

I. INTRODUCTION

Research infrastructure is an important component of every scientific and research system. Its availability serves the needs of progressive fundamental studies and provides a possibility for the performance of complex and interdisciplinary tasks. The access to modern research infrastructure guarantees a framework for development of scientists and is a prerequisite for the transfer of technologies and knowledge.

The availability of open, competitive and quality-based access to pan-European and global scientific research infrastructures is of great importance in order to enable the transformation of European research space into a more attractive place for development of science and innovations. The research infrastructures' roadmap is of fundamental significance for the achievement of these objectives and is one of the most successful initiatives for attraction of European and international scientific organizations to the processes of carrying out scientific research. This is also evidenced by the inclusion of research infrastructures on the agenda of a number of strategic documents for science and development, such as the strategy Europe 2020.

In its Conclusions of 11 December 2012 the Council emphasized the necessity of renewal and adaptation of the mandate of the European Strategy Forum on Research Infrastructures (ESFRI), in order to respond in an appropriate manner to the existing challenges, as well as ensuring the performance of ongoing projects of ESFRI and determination of the priorities in the infrastructural projects listed in ESFRI Roadmap, for new research infrastructures of common European interest. In its conclusions of 26 May 2014 the Council has accepted the work completed by ESFRI for determining priority projects which are sufficiently mature in order to be in a process of implementation in the period 2015-2016.

The first national research infrastructure roadmap of Bulgaria was adopted in the year 2010 by Decision No. 692 of the Council of Ministers and it has defined the national needs in the field of research infrastructure, the problems to be resolved and the obstacles for their resolving.

In the process of preparation of Bulgaria for the period 2014-2020 actions have been taken for elaboration of the National Strategy for Intelligent Specialization and Priorities under the operational programmes of the Structural and Cohesion Funds of the European Union. The main activities in the policies in the area of scientific research being elaborated in Bulgaria are focused on the support to and increasing of the top scientific achievement, including the training and retaining of new generations of highly qualified experts in the country and support to the research and development of research infrastructure and facilities.

The updating of the National Roadmap is coordinated with the objectives of the Innovation Strategy for Smart Specialization is being elaborated and it takes into account the priorities of the scientific research activities, which are currently developed within the pan-European research system. Priority for Bulgaria is also the achievement of synergy between the different programmes for support of research infrastructures, meeting the requirements for priority facilities of ESFRI and those meeting the economic, social and environmental challenges for the country and the regions in Bulgaria.

In 2011 the infrastructures of national interest identified in the Roadmap obtained support for the performance of feasibility studies. A part of them, after starting the process of updating the Roadmap, showed a progress in the performance of activities of research and development of scientific research infrastructure. The process of updating has passed through preliminary national selection and international expert verification with the assistance of ESFRI.

The updated roadmap reflects both the wish for advancement in the process of taking long-term decisions for investments in the future of society, and the achieved consensus between the representatives of the financing organizations and the scientific community.

In brief, the updating of the Research Infrastructure Roadmap in Bulgaria has the following general objectives:

- support to the policy on development of scientific research in Bulgaria ;
- provision of financing and transparency for the implementation of the Roadmap during the period 2014-2020.

II. RESEARCH INFRASTRUCTURE – GENERAL TERMS

1. DEFINITION OF RESEARCH INFRASTRUCTURE (RI)

"Research infrastructure" includes facilities, resources and the related services being used by the scientific community for conducting high-level scientific research in the relevant areas and encompass large-scale research facilities, integrated small research facilities and high-speed communication networks with large transmission capacity, distributed highly productive computing systems, such as Grid, networks of computing systems, etc; knowledge-based resources, such as collections, databases with archives and other types of structured scientific information; infrastructural competence centers, which provide services for wider research

communities, as well as any other site with unique nature that is of substantial importance for attaining top achievements in scientific research.

These infrastructures can be "concentrated in one place in a single resource", "distributed" (organized as a network of resources) or "virtual" (the service is provided electronically)¹.

Research infrastructure and especially the electronic research infrastructure (e-infrastructure), via which all researchers working within their own organization or nationwide, or within multinational scientific initiatives, have shared remote access to a unique or distributed research equipment and research data, irrespective of their type and location in the world, is a very important prerequisite for the successful inclusion of Bulgarian scientific research community in the European research area.

Research infrastructure combines the three key factors necessary for the formation of dynamic economic model of sustainable development and employment based on the "knowledge triangle": education, scientific research and innovations, due to the availability of the critical mass of modern research equipment and scientific capacity with new competencies and skills. In 2001 the European Commission presented the member states with the working document "European Research Area for Infrastructures" commenting on the necessity of a better exploitation of already existing research facilities as well as specifying of new facilities in areas of major significance as a guarantee for compatible researches in Europe and its recognition as one of the leaders in the global research area.

2. CATEGORIZATION OF RESEARCH INFRASTRUCTURES ACCORDING TO THEIR SIGNIFICANCE

Most generally, the following categories of research infrastructure can be specified:

- International infrastructures administered on the grounds of concluded agreements and conventions; ²
- International infrastructures providing wide access opportunity³
- Unique infrastructures ⁴

¹ The definition is part of the major documents of the European Strategy Forum on Research Infrastructures and of the European Commission.

² Such infrastructures are for example: the Organization for Nuclear Research – CERN, the European Space Agency, the European Molecular Biology Laboratory, etc:

³ *Wide access* – free access to RI granted to students, PhDs, scientists from various institutes, including the opportunity that RI provides services and serves the industry, the business and the community.

⁴ Unique flora and fauna reserves in a particular region; genetic banks, etc.

- Facilities and/or databases created in/by a country providing wide access to native and foreign researchers;
- Networks of national research units with providing a possibility for *wide access*, with well-defined research objectives and open access for foreign researchers or development of new satellite units to already existing research networks with a possibility for extension upon stated interest;
- Research complex or databases (created by a university, scientific research institute or another large organization) used in collaboration between various research groups mostly within the boundaries of an organization;
- Research equipment or limited databases, situated in different laboratories used by a specific research group, with a possibility of regulated access for external researchers;
- Local partnership networks, forming an inseparable part of a pan-European research complex, providing similar services, which conduct scientific research upon identical terms and quality, but are designated to serve a particular region.

III. OBJECTIVES OF THE NATIONAL ROADMAP

Investments in research infrastructure should be planned and developed so that the utmost contribution is insured on the part of the research and innovation system for economic development and social welfare. The development of research infrastructures and large-scale scientific research complexes invariably creates conditions for fast economic growth, employment and guarantees high-level competence of the conducted research studies. Research infrastructures should unite the existing scientific research capacity at national, regional and European level for work on joint research issues. Also taken into account is the interconnecting and development of networks of scientific research institutions and higher education establishments, which guarantees the large-scale nature of the scientific research being conducted and the overcoming of the fragmentariness of the national and European research system. On a European scale uniting of financial and human resources is achieved, which guarantees efficiency and efficacy of the means for development of infrastructures of European and global significance.

The National Roadmap is tied to the priorities of the European Research Infrastructure Strategy. Every member state must should make an evaluation and validation of its scientific potential and priorities, and on such basis, to elaborate national strategies for participation in the process of developing pan-European research complexes. This is implemented through two approaches:

1. Joining to and participation in the European research infrastructure consortia, which presupposes the establishment and refurbishment of regional centers and taking part in various experiments and scientific research programmes. The financial commitment includes maintenance of high-level research equipment at national level, that has the capacity to perform high-quality tests compliant to the European standards; membership fee to the operating expenses of the European facility; training of new human resource generation, preparation of the business for performance of specific orders and services for the European infrastructure, etc.;
2. Establishment of national centers uniting the existing scientific research capacity in leading research fields, which are unique for the country and do not have analogy on a regional scale. These centers can be partners to the present and / or future European research infrastructure consortia. The financial commitment is in the creation of high-level technological and human potential.

With the update of the Roadmap priority projects are determined which are at a sufficiently advanced stage in order to enter in their implementation process in the period 2015-2016 and the timely implementation of which is considered as especially important for extending the limits of knowledge in the relevant areas. Two groups of projects are identified.

Within the first group nine projects are indicated for which development preparedness is available and which are of strategic importance for Bulgaria. Within the second group five additional projects are determined (*Distributed infrastructure of centers for production and research of new materials and their application for conservation, access and e-storage of artifacts; Research and innovations in agriculture and food; Cell technologies alliance – CTA; National geoinformation center ; Eco and energy saving technologies*), which have the potential to reach a stage for implementation in 2015-2016 and in respect of which support to feasibility studies will be provided.

IV. PARTICIPATION OF BULGARIAN SCIENTIFIC RESEARCH INSTITUTIONS IN EUROPEAN INFRASTRUCTURE PROJECTS

The European Roadmap includes 48 infrastructural projects, which are determined as especially important and significant for the development of European research area and building a knowledge- and innovation-based economy. Within the period after the publication of the Roadmap in 2006 up to its updating in the years 2008 and 2010, ten projects have entered into

their development or operational phase. The Roadmap of Europe provides the possibility for annual renovating of the list with the "leading" infrastructure initiatives

The construction of such complexes is not within the power of a single country so member states make an assessment of their national priorities in order to take part in the construction of these infrastructures that will register high added value for the respective country. The construction of the European infrastructures requires administrative and financial engagement on the part of the member states, the countries associated under the Seventh Framework Programme as well as interested third parties, including European and international organizations appreciating the advantages of a participation in such large research complexes. The European Commission partially finances the preparatory activities accompanying the realization stage. The financial support of the European structural funds will secure the phase of construction of large research facilities. This guarantees the expanding of European scientific cooperation and the involvement of the new EU members states in the process of modernization of the scientific research system in Europe.

Bulgaria already participates in some of the European projects preparing the construction of research infrastructure complexes. These are:

- **EURO-ARGO** - global monitoring of oceans and seas;
- **CLARIN** - electronic linguistic models;
- **BBMRI** - European biobanking infrastructure;

In order to carry out a review of the efficiency and benefits of our involvement in a part of these projects, in 2013 the Ministry of Education and Science initiated activities on updating the National Roadmap for review and assessment of existing and new research infrastructures for the purpose of identifying those of them, which are consistent with the European priority fields for refurbishment and/or construction of new research facilities.

The assessment includes the following parameters:

A. National infrastructures:

- large-scale, interdisciplinary and unique facilities, databases and computer networks;
- widely accessible, multifunctional research infrastructures of scientific significance at national, regional and/or international level;
- technologically and financially foreseeable and achievable conditions;
- availability of national research potential for their full-range exploitation;

B. Participation in international research infrastructures:

- existence of consortium of research units/ teams from scientific research establishments of various types, interested in participation in the international infrastructure ;
- argumentation of the necessity of Bulgaria's participation in the international infrastructure; significance for resolving national and regional research problems, social and economic effect for our country;
- assessment of the effect of our participation in the international research infrastructure for enhancing the scientific research potential of our country and attaining economic prosperity;
- available resources of the research units/ teams for participation in a particular international research infrastructure, including available facilities, human capital, etc.;
- compliance of the research activity of the units/teams with the scientific research areas to be serviced by the international research infrastructure;
- traditions of the research units/teams in the respective scientific research area/s;
- existing scientific research projects being implemented during the last 5 years by the respective research units/teams and the compliance of such projects with the scientific research area/s of the international infrastructure;
- assessment of the necessary additional resources for participation of the research units/teams in the international infrastructure;
- risk assessment of our participation.

The activities on updating the Roadmap include national and international assessment. At national level the assessment has been performed by inter-institutional working group with representatives of the Bulgarian Academy of Sciences, universities, nongovernmental organizations and ministries. The national working group has reviewed, assessed and selected the received proposals by thematic fields. A part of the project proposals received a support for consolidation and the group suggested the following infrastructures for validation by the international expert panel of ESFRI:

1. National Grid infrastructure (member of EGI.eu);
2. Infrastructure for genome, proteome, and metabolome research and computer simulation and design of applicants for medicines in relation to Bulgaria's participation in BBMRI;
3. Bulgarian supercomputer center: high-productive infrastructure for computer modeling, simulations and research with application in industry, medicine, pharmacy, energy, transport, finance and the environment - PRACE;
4. Regional astronomical center for research and education - RACRE;

5. Storage of energy and hydrogen energy;
6. European social survey – ESS;
7. Infrastructure for biological microscopy and biomedical imaging methods – Euro-BioImaging;
8. National interdisciplinary research e-infrastructure for culture and humanitarian studies – DARIAH – BG;
9. National interdisciplinary research e-infrastructure for integration and development of electronic resources for Bulgarian language – CLARIN;
10. National cyclotron center ;
11. Distributed infrastructure for sustainable development in the field of maritime development – EURO-ARGO.

Based on the performed international expert assessment as per the specified criteria, 9 national infrastructure complexes are proposed as infrastructures of national significance. Six out of them have the potential to participate in pan-European research infrastructures.

The determined infrastructure complexes are the following:

1. National university complex for biomedical and applied research (BBMRI)
2. Modern microscopy center for fundamental and applied research in the field of biology, medicine and biotechnologies (EuroBioImaging);
3. Sustainable development infrastructure in the field of marine research, related to to Bulgaria's participation in the European infrastructure Euro-Argo;
4. Research infrastructure Storage of Energy and Hydrogen Energy;
5. European social survey for Bulgaria (ESS);
6. National center for highly productive and distributed computing (EGI and PRACE);
7. National interdisciplinary research e-infrastructure for resources and technologies for the Bulgarian linguistic and cultural heritage, integrated within the European infrastructures CLARIN and DARIAH (CLARIN-BG);
8. Regional astronomical center for research and education (RACRE);
9. National cyclotron center – infrastructure for scientific and applied research and innovations with educational functions in the areas of nuclear medicine, nuclear physics, nuclear energy, radiochemistry, radiopharmacy, acceleration technology and centralized radiopharmacy for production of pet radiopharmaceuticals for the needs of nuclear medicine.

The Roadmap specifies the financial and research coordinator, as well as the partners for the implementation of the research infrastructures. The national consortia are of open type and they can be joined by new partners, given the consent by the managing bodies of the infrastructure.

The international expert committee, based on a decision adopted by the Inter-institutional working group, has performed a review of 13 other project proposals, designated for reworking, supplementing, combining with or joining to the existing infrastructure, where possible. Five infrastructure complexes out of these have a development potential as regards their preparedness for development by the year 2016 and they will be provided with the possibility to carry out feasibility studies, as follows:

- Distributed infrastructure of centers for production and research of new materials and their applications for conservation, access, and e-storage of artifacts (archaeological, folklore) (INFRAMAT);
- Research and innovations in agriculture and food;
- Cell technologies alliance– CTA;
- National geoinformation center ;
- Eco- and energy saving technologies.

LIST OF RESEARCH INFRASTRUCTURE PROJECTS WITHIN THE NATIONAL ROADMAP

NATIONAL UNIVERSITY COMPLEX FOR BIOMEDICAL AND APPLIED RESEARCH

Name of the infrastructure	National university complex for biomedical and applied research, Biobanking and Biomolecular Resources (BBMRI)
Coordinator and location of the infrastructure	Medical University –Sofia, Location : Medical University – Sofia and Medical University – Plovdiv
Bulgarian consortium	<i>Financial coordinator:</i> Ministry of Education and Science <i>Scientific coordinator:</i>

Medical University – Sofia

Consortium members:

- Molecular Medicine Centre;
- Faculty of Medicine;
- Faculty of Pharmacy
- National genetic laboratory, *Maichin Dom* Specialized Hospital of Obstetrics and Gynecology;
- *Aleksandrovska* University Hospital,
- *Pirogov* University and ER Medicine Hospital;
- *Academician I. Penchev* University Hospital

Medical University – Plovdiv:

- Faculty of Medicine;
- Immunology Research Centre;
- Centre for medical molecular biology research

Medical University – Varna:

- Nutrigenomics Centre

Description of the infrastructure

BBMRI is a strategic network of infrastructural facilities for fundamental and applied biomedical research and includes partners from two of the largest medical universities in Bulgaria, as well as a number of hospital establishments and centers. In parallel, the infrastructure includes some of the largest biobanks for genetic and tissue matter in the country.

The role of the consortium is to connect the existing resources by achieving a critical mass of expertise and technological opportunities, thus giving a new impetus to research in the area of molecular medicine genetics and epidemiology in Bulgaria in the post-genomic era. The purpose is to accelerate the transition between fundamental research and clinical practice in order to improve preventive medicine and treatment of diseases that have the greatest social significance.

Development stage

Presence of distributed excellence centers in the field of molecular medicine, genomics and metabolomics.

Phase of development and refurbishment of centers for high scientific competence in immunology and molecular biology research, pharmacy and pharmacology, pharmacogenetics, *in silico* design of drugs, pharmacotherapy, and toxicology, medical nanotechnologies, proteomics, bioinformatics, national

	network of biobanks and clinical registers, diagnostic laboratory in clinical genomics.
Necessary financial resource (including membership fee for participation in pan-European infrasturcture)	<p>Budget per years:</p> <p>For the year 2015 – BGN 6 million, 48 896 out of which comprise membership fee.</p> <p>For the year 2016 – BGN 6 million, 48 896 out of which comprise membership fee.</p> <p>For the year 2017 – BGN 4 million, 48 896 out of which comprise membership fee.</p> <p>For the year 2018 – BGN 4 million, 48 896 out of which comprise membership fee.</p> <p>For the year 2019 – BGN 5 million, 48 896 out of which comprise membership fee.</p>
Expected benefits	<ul style="list-style-type: none"> ○ improvement of the level of biomedical sciences and education through the establishment, extension and maintenance of modern infrastructure for genomic, proteomic, metabolomic and translational research; ○ application of the principles of systemic biology for clarification of the molecular mechanisms of genetic and infectious diseases in order to find new treatment approaches and more efficient medicinal products; ○ stimulation of applied research in the field of genomic medicine for establishment of personalized therapy approaches for the purpose of improving diagnostics, preventive medicine, and treatment of socially significant diseases, such as oncologic, cardiovascular, neuropsychiatric, metabolite, and rare genetic disorders;. ○ improvement of the life quality of Bulgarian patients and supporting the activity of the health insurance system; ○ connecting the biobanks existing in Bulgaria in a common national network, a part of the European BBMRI infrasturcture. Upgrading and development of the biobanks' network; ○ inclusion of BBMRI in European and international networks and initiatives in the field of biomedical research and more specifically, in applied research focused on the development and introduction into practice of personalized treatment approaches.
Participation in the	BBMRI (Biobanking and Biomolecular Resources Research Infrastructure) –

European infrastructure	<p>European research infrastructure for biobanking</p> <p>The Molecular Medicine Centre at Sofia Medical University is an associated member of BBMRI since the year 2010.</p> <p>EATRIS (European Advanced Translational Research InfraStructure) – European infrastructure for applied medicine</p>
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MODERN MICROSCOPY CENTER FOR FUNDAMENTAL AND APPLIED RESEARCH IN THE FIELD OF BIOLOGY, MEDICINE AND BIOTECHNOLOGIES

Name of the infrastructure	<p>Modern microscopy centre for fundamental and applied research in the field of biology, medicine and biotechnologies (EuroBioImaging)</p>
Coordinator and location of the infrastructure	<p>Institute of Molecular Biology <i>Academician Rumen Tsanev</i>, Bulgarian Academy of Sciences</p>
Bulgarian consortium	<p><i>Financial coordinator:</i> Ministry of Education and Science</p> <p><i>Scientific coordinator:</i> Institute of Molecular Biology <i>Academician Rumen Tsanev</i>, Bulgarian Academy of Sciences</p>
Description of the infrastructure	<p>The modern microscopy centre for fundamental and applied research in the field of biology, medicine and biotechnologies at the Euro-</p>

BioImaging consortium has the purpose of developing infrastructure for modern microscopy which is to provide free access for Bulgarian researchers to innovative technologies for obtaining images. The centre will provide access to the following cutting edge techniques of microscopy:

1. Multiphoton and confocal scanning microscopy. This type of system, which is currently not available in Bulgaria, enables high-resolution in-depth observation of tissues in organisms.
2. Laser micro-dissection allowing the separation of cancer cells from normal tissue with high precision for subsequent research and diagnostics.
3. Light sheet microscopy (SPIM) is a new technique with a vast potential, which enables the making of tridimensional images of cells and small organisms for days without phototoxicity.
5. High productive fluorescent microscopy enabling the simultaneous study of the effect on normal and cancer cells of thousands of biologically active chemical compounds with potential use in medicine.

Development stage

As a first part of the center's development a purchase, installation and commissioning is completed of a last generation Spinning Disc Fluorescent Microscope (BGN 918 000) for study of living cells with options for laser micro-irradiation and photoactivation.

Necessary financial resource (including membership fee for participation in the pan-European infrasturcture)

For the year 2015- BGN 4 458 901, , out of which BGN 39 167 comprise membership fee
For the year 2016. -BGN 177 981, out of which BGN 39 167 comprise membership fee
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For the year 2018 - BGN 177 981, out of which BGN 39 167 comprise membership fee
For the year 2019 - BGN 177 981, out of which BGN 39 167 comprise membership fee
For the year 2020 - BGN 177 981, out of which BGN 39 167 comprise membership fee

Expected benefits

The development of this infrastructure will enable the researchers to make use of cutting edge techniques for microscopy for observation of fixed and living cells for the purpose of researching a large variety of issues in biology, medicine and biotechnologies.

The provision of free access to modern microscopy technologies through the establishment of Centre for modern biomedical microscopy as a part of the international infrastructure Euro-BioImaging will increase the opportunities for Bulgarian scientists to elaborate both fundamental research studies, and R&D activity. The development of a system for sharing technologies and facilities between science and business will facilitate the conceptual and technological integration of biomedical research of Bulgaria in EU.

In a long-term aspect, stimulation will be provided for the creation of biomedical products with protected intellectual property as medicinal products, other biologically active substances, tests having application in diagnostics and criminology, etc. The opportunities for transfer of knowledge from the sphere of science to the production sphere will be extended in order to transform the technological concept in a real production technology for products with high value added. This research infrastructure will enhance the competitiveness of Bulgarian economy in the area of health and biotechnologies and will support the development of modern economy based on knowledge and scientific achievements.

Participation in the European infrastructure

The modern microscopy centre for fundamental and applied research in the field of biology, medicine and biotechnologies is a part of Euro-BioImaging, a pan-European consortium, which is included in the roadmap of the European Strategy Forum on Research Infrastructures (ESFRI)

SUSTAINABLE DEVELOPMENT INFRASTRUCTURE IN THE FIELD OF MARINE RESEARCH TIED TO THE PARTICIPATION OF BULGARIA IN THE EUROPEAN INFRASTRUCTURE EURO-ARGO

Name of the infrastructure	Sustainable Development Infrastructure in the Field of Marine Research tied to the participation of Bulgaria in the European infrastructure Euro-Argo
Coordinator and location of the infrastructure	Institute of Oceanology at the Bulgarian Academy of Science
Bulgarian consortium	<i>Financial coordinator:</i> Ministry of Education and Science <i>Scientific coordinator:</i> Institute of Oceanology at the Bulgarian Academy of Science <i>Consortium members:</i>

- Sofia University *St. Kliment Ohridski*;
- National Institute of Meteorology and Hydrology, BAS
- Hydro- and Aerodynamics Centre, Varna, at the Institute of Metal Studies, Facilities and Technologies, BAS;
- Institute of Fishing Resources, Agrarian Academy
- *N. Y. Vaptsarov* Naval Academy, Varna
- Technical University – Varna;
- Medical University – Varna;

Description of the infrastructure

It consists of four thematically unified modules:

1. Scientific research fleet;
2. National operational programme for marine observation;
3. High productive computing complex;
4. Laboratory research complex.

Each of the modules represents a functionally distinguished part of the research infrastructure and comprises separate elements, physically distributed in various scientific organizations in the region of Varna city. The modules include: research equipment, facilities, databases, specialized laboratory research centers connected in a computer network and necessary to the scientific community in order to perform modern, high-quality, and competitive research studies, transfer, exchange and protection of research knowledge.

Development stage

Feasibility study

Necessary financial resource (including membership fee for participation in the pan-European infrastructure)

For the year 2015 – BGN 2 480 000, out of which \approx BGN 80 000 comprise membership fee;
 For the year 2016 – BGN 29 515 000, out of which \approx BGN 80 000 comprise membership fee;
 For the year 2017 – BGN 19 395 000, out of which \approx BGN 80 000 comprise membership fee;
 For the year 2018 – BGN 3 130 000, out of which \approx BGN 80 000 comprise membership fee;
 For the year 2019 – BGN 3 130 000, out of which \approx BGN 80 000 comprise membership fee;
 For the year 2020 - BGN 3 130 000, out of which \approx BGN 80 000 comprise membership fee.

Expected benefits

Oceans and seas are the key to climatic changes and weather, influenced by the streams and temperature changes in large water basins.

The ARGO system is a unique development making it possible to measure the change in salinity and temperature and their preservation, the change in the streams and the ability of oceans and seas to absorb the excess carbon dioxide from the atmosphere.

ARGO is an essential component of the programme *Global Monitoring for Environment and Security* (GMES) and more specifically, the part thereof relating to marine research. GMES is an initiative for Earth monitoring performed under the guidance of the European Community and is implemented in partnership with the Member States. The Earth observation allows for the collection of information about the physical, chemical and biological systems on the planet, or the so-called natural environment monitoring.

The benefits for Bulgaria from the participation in **EURO-ARGO** can be grouped in the following main aspects:

- development of a centre for research of various factors influencing marine environment and its protection;
- database and monitoring of industrially important fish species in order to determine the stocks thereof and in view of their rational exploitation, as well as in view of preserving biodiversity;
- development of competencies and infrastructure in the field of maritime technologies and more specifically, those having application in maritime and coastal engineering, aerodynamics, and water transport;
- improvement of the existing technologies for prevention of pollution by the marine transport and petrol spills;
- elaboration of apparatus sets and technologies for collection of spills of black oil, oil and other pollutants in the event of incidents above and underwater;
- participation in various European networks and technological platforms for data exchange and joint research programmes;
- improvement of the methods of research, training and qualification

- of young people in the field of marine sciences and technologies;
- development of modern laboratories and centers in view of competitive presence in the European networks and programmes in the field of marine research and technologies;
- elaboration of pre-operational and climatic numerical models of physicochemical and ecological parameters in the coastal and pelagic zone;
- assessment of climatic changes in surface and deep layers.

Participation in the European infrastructure

IFREMER, France, French Research Institute for Exploitation of the Sea
 EuroARGO, EUROFLEETS, JERICO, SeaDataNet, DANUBIUS-RI, FixO3, EMSO and MyOcean

ENERGY STORAGE AND HYDROGEN ENERGY RESEARCH INFRASTRUCTURE

Name of the infrastructure	Research infrastructure <i>Energy storage and hydrogen energy</i>
Coordinator and location of the infrastructure	Institute of Electrochemistry and Energy Systems – Bulgarian Academy of Sciences Distributed infrastructure: Sofia (BAS, University of Mining and Geology, University of Chemical Technologies and Metallurgy), Blagoevgrad, Plovdiv
Bulgarian consortium	<i>Financial coordinator:</i> Ministry of Education and Science <i>Research coordinator:</i> Institute of Electrochemistry and Energy Systems – Bulgarian Academy of Sciences (BAS)

Consortium members:

- Unified Innovation Centre of BAS;
- Institute for Polymers (IP - BAS)
- University of Mining and Geology *St. Ivan Rilsky* (UMG);
- Plovdiv University *Paisii Hilendarski* – Laboratory of bioelectrochemistry (PU);
- University of Chemical Technologies and Metallurgy - Hydrogen Technologies Centre (UCTM);
- Central laboratory for solar energy and new energy sources (CLSENES - BAS);
- Southwestern University *Neofit Rilski* – Innovation Centre for Ecoenergy Technologies (ICEET-SWU)

Description of the infrastructure

The infrastructure covers completely the priorities of Strategy 2020 and provides conditions for the integration of Bulgaria within the implementation of European Strategy Plan for Low Carbon Energy Technologies (SET-Plan). It unites the active Bulgarian research centers working in the defined zone with their available base (research equipment, expertise, research and innovation potential, international cooperation) for joint research and application activity in a tremendously topical area both for European and for Bulgarian economy – production, storage and use of energy from renewable sources and accelerated introduction of hydrogen technologies in various spheres of economy. Coordinated target upgrading will be ensured in compliance with the intelligent specialization principle and with the specificity of the individual geographic areas in the country, which will include:

- stage-by-stage refurbishment and extension of 4 distributed thematic laboratories (the development of which is based on 15 existing laboratories), including the creation of electronic infrastructure for digitization of experimental processes (VRIMS);
- establishment of laboratory for certification of batteries which will fill in an empty niche at a national and regional level;
- development of general laboratory for tests of batteries and fuel

cells (components and systems) for electromobiles and for storage of energy, including their inclusion in a network or renewable energy sources.

The thematic orientation of the infrastructure will guarantee the establishment of an environment for public-private partnership, for close cooperation with the stable national battery industry and expert support to the entry and efficient application of the new hydrogen technologies.

Development stage	The consortium applies for establishment of a new infrastructure	
Necessary financial resource (including membership fee for participation in the pan-European infrasturcture)	Indicative budget	BGN 10 000 000
	Amount of requested financing	BGN 8 000 000 (75%)
	For the year 2015 – BGN 3 390 000	
	For the year 2016 – BGN 2 415 000	
	For the year 2017 – BGN 1 375 000	
	For the year 2018 – BGN 1 100 000	
	For the year 2019 – BGN 865 000	
For the year 2020 – BGN 855 000.		
Expected benefits	<p>The proposed infrastructure is strongly oriented towards the innovative and efficient scientific research servicing of certain niches of Bulgarian economy, including some currently "hot" zones in the Energy sector.</p> <p>The development of industry-oriented laboratories will ensure efficient and overall realization of the research potential, including active international cooperation, including active international cooperation, by way of: retaining and returning to Bulgaria of qualified experts; overcoming the thematic fragmentariness, increasing the efficiency of scientific research; creation of new expert potential for the implementation of innovative technologies in the energy and transport sectors of the national economy; increasing the possibilities for involvement of target teams of scientists and experts in projects and programmes at national, regional and international level, working in close cooperation with prestigious European scientific institutions (CEA, DLR, CSRS, CNR, ENEA, SINTEF, etc.); integration in research networks and programmes.</p>	

The infrastructure will provide knowledge and technical expertise in such areas as:

- peak shaving in intelligent electricity networks;
- integration of the energy obtained from RES in the power distribution grid;
- implementation of low carbon technologies in transport. The infrastructure has an excellent basis and traditions in the training of students, PhD students and experts in the area, as well as a potential and skills for popularization of innovative technologies among the public.

The provision of possibility for testing pilot systems and the existence of certified laboratories will meet the national and regional needs and will open new opportunities for further cooperation between science and industry, enabling the access of small and medium-sized enterprises (SMEs) to the proposed services. The experience in applying electronic science will intensify these processes.

Due to its interdisciplinary capacity, the infrastructure will assist for the updating of the national research strategy in the field, for formulation of the priorities of Bulgaria in the area of energy storage and hydrogen technologies and their successful implementation in the use of the co-financing mechanisms and possibilities offered under the programmes of Horizon 2020. At a regional level the infrastructure will contribute to the implementation of the Bulgarian initiative for establishment of *Regional network for research and innovation centers for hydrogen energy systems*. At a national level governmental support may be granted in respect of the application for *Teaming for Excellence and Innovation*.

Participation in the European infrastructure

The institutes of BAS participating in the consortium are members of:

- Fuel Cells and Hydrogen Joint Unit (FCH 2. JU);
- European Energy Research Alliance (EERA).

The infrastructure will extend the possibilities for participation in other European technology platforms, such as:

- energy (EU PVTP, SmartGrids, Biofuels, EHC, EuMAT);
- transport (ERTRAC, Logistics)

The infrastructure has the potential to join the new scheme of the

European Forum on Research Infrastructures in the energy field (currently an open competition is underway).

In 7th FP one of the partners (1) participates in activities of the research infrastructure H2FC.

EUROPEAN SOCIAL SURVEY FOR BULGARIA

Name of the infrastructure	European Social Survey for Bulgaria (ESS)
Coordinator and location of the infrastructure	University of National and World Economy
Bulgarian consortium	<i>Financial coordinator:</i> Ministry of Education and Science <i>Research coordinator:</i> University for National and World Economy <i>Consortium members:</i> <ul style="list-style-type: none">○ Institute for the Study of Societies and Knowledge at BAS;○ Agency for Social Analyses (ASA)○ Union of Economists in Bulgaria

Description of the infrastructure

The scientific and research distributed infrastructure ESS ERIC-Bulgaria is established in order to ensure full-range and full-right participation of Bulgaria in the pan-European infrastructure ESS ERIC, which by decision of the European Commission is a transformed variant of the previously functioning project of the European Commission and the European Science Foundation – (European Social Survey – ESS), in which Bulgaria has an almost 10-year successful participation through the Agency for Social Analyses (ASA).

The global objective of the infrastructure is to make available, every two years, in Bulgaria and Europe reliable data about the social climate at national, regional and European level which are to reveal the dynamics in the attitudes, values, and apprehensions of European citizens.

The organization and functioning of ESS in Bulgaria is governed by the general notion for the ESS results to bring along multilateral benefits not only to the academic and scientific research community in our country and worldwide, but also to be useful for a maximally wide range of individuals and institutions – politicians, governmental and nongovernmental organizations, students, journalists, university lecturers, PhD students, young and experienced scientists – i.e., for everyone who is interested in the place of Bulgaria on the social map of Europe and why it is there.

Main tasks of ESS ERIC-Bulgaria:

- Conducting and processing of the empirical results from 4 social studies every two years, namely:
 - Cognitive research for establishment of the degree and manner in which the theoretical concepts embedded in each edition work in our country, what is the most optimal way to make them operational and what are the most adequate ways of translating the individual questions and answers included in the research set of tools;
 - Pilot pretest for checking to what degree and in what manner the research tools work in the Bulgarian context among various socio-professional and demographic groups and clusters;
 - Main national survey, representative for the entire population of the country above the age of 15, with a set of methods and sample size validated by international expert team;
 - Contact form research for revealing the access to each individual

respondent, for registration of the attitudes for cooperation and the conditions in which each individual person included in the sample lives in, irrespective whether s/he has been interviewed *face-to-face*, or not.

Development stage

The international infrastructure ESS (currently ESS ERIC) is sustainably defined and has been functioning for twelve years to date. Six waves of ESS have been accomplished. The registered users of the project results are from all continents and exceed 30 000, the publications in various languages are more than 6 000, whereby ESS consolidates its supra-European recognition and significance.

The participation of Bulgaria in the European Social Survey (ESS) started in 2005 when the Scientific Research Fund provided support to a research project providing access to the third edition of ESS. The Bulgarian research team has successfully implemented 5 editions of ESS hitherto.

The participation of Bulgaria in ESS enables the elaboration of analyses and social assessments on topical social themes based on information collected by way of advanced research set of tools, unified for all participating countries. The abundant array of national and international data allows for follow-up of the dynamics in the value orientation of Bulgarian citizens from various social groups and on this basis, for drawing up of comparative analyses related to the changes taking place in Bulgaria and in the other countries.

Necessary financial resource (including membership fee for participation in the pan-European infrastructure)

For the year 2015 – BGN 192 290, out of which BGN 40 290 comprise membership fee;

For the year 2016 – BGN 231 498 out of which BGN 41 499 comprise membership fee;

For the year 2017 – BGN 202 747 out of which BGN 42 745 comprise membership fee.

For the year 2018 – BGN 244025 out of which BGN 44 025 comprise membership fee

For the year 2019 – BGN 215 345 out of which BGN 45 345 comprise membership fee

For the year 2020 – BGN 256 715 лв. от които 46 715 comprise membership fee

Expected benefits

The benefits for Bulgaria from maintaining the research infrastructure ESS

ERIC-Bulgaria and from our participation in ESS ERIC can be grouped as per the following main aspects:

- due to its participation in ESS Bulgaria has available reliable, updated and comparable in geographical and temporal terms information having a wide application scope: it may be used for research, educational, political, diplomatic and other purposes.
- ESS covers an exceptionally wide perimeter of social, economic, and political problematic topics, trends, and the attitudes to them, all the more in a dynamics that provides a unique opportunity for comparison in time and between the separate countries.
- ESS enables the academic community to have at its disposal not only the information being updated every two years about the dynamics of social climate in our country and in Europe, but also the special innovative training programme ESS EduNet, which allows for synchronization of higher education in Bulgaria with that in Europe and the world, as well as to provide training in modern research methods and techniques to students, PhD students, and young scientists.
- ESS enables the governmental and nongovernmental organizations, state authorities, business and managing staff on all levels, to have at their disposal reliable and temporally comparable information about the social attitudes to the entire spectrum of socially significant phenomena, processes and trends both in national, and in European and global terms, which may be used as scientific rationale, assessment, updating and elaboration of policies, strategies, programmes, concrete measures and political decisions;
- ESS provides the journalistic guild with a vast set of "news" in the comparisons between Bulgarians and other Europeans, which not only serve to inform the public "Where we are", but also to provoke civil activity in searching answers also to questions like "What are we like?", "Why are we such?", and many others.
- ESS is one of the few projects which guarantee free access without any charge to the entire array of internationally comparable social data, which are processed, stored and distributed by the Norwegian Social Science Data Services, NSD - one of the most prominent

- institutes in this area not only in Europe, but worldwide as well;
- ESS delivers tremendously abundant material for organization of scientific discussions, seminars and public debates on topics and problematic areas being of concern for the people, the institutions, the business;
- The full participation of Bulgaria in ESS guarantees powerful information flow of reliable and updated information towards Bulgaria, which is to maintain a high level of social awareness of the various research and public institutions, ministries, offices.

Participation in the European infrastructure

Through ESS ERIC-Bulgaria, Bulgaria becomes a full member of the European Research Infrastructure Consortium for the European Social Survey Research Infrastructure - ESS ERIC), established by virtue of decision of the European Commission of 22 November 2013 (2013/700/EU)
 Coordinator of ESS ERIC is City University, London, United Kingdom.

NATIONAL CENTER FOR HIGHLY PRODUCTIVE AND DISTRIBUTED COMPUTING

Name of the infrastructure	National Center for Highly Productive and Distributed Computing (EGI and PRACE)
Coordinator and location of the infrastructure	Institute of Information and Communication Technologies, Bulgarian Academy of Sciences (IICT-BAS)
Bulgarian consortium	<p><i>Financial coordinator:</i></p> <ul style="list-style-type: none"> ○ Ministry of Education and Science, ○ Ministry of transport, information technologies and communications <p><i>Research coordinator:</i></p> <p>Institute of Information and Communication Technologies, BAS, is a scientific coordinator of the following two consortiums:</p> <p><i>Consortium for supercomputer applications (since 2009)</i></p> <p>Consortium members:</p>

- Sofia University *St. Kliment Ohridsky*
- Technical University – Sofia
- Medical University – Sofia
- National Centre for Geophysics, Geology and Geography – BAS
- Institute of Mechanics – BAS;

Consortium for distributed (grid and cloud) applications (established in 2004, renovated in 2012)

Consortium members:

- Institute for nuclear research and nuclear energy - BAS;
- Sofia University *St. Kliment Ohridsky*
- Technical University - Gabrovo;
- Institute of Molecular Biology *Academician Rumen Tsanev* - BAS;
- Organic Chemistry Institute with Phytochemistry centre -BAS;
- National Institute of Geophysics, Geodesy and Geography – BAS;
- Institute of Mechanics - BAS;
- Institute of Mathematics and Informatics - BAS.

Description of the infrastructure

The National Center for Highly Productive and Distributed Computing integrates computing systems and systems for storage of data, software, middleware, and services and offers to Bulgarian researchers transparent and open access for elaboration and work with computing intensive research applications. The infrastructure has a centralized model of control, maintenance and management providing computer security, fast resolving of technical problems, regular installations and updates of the middleware as well as support for the users and the applications, which they use.

Development stage

The infrastructure was commissioned in the year 2010 and is equipped with basic and applied software, databases, libraries and packages, middleware and services. The computing systems have a total capacity of over 1500 computing nucleuses and over 200 terabytes of disc space as well as highly productive internal Infiniband connection. There is also an option for computing of highly productive graphical maps of the type NVIDIA CUDA and Intel Xeon Phi, with which the total output

exceeds 40 TFLOPS.

For the period 2015-2016 - substantial extension of the system through addition of new computing nodes with accelerators (for maximum energy efficiency) and data storage devices (in order to enable the work on applications with large data volume).

For the period 2017-2020 - full operation of the infrastructure with the developed main parts.

Necessary financial resource (including membership fee for participation in the European infrastructure)

For the year 2015 – BGN 5 470 100, out of which BGN 8 500 comprise membership fee for EGI

For the year 2016 – BGN 560 100, out of which BGN 8 500 comprise membership fee for EGI

For the year 2017 – BGN 460 100, out of which BGN 8 500 comprise membership fee for EGI

For the year 2018 – BGN 460 100, out of which BGN 8 500 comprise membership fee for EGI

For the year 2019 – BGN 460 100, out of which BGN 8 500 comprise membership fee for EGI

For the year 2020 – BGN 460 100, out of which BGN 8 500 comprise membership fee for EGI

Expected benefits

- Transparent access to most advanced computing devices for research teams from various scientific disciplines;
- full participation in the European research electronic infrastructures;
- competent support for scientific achievements in such key areas as medicine and bioinformatics, ecology and biodiversity, new materials, transport, energy efficiency, humanitarian and social sciences, etc.;
- assistance for the formation of interdisciplinary teams using the new achievements in information technologies;
- possibility for modeling of processes and phenomena with processing of large volumes of data and complex mathematical models;
- exchange of experience and know-how;
- consolidating the position of Bulgaria as a regional leader in the field of information technologies;

- extending the participation of Bulgarian research teams in European projects and research programmes;
- serving as electronic infrastructure for other national research infrastructures;
- training of young scientists and development of the human potential in priority axes.

Participation in the European infrastructure

IICT-BAS is a member of the European Grid Infrastructure (EGI), and takes part in PRACE through cooperation with National Center for Supercomputing Applications. The submitted estimations do not include annual membership fee for PRACE, which is paid by the Ministry of Transport, Information Technologies and Communications.

NATIONAL INTERDISCIPLINARY RESEARCH E-INFRASTRUCTURE FOR RESOURCES AND TECHNOLOGIES FOR THE BULGARIAN LINGUISTIC AND CULTURAL HERITAGE, INTEGRATED WITHIN THE EUROPEAN INFRASTRUCTURES CLARIN and DARIAH

Name of the infrastructure

National Interdisciplinary Research E-Infrastructure for Resources and Technologies for the Bulgarian Linguistic and Cultural Heritage, Integrated within the European Infrastructures CLARIN and DARIAH (CLARIN-BG)

Coordinator and location of the infrastructure

Institute of Information and Communication Technologies, Bulgarian Academy of Sciences (IICT - BAS), Sofia, Bulgaria
Distributed, situated in one region, but within various institutions

Bulgarian consortium

Financial coordinator:
Ministry of Education and Science

Scientific coordinator:
Institute of Information and Communication Technologies,

Bulgarian Academy of Sciences (IICT - BAS);

Consortium members:

- Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences (IMI-BAS);
- Sofia University *St. Kliment Ohridsky* (SU);
- New Bulgarian University (NBU);
- Shumen University *Konstantin Preslavski* (ShU);
- Bulgariana – not-for-profit organization for cultural heritage protection;
- Southwestern University *Neofit Rilski* (SWU)
- Sirma Media (SM)
- Cyril and Methodius Research Centre at the Bulgarian Academy of Sciences (CMRC - BAS);
- Institute of Balkan Studies with Centre of Thrace Studies at Bulgarian Academy of Sciences (IBSCTS–BAS);
- Institute of Ethnology and Folklore Studies with Ethnography Museum at the Bulgarian Academy of Sciences (IEFSEM–BAS);
- Burgas Free University (BFU)
- National Library *Ivan Vazov* - Plovdiv (NLIV-Plovdiv);
- Historical Museum – Sofia;
- Ontotext AD (Onto);

Description of the infrastructure

The main objective of the CLARIN-BG infrastructure is to create national technological infrastructure for resources and technologies for linguistic, cultural and historical heritage. CLARIN-BG will provide public access to linguistic resources and digital presentations, programme devices and services for the specified areas. The infrastructure will support resolving of various issues oriented towards specialized and wider audience.

This objective will be attained through:

1. Adaptation of Bulgarian conditions to the European achievements in the field of linguistic technologies via close integration in the European infrastructure CLARIN ERIC and

in the area of cultural and historical technologies through integration in the European infrastructure DARIAH ERIC.

2. Supplementing the existing linguistic resources and technologies, as well as establishment of new ones, as a necessary minimum for the functioning of the national infrastructure for processing of texts in Bulgarian language.

Further development of the existing technologies in cultural and historical heritage (mostly 3D technologies and semantic technologies) and digitization of database for cultural and historical heritage in order to support the functioning of the national infrastructure of the arts and humanitarian sciences.

Development stage

The infrastructure - CLARIN-BG will be developed based on various types of centers which will provide technology and resource basis and its linking to the European infrastructures. The development stages of CLARIN-BG are three:

- During the first two years the main infrastructural, technological and resource centers will be developed, and the minimal resources and services being necessary for the operation of CLARIN-BG will be provided.
- In the following three years there will be accomplished: the optimal amount of resources and the final implementation of the complete multitude of services of the infrastructure. Pilot applications will be developed by employing the means of CLARIN-BG.

After the fifth year CLARIN-BG will be made accessible for operation by a wide range of users and will form a basis for real applications.

Necessary financial resource (including membership fee for participation in the European infrastructure)

For the year 2015 – BGN 2 068 500, out of which ≈ BGN 25 000 comprise membership fee (*for participation in CLARIN*);

For the year 2016 – BGN 1 418 500 , out of which ≈ BGN 25 000 comprise membership fee (*for participation in CLARIN*);

For the year 2017– BGN 1 488 500 , out of which ≈ BGN 25 000 comprise membership fee (*for participation in CLARIN*);

For the year 2018 – BGN 1 418 500, out of which ≈ BGN 25 000 comprise membership fee (*for participation in CLARIN*);

For the year 2019 – BGN 1 418 500 , out of which \approx BGN 25 000 comprise membership fee (*for participation in CLARIN*);

For the year 2020 – BGN 900 000 , out of which \approx BGN 25 000 comprise membership fee (*for participation in CLARIN*);

Expected benefits

CLARIN-BG will use the latest developments and good practices in the area of information, linguistic and semantic technologies in order to provide to a wide range of users linguistic, cultural and historical electronic resources and technologies. Linguistic technologies and resources will provide such applications as: automatic processing of texts in Bulgarian language, measurement of the quality of Bulgarian language processing systems, the development of which is underway, creation of dictionaries, (assisted) machine translation.

These applications will be used in the following areas:

1. *Scientific*: supporting the objective observations and improvement of the efficiency of the research work performance;
2. *Social*: facilitation of the access to information for the citizens in various areas, which presuppose intensive work with texts in Bulgarian language; content adaptation depending on the needs of people/children with speech impediments, etc.
3. *Cultural and historical*: the cultural and historical electronic resources and the technologies for their creation and processing will be accessible for the wider public in view of their popularization and the attraction of greater tourist flow to Bulgaria.

The infrastructure CLARIN-BG will include: computer networks and interface to the Internet, archives of linguistic resources (databases of structured information), as well as specialized software for services based on linguistic technologies. The services of CLARIN-BG will be accessible for citizens, lecturers, students and scientists without any user fees.

CLARIN-BG is a powerful tool for preservation of cultural identity and supporting the links with Bulgarians living abroad.

Participation in the European infrastructure

The national infrastructure CLARIN-BG will be integrated in the following two European infrastructures: CLARIN ERIC and DARIAH ERIC.

REGIONAL ASTRONOMICAL CENTRE FOR RESEARCH AND EDUCATION

Name of the infrastructure

Regional Astronomical Centre for Research and Education (**RACRE**)

Coordinator and location of the infrastructure

Institute of Astronomy with National Astronomical Observatory (**IANA**O).

Situated in a single place – National Astronomical Observatory - Rozhen

Bulgarian consortium

Financial coordinator:

Ministry of Education and Science

Research coordinator:

Institute of Astronomy with National Astronomical Observatory

Consortium members:

- Astronomical Observatory Belogradchik,
- Astronomy Department at Sofia University *St. Kliment*

	<p><i>Ohridsky;</i></p> <ul style="list-style-type: none"> ○ Astronomical Centre at Shumen University <i>Konstantin Preslavski</i>
<p>Description of the infrastructure</p>	<p>RACRE is an association of the research and educational institutions in the field of astronomy in Bulgaria. At the National Observatory - Rozhen there is a concentration of specialized resources for astronomical observations used for conducting practical training of students and PhD students. With its unique infrastructure and observation technique, as well as with the available basic infrastructure, the National Astronomical Observatory is the largest operating observatory in Southeastern Europe. The main components of the specialized infrastructure include four telescopes:</p> <ul style="list-style-type: none"> - Ritchey-Chretien-Coude Telescope 200 cm; - Cassegrain Telescope – 60 cm; - Schmidt Telescope – 50/70/172 cm. - Bio-Coronagraph – 15 cm. <p>The construction of observatory on the Shumen plateau is also underway, with 40 cm telescope which will enable the conducting of scientific research activities by lecturers and students.</p>
<p>Development stage</p>	<p>Necessity of refurbishment and maintenance of the existing unique infrastructure and renovation of the equipment for monitoring and control of the telescopes.</p>
<p>Necessary financial resource (including membership fee for participation in the pan-European infrastructure)</p>	<p>For the year 2015 – BGN 4 107 243 For the year 2016 – BGN 6 454 239 For the year 2017 – BGN 7 254 170 For the year 2018 – BGN 6 454 239 For the year 2019 – BGN 5 280 741 For the year 2020 – BGN 4 498 409</p>
<p>Expected benefits</p>	<p>The telescopes of NAO-Rozhen are used for obtaining unique observation materials that serve as a basis in the research of a wide range of problems of the modern astrophysics. The results of this research are published in a number of prestigious international astronomical editions. NAO works in close cooperation with many universities, such as the Sofia University (SU) and the Shumen</p>

University which are accredited for providing astronomy education. Many of the research studies are conducted in collaboration with scientists from almost all European states, the USA, Canada, Chile, and other countries with highly developed astronomy. The Institute of Astronomy is a founder and active participant in the sub-regional astronomy committee in Southeastern Europe.

As expected benefits there can be indicated:

- preservation of the status of largest astronomical observatory in Southeastern Europe;
- improvement of the quality of education and consolidation of the connections between the education and the scientific research sector, through practical training of students in astronomy in real conditions;
- application of innovative methods for study of processes running under conditions that are inaccessible for the laboratory conditions on the Earth: powerful gravity and magnet fields, enormous densities and temperatures, almost absolute vacuum and temperatures close to the absolute zero, relativistic velocities;
- Study of the physical processes affecting celestial bodies in view of developing areas with practical application, such as nuclear physics, plasma physics, neutrino physics and magnet- and hydro-dynamics;
- Detection and follow-up through astronomical observations of asteroids and comets passing in dangerous proximity to our planet.

Participation in the European infrastructure

Participation in [ASTRONET](#) and [OPTICON](#).

A preliminary study has been performed for participation in the [European South Observatory](#).

NATIONAL CYCLOTRON CENTRE – INFRASTRUCTURE FOR SCIENTIFIC AND APPLIED RESEARCH AND INNOVATIONS WITH EDUCATIONAL FUNCTIONS IN THE AREAS OF NUCLEAR MEDICINE, NUCLEAR PHYSICS, NUCLEAR ENERGY, RADIOCHEMISTRY, RADIOPHARMACY, ACCELERATION TECHNOLOGY AND CENTRALIZED RADIOPHARMACY FOR PRODUCTION OF PET RADIOPHARMACEUTICALS FOR THE NEEDS OF NUCLEAR MEDICINE.

Name of the infrastructure	National Cyclotron Centre – infrastructure for scientific and applied research and innovations with educational functions in the areas of nuclear medicine, nuclear physics, nuclear energy, radiochemistry, radiopharmacy, acceleration technology and centralized radiopharmacy for production of pet radiopharmaceuticals for the needs of nuclear medicine.
Coordinator and location of the infrastructure	Institute for Nuclear Research and Nuclear Energy - BAS
Bulgarian consortium	<i>Financial coordinator:</i> Ministry of Education and Science

	<p><i>Research coordinator:</i> Institute for Nuclear Research and Nuclear Energy (INRNE) at BAS</p> <p><i>Consortium members:</i> Medical University – Sofia; Medical University – Varna.</p>
<p>Description of the infrastructure</p>	<p>The cyclotron centre, as a large-scale research infrastructure, will comprise a building that will house the cyclotron accelerator, the laboratories for scientific research in radiochemistry and radiopharmacy, laboratories for applied research tests.</p> <p>The main building element of the unit is the cyclotron, as it also includes the accompanying equipment (vacuum pumps, power supply, lines for transmission of the accelerated particles' shaft, etc.).</p> <p>In the premises for synthesis and those adjacent there will be located apparatuses including hot chambers with modules for synthesis of radiopharmaceuticals; systems for gas, liquid and thin layer chromatography as part of quality control laboratory; apparatuses for measurement of the purity of the produced radiopharmaceuticals; apparatuses for microbiological control of the waste products, etc.</p>
<p>Development stage</p>	<p>Elaboration of conceptual design for upgrading the existing base of INRNE for research studies in the fields of radiochemistry, radiopharmacy, experimental nuclear physics through the development of National Cyclotron Center. A procedure for purchase of accelerator is being conducted</p>
<p>Necessary financial resource (including membership fee for participation in the pan-European infrastructure)</p>	<p>For the year 2015 – BGN 7 560 000 For the year 2016 – BGN 9 400 000 For the year 2017 – BGN 8 303 125 For the year 2018 – BGN 2 050 000 For the year 2019 – BGN 2 000 000</p>
<p>Expected benefits</p>	<p>The described infrastructure ties the three key factors that are necessary for the development of dynamic economic model of sustainable development and employment – students' training (new master's</p>

programme in radiopharmacy jointly with higher education establishments, graduate students, staff for the industry), scientific research (in the field of radiochemistry and radiopharmacy) and innovations (a method will be elaborated for production of Technetium - 99 for the needs of nuclear medicine with a cyclotron instead of the technetium generator technology that has been used for that purpose hitherto).

With the development of NCC modern and high-quality conditions will be created for development of Bulgarian science, by way of:

- development of modern base for synthesis and research into new radiopharmaceuticals with application in nuclear medicine (PET/CT and SPECT radioisotopes);
- provision of experimental base for applied research studies in the fields of radiochemistry, radiopharmacy, experimental nuclear physics with application in energy, the study of materials, radiobiology, archeometry, etc.;
- development of educational activities, practical activities for students, young researchers and PhD students in the fields of radiochemistry, radiopharmacy, biochemistry, acceleration physics, nuclear physics;
- establishment of new master's programme in radiopharmacy jointly with higher education schools and university hospitals.

The benefits from the National Cyclotron Centre reach far beyond the framework of Institute for Nuclear Research and Nuclear Energy - BAS. This is a project of national significance and interdisciplinary nature, a centre that will train and provide an opportunity for professional realization to staff in the fields of nuclear medicine, nuclear physics, acceleration equipment, radiochemistry, biochemistry, etc. Of the greatest significance to the public will be the improved possibilities for diagnostics of tumors as a result of the development and functioning of NCC. This is the largest scientific research project of Bulgaria during the last 30 years.

**Participation in the
European
infrastructure**

The Institute for Nuclear Research and Nuclear Energy works for the establishment of partnerships with leading European cyclotron centers carrying on scientific and applied research activity in the field of

acceleration equipment, radiochemistry and radiopharmacy. Such centers are the following: the Cyclotron at Hubert Curien Multidisciplinary Institute in Strasbourg, France (Le cyclotron Cyréc l'IPHC), the Cyclotron at the Joint Research Centre in Ispra, Italy (JRC Cyclotron, IHCP Ispra), the National Nuclear Research Laboratory in Legnaro, Italy, the PET Center Dresden-Rossendorf, Germany, the Cyclotron Centre in Krakow, Poland, the Scientific Research Centre in Uelich, Germany, etc. Some of these centers have already stated their interest in cooperation and currently the way for realizing such partnerships is being sought.

V. FINANCING AND MANAGEMENT – GENERAL PRINCIPLES

1. FINANCING OF BULGARIA'S PARTICIPATION IN THE EUROPEAN RESEARCH INFRASTRUCTURE ROADMAP

The development and/or modernization of large research infrastructures is a highly resource-consuming process that is not within the powers of a single member state. That is why it is necessary that member states coordinate their policies, programs and efforts in order to identify their mutual objectives and activities. These principles are supported by a series of documents of the European Community, such as the renovated Roadmap for Research Infrastructures of the European Forum, 2012; the conclusions of the Council for scientific research infrastructures with an emphasis upon the regional approach in their development, and last but not least, Vision 2020 for development of a new model of integrated European research space where the significance of research infrastructures for the economical development of member states takes a central place. With the adoption of the Regulation for establishment of legal framework for development of European infrastructure consortia it has become possible for European infrastructures to acquire a status of "international organizations", which facilitates the regulating of the membership of the individual member states and the defining of the financial contribution and reliefs for the infrastructure in respect of taxes, duties, fees, state aid and public procurements. In its conclusions of 26 May 2014 the Council acknowledges that the work accomplished by ESFRI for determination of priority projects which are sufficiently mature to be in the process of

implementation in the period 2015-2016, and the timely implementation of which is regarded as necessary in order to extend the limits of knowledge in the relevant areas.

On the grounds of these European recommendations and practices the following principles in regard of financing and management of research infrastructures that will apply to the national research complexes as well, could be summarized as follows:

- Balance approach toward investments and effective operation, management and use of research infrastructure as well as of research results;
- Introduction of the principle of consolidated application of different financial resources – national and European funds;
- Definition of different types of financing – institutional, funds received after participation in programs and competitions; business contracts and loans necessary for the development and maintenance of research infrastructures.
- Coordination during development, use and granting access to the research infrastructure in order to be insured optimal utilization, to maintain competent technical staff and to attract the necessary resources for the performance of research activities;
- Granting wide access and rules of access concerning the research infrastructure to external scientists, research and business organizations
- Preservation of public financial engagement concerning critical and unique scientific resources and infrastructures, and guarantee for mixed use of national and European funds;
- Regular assessment of the operation of research infrastructures.

1. FINANCING OF NATIONAL INFRASTRUCTURE FACILITIES

The renovated roadmap outlines the national vision concerning significant infrastructure facilities for the period 2014 - 2020 that will be developed in compliance with the relevant national priorities as regards the development of scientific research activity and intelligent specialization.

The financial coverage of the national roadmap presupposes efficient and integrated use of the available national and European funds

⁵ Such as laboratories for early warning in case of disasters, break-downs, terrorist attacks; monitoring stations for seismic activity and radiation measurements; emissions in environment; certification laboratories for oil products and food products for risk groups in population; nuclear reactors and repositories, etc.

After completing the phase of initial development the scientific complexes will serve the needs of the public sector by providing vacancies, access opportunities to modern equipment for students, young and experienced scientists; opportunities to attract European scientists and scientists from third countries. In addition, they will provide opportunities for knowledge transfer and for provision of more qualified services to the local and foreign business

In that regard it is important to realize the necessity of combined financing of different components of the research complexes and more specifically, through financing from the state budget; programme and competition financing from the Scientific Research Fund; the EU Framework Programme for Research and Innovation "Horizon 2020", through direct granting of funds to the Ministry of Education and Science and/or open competition under Operational Programmes "Science and education for intelligent growth" 2014-2020, "Innovations and Competitiveness" and "Regions in growth", financed by the European structural funds.

It is important for the Roadmap to become an integral part of governmental priority activities for the next program period after 2014-2020 and to be a key component in the development of areas of intervention by purpose of improving the competitiveness of national economy and its stage-by-stage development to a middle and highly technological economy.

All infrastructural facilities listed in the roadmap participating in pan-European research complexes based on executed memorandums and letters for joining European consortia, are to pay annual membership fee. The funds for its payment are provided by the Ministry of Education and Science in its capacity of financial coordinator.

The national infrastructural complexes can participate in more than one European research infrastructure consortium. Such is the case with the facility "National center for highly productive and distributed computing", which participates in two pan-European consortia - EGI and PRACE. The membership fee for the participation of Bulgaria in PRACE is paid by the Ministry of Transport, Information Technologies and Communications as financial coordinator

Appendix 1 presents the allotted indicative budget of the infrastructural facilities per years.

2. MANAGEMENT OF NATIONAL INFRASTRUCTURE COMPLEXES

In regard of each research complex a specific approach will be applied in conformity with the peculiarities and the type of research infrastructure. The common elements in the management of research complexes are as follows:

- Establishment of scientific, technical and financial controlling committees with clearly distinguishable functions and tasks. These committees will include representatives of the

Ministry of Education and Science, the Ministry of Economy, Energy and Tourism and other specialized structures;

- Involvement of international boards of experts;
- Development of middle-term scientific programs and plans;
- Involvement of non-governmental organizations and private structures in the managing committees in view of guaranteeing partnership and work on problems of social significance and on issues of practical nature concerning the national economy.

The scientific research complexes have to elaborate plans for management, including to define the conditions of access to the research infrastructure, request forms for performance of specialized services for citizens and the business, where applicable.

The scientific complexes have to provide services to the business, where applicable, and to work jointly for the creation of new scientific knowledge and for its application in favour of the local and national private sector.

Every research infrastructure will have to present to the attention of the Ministry of Education and Science annual research and financial reports as well as ensure publicity of performed surveys. An important task of research complexes is to encourage the scientific interest of young people and foster a new scientific generation. The Ministry of Education and Science commits to organize independent external assessment of the research activity of the national complexes, including public opinion poll, as well as of their benefits for the regional and national economy.

VI. ASSESSMENT AND IMPLEMENTATION OF THE NATIONAL ROADMAP

In regard of the performance and monitoring of the National Roadmap for Research Infrastructure an inter-institutional coordination council with representatives from the Ministry of Education and Science, the Ministry of Economy, Energy and Tourism, the Ministry of Finance, the Ministry of Transport, Information Technologies and Communications, the Ministry of Health and the other concerned ministries and institutions will be established.

The roadmap and the research complexes will be subject to regular international monitoring and assessment of the effectiveness of our participation in the European Roadmap as well as of the performed research and technological programmes and activities

The assessment will be performed on a regular basis on the part of European experts from the Strategy Forum on Research Infrastructures and will include a review of the performance of the

policies in support of research infrastructure as well as of the separate infrastructure complexes. It will carry out analysis and monitoring of the national research infrastructures and will offer corrective activities and opportunities for introduction of new instruments and schemes. The assessment criteria for research infrastructures most generally cover the following components:

- Scientific quality, research benefits and major beneficiaries of the results (measured by publications, patents; quotes);
- Institutional capacity (staff performing the specific research activities; availability of habilitated staff, number of PhD students, age profile and etc.);
- Management of Scientific Research Programs financed by national and international sources on a competitive basis (number of ongoing programs, number and type of partnerships);
- Active attitude in attracting funds from various sources;
- Socioeconomic benefits and relevance of the results (availability of created product, technology, methodology, etc.);
- Established partnerships – national, regional and European.

VII. UPDATING OF THE NATIONAL ROADMAP

On the grounds of a regular international assessment new national infrastructures and/or further development of existing research complexes of regional and European significance could be offered. The involvement of new and/or renovated consortia will be carried out in compliance with the bottom-up principle every two years based on detailed project for the development or modernization of a specific research complex and after publishing a call for proposals. Each new project will be subject to external assessment on the part of a panel of experts having the relevant competence.

The assessment methodology in respect of proposals for national roadmap updates comprises the following main criteria:

1. Scientific and technological quality of the research infrastructure

- significance of the infrastructure for the respective scientific areas in national, regional and European terms;
- identification of the strong and weak aspects, opportunities and threats;
- degree of integration in the international initiatives of the European Strategy Forum on Research Infrastructures;
- degree of interdisciplinary nature, including the effect of the infrastructure for consolidation of interdisciplinary research in Bulgaria;

- assessment of the results from the conducted activities for training of researchers and young scientists.

2. Management capacity

- assessment of the managing structure in respect of the proposed scientific objectives;
- performance of the envisaged action plan as regards the distribution of responsibilities, experience and capacity;
- contribution to increasing the access to knowledge, resources and research capacity in the field of operation of the infrastructure;
- assessment of the available equipment and the improvements of the existing one, as well as the acquisition of new equipment;
- assessment of the access policy and of the data management plan;
- assessment of the preparedness for development of the infrastructure;
- analysis of the risk, including the risk for the infrastructure itself generated by particular geographic, geological or meteorological conditions; risk factors related to the security of the region; risks related to the insufficient resource availability – physical, capital and human.

3. Budget and sustainability

- technical feasibility, expenses for human resources and cost efficiency of the proposed infrastructure (based on the adequacy of the requested financing and the envisaged sources of funding, multiannual budget plan with financing sources, investment sustainability);
- risk assessment.

VIII. TERMINOLOGY

1. Roadmap – a strategic national document that presents methods for resolving specific problems and outlines a short-term vision of the scientific and innovational development of the region. It comprises specific objectives that should be accomplished on the grounds of preliminary provided measures and instruments provided for under European documents and strategies supporting research infrastructure development.
2. Research complex – a network of thematically similar research infrastructures that could be located in a single campus or territorially distributed.

IX. MAJOR EUROPEAN DOCUMENTS

1. *European Roadmap for Research Infrastructure* -
ftp://ftp.cordis.europa.eu/pub/esfri/docs/esfri_roadmap_update_2010.pdf
2. *Legal Framework for development of European infrastructure consortia* -
http://ec.europa.eu/research/infrastructures/pdf/council_regulation_eric.pdf
3. *Report of the working group on regional issues within European Strategy Forum on Research Infrastructures* -
http://ec.europa.eu/research/infrastructures/pdf/esfri/publications/esfri_regional_issues_wg_2008_en.pdf#view=fit&pagemode=none
4. *Report of the working group on electronic infrastructure* -
http://ec.europa.eu/research/infrastructures/pdf/esfri/publications/esfri_regional_issues_wg_2008_en.pdf#view=fit&pagemode=none
5. *Overview of the situation in other European countries concerning the availability of National Roadmaps* -
http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri-other-roadmaps
6. *European vision of encouraging significant research infrastructures* -
http://ec.europa.eu/research/infrastructures/pdf/era_100216.pdf
7. *Council conclusions concerning priority projects of the ESFRI Roadmap 2014-2016.*
http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/intm/142794.pdf