund, 2011.

The change that is needed for Bulgaria to increase and realize its innovation potential is not solely and primarily in the amount of allocated funds. As a small economy, Bulgaria should act wisely, which in respect to innovation means:

- Participation in Europe's debate on the future of the funding instruments over the next program period for EU funding, including with a view of providing specific focus on the needs and capacity of new member-states;
- Strengthening administrative capacity for effective and transparent absorption of the funds under the operational programs as the most significant source of funding for developing the innovation potential of the economy;
- Adopting innovation-oriented regulations to restart financing from the National Innovation Fund which together with the National Science Fund should cover the entire life-cycle of creation and introduction of new knowledge;
- Management of the Bulgarian Academy of Sciences and the higher educational establishments as an integral part of the national research infrastructure and on the basis of their specific functions, experience and competencies.

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APPLIED RESEARCH AND COMMUNICATIONS FUND

The Applied Research and Communications Fund is a Bulgarian research non-profit organization, registered in public benefit, established in 1991. Its mission is to support the development of innovation and the knowledge economy in Bulgaria through:

- advice and advocacy on establishing national, regional and local level policies and strategies for the country's successful integration into the global innovation economy;
- research and analyses of development trends and policy options for supporting innovation as well as information and communication technologies;
- public-private partnerships among businesses, public institutions, the academic community and civil society for addressing specific issues of ICT and innovation based competitiveness.

The Applied Research and Communications Fund has set up two functional units for the provision of IT and consulting services:

- European Innovation Centre – Bulgaria is part of the largest information and consultancy support network in Europe: Enterprise Europe Network, and coordinates its work in Bulgaria. The Network aims to assist small and medium-sized enterprises in their innovation potential development and to raise their awareness about the European Commission's business-oriented policies.
- ARC Consulting EOOD is the consulting arm of the Applied Research and Communications Fund. The company offers consulting services in the fields of innovation and information and communication technologies, as well as advisory services in the design and implementation of national and international projects under the EU Framework Programs, the Cohesion and Structural Funds.

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