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Research Infrastructures Roadmap 2011–2020

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1. Introduction

The primary objective of this Roadmap is to set-up and present priorities of the Republic of Slovenia in the area of research infrastructure. Regarding its content, it complements the Research and Innovation Strategy of Slovenia 2011–2020, and presents the area implementation document. An important function of the document, serving as a guide and a point of reference for the state administration bodies and bearers of public authority in this area, is the integration of their activities, the enabling of more synergy and the avoidance of duplication, and thereby more effective distribution of public funds. At the same time, the document enables a certain level of predictability and understanding of plans of the state, and monitoring of implementation of public policy and goals in the research infrastructures area. Speed and scope of achieving the goals depend in particular on year to year capacity of the budget and public financial circumstances in the state, respectively. The document is not legally binding, and it is inadmissible that any of its parts should be understood in a sense other than the one that is stated.

1.1. Definition of the RI

Research infrastructures *are facilities, resources or services that constitute larger sets of research equipment or instruments and represent or complement knowledge resources such as collections, archives and databases. Research infrastructures can be concentrated on a single spot, distributed or virtual (enabling services electronically). They often require a structured information system for data management and for enabling information and communications.*[1]

The SSKJ (Dictionary of Standard Slovene Language) defines infrastructure as *"what is necessary to perform any activity at all".* In this respect, the research infrastructure is, at least, a very important tool of the research community. In the wording of this Roadmap, these are centres or consortiums of public research organisations that have research infrastructure at their disposal, and enable access to unique capabilities and means and services that were identified by researchers as necessary for research in all the research fields, from social sciences to geology and astrophysics.

The examples of research infrastructures are as follows: large research installations, collections, libraries, databases, biological archives and collections, high-performance and broadband communication networks, research crafts, telescopes, satellite and aircraft observation facilities, high-performance computing facilities (HPC), clean rooms, coastal observation stations, synchrotrons, etc.

There are no generally or internationally agreed upon definitions of class sizes of research infrastructures. Within this document, the expression "large research infrastructures" describes infrastructures in which it is possible to perform all the research activities in individual research processes in the scientific field of the research infrastructure, while at the same time, they operate as units with their own administrative structure. "Medium-sized research infrastructures" enable performance of individual or several phases of the research process or (as, for example, regional centres) are to be integrated into large research infrastructures as their integral part. "Small research infrastructures" enable only the execution of individual tasks within research processes and provide support for those tasks. These notions encompass data infrastructure, presenting the framework of data, metadata, standards and tools integrated in mutually dependent manner that ensures their processing, distribution, maintenance, supplementation and usage for further scientific and research work.

1.2. Importance of research infrastructures

The research infrastructures are the precondition for research and simultaneously, medium-sized and large infrastructures in particular, are also of key importance for the excellence of such work and for conducting the most demanding research. Namely, the quality and precision of the research results are to a large extend determined by quality and precision of means used by the researchers when performing their work; certain research can even be possible merely with the usage of demanding and complex systems of equipment, means or services.

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[1] Summarised from European Roadmap for Research Infrastructures 2008, 'ESFRI Roadmap'; http://ec.europa.eu/research/infrastructures/pdf/esfri/esfri_roadmap/roadmap_2008/esfri_roadmap_update_2008.pdf

Therefore, access of Slovenian researchers to large research infrastructures is essential for reaching and maintaining a globally comparable level of scientific development in the state that stays. In this connection, in some scientific fields a very important role is played by the development of national research infrastructure, and in many cases, the linking of states' capacities and efforts upon establishment of common research infrastructure, accessible to all under the same rules, is more meaningful. Undoubtedly, the location of the specific research infrastructure (if it can be determined) has very positive consequences, among them attracting top scientific talents, preventing brain drain, and scientific specialisation; as a source of innovations and development, it is also important for the development of the national economy and the society as a whole. In any event, due to high interlinkage and costs, it is reasonable that larger national research infrastructure is integrated in a wider – at least European – network of research infrastructures.

There are several reasons for collaboration of states upon construction or establishment of research infrastructures. On one hand, this is called upon by the rationalisation to avoid duplication of similar research infrastructures in the area of Europe, and on the other, large infrastructural projects in science have become so vast that the linkage of affords and means has become necessary. In 2000, the then Member States of the EU, the European Commission and the European Science Foundation discussed thereof at the conference on research infrastructure in Strasbourg, and established the need for development of a more co-ordinated approach regarding forming of public policies in the area of research infrastructures. Therefore, at the beginning of 2002, ESFRI, the European Strategy Forum on Research Infrastructures, was established on proposal by the Council of the EU. This informal body of the Member States of the EU, other states and the European Commission, which enables counties to be informed on international and national incentives regarding construction and upgrading of research infrastructures of European significance, has, over the last few years proved to be, above all, the incubator of large pan-European research infrastructures.
The best known result of this forum is the European Roadmap for Research Infrastructures (also known as the "*ESFRI Roadmap*") within which the needs of European science in the area of research infrastructure for the next 10–20 years are described. The first roadmap of this kind was launched in 2006, and in 2008, the ESFRI published its updated version. In the document, there are 44 large projects involving construction and upgrading of the European research infrastructure in all the fields of science identified, in the total estimated value of construction exceeding EUR 17 billion. Investments in construction and development of the most modern research infrastructure do not present just expenditures for the states, but also a measure of encouragement of science, innovations and economy, since they most often involve development of unique, as of yet unknown technologies, methods and solutions, directly influencing the structure and competitiveness of their economy. Furthermore, their operation, in addition to the importance it has for the scientific progress, significantly supplements the capability of the economy to create higher added value and technologically more demanding products and services.

Thus, infrastructures are among the first conditions for enrichment of knowledge and development of all sciences. Also, they present the flagships of science and progress, highlighting scientific and technological achievements, and contribute to the popularisation of science and to the attracting of young talents to the research profession.

1.3. Activities leading to the Roadmap

The ESFRI Roadmap and the needs for co-ordinated and consistent development of the research infrastructures encouraged the Ministry of Higher Education, Science and Technology to create a national strategy for the development of the research infrastructure in which:

- the priority international projects, having strong short and long-term influence on the development of Slovenian science, industry and society are specified, and consequently, the inclusion of the Republic of Slovenia in these projects is meaningful, and
- the fields in which additional efforts and investments in the direction of development of medium-sized or large Slovene infrastructure centres are meaningful, are described; these centres are in the national interest and are or will be of long-term strategic importance for development of the research sphere of the Republic of Slovenia, and have the potential to become the development actors in their field on the European and the world level.

Therefore, at the Ministry of Higher Education, Science and Technology (MHEST), a special Project Group was formed in May 2009, composed of the following: Dr. Jana Kolar (head), Dr. Aleš Mihelič, Sergej Možina (all from MHEST), Dr. Jure Marn (University of Maribor, and then Slovenian delegate to ESFRI), Dr. Miran Čeh (Jožef Stefan Institute, and Slovenian delegate to ESFRI), Alenka Avberšek (Chamber of Commerce and Industry of Slovenia), and Dr. Peter Dovč (University of Ljubljana). The Project Group conducted the procedure for preparing the Slovenian proposal for the Research Infrastructures Roadmap, and in this regard, it provided for the representation of views from all sectors, and for as wide as possible an inclusion of the professional public in the Roadmap's preparation.

In May 2009, the MHEST also organised a public consultation event on the preparation of national development priorities with emphasis on research infrastructure, at which the researchers and economists presented some initiatives and needs for the inclusion of Slovenia into international projects and incentives for the development of national research infrastructure.

The main formal entry point of the Slovene scientific and entrepreneurial public to the process of creating the Research Infrastructures Roadmap were two calls for expression of interest, published by the MHEST on 13 November 2009: *The call for proposals of international projects for development of large research infrastructures (RI), in which the Republic of Slovenia shall participate,* and *The call for collecting proposals of projects of development of large national infrastructure (RI) for the needs of determining priority fields.* By means of the public calls for expression of interest, the MHEST invited research organisations, as well as all other interested natural and legal persons, to forward their proposals for the inclusion of Slovenia into individual international infrastructural projects and for development project proposals of large research infrastructure in Slovenia, via completed questionnaires. A special invitation for participation in these calls was sent by the MHEST to more than 200 registered research organisations in Slovenia.
The primary objective of collecting expressions of interest was to identify needs of the Slovene science and entrepreneurship for access to new or upgraded national or international research infrastructures in an open procedure. From the submitted proposals, it was possible to discern the framework inventory of the medium-sized national research infrastructures that the Slovene research organisations proposed upgrading, along with the visions of the Slovene research organisations for the development of research infrastructures, the potentials of their linkage, and their preparedness to actively participate in the establishment of new research infrastructures, and in international projects.
In the proposals, the Slovene research organisations, inter alia, described the situation of the existing infrastructures, the opportunities to researchers that would be offered by the new research infrastructures, and their benefits to scientific progress, economy and society as a whole. They also placed the suggested national infrastructures in a regional context.

Based on all the described activities and following the procedure of expert peer-review of the applications, the Project Group for the Preparation of the Slovenian Research Infrastructures Roadmap has set out a proposal for priority international projects of research infrastructure in which the Republic of Slovenia shall participate, and the priority fields to which it is reasonable to target additional efforts and investments for the development of medium-sized or large Slovene infrastructural centres.
It has also created a proposal for a Roadmap in which the selected proposals and recommendations for their realisation are described. This Roadmap has been submitted to the Ministry of Higher Education, Science and Technology.
The latter supplemented the document with more detailed definitions of the proposed changes to the instruments of financing the development and operation of the research infrastructures and submitted the draft of the Slovenian Research Infrastructures Roadmap 2011–2020 for a public debate. Based on the proposals from the public debate, the final wording was created and then adopted by the Government of the Republic of Slovenia.

1.4. Methodology of the priorities selection

Upon placement of individual international projects in the Research Infrastructures Roadmap and determination of the priority fields, the scientific relevance and attractiveness of projects for the Slovene scientific community and their benefits for development of knowledge, the economy and society as a whole, is particularly highlighted. When the projects that are currently still in preparation

move into the implementing phase, their financial and technical feasibility will become increasingly important.

Within the procedure of acquiring proposals for upgrading the existing and construction of the new capabilities on the national level and the proposals for the inclusion in the international infrastructural projects, a total of 77 proposals were collected, of which 26 were related to international infrastructural projects and 51 to the national ones. The majority of the proposed research infrastructures would serve several scientific fields and can be arranged according to disciplines as follows:

- 14 proposals from the field of social sciences and humanities,
- 20 proposals from the field of biological and medicine sciences,
- 27 proposals from the field of physical sciences and engineering,
- 23 proposals from the field of material and analytical capabilities,
- 16 proposals from the field of energy,
- 23 proposals from the field of environmental sciences, and
- 20 proposals from the field of e-science.

The proposals were submitted by 23 members of the 4 Slovene universities and 6 independent higher educational establishments, 14 Slovene public research institutions, 99 economic operators, 12 societies and associations, and 20 other institutions or organisations (Centres of Excellence, municipalities, foreign research organisations, hospitals, etc.).

All the proposals were reviewed by a total of 22 independent external experts from research, higher educational and entrepreneurial spheres and from all over Slovenia. The experts were divided into 7 area committees according to their areas of work. The committees for each mentioned field were composed of 3 experts, while the committee for physical sciences and engineering was composed of 4 experts.
The overview of the proposals started in February 2010; each expert first filled out a form giving his/her opinion individually for each proposal. Afterwards, the committee of all 3 (or 4) experts from the individual field accepted a consensus opinion for each project, along with a recommendation regarding the placement of the project/field in the national Research Infrastructures Roadmap.

Upon forming an opinion on the proposal for the national research infrastructure, the experts reviewed the following categories using the described guidelines:

- Proposers: preference was given to proposers who submitted their proposal jointly (in informal consortium), were arriving from diverse sectors, were proving scientific excellence, or were internationally active.
- Existing infrastructure: to what extent does it already exist, what kind of investments in infrastructure have been made so far, whether or not it is integrated into the scientific, business and social environments in Slovenia, and whether it is internationally recognized.
- The importance of the research infrastructure for the researchers: how many potential researchers/users exist, what is the potential for post-graduate education and training, what are the employment possibilities of Slovene researchers in this infrastructure, and what are its effects on enhancement of the mobility of Slovene researchers.
- The significance of the research infrastructure for the economy: what are the possibilities and benefits of the participation of Slovene companies in construction and upgrading of the infrastructure, what is the importance of the infrastructure in the context of complementing R&D capabilities of the industry, what are the possibilities of market applications of the research results, what is the potential for the emergence of Slovenian spin-off companies, and what is the direct and/or indirect potential for development of new applicative technologies.
- The importance of the research infrastructure for the development of knowledge in the RI area: whether the RI on the proposed area will contribute to effectiveness of research and to success in comparison to access to comparable research equipment in Europe or whether the comparable infrastructure in not available in the neighbourhood, whether the infrastructure will significantly increase the international activities of the Slovene researchers, whether it will cause an increase in the existing or the forming of new research groups in this area, whether it will contribute to the strengthening of interdisciplinary research in Slovenia, and whether it will increase the probability of scientific breakthroughs in this area.

- The importance of research infrastructure for society; particularly, whether the research infrastructure will have a quick and direct impact on improving the living conditions of people, and will contribute to solving major social challenges.
- The significance of the research infrastructure for the state: whether it will attract top scientists to Slovenia, whether it will serve to promote science and develop scientific talents, whether it has the potential to attract international partners in its further development with a goal to become a large European RI, and whether it will contribute to reducing regional differences in Slovenia.
- Influence of the research infrastructure on regional co-operation: will cross-border regional co-operation (in ERA) expand, is it placed in the European research area, does it serve the integration and concentration of existing capabilities and activities in this area, and is new internationally comparable equipment foreseen.
- Financial aspect: mainly the diversity of the foreseen sources of finance and the proportionality of the annual costs with regard to the benefits to Slovene science, economy and society.

Afterwards, the experts also evaluated whether the proposed research infrastructure was comparable to similar infrastructures in Europe and worldwide, and gave general recommendations regarding placement in the national Research Infrastructures Roadmap.

Similar proposals were also examined by the experts with regard to the inclusion of the Republic of Slovenia in international infrastructural projects. Upon evaluation of these proposals, the difference between the estimated input of Slovenia and the benefits for Slovenia, deriving from inclusion in the proposed project, stood at the forefront.

The proposals and opinions of the evaluating committees were eventually used by the Project Group for preparation of the proposal for the national Research Infrastructures Roadmap. Within the selection of proposals for international projects of construction or upgrading of the research infrastructures and of priority fields of science, in which more efforts and means will be directed into construction and upgrading of the national research infrastructure centres, the Project Group did not substantially depart from the selections and recommendations of the evaluating committees. The exceptions are the placement of EATRIS and ELIXIR among the priority international projects of construction of research infrastructures and non-placement of medical physics and diagnostics among priorities on a national level. EATRIS and ELIXIR were placed by the Project Group in the proposal for the Roadmap for reasons of harmonisation with national investments in the field of biomedicine, biotechnology and biological sources that are directly included in these two international projects; therefore, they present a large potential benefit in comparison to the necessary input. The fields of medical physics and diagnostics were not placed in the proposal for the Roadmap by the Project Group due to their being informed that the foreseen agreement on repayment of part of the Russian clearing debt by means of supplying cyclotron to Slovenia will not be implemented. Since this single priority project within the framework of this field and the source for its implementation was no longer probable, the Project Group estimated that the necessary input would be too big in comparison to the benefits it would provide.

The Ministry of Higher Education, Science and Technology, upon preparation of the draft Roadmap considered all the proposals by the Project Group and added CERIC to the priority international projects. CERIC's preparation only started quite recently, on the basis of discussions and consultations among ministries and research organisations in the participating countries. Also, the Ministry supplemented the proposal for participation in the XFEL project with an alternative possibility of participation in EuroFEL, since the two research infrastructures have very similar fields of application.

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2. Description of the priority international projects

The experts that examined the proposals of participation in international projects reviewed the following to help form their opinions on the proposals:

- Proposers, in particular if already in the proposal several institutions were linked together, and if the proposers were coming from diverse sectors, and also the type and scope of the stated international activities.
- The importance of RI for researchers in a sense of the number of potential researchers/users, its potential for post-graduate education and training, the employment possibilities for the Slovene researchers, and its potential impact on increasing the mobility of the Slovene researchers.
- The importance of RI for the economy and particularly the possibilities and the benefits of participation of Slovene companies in construction/upgrading RI, the importance in the context of supplementing R&D capabilities of the industry (for the development of technological improvements and performing the most demanding experiments), the possibilities of market applications of the results of research in the RI and the potential spin-off of Slovene companies as a consequence of participation in any of the phases of the RI.
- The importance of the international RI for the development of knowledge in its area in Slovenia; whether the RI enables access to equipment that is otherwise inaccessible to Slovenia, the impact of inclusion of the RI on a significant increase of international activity by the Slovene researchers in the RI area, the impact of inclusion of the RI on enlargement of the existing or the emergence of new research groups in the RI area and on strengthening interdisciplinary research in Slovenia.
- Importance of RI for society – whether the RI enables direct and fast impact on improving the living conditions of people (environment, benefits for consumers, etc.), and to which extent it contributes to solving major social challenges.
- Importance of RI for the state in a sense of attracting top scientists to Slovenia, similarity of infrastructural project to national activities in this field, impact on the promotion of science and the development of scientific talents in Slovenia.
- Financial aspect of the proposal; particularly, the diversity of foreseen sources of finance, the proportion between Slovene input and the benefits of participation in the project, and the proportion between the amount of membership fee/annual costs for Slovenia and the benefits of the RI for Slovene science, economy and society.

Upon acceding to selected priority international research infrastructure, the mentioned aspects shall be, where necessary, assessed once more, along with the current situation and organisation of the research in the fields relevant for individual RI and with size of scientific community and its cohesion in these fields.
Within the same framework, the indicators of success for each of the selected international research infrastructures and of the benefits of Slovenia's participation in them will be set subsequently.

2.1. CERN

European Organization for Nuclear Research

Description of the infrastructure

The European Organization for Nuclear Research (CERN) is a European intergovernmental organisation with its head office in Geneva, established on 29 September 1954. In a professional sense, it presents the central world laboratory for particle physics. Its purpose is to ensure co-operation between European countries regarding fundamental nuclear research and research connected with this field, and to combine human and financial resources to enable research infrastructure that no country could afford independently. Thus, the CERN enables research infrastructure in the form of a system of accelerators composed of the chain intended for acceleration of protons, antiprotons, heavy ions, electrons and positrons. The key accelerators of this chain are the Proton Synchrotron (PS) with the energy of 28 GeV, the Super Proton Synchrotron (SPS – 450 GeV) and, from September 2008, the Large Hadron Collider (LHC), colliding protons at the energy centre of gravity of 14 TeV.
Regarding scientific results, the CERN belongs among the most elite institutions in the world. Among the professionals who work there, we find several Nobel Prize winners. The achievements of the experiments conducted in the CERN have already been awarded twice with the Nobel Prize in the

field of physics (in 1984 and 1992). In the CERN, the usage and the invention of new technologies are necessary conditions for operation with regard to both the construction of accelerators and the performance of experiments along them. With such concentration of intellectual capabilities, the spin-offs are quite frequent; among them, the most known is the World Wide Web (www), created in the CERN at the beginning of the nineties, which was primarily intended for the exchange of information over the Internet network between co-workers involved in large collaborations that devised experiments along the Large Hadron Collider (LHC).

Previous activities of Slovenia

In 1954, Yugoslavia was among the founding member states of the CERN, but for financial reasons, it withdrew from the organisation in 1961. Due to dissolution of the state, the CERN Council ended Yugoslavia's status as an observer in 1992.

Otherwise, the scientific co-operation of Slovene scientists with CERN began in the mid seventies, when professor Gabrijel Kernel joined the international OMICRON Group on synchrocyclotron. The initial individual co-operation soon grew into the work of the Slovene group, which was a proposer and holder of the last experiment involving the OMICRON detector, and with professor Kernel as the head (and the spokesman) of the experiment.

At a beginning, the work of the Slovene group was concentrated on labour-intensive assignments, mainly analysing data, and in 1992, it had already reached the level of qualification enabling it to formally join the DELPHI Collaboration. This presents the recognition of the Slovene group's competences, since the DELPHI Collaboration, following several decades of planning, development and construction of the spectrometer, never invited new members who immediately produced physical results without multi-annual investments.

In the CERN, the largeness of accelerators and detectors of the new generation research in particle physics led to the development of an accelerator for research of events in nature on the largest energy scale accessible to humanity, at 1 TeV – LHC. On it, two large detectors that have been in the process of being designed by the ATLAS Collaboration and the CMS Collaboration since the beginning of the nineties will perform measurements. Following exhaustive conversations with the two groups, Slovenia decided to join the ATLAS Collaboration in 1996.

Therefore, Slovenian scientists currently work in CERN in the ATLAS Collaboration, in three collaborations that develop radiation resistant semi-conductive sensors, in the collaboration for development of detectors for medical imaging, and on the project working on Grid computing, EGEE. With the Slovene pilot Grid installation, SiGNET, the Slovene researchers are included in the WLCG as the second level cluster.

So far, based on the research conducted in the CERN, Slovene scientists have published over 400 scientific articles, all in reputable international magazines. These works brought approximately 8000 quotations to Slovene science. Upon work in the CERN, 17 diplomas, 12 master and 17 doctoral theses were obtained. The apparatus for positron tomography with a detector on the basis of multi-wire proportional chambers was made. The prototypes for a portable radiation detector in the environment on the basis of a proportional chamber, and for the detector for strontium in the environment on the basis of the Čerenkov detector were made. The development of a new type of detector for medical imaging on the basis of silicon position-sensitive sensors and of the apparatus for the PET scan, functioning in a powerful magnetic field (compatible with magnetic resonance imaging), is ongoing.

On 10 September 2009, the Government of the Republic of Slovenia decided that the Republic of Slovenia shall apply to be a candidate for membership in the CERN. On this basis, the CERN sent an application for membership on 15 September 2009, and in 2010, the Government co-operated with the representatives of the CERN in their forming of the report on the readiness of Slovenia for membership.

The expected benefits of Slovenia's inclusion in the project

Co-operation in the CERN shall bring Slovenia the following benefits, in particular:

- participation of Slovene science in research directed towards the understanding of the elementary constituents of nature and the processes among them,
- the use and creation of high tech products in the company of top experts from the entire world;
- training of post-graduate and post-doctoral co-workers upon competition and co-operation with colleagues from the most advanced countries, familiarisation and work with apparatuses at the highest technological level, and encouragement of non-conventional approaches to

solving problems, all resulting in top trained experts also qualified for work outside the narrow scientific field.
- transfer and use of detection methods of high energy physics in the other fields, particularly medicine and measurements in environment,
- limited access to other, mainly technological programmes of the CERN (computing and informatics, technology of accelerators, cryogenic technology, supraconductivity, etc.)

On the current level of co-operation in CERN programmes, the most appropriate possibility for Slovenia is full membership. This will facilitate co-operation of Slovene experimental physicists. At the same time, there is an important technological and economical motive existing in Slovenia, since this would fully open up opportunities in Slovenia for the following:

- full access for scientists and engineers from the other fields of the research infrastructure and technological projects conducted at the CERN,
- unlimited access to CERN programmes for education of young engineers in the mentioned fields, which could increase the interest of young people in science,
- full access of Slovene industry to CERN orders, and the connected breakthrough to demanding markets with high levels of invested knowledge.

The CERN also offers wide possibilities of educational and training programmes on all levels, study programmes of the second level for students and teachers, doctoral study programmes in which the students research at the CERN for a long period of time, and programmes for visiting researchers. These programmes are only accessible to citizens of CERN member states.
The needs of the CERN for equipment are covered with purchases mainly in the member states, while significant obstacles stand in the way of non-member states competing. In addition to the direct financial effect, the attestation of qualifications to supply high-tech products is important for the producer. Studies have shown that for each Swiss franc earned on CERN orders by companies, an average of three additional francs are obtained from orders from other resources.

Financial aspect
Expenditures for the membership of the state in the CERN are settled in the form of an annual membership fee. The latter is calculated separately for each state in relation to the entire CERN budget, and is proportional to the net national income (NNI, according to the OECD methodology and data). The procedure to become a member of the CERN is biphasic; first, the state applies for status as a candidate for membership, lasting from 1 to 5 years, and before the expiry of this period, both the CERN and the candidate decide on furthering the status of the state in the CERN. Within the period in which the candidate country enjoys the majority of rights, except the right to vote in the decision-making body, it pays a reduced membership fee that increases with time from 25% (for the first year) to 75% of the normal contribution of a member state, although it must work out to a minimum of 500,000 francs annually.
If Slovenia had been a member from the beginning of 2009 (when the calculation was made), its full membership fee would amount to 3,163,000 Swiss francs. According to this calculation, the reduced membership fee for Slovenia for the entire first year (25% of the full membership fee) would amount to CHF 790,750 or approximately EUR 630,000.
According to previous analyses and contact of Slovenia with the CERN, it may be expected that the CERN would spend a part of the Slovene membership fee for the purchase of products and services from Slovene companies, since some Slovene companies have fallen out of the competition for CERN orders several times already due to the fact that Slovenia is not a member of the organisation.

2.2. FAIR

Facility for Antiproton and Ion Research in Europe
Description of the infrastructure
The Facility for Antiproton and Ion Research in Europe (FAIR) is one of the first and financially the largest project in the ESFRI Roadmap. Once it is built, it will be intended for study of the elementary constituents of matter and the development of the universe. Several European and non-European states are included in the project of construction of this large research infrastructure, which will be placed in Darmstadt in Germany (next to Slovenia, for now at least, Finland, France, India, Germany, Poland, Romania, Russia, Spain, Sweden and Great Britain). The overall value of the project exceeds EUR 1.2 billion, from which the largest share will be contributed by the Republic of Germany (EUR 705 million), which will cover the bulk of expenses for the construction works. The main elements of the infrastructure are accelerators and hoops (in the value of approx. EUR 553 million), the building (approx. EUR 289 million), the basic infrastructure for experiments (EUR 180 million), the employees

(240 FTE or approx. EUR 185 million), and high-tech control equipment, instruments, and other equipment (approx. EUR 60 million).
The FAIR will enable work with high-energy primary and secondary ion beams of the highest intensity and quality, as well as beams of "antimatter" antiprotons that enables the most advanced research in these areas of physics. The two superconductive synchrotrons will produce high-intensity ion beams up to 35GeV/nucleon for experiments with primary beams, with a mass of ion equal to uranium, and for the production of a wide spectrum of beams of radioactive ions.

Previous activities of Slovenia
On 6 November 2010, when the international company FAIR GmbH was established for its implementation, the project officially moved from the preparatory to implementation phase. The Government of the Republic of Slovenia has been participating in project preparations. On 19 October 2007, the FAIR sent a statement on intended participation in the construction of this centre in the form of material investment in the amount of 1% of the estimated construction costs, adding up to EUR 12 million (in prices from 2005). In 2009, the line ministry re-examined the entire project in detail along with Slovenian's eventual participation and established that strong and wide interest for co-operation in the project of construction of the FAIR exists in Slovenia, presenting bottom-up incentive, that in this connection, Slovene companies are strongly linked with each other and with the research organisations, and that the knowledge of Slovene partners is at the very top of the global scale and, in many segments of the construction of accelerators so vast, is even indispensable. Therefore, the Government of the Republic of Slovenia agreed on participation by the Republic of Slovenia in this project on 11 June 2009. On 6 October 2020, Slovenia signed, together with the other states, acts on the (co)establishment of the FAIR GmbH that were in the process of ratification in Slovenia at the time of creation of this document.

The expected benefits of Slovenia's inclusion in the project
Participation of Slovenia in the FAIR will bring benefits in many fields as follows:

- a top network of Slovene knowledge in a field that is developing and very quickly spreading throughout Europe and worldwide will be formed,
- it will open doors to Slovenian partners that will successfully participate in such a reference project, to many present and future similar projects, and to world markets,
- it will enable Slovenian science to equally participate in the phase of operation of this centre; we also expect that in the phase of construction, new scientific groups will be formed or the existing groups will strengthen.

In Slovenia, the Slovenian input in the project will be reflected in the form of orders for supply of equipment, services and knowledge of the Slovene FAIR partners. In the future, this knowledge will multiply with the development of the concerned technological sector and scientific work. The membership of Slovenia in the FAIR will enable Slovenian partners to carry out potential additional direct orders by the FAIR.

Financial aspect
In the construction of the FAIR Centre, Slovenia will participate with the lowest share, amounting to 1% of the estimated value of the project, i.e. EUR 12 millions (in the overall period of the construction). The input by the Republic of Slovenia will be in material form and in the form of high technology or work of the researchers. Once it starts operating, presumably around the year 2017, the FAIR member states will also be paying for its operational costs. These costs are estimated to amount to EUR 118 million annually. The principle of dividing these costs among the states is still under negotiation; the essential element will presumably be the size of the input by each state.
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2.3. CERIC

Central-European Research Infrastructures Consortium
Description of the infrastructure
In Trieste, which is in direct vicinity of Slovenia, one of the largest facilities in the field of synchrotron radiation and its application in science on substances in Europe, Trieste Synchrotron, operates. In Europe, its most know facility is its laboratory Elettra, the capabilities of which are often used by Slovene scientists, mainly researchers at the University of Ljubljana, the Jožef Stefan Institute, the National Institute of Chemistry, the University of Maribor, the University of Nova Gorica and the National Institute of Biology.

Therefore, discussions on the formalisation of this co-operation have begun; upon these discussions and along the lines of similar processes elsewhere in Europe, the idea of the establishment of newly distributed research infrastructure in the spirit of the European Research Infrastructure Consortium (ERIC) has developed. By linking Trieste Synchrotron and the diverse, but related research capabilities in the region and wider area (discussions have started among Slovenia, Italy, Austria, Poland, the Czech Republic and Romania), the widely distributed research infrastructure could offer complete service to researchers who must otherwise access several diverse research infrastructures in their research process.
Such an organisation (ERIC) would, as an international organisation, be exempted from VAT payment, and could apply for co-financing from EU programmes (particularly the 7th or 8th OP of Research). Later on, the integration could also be followed by the common upgrading or construction of new capabilities.

Previous activities of Slovenia
The line ministry will sign a non-binding Letter of Intent to participate in designing this new infrastructure, with which the work group will be established to identify the capabilities that could be linked to the ERIC, their integration modes, a set of possible common activities, potential locations for implementation of the common activities, and other financial and administrative questions. From Slovenia, several or at least one of our most excellent research infrastructures could potentially be linked to ERIC, for example: the NMR Centre or any of new Centres of Excellence.

The expected benefits of Slovenia's inclusion in the project
The idea of regional co-operation with regard to the establishment of new research infrastructures was developed from the need to institutionalise the co-operation between Trieste Synchrotron and Slovenia; therefore, the project presents a solution in this direction. In addition, the existing capabilities' obsolescence will be optimised, and with the international co-operation, the knowledge base at these institutions and their recognisability will be increased, and the price of application reduced. Slovenia, as one of the leading states in this project, has the possibility to additionally add to their good reputation and take up an important role. The synergies with the EuroFEL project, in which the FERMI@ELETTRA at Trieste Synchrotron is included, are also possible.

Financial aspect
The project is set to link the existing capabilities and in this context, so far, the construction of new capabilities or larger collective upgrading of the existing ones is not foreseen. In case Slovenia upgrades its national research infrastructure within the ERIC framework, these investments will constitute the material input of Slovenia in the ERIC.

2.4. SHARE

Survey of Health, Ageing and Retirement in Europe
Description of the infrastructure
The SHARE is an international multidisciplinary longitudinal research programme establishing economic, health and social conditions of the population over 50 years of age. With construction of infrastructure of micro data necessary for understanding individual and social ageing as a process in time, it gives scientific bases for empirical research of the ageing processes to many disciplines, such as demography, economics, gerontology, medicine, psychology, sociology and statistics. Since the ageing process significantly influences the pension and health systems, as well as labour market arrangements and their reforms, it also enables better planning of the measures for managing these difficulties and social challenges. These are of particular interest to Slovenia, since it is undergoing a process of quick ageing of the population, outstripping social and health institutions and arrangements. Therefore, the SHARE project can significantly contribute to achieving a development level of the states, facing these challenges successfully.

The main advantages that make SHARE such a unique research infrastructure in the world are that, firstly, it is based on ex ante harmonisation of the questionnaire among the states, enabling comparison of impacts caused by diverse systems of the welfare state (such as the pension and the health systems) on well-being, health, economic status, retirement and social inclusion of the elderly population. Despite free (of charge) access to the SHARE databases, their application value for the research community is much larger in case the states participate in the project. Secondly, the SHARE project, with its interdisciplinarity, fills the current research vacuum among teaching about economical

and social impacts on one hand and health and related impacts of individual and social process of ageing of the population on the other. Different modules of the questionnaire, which is based on the personal, computer assisted surveying of individuals, encompass health, psychological, economical and social variables.

The planned period of upgrading of the SHARE 2010–2024 research infrastructure is divided into three phases. In the first phase, from 2010–2011, one wave of questionnaires will be carried out; in the second phase, from 2012–2017, three waves of questionnaires will be carried out; and in the third period, from 2018–2024, the next three waves of questionnaires will be carried out. Namely, in the entire period from 2010–2024, every 2 years, the collection of data on selected sample panels will be performed, so that at the end, along with the 7 newly selected data, there will be 10 subsequent waves (so far only three have been carried out).

Previous activities of Slovenia
So far, through the Institute for Economic Research (IER), Slovenia has participated in two international research projects from the wider SHARE project family, the purpose of which was to carry out all the necessary preparation activities for undisturbed upgrading of the SHARE research infrastructure in the 2010–2024 period.

The expected benefits of Slovenia's inclusion in the project
Slovenia is one of the EU states that are among the most exposed to the dramatic process of population ageing and many of its consequences in the economic, particularly the public finance field, in welfare and social politics, health, the long-term care of the elderly population, the labour market and in the residential field. In Slovenia, we are not familiar enough with the situation, problems and potential of the elderly segment of the population, since the existing records are insufficient, poorly integrated and inconsistent, making more serious research work, insight into the situation, suggestions regarding system solutions orientation and concrete measures impossible.

Therefore, the SHARE databases will be especially applicable in certain key fields of structural reforms, in particular those regarding the labour market, pension and health systems, since usage of the SHARE research infrastructure will enable monitoring and analysing of impacts by individual reform suggestions and policies in many fields concerning ageing of the population, as well as creating and testing adequate system solutions.

Further, the inclusion of Slovenia in the SHARE project will enable the participating researchers to assume the knowledge and seize experiences of the international pool of experienced researchers from previous project operations. These researchers will be able to gather experiences through exchange of lessons and best practices and through joint solving of problems that will appear as the project unfolds. Other researchers will be able to freely use the internationally harmonised Slovene data and data from other states, and on this basis, conduct consistent internationally comparable analyses according to several dimensions of population ageing processes (economic, social, health, retirement, etc.), and their consequences in Slovenia and in other states participating in the project. It can be expected that this research infrastructure will be used by increasingly more Slovene researchers every year, since the databases will be available to all researchers free of charge.

The SHARE database, and in particular the possibility of adequate processing and analysing of the acquired data, can also enable identification of new business possibilities in the Slovene economy, mainly specialised companies that cover the needs relating to the process of intensive ageing of the population in Slovenia and in Europe.

Financial aspect
The total estimated value of the entire international project, SHARE, is approximately EUR 230 million, covering all three phases of upgrading and seven full waves of questionnaires to be carried out. In this period of 15 years until 2024, the total cost for Slovenia (costs of implementing the project in Slovenia and costs of membership in the research infrastructure) amounts to maximum EUR 8 million or approximately EUR 1 million per (two-year) wave. The contribution for covering the expenses of the central SHARE-ERIC organisation is also included in this amount, which will, for Slovenia (according to the calculation based on the GDP of the state) amount to approximately EUR 49,000 per year. The largest share of the costs of implementing the project in Slovenia will constitute carrying out of the questionnaire (collecting data), amounting to approximately EUR 250,000–280,000.

2.5. ESS

European Social Survey

Description of the infrastructure

Modern democratic societies have developed into complex structures of legislative, political and social institutions, and informal networks of social groups and individuals. Thus, one of the big questions of our time is regarding the similarities and differences among modern national states, taking the constant differentiation, vast migrations and globalisation into account. The social sciences cannot tackle this without systematic and long-term empirical research of these phenomena.

The European Social Survey (ESS) is the youngest and among the largest comparable social pools, and its most recognisable characteristics are high demands regarding the quality of all the aspects of preparation and implementation of the research procedure. Namely, the ESS data is originally intended for the entire academic community and the policy formers, thus for the quality analyses of social trends, and for directing social systems. Therefore, the content of the ESS pools is general and at the same time disciplinary heterogeneous, intended for diverse scientific and management profiles of the users in the fields of sociology, psychology, politology, criminology, etc. involving mainly subjective indicators of the standpoints, and to a smaller extent, the behaviours of people.

The ESS is framed longitudinally. By means of repetitive measures, the time line is taking shape, representing an increasingly more useful basis for monitoring social development. Its principal methodological advantage is that in its organisational conception, it has found the most effective compromise between principals of central management and national participation, of democracy, control and methodological and substantive expert valuation, the consequence of which is increased equivalence of measurements of social phenomena on the international level. Due to such quality breakthroughs and outstanding achievements respectively, upon the harmonisation of the quality of international social sciences research, the ESS research was also awarded with the highest European prize in the scientific and research field, the Descartes Prize, in 2005.

Previous activities of Slovenia

The ESS project started being implemented in 2001, and Slovenia have been included in the project from the beginning through the Faculty of Social Sciences at the University of Ljubljana. From 2004 on, this Slovene institution has also been a member of the managing consortium, and therefore one of the seven managing partners of the project that is otherwise carried out by 35 states.

In addition to the data users, ten Slovene researchers from the public and private organisations are already participating in the ESS methodology seminars (ESS Train), and several hundred are also using the internet programme for methodology learning (EDU-Net).

The expected benefits of Slovenia's inclusion in the project

Next to acquiring reliable indicators of the situation and the dynamics of the standpoints of the population on diverse social areas, being an important goal by itself, a large advantage of the ESS lies within the possibility of systematic and valid comparison of the Slovene indicators with the indicators of other European societies.

The participating researchers, lecturers and analysts that will acquire knowledge and skills in the field of social sciences research will significantly benefit from the project and will share the flow of methodological knowledge and methodological innovations in the fields of, for example, research organisation, construction of questionnaire, translation, archiving, sampling and analysing. This way, the ESS will significantly contribute to the improvement of the quality of research work both in the public and private research sectors, which will enable social science analyses of higher quality and professionally supported political decisions. The continual co-operation and simultaneous exchange of knowledge and experiences, respectively, will substantially contribute to the forming of a new generation of methodologically qualified researchers, and thus to the improvement of the quality of pedagogic and research work.

In the wider sense, by means of Slovenia's co-operation in the ESS, researchers, lecturers and students will have access to social indicators of the new generation, and thus to empirical bases for verifying scientific hypotheses in the comparative framework. For reasons of general social as well as comparative nature of the indicators, it can be expected that the important scientific achievements will

be most common in the field of sociology, politology, and partly also economy and pedagogical sciences.

The knowledge that is being acquired by the researchers from the private sector within the framework of the ESS training programmes and free access to the ESS databases is directly useful in the field of marketing, advertising, all types of quantitative research of public opinion, and in diverse analytical departments of industrial activities, the subject of which are analyses of databases (human resources departments, analyses of employee satisfaction, internal departments for market analyses, etc.).

Next to wide analytical potential of the ESS, which enables achievements in the academic field, the ESS may also have wider social effects in several fields. Namely, the research enabled by the ESS offers monitoring of social trends in the majority of the most politically relevant fields. The results can serve the public administration as information bases and theoretical backgrounds, for example, for identification of socially and politically relevant problems, for forming strategies and measures, and for planning public information programmes. Better political management indirectly means a rise in the quality of living, and the social indicators enable the deepening of knowledge regarding our own society in the context of comparison with other societies, and thus the outline of the national identity and its particularities.

Financial aspect
The total estimated value of the ESS international project is approximately EUR 10 million, constituting the costs of measurements implementation in all the participating countries and the costs of the central co-ordination for the period of two years. The total costs for Slovenia amount to an approximate maximum of EUR 150,000 annually, and cover measurements implementation in Slovenia, work of the national co-ordinator and the team, upgrading of the hardware and software that enables controlled digital data recovery in the field phase, and a contribution to central co-ordination and common activities in the amount of approximately EUR 30,000.

2.6. DARIAH

Digital Research Infrastructure for the Arts and Humanities
Description of the infrastructure
The DARIAH will be the first digital research infrastructure in the field of arts and humanities in Europe that will enable and encourage comparative international and interdisciplinary digital research in these two fields.

Its importance is pointed out by the fact that the necessary research infrastructure for these two fields still needs to be established on the European level, especially with unified standardisation, knowledge organising, and integration of databases from diverse national academic traditions and disciplines. In this sense, the digital research infrastructure means a network that will connect diverse knowledge, methodology, analytical and interpretative tools of different disciplines by means of digital databases and researchers, and will encourage digitally designed research in humanities and arts.

Therefore, the DARIAH is establishing a uniform technological platform that establishes access to this material and, on one hand, integrates very different forms of data (manuscripts, printed documents, texts, music notations, illustrative and verbal material, etc.) in an interoperable manner, and on the other, research institutes and digital centres. By means of integration and interweaving of information and communication technologies, humanities and arts, new methodologies, new analytical and interpretative tools and new research modes – digital or e-humanities, will be developed.

Since the digital research infrastructure in the fields of arts and humanities is only just being established in all the states, the special value of the DARIAH project lies precisely in the international integration of the knowledge, methodologies, analytical tools and approaches developed by the digital humanities. Since the project is developing digital humanities and arts on the European level, the expected results of this process are logically better in quality and cheaper than if they were to be developed by each state separately. The digital humanities do not mean just forming of digitalised databases, but also opening the way to new integrations (with specific modes of structuring and organising knowledge), and thus modifying analytical contexts and research methodologies.
Due to fast operation, special links and search engines enabled by digitalisation, such infrastructures encourage and enable new interdisciplinary integration of databases on the international level. In this

sense, the DARIAH will form European digital humanities and encourage the creation of digital archives and digitalised databases, respectively, on the national level. Through education and promotion, it will also enable the transfer of knowledge and good practises of data management in humanities, data preservation and storage, and integration, structuring, organisation and ensuring legal bases for such databases.

Previous activities of Slovenia
Slovenia, through the Institute for Contemporary History (INZ), is participating in DARIAH activities from the beginning of the project (September 2008), and in 2009, the Institute actively engaged in its strategic and business and logistical work package. The INZ is also entering the DARIAH with the programme for the research infrastructure of the Slovene historiography, Sistory, and within the framework of specific operations in the strategic and business work package, as well as with preparation of the business and logistical model, with research of digital humanities, national policies and strategies, and actual development of digital research infrastructure for the humanities and arts in Slovenia, as well as in the European framework. In the research field, linked to the activities of and the goals within the DARIAH framework, more research institutions are operating in Slovenia, among them, for example, the Institute of Slovenian Literature and Literary Studies (ZRC SAZU), the Institute for Mediterranean Heritage and the Institute for Historical Studies at the Science and Research Centre at University of Primorska (the latter have important experiences in the field of computed added technologies for humanities and arts), and also others. Thus, we will strive for linking as many interested institutions in this field as possible with the activities within the DARIAH framework. Also, a quality international comparative judicial database is necessary for quality research work and a faster track to resonant scientific knowledge and achievements in all fields, particularly in the fields of social sciences and humanities. Participating in the DARIAH on the national level can also be an important opportunity for adequate linking in the context of development such a database in Slovenia.

The expected benefits of Slovenia's inclusion in the project
The DARIAH presents support and accelerates digitalisation of the cultural heritage, enables its study from several viewing angles of diverse disciplines of humanities and arts, encourages linking of diverse digital centres and databases (libraries, museums, archaeological sites, research institutes, private collections, archives, etc.), and, at the same time, opens an opportunity for the integration of cultural heritage of Slovenia in the European area.
By means of forming friendly programme solutions for different users, and providing fast and free access to very diverse (so far, to a large extent, inaccessible) materials, it opens up the possibility for better access to cultural heritage for all people. Due to the latter, it also has a significant importance for popularisation of the humanities sciences, and for construction of appropriate attitude towards the cultural heritage.

The DARIAH network will create an international area of digital research, in which Slovenia will be able to be included on equal footing by means of implementation of complex technological solutions and of establishment of technological platforms that will be formed in this network. Upon forming new technological solutions, we will strive for them to be based on open and interoperable standards and on open code, both on the national and international levels. The new analytical tools, interpretative systems and all-European integration of bases in humanities and arts will enable fast, user friendly and free access to the databases and, via ICT tools, the creating of new connections and solving of more difficult soluble research questions. In Slovenia, the researchers will integrate their knowledge in humanities and arts in the European area, open databases, enable access to sources, analyses or already carried out research. The option to compare their analyses with comparative critical analyses of other states and disciplines will also be enabled.

With development of the digital humanities, the DARIAH will enable implementation of declared national strategies and policies, establishment of digital databases in Slovenia, their integration on a national level, and thus the linking of researchers and institutes. It will offer education, advisement, recommendations and good practices on how to develop digital bases and integrate them, not merely from the scientific point of view, but also legal. Currently active digital infrastructure in Slovenia will be linked together and unified, enabling, among other things, outside access to databases previously functioning merely for internal research of individual institutes, and duplication of digitalised documents in diverse digital centres will be avoided.

The DARIAH project also presents a technological challenge for the economy in a sense of the development of diverse applications, testing of tools, compilers (for language and for diverse forms of information) and software, upon analytical data processing and enabling fast access to very diverse data. In addition, the digital humanities will, by means of diverse knowledge, contribute to the digitalisation of cultural heritage, part of which is also the Slovene economy. With fast and free access, and interoperability of diverse databases, it will contribute to comparative critical international analyses relevant to the economy.

Financial aspect
The total estimated costs of establishment of the international digital research infrastructure DARIAH are EUR 12 million, and the total costs of operation, EUR 6 million, annually. Precise distribution of individual states' contributions is not yet possible, since the final number of participating states is still not known. The states will contribute to the project by means of material input and cash contribution, the latter amounting to at least 10%. According to the up-to-date information, Slovenia will participate in the DARIAH by means of cash contribution in the amount of approximately EUR 2,500, and material contribution in the amount of approximately EUR 22,500.

2.7. CESSDA

Council of European Social Science Data Archives
Description of the infrastructure
The CESSDA project presents organisational and professional upgrading of data infrastructure in the field of social sciences. It uses possibilities of co-operation by national organisations and territorial responsibility to take care of data on the European level by linking work on the development projects. It also takes care of data by means of the implementation of standardised solutions for the handling of data materials and unifies the quality level of provision of services. The CESSDA result will be cheaper joint operation, larger amount of free accessible data, user friendly access from one spot, and possibilities for training for work, and for co-operation.

Today, data access for quality social science research is ensured by national data archives, integrated on the European level in the CESSDA. They are each independently in charge of important data sources selection and its storage, and of provision of access for scientific, educational and other purposes. Within the framework of the association, the access to large amounts of unique and quality data is ensured, together with documentation and aids for its usage. Archives, among other things, store some of the most important national and international continual research of general and specific problems in society, covering all areas of life, from economy to well-being, environment, politics and democracy to standpoints, values and culture.
The CESSDA has, so far, functioned as a volunteer association of the national data archives from the fields of social sciences. In the seventies, the original purpose of the association was to ensure data exchange among states for researchers. With the arrival of the Internet, the limitations of physical access were overcome, but limitations with regard to access due to uncoordinated functioning of national data services remained.

The goal of the upgrading of the CESSDA is to form new organisation with a solid inner organisational structure and rules. This will ensure member states the usage of common services that will be based on uniform rules of operation, both in substance, regarding the usage of protocols, and by the method for assuring high-quality and effectiveness of operation.

The key areas of the upgrading of the CESSDA will be: uniformity of the process for handing over data upon its recovery in such a manner that the copyrights of grantors will be protected; the possibility of user registration for the access to data in their state by means of the usage of uniform ontology of statuses; the creation of common tools for preparation, documentation and handing over data; counselling and training of researchers for preparation of quality data appropriate for handing over to the archive; establishment of data takeover service and defining obligations regarding handover of research data from public funds in accordance with the OECD Declaration; creation of common tools and portals for provision of the data value added services; designing of repository and support for its operation; development of the best practises in the entire spectrum, of services in accordance with the concept of data life cycle, and development and verification of systems for long-term storage.

Previous activities of Slovenia

Slovenia has established data services and closely co-operates, by means of the existing international links, through Social Science Data Archives (ADP). The experts of this organisation co-operate within the CESSDA framework in activities, such as preparation of portal, and protocols for data exchange and its access, professional training, and preparation of common tools for support of the operation.

For equalising the level of services and fulfilment of conditions for co-operation in the new CESSDA installation, additional investment in upgrading of the Slovene share of provision of services will be necessary. The set-up of recovery, storage and access to quality data, the inventory of data materials, the supplementing of protocols and tools for access to delicate personal data, remote access to data of other public institutions in other fields, the set-up of inner control protocols over quality of services upon handling data linked with the system of long-term storage, the implementation of tools for handling metadata and for usage of common technology, and education and training of the users will be necessary.
Participation of Slovenia in the CESSDA project will enable direct transfer of experiences and examples of organising a comprehensive national system of access to research data for the other disciplinary fields. Namely, some partners cover wider disciplinary fields of humanities, social sciences, medicine, land use, history, etc., and co-operate in advanced development of comprehensive national scientific infrastructure. While on one hand, specialist consideration of research data according to the traditions and needs of individual disciplines is necessary, on the other hand, integration and uniformity of access to materials of diverse disciplines from one spot is necessary, as well as knowledge and control over provision of repository services for permanent storage of digital data materials for research purposes. In addition, the project presents an opportunity for examination of the situation, and forming and adjusting of the legal framework of collecting data on research from public funds in adequate form in an appropriate place, respectively, where according to the type of material, collection can be as follows: in a manner of personal or institutional self-archiving (for data materials from projects of minor importance); in a manner of national disciplinary authorised data archive linked in parallel international integrations, for which the ADP integrated in the CESSDA presents an example; or in a manner of direct supply of data materials to adequate international archive of individual disciplinary fields.

The expected benefits of Slovenia's inclusion in the project
The CESSDA will ensure the establishment of modern and quality service of data access for social sciences with minimum risk, since the member states will lean on jointly established solutions instead of developing them themselves from the start. Solid inner organisational structure and rules of the CESSDA will ensure member states the usage of common services that will be based on uniform rules of operation, both in substance regarding the usage of protocols, and by method upon assuring high-quality and effectiveness of operation. Therefore, co-operation in the CESSDA will be a new opportunity for assurance of national service of data access comparable to a more developed environment.

The data user (researchers, students and the wider public) will have unlimited access to national and foreign data sources and related materials that, according to its content and methodological nature, assure unique bases for research of a variety of important problems. The CESSDA will ensure counselling, training for data management, tools and standards, and materials. Thus, inclusion in the CESSDA with relatively small investments will ensure a rise of scientific discoveries and of the general level of qualification for research work with data, in accordance with the worldwide trend of data, and on related knowledge-based quality scientific production. Thus, by means of full operation of the data infrastructure, the possibility of co-operation in the scientific community will be extended, since students, professors and the wider public can, under the same conditions as researchers, access source data for their own projects and contribute to the treasury of knowledge with their own analyses. Linking to the CESSDA also opens up and spreads opportunities for international corporative projects in numerous fields.
Also, upon the same quality of research infrastructures, it will enable savings in means and time that, within the research projects, are represented by the production of more data. Since infrastructure also ensures long-term storage and applicability of data materials to current society, it also presents an important part of protection of scientific and cultural heritage for future historical research.

The CESSDA will also present numerous opportunities for economy, particularly in certain fields of IT support, where there is a high level of knowledge present in Slovenia, for example, with use of artificial intelligence with semantic support and web3 technologies, multimedia content (e.g. Videolectures),

sources and tools for companies that deal with commercial data collection (analyses of public opinions), etc.

Financial aspect
The total value of the entire project amounts to approximately EUR 30 million. Annual costs should amount to approximately EUR 1.8–2 million, from which Norway and Germany are, as potential hosts of the administrative head office of the CESSDA, offering coverage of EUR 1.4 million annually for the first 5 years. The Slovene contribution to the central organisation will be comparatively small (calculated on the basis of GDP of the state), thus the majority of costs of Slovenia's participation in the CESSDA will be presented by investments in construction of the national infrastructure in this field. These new costs are estimated to approximately EUR 75,000 annually.

2.8. XFEL or EuroFEL

X-ray Free Electron Laser or European Free Electron Lasers
The free electron lasers XFEL and EuroFEL are, in their field of usage partly exchangeable; the consortium of free electron lasers, EuroFEL, combines several devices of this kind in Europe (existing or under construction), while EFEL is a new device of this kind with larger capabilities (under construction). For Slovene scientists, access to merely one device of this kind is important, therefore, the line ministry will again consider all the aspects of both projects upon making the final decision on participation in one of these two infrastructures, since their characteristics and circumstances can, during project implementation and other activities in the framework of the Roadmap, still change in Slovenia.

Description of the infrastructure
The XFEL will be a new international centre for production and scientific application of very light and ultra short pulses of spatially coherent hard X-rays. It will offer new possibilities that will be particularly interesting for science in the development of new advanced and complex multifunctional materials. The complex will encompass a 1.7km-long superconductive linear accelerator for the acceleration of electrons, and 6 experimental stations with modern and advanced equipment for the scientific application of rays. The rays will enable the carrying out of entirely new and potentially revolutionary experiments in a large number of disciplines, from physics and chemistry to nanoscience and nanotechnology. Similar understanding of chemical reactions and the operation mode of the molecular systems will be of essential importance for planning new inorganic and organic (nano) materials. The EFEL will use new superconductivity technology for electron acceleration using a high speed of repetitions, which will be the basis for the development of future accelerators.

The EuroFEL project merges the national FEL centres that already operate or are in the start-up phase for unified, distributed and internationally open infrastructure. The linking of centres presents the effective usage of complementary instruments that are available in each centre, thus enabling characterisation of the materials from very diverse viewpoints. The EuroFEL will offer a wide range of ray lines and equipment that will be much richer than it would be if offered by solely one existing centre. The laser light that will be offered by the EuroFEL upon its completion will cover the area from distant infrared wavelengths to soft X-rays. With a wide set of characterisation techniques offered by the EuroFEL, it will be possible to research electronic, structural, optical and chemical characteristics of a wide variety of materials from nanostructured to mesoscopic and macroscopic, inorganic and organic and biological. It will also be possible to monitor the majority of characteristics in relation to time, since the majority of the FEL centres enable picosecond and femtosecond laser flashes, making high time resolution possible upon availability of the appropriate systems for data recovery.

Previous activities of Slovenia
With their previous work on synchrotrons (ESRF, ELETTRA, DESY), Slovenian researchers have been involved primarily in structural analyses of diverse materials, but they also have experience in the field of roentgen absorption and emission spectroscopy, which will be one of the key techniques of the EXFEL and EuroFEL.
As many as 5 Centres of Excellence are included in the participation proposal and are as follows: for Nanosciences and Nanotechnology (CO NIN), for Biosensors, Instrumentation and Process Control (CO BIK), for Low-Carbon technologies (CO NIZ), for Advanced Materials and Technologies for the Future (CO NAMASTE), and for Polymer Materials and Technologies (CO POLIMAT).

The co-operation is also important in the context of the development of the new generation desktop XFEL source ("Surfatron"), and time-resolved electronic electron microscopy, taking place in CO NIN. One of the FEL centres in EuroFEL will also be the FERMI@ELETTRA Centre within the framework of Trieste Synchrotron. Slovenia's participation in the EuroFEL is therefore possible within the context of linking the Slovene research infrastructures and the latter (referred as the CERIC project in this Roadmap).

The expected benefits of Slovenia's inclusion in the project
Slovene science, in the field of materials research, cannot make significant progress without access to large research infrastructure. With integration in the EFEL or EuroFEL, international co-operation will deepen or be newly established, both in the field of theoretical support to experiments, and for full usage of RI capabilities and making new discoveries. The usage of XFEL or EuroFEL capacities will enable Slovene scientists to carry out research of exceptional quality. The users that can currently be identified in Slovenia will mainly take advantage of the opportunities that exist for research of 3D nanostructures, complex structures and systems, bio-molecules, monitoring of chemical reactions at the atomic level and in new time-scale, far exceeding current capabilities.
The XFEL and EuroFEL will enable scientific breakthroughs in several scientific fields, and globally, will hold a leading position in the ability to generate very intensive and extremely short pulses of X-rays for scientific research and for breakthroughs in a large number of disciplines, giving European, and therefore also Slovene science, the possibility to take a leading role in new and inventive achievements in the fields of nanoscience, materials science, energy and sensors science, and other key fields. Upon the usage of the infrastructure, the Slovene research groups will be included in other user groups and thus will be in direct contact with the most popular trends in individual research fields.

The understanding of materials and processes will be of key importance for their usage for engineering and biomedical purposes. New inorganic and organic (nano) materials with improved characteristics, and systems with complex behaviour, originating in dynamic attributes, and closely linked with the development plans and visions of the Slovene chemical industry, will be developed. Previous research on synchrotrons will be upgraded and upon carrying out the research, Slovene students and researchers will become further educated and will advance, and by creating new knowledge, will transfer it to others for the development of new products with high added value.
Therefore, in the long run, the co-operation of Slovenia in the EFEL or EuroFEL will enable transfer and usage of the latest discoveries to Slovene science and industry, and thus by means of development of individual fields, the upgrade of basic knowledge, and development of new products and technologies, also enabling the creation of new work posts in research organisations and industry, and the establishment of new spin-off companies.

The research expected to be carried out in the EFEL and EuroFEL will also be strongly socially integrated, since their results can be used for solving acute global social problems, such as improving quality of life and health, ensuring sustainable development and development of a low-carbon society, introducing energy-saving technologies, and fulfilling more and more stricter environmental requirements.

Financial aspect
The total value of the XFEL project is EUR 1.043 billion. The member states will contribute to the project in material or monetary form, the minimum contribution enabling the acquisition of an equity stake, and management of this research infrastructure being EUR 12 million. The total costs of operation will be approximately EUR 84 million, and the principle of dividing these costs among the states is not yet set. At this moment, Slovenia is not planning its own investment in the EFEL project to be in the amount that would enable acquisition of an equity stake (minimum EUR 12 million), therefore, upon enabling access to the EFEL capabilities for Slovene scientists, it will, above all, examine the possibilities of linking with the other states.
The framework total value of the EuroFEL project is from EUR 1.2 to 1.6 billion. The most realistic possibilities of co-operation in the EuroFEL are either access to its capabilities (mainly FERMI@ELETTRA) within the framework of co-operation with the Trieste Synchrotron (the CERIC project) or upgrading and construction of national capabilities, respectively, that could be included in the EuroFEL.

2.9. ILL

Institute Laue Langevin

Description of the infrastructure

The Institute Laue Langevin (ILL) in Grenoble, France is the leading international research centre for neutron scattering. Due to its specific characteristics, the neutrons present a complementary approach to other diffraction and spectroscopic methods (X-ray diffraction, IR and NMR spectroscopy, etc.), and play an essential and, frequently, the key role in modern research in chemistry and physics of (nano) materials, and in life sciences (biochemistry, biophysics and biology). Diffraction and spectroscopic methods enable detailed insight in the structure and dynamics of condensed matter on an atomic or molecular basis.

The ILL research equipment includes approximately 40 ray lines with diverse characteristics for study of the structure and dynamics of the matter on diverse space and time scales. The ILL is, in equal equity shares, owned by France, Germany and Great Britain, and has been functioning since 1973; formally, the institute is a French company. On an annual basis, approximately 700 experiments are carried out, and more than 450 scientific articles are published. The institute can pride itself on the largest number of scientific publications with a high impact factor among all related institutions of the world for neutron scattering. Currently, next to its three states of establishment, there are also 10 partner states as follows: Austria, Belgium, Czech Republic, Denmark, Italy, Hungary, Slovakia, Spain, Sweden and Switzerland.

Previous activities of Slovenia

Slovenia is not currently an ILL member state. On 21 May 2008, the ILL organised, with help from the National Institute of Chemistry and the Jožef Stefan Institute, a workshop that attracted a very large number of researchers from all the most visible research institutions in Slovenia. Strong interest from researchers assures adequate critical mass, and at the same time, encourages interdisciplinary research in international environment.

Immediately after the workshop, the Slovene researchers formed the following project proposals:

- The use of neutron diffraction method with microporous materials,
- Determination of the structure of technical, oxide ceramic and piezoelectric materials without lead and with powder diffraction,
- Structural analysis on the basis of monocrystal,
- Research on hydrogen storage and hydrogen diffusion through membranes,
- Development and research of new electronic and photocatalytic materials with improved characteristics, Neutron scattering as a complementary method to other analytical methods, giving essential information on the structure of the materials on the basis of oxides,
- Measurements of small angle neutron scattering (SANS) of solutions of self-organising colloidal systems,
- Coherent neutron scattering for determination of structures and structural errors for electrochemical materials,
- Dynamics of the proton in very short hydrogen bonds,
- Neutron reflectometry.

The expected benefits of Slovenia's inclusion in the project

The introduction of research with neutron scattering (namely, the standard method for study of condensed matter worldwide) opens a wide range of the most modern analytical methods in the fields of chemistry and physics of materials and nanomaterials, structural biology and nuclear physics to Slovene researchers. The use of neutron scattering methods is complemented with other methods of scattering (X-rays); therefore, such methods are an indispensable tool of modern science on materials and life science. These methods would, with the inclusion of Slovenia in the ILL, become easily accessible. For reasons of optimal organisation of ILL operation, as evidenced by exceptional production of high-quality scientific publications and a very large number of international projects in which the ILL participates, Slovene researchers would also acquire unique opportunities for inclusion in international scientific flows.

Also, numerous opportunities for advanced training and research of younger professional staff at the ILL would be presented. Training for research with neutron scattering for all the participating researchers is part of established practices at the ILL and is conducted by employees working on ray lines. Slovene doctoral students could also be trained for work on ray lines, thus acquiring important knowledge and skills in Slovenia.

Studies of ILL results have shown that one quarter of the experiments carried out at ILL has direct importance for industry. Interest in co-operation in this project has already been expressed by the Slovene company Cosylab, since institutions of this kind are their basic business partners. Since the research with neutrons also enables the study of industrial materials (for example cracks in alloys), and the study of cocrystals of pharmaceutical substances that present a large challenge in the pharmaceutical industry, wider interest by Slovene industry can also be expected. The direct research of pharmaceutical reagents and modes of their positioning on the desired place in the body is, for example, important for the pharmaceutical industry, and the research of polymers characteristics is important for a variety of industries, needing advanced materials.

Since the ILL is a research infrastructure that already exists, the membership of Slovenia would enable the transfer of successful practices of industrial co-operation in the national economy in the Slovene research sphere. Such knowledge transfer would encourage Slovene researchers to develop spin-off companies that would enable research at the ILL to interested pharmaceutical, chemical and other industries.

Financial aspect
Slovenia can join the ILL as a full member or as a member of the consortium of central European states of Austria, Czech Republic, Hungary and Slovakia (the CENI Consortium). As a member of the consortium, it will have significantly lower financial obligations. Thus, this will be the first opportunity that shall be examined in the initial phase of co-operation with the ILL, and in the future, full membership is not necessarily excluded. Participation through the CENI Consortium requires a one-off payment of the membership fee (entrance fee) in the amount of approximately EUR 0.2 million, and payments of annual operating costs, normalised according to extent of the research carried out by the Slovene researchers at the ILL. Bearing in mind the interest that has been expressed, it is estimated that Slovene researchers will use approximately 10 days of ray time on an annual basis, corresponding to annual cost in the amount of approximately EUR 150,000.

2.10. Belle II

Description of the infrastructure
The research infrastructure Belle II will be intended for experiments in basic particle physics. In the SuperKEKB accelerator, the electrons and positrons will be accelerated, and in the centre of the experimental apparatus, will collide. Upon this collision, heavy particles and their antiparticles are formed. The Belle II spectrometer will enable detection of traces of their products with detection systems for positioning the integration point, including a central tracking chamber. The electrical signals from the detection sets will be processed by electronic components, partly in the interior, and partly on the outer side of the spectrometer, and the high-power computer system will provide for their further processing and storage.
The essential improvement of the precision of measurements enabled by the Belle II, both by improving detection capabilities and substantial increase of the size of the recorded pattern, will make, for example, answers to questions on discrepancies with otherwise very precise verification of the Standard Model, i.e. the search for phenomena of New Physics, possible.
Thus, the SuperKEKB accelerator (the project by the Japanese Government in the amount of EUR 250 million), and the Belle II spectrometer, should be ready at the end of 2014.

Previous activities of Slovenia
In preparation of the Belle II research infrastructure in the total value of approximately EUR 300 million, thirteen states participate (among them Japan, USA, Germany, Russia, Australia, Austria, Czech Republic, Poland, China, South Korea and Slovenia), and in total, approximately three hundred researchers. The Slovene research group is among the carriers of this project. Upon its preparation, it bears key responsibilities (project manager, coordinator of the physics programme, head of one of the detector subsystems of the Belle II spectrometer).

The expected benefits of Slovenia's inclusion in the project
Discovery of possible new processes in basic particle physics would have a similar impact on the development of science as the development of quantum mechanics and its probability principle at the beginning of the previous century. By combining experimental approaches on the limit of achievable energies (the CERN and LHC), and on the limit of achievable precision (the KEK and Belle II), it will be possible to discover and identify new types of particles and corresponding theories that would change

the understanding of basic forces in nature at their very roots. With a view towards the key role of Slovene researchers in the project, this would, in addition to exceptional scientific achievement, also significantly influence the position and reputation of Slovenia worldwide.
So far, Slovene researchers have already been trained at this research organisation (within the framework of the Belle project, 4 doctoral degrees have been obtained, and 5 doctoral dissertations are being prepared), and by upgrading the Belle detector, an even larger number of trainings can be expected.
The potential for the participation of Slovene high-tech industry in search of technological solutions, in preparation of the components of the experimental apparatus and equipping the SuperKEKB Accelerator, in which the Japanese government will invest over EUR 250 million, is also large.
Important contributions in the field of knowledge transfer are also possible upon 'Grid' technologies in computing, where in Slovenia, with approximately 600 processors and 300 TB of memory, the 'SIGNET' operates. Development of Grid technology is also important for applications in medicine, since it enables transfer and processing of data among diverse institutions. Another example of knowledge transfer possibility upon basic particle physics is the development of new methods for healthcare, particularly, improvements with regard to imaging in medical diagnostics (positron tomography – PET), that became possible due to usage of improved detectors developed for the Belle II spectrometer.

Financial aspect
The overall value of upgrading the research infrastructure, Belle II, amounts to approximately EUR 300 million. Slovenia will contribute the framework amount of approximately EUR 1.5 million upon construction. Once the infrastructure begins operations, it will bear a part of the costs of functioning in the estimated amount of EUR 100,000 annually, and for financing the costs of work by Slovene researchers, approximately an additional EUR 150,000 annually.

2.11. LifeWatch

Science and Technology Infrastructure for Biodiversity Data and Observatories
Description of the infrastructure
LifeWatch will be world research infrastructure, combining the following:
- the system of sea, land, and freshwater observatories,
- common access to a huge scope of integrated data from diverse bases and observatories,
- calculating capabilities in virtual laboratories by means of analytical and modern tools, and
- directed user support and training, and public services programmes.

This way, it will support research on protection, management and sustainable use of biodiversity, and help to improve the understanding of our natural environment. The data from the networks for observation and biological data collection will be processed and integrated by analytical and modelled tools in such manner that it will be available to all interested parties. Therefore, LifeWatch will support access to integrated databases in an innovative manner, and thus shed light on shortcomings in the knowledge and understanding of life on Earth. On the European and multidisciplinary level, it will make data analyses and modelling to determine samples and mechanisms on diverse levels of biodiversity, and familiarisation with them, possible.
In the infrastructure, alongside the basic scientific research, there will also be an applicative component with included users, namely the public and private sectors, equally represented, which will enable proper understanding and management of biodiversity. With its research goals, LifeWatch is integrated in the EU policy in the field of biodiversity, and the Global Earth Observation System of Systems (GEOSS) project is the main component of the policy.
The research infrastructure will be composed of (1) sources and means, (2) e-infrastructure, (3) an analytical centre and (4) users. The sources are presented by the databases of measurements and observations, statistical operational programmes, computing capabilities, devices and other means for analysing and modelling. The e-infrastructure, through the identification system, admission and processing of data located inside administrative domains, as well as through unified security and access protocol and unified semantics stylist, will enable mechanisms for dissemination of specific sources. The analytical centre will perform tasks by means of systems for the uniform transfer of integrated data, detecting and safely storing information, and sending it to the computer network. The last constituent of this infrastructure includes the main portal for work and management, enabling the users to create specific domains and portals to support specific research (e.g. Karst biodiversity); This way, the specific scientific environment for exercising control, monitoring tasks and tools, and mutual communication and co-operation, will be created.

Previous activities of Slovenia
Since 2008, through the Scientific Research Centre of the Slovenian Academy of Sciences and Arts, Slovenia has been included as a partner in the preparation project concluded on 31 January 2011. By means of important research infrastructure and services in the fields of application of molecular biology upon study of biodiversity in the area of Slovenia and South-eastern Europe, the University of Primorska has at its disposal the infrastructure necessary for the establishment of a bank of tissue samples (in co-operation with the Slovenian Museum of Natural History in Ljubljana), an analytical centre – molecular laboratory with necessary programme software for analyses of genetic diversity, and instrumentation of the Institute for Mediterranean Agriculture and Olive Growing of the Science and Research Centre of Koper in the field of plant genomics and biotechnology.
Through future activities of participation in LifeWatch, Slovenia will strive for the inclusion of as wide a circle as possible of Slovene institutions in this field, as well as linking to the existing international collections (in the field of forestry e.g. on the condition of forests, dynamic units of genetic sources protection, etc.).

The expected benefits of Slovenia's inclusion in the project
The research infrastructure LifeWatch is of extreme importance for society, since it will enable protection and sustainable management of biodiversity, which is one of the key values of human society, and which will be passed down to future generations, if compatibility with nature and sustainable management of natural sources are applied.
It can be expected that this future biodiversity will primarily be enjoyed by nature protectionists, managers of national parks and other important places for biodiversity, the natural sciences profession for scientific purposes, and state administrations upon undertaking the guidelines and action plans for biodiversity protection. Directly or indirectly, this research infrastructure may also be used by school professors and their students, and laic interested public. Since it will enable the establishment of the meta database, accessible through the World Wide Web, it will not only serve for data exchange in the scientific sphere, but also for spreading knowledge and new findings, both within educational processes, and for the interested public.
Study of the biological variety in the selected ecosystem with the use of technology, covering remote data, and having the smallest influence on space, will further strengthen Slovenia in its top global position with regard to contributions from the fields of speleobiology and Karst science. Namely, Slovenia, with almost half of its territory being Karst, is at the very top of the world in richness of underground biodiversity. Data on the rich Karst flora, fauna and vegetation, as well as social and economical aspects that are typical for the selected Karst areas, will be generated at a common base, and then processed. We will add more value to our current knowledge on the Karst, its biodiversity, and need for protection of the fragile balance, and connect research, education, and mobility of knowledge and people in society. By means of information technologies development, free exchange and spreading of data will be introduced, which, in today's circumstances of territorial data protection in the scientific sphere, presents a cultural turning point and innovation co-operation among research and the scientific sphere.
Participation in LifeWatch will enable Slovenia to develop and use the most advanced research methods, as it will be possible to use the experiences and solutions of other national networks. In Slovenia, the technological network for integration of data on ecology and biodiversity will link researchers and experts from diverse multidisciplinary scientific sciences who participate in long-term biodiversity research. This will, among other things, enable determination of the most important factors that have an impact on biodiversity, as well as impact assessment of individual factors on processes in ecosystems.
Based on selected and processed data, we will acquire information on endangerment of individual organisms, groups of organisms, and habitats. Protocol with the included spatial plan and measures for protection of biodiversity will enable the protection of places with a high level of biodiversity. Thus, the research infrastructure will contribute to preservation, protection, and sustainable management of the natural and cultural inheritance of the Karst in Slovenia.

Financial aspect
The total value of the entire project for the research infrastructure amounts to approximately EUR 370 million. The costs of Slovene participation in the project, including costs of development of the national infrastructure that will be linked to LifeWatch, are estimated to EUR 555,000, annually.

2.12. ELIXIR and EATRIS

European Life Sciences Infrastructure for Biological Information and European Advanced Translational Research Infrastructure in Medicine

The two large infrastructures ELIXIR and EATRIS are mutually complementary, therefore they are discussed jointly. ELIXIR presents a foundation for other research infrastructures of the biomedical field, and EATRIS presents upgrading of the research in the biomedical sciences.

Description of the infrastructure

The ELIXIR project presents upgrading and maintenance of the permanent infrastructure for biological information in Europe, for support to research and sciences of life, their transfer in medicine and the environment, in bio-industry and in society in general. It will be organised as a trans-national network of biological information co-ordinated on a European level and will be complementary to activities and priorities on the level of individual states. Within its framework, basic and specialised biological data will be acquired, and tolls and services for the integration of data from diverse sources will be accessible; it will also enable schooling for users. In Europe, ELIXIR will contribute to: (a) improving the health condition of the ageing population in the sense of better understanding and control of diseases, and earlier diagnosing and prognosis, (b) sustainable production of quality food in sufficient quantities by use of enhanced information on plant genomes, (c) competitive pharmaceutical and biotechnological industry and (d) environmental protection. The ELIXIR infrastructure will have the central collection centre, but will be otherwise spread into numerous nodes. They will present areas of (a) data sources, (b) centres for bio-calculations, (c) infrastructure for integration of biological data, software, tools and services, and (D) services for the research community, including schooling, and development of standards.

The goal of the EATRIS project is to establish infrastructure that will enable faster and more effective transfer of findings from basic research laboratories to clinics, and transfer of complicated clinical and development problems in laboratories for basic research. The EATRIS research equipment will serve the development of the most modern diagnostic methods and therapeutic approaches, including genome, cell and imaging technology for biomedical research that, due to the applicable directed nature, is called transfer or translational research. Within the framework of the EATRIS preparatory project, the partners from the majority of West European countries of the EU are linked, and are achieving an enviable level of infrastructure in the field of translational biomedicine. Namely, they are linked into a network of infrastructural centres and bound to co-operation and coordination in normative, scientific and professional areas. The interactive approach of EATRIS includes persons under examination or patients in the process of individualised medical treatment; therefore, the infrastructure will be organised in the network of highly specialised partner centres. Their importance also lies in standardisation of procedures, harmonisation of regulations, and introduction of high safety standards in the field of clinical research. Therefore, the EATRIS concept is multicentric, and encompasses all the phases of research and development, from research of pathogenesis and making of diagnostic biomarkers, through synthesis of new molecules to the first phase of clinical testing either of new substances or diagnostic markers.

Previous activities of Slovenia

Thirteen states are participating in the ELIXIR preparatory phase, which will be concluded in December 2011. Slovenia is not among them, but the Centre for Functional Genomics and Bio-Chips (CFGBC) has, upon invitation from ELIXIR, reported interest for construction of nodes in April 2010. From 2005 onwards, the CFGBC, functioning as a national platform that combines infrastructure for high performance analysis of transcriptome and genome from 16 members of the Slovenian Consortium for Bio-Chips, upon adequate upgrading and linking with other research organisations in this field in Slovenia (e.g. the Institute for Mediterranean Agriculture and Olive Growing at the Science and Research Centre of Koper at University of Primorska), could be included in ELIXIR as a national unit (node), offering research support and equipment for Slovenia and the other ELIXIR states.

The EATRIS preparatory phase was concluded in December 2010. Slovenia did not officially participate, but the Faculty of Pharmacy at University of Ljubljana submitted expression of interest for participation in the EATRIS activities to EATRIS coordinators in the period from 2007–2008, in which it could be included with its infrastructure, together with other research organisation in this field in Slovenia. Multicentric design of the EATRIS research infrastructure provides for nodes in partner member states as well. Thus, in Slovenia, following the EATRIS example, it would be necessary to organise a distributed network of research organisations dealing with translational medicine. This way, a stronger professional background and integration of fields and infrastructure would be ensured, and

at the same time, better usage of equipment would be enabled. Such a network would be, as one of its branches, easier and more meaningfully upgraded and included in the EATRIS.

The expected benefits of Slovenia's inclusion in the project
Within the framework of Slovenia's participation in ELIXIR, the construction of permanent infrastructure for acquiring, storing and linking biological information from the post-genome era in Slovenia is planned. Basic and specialised biological data will be acquired, tools and services for the integration of data from diverse sources will be accessible, and schooling for the users will be enabled. The use of the research infrastructure upon co-operation with newly founded smaller companies in the field of biomedical and biotechnological sciences will be strengthened further and will also be available to spin-off companies that are or will be established. Thus, the inclusion of Slovenia in ELIXIR as the basic infrastructure for all the research in life sciences brings many benefits for Slovene society, such as improving health conditions of the ageing population, sustainable production of quality food, larger competitiveness of the pharmaceutical and biotechnological industries, and better environmental protection.
The inclusion of Slovenia in EATRIS will enable the upgrading of the current research potential in the field of applicative biomedical research and application of the concepts of transfer biomedicine, making faster adaptation to new world trends possible and contributing to the competitiveness of the Slovene pharmaceutical industry. Access to the most modern infrastructure in the sense of physical equipment and introducing standards and harmonisation of the procedures would enable equal position to researchers when standing as candidates for large applicative projects (clinical studies), and for the achievement of top-level results in the fields of pharmaceutical sciences, clinical biomedicine, medicine and biotechnology. It would contribute to the implementation of legal and professional standards in the field of applicative medicine, for example, in the establishment of spin-off companies and support for medium-sized companies, business centres and competence centres in the mentioned, as well as the supportive technological fields. It would enable standardisation of the procedures of preclinical research and research of the first phase of clinical testing, as well as faster implementation of diagnostic methods. Finally, the inclusion of Slovenia in EATRIS would bring numerous general benefits for Slovene society in the sense of the rise in standard of living, by supporting preventive and personalised medicine, by contributing to better diagnostic and therapeutic approaches as well as effective and economic medical treatment.

Financial aspect
For participation in ELIXIR on the desired level, upgrading, drive and maintenance of the research infrastructure is necessary in Slovenia. Together with possible contributions to the ELIXIR central organisation for common activities (i.e. the contributions are not yet set, since the preparatory project is still ongoing), these costs would amount to approximately EUR 0.5 million annually.
These total costs of participation in EATRIS, including international obligations, organisation of the Slovene network of the organisation from the field of translational medicine and smaller interventions in the upgrading of the Slovene research infrastructure in the field, would amount to approximately EUR 0.5 million annually.

2.13. CLARIN

Common Language Resources and Technology Infrastructure
Description of the infrastructure
The CLARIN infrastructure is intended to extensive and easily accessible storage of language source and technologies, encompassing languages of the member states and languages taught in the member states or being important for reasons of migration flows. The usage mode of the language sources and tools in the CLARIN is uniform, and thus the infrastructure contributes to the preservation and sustaining of multilingual European heritage. The open web infrastructure of the language services creates a new paradigm of group co-operation in the development of sources and tools, upon which it ensures mainly the multiple applicability, and simultaneously, adaptations to individual needs.
The purpose of CLARIN is:

- making existing tools and solutions available in the unified infrastructure,
- enabling counselling and teaching activities on how to adapt the tools and sources to specific research needs,
- contributing to the standardisation of sources and tools.

Previous activities of Slovenia

Slovenia did not participate in the CLARIN project preparatory phase. On the national level, several companies and research organisations operate in the field of language technologies, among them the Faculty of Arts at the University of Ljubljana, the Jožef Stefan Institute and the University of Primorska; the researchers are also linked in the Slovene Language Technologies Society.

The expected benefits of Slovenia's inclusion in the project
With increasingly rapid development of the Internet and other e-technologies, technological support to individual languages is extremely important. In this sense, the CLARIN infrastructure is an ideal environment for the development of Slovene language sources and tools that would be, due to international co-operation, better standardised and used by a multiple of people; also, the co-operation with experts for technologically better assisted languages and education of the researchers in this field enable a clear flow of knowledge on these technologies. Since the development of language technologies for languages with a smaller amount of speakers lags behind larger ones, participation by Slovenia in the CLARIN project indicates an important contribution to its position regarding these technologies.
Language technologies are used in all applications where users of digital aids use their native language for communications (word processors, World Wide Web, mobile telephony, etc.). Therefore, in the multilingual European environment, it needs to be ensured that the Slovene language is included as a part of the linguistic and technical infrastructure, and of umbrella European terminological and grammar translation projects. The development of this field also indicates an opportunity for the Slovene economy that can offer tools and aids for written and spoken communications to the market.

Financial aspect
The total value of the entire project amounts to approximately EUR 140 million. Within the context of development of the national infrastructure for storage of language sources and development of language sources and tools, the participation of Slovenia in CLARIN would require investments in the amount of approximately EUR 2.2 million.

2.14. PRACE

Partnership for Advanced Computing in Europe
The decision on inclusion in the Roadmap is conditioned by the decision on construction and lease of the HPC capacities in Slovenia, upon which the stress will be placed on better defined usage in the economy.

Description of the infrastructure
The PRACE project is the European response to the needs for increasingly larger computing power in science and industry that can no longer be optimally ensured merely by means of purchase of high-performance computers. Since today's technology of making electronic circuits no longer allows for the increase in computing power at a satisfactory pace, the prosperity of parallel computing in which a larger number of interlinked units participate, takes place.
Such a system is the e-infrastructural centre Partnership for Advanced Computing in Europe (PRACE) that integrates individual centres for advanced computing in uniform infrastructure linked to national, regional and local centres, and thus forming a scientific and computing network at the worldwide level. Therefore, the purpose of the PRACE is to construct European infrastructure with an ambition to become the best in the world and, in addition to very advanced computers, to offer virtual computer networks and data storage with the information sources distributed throughout Europe, as well as related fast communications networks, to the users. The PRACE tightly co-operates with similar initiatives, namely the Distributed European Infrastructure for Supercomputing Applications (DEISA), the Enabling Grids for E-sciencE (EGEE), and the European Grid Initiative (EGI)
The PRACE will be organised in three tiers: On the highest tier-0, there will be from three to five PRACE super-computers (HPC) of European centres. On tier-1, there will be national centres, interlinked with the Grid or similar technologies. On tier-2, the local centres are foreseen. In Slovenia, we could, on the basis of mutual co-operation, link the existing systems of tier-2 that are located at universities, research institutions, and partly in the economy, and are in accordance with the needs of the Slovene scientific and research community, and by means of upgrading the existing capacities, establish a national tier-1 centre. With such national infrastructure, we could participate in the PRACE and agree on terms and ways of co-operation in this partnership.

Previous activities of Slovenia

Currently, there are around 10 computer clusters functioning in Slovenia, with an average of 32 processors per cluster, but they are not interlinked, nor coordinated. Larger clusters are located at the National Institute of Chemistry, the Jožef Stefan Institute, and the Faculty of Mechanical Engineering at the University of Ljubljana. The largest cluster, with more than 1000 processors, is located at Turboinštitut d.d. The linking and coordinating of the spare capacities of the clusters in Slovenia could present the initial core of the Slovene national infrastructure.

Slovene researchers participate in several EU projects directly linked with the e-infrastructure and advanced computing, but so far, they do not have equipment sufficiently powerful to establish the critical mass of the HPC knowledge at their disposal, with which they could acquire computing time in large centres on the basis of already tested code.

At the Jožef Stefan Institute, the beginnings of such equipment already exist and could be increased to the size of thousands of nodes. The system contains all the grid and cluster characteristics already. Slovene researchers are also qualified for inclusion in the computer infrastructures within the PRACE project.

The expected benefits of Slovenia's inclusion in the project

Joining of the Slovene RI to the PRACE is beneficial for Slovenia, since it links and supplements strictly necessary infrastructure for the needs of e-science and other sciences, and particularly, natural sciences and life and technical sciences that need high performance computing and communications systems for processing and transferring data. It also enables access to the most high performance European computing systems. The development and use of programme tools for solving demanding computing tasks in parallel and distributed autonomous networks will be accelerated and optimised.

The analysis of larger quantities of data will enable management and prediction of complex situations for the needs of industry and government institutions, for example, in ecology, meteorology, seismology, bioinformatics, medicine and economy or linguistics; it will significantly contribute to the development of diverse sciences and information technologies.

Financial aspect

The total value of the PRACE project amounts to approximately EUR 200–400 million for renovation (upgrading and amortisation, respectively) of the equipment every 2–3 years. In Slovenia, the national infrastructure that could be included in the PRACE would have to be linked and upgraded in the amount of approximately EUR 1–2 million; the costs of membership depend on the rights to the research infrastructure that are needed by the state. For associated member status, which would probably be sufficient for Slovenia, the costs would amount to approximately EUR 100,000 annually.

3. National priority areas:

The research equipment and data infrastructure in Slovenia is dispersed. At a national level, the overview of interconnection of this equipment, which would attain the critical mass of a medium-sized or large research infrastructure centre, is not appropriate. Some particular equipment and data infrastructure among institutions is duplicated, and in some cases, it's even duplicated within an institution. Furthermore, research equipment is, for the most part, depreciated and partly obsolete.

The main financing instrument of the operation of research infrastructure is the co-financing of infrastructural programmes provided by the Slovenian Research Agency (SRA). Through year-long contracts, the Agency finances the operation, management and maintenance of research organisations' infrastructure as support to the research activity.
However, this form of financing research infrastructure does not ensure their growth and development. This shortcoming is partly subsidised by the SRA public tenders for subsidising equipment purchase. To this end, from 2 to 4 million Euros of co-financing is granted, with the co-financing condition being at least 20% own participation of research infrastructure, whereby the amount of participation is an important criterion for selection for co-financing.

For now, both mechanisms combined do not produce the impact of quick enough development of research infrastructure or the infrastructure attaining critical mass and thus having scientific excellence comparable to large European and world research infrastructures. Therefore, Slovenia will build and upgrade the research infrastructure at an accelerated pace with the goal of attaining the critical mass of a medium-sized or large research infrastructure in the selected priority areas complementing the areas of smart specialisation and contributing to a balanced development of society. The sources and instruments of financing the national research infrastructure will be adapted in the manner that will provide for their long-term development and operation, as well as participation of representative consortia of partners in a particular field in the planning and management system of research infrastructure public policy. Simultaneously, in order to exceed fragmentation, poor transparency and incomplete utilisation of current capabilities, a virtual infrastructure node will be established.

3.1. Virtual infrastructure node and open access

Research equipment and data infrastructure of high value, located at the public research organisations and of which purchase or set-up was co-financed by the Republic of Slovenia, has to be transparently documented and utilised as much as possible. SRA has kept records of all equipment bought through public tenders for purchasing research equipment in recent years; however, these records do not reflect its actual utilisation and connection of individual pieces of equipment in a research device or research infrastructure and its present availability. Research organisations, except those that have this infrastructure at their disposal, cannot access these records in a way other than based on individual ad-hoc or contractual arrangements with these research organisations. The practice in this field varies and primarily depends on the holders or managers of the equipment.

Thus, a virtual infrastructure node (portal) with the following characteristics will be established in Slovenia:

- on a voluntary basis but with the option of co-financing by the State (see 3.3), research equipment will be recorded and its current available capabilities indicated *(e.g. scanning probe microscope, 11 November 2010, 64% occupied);*
- research equipment will be connected to the topical level of area infrastructure in the form of a consortium of organisations and individuals who have it at their disposal and who manage it *(e.g. electron microscopy);*
- it will enable registration and information for accessing equipment for all research organisations from the public and private sectors.

In the short- and medium-term, the virtual node will significantly contribute to the defragmentation of national research capabilities. The research organisations, which will connect their capabilities in a particular field to a research infrastructure consortium and make it available on the node, enabling open external access to a large part of them (under agreed conditions), will be entitled to priority financing of the construction and upgrade of this research infrastructure. The consortia will also have a larger role in the management and development system of the entire field of research infrastructure (they will deliver an opinion on the proposals of co-financing the upgrade as well as the proposals

themselves), and in case of transferring the infrastructure programmes from the institutions to the consortia in the future, they will autonomously decide on the most appropriate manner of providing support and maintenance to the research infrastructure.

Open access to free capabilities of research infrastructure will significantly improve research intensity in companies, for this (expensive) equipment will complement their own, which is particularly important for small and medium-sized innovation companies.

In the future, the portal will have the ability to connect to similar portals in countries close by and will, in this manner, enable agreements on the international exchange of free capabilities, which will significantly improve the range of research infrastructure accessible to Slovenian researchers and, within the context of building the European Research Area, result in lower general government expenditure.

3.2. Priority areas of national RI development

In the procedure described in the chapter *Methodology of selecting priority international projects and national areas* and based on various studies and national strategic documents mentioned and described in the Research and Innovation Strategy of Slovenia 2011–2012, the following framework priority areas were determined, at which research infrastructure with the objective of attaining the critical mass of medium-sized and large research infrastructure has to be developed with priority from the viewpoint of attaining critical mass and scientific excellence in Slovenia:

- advanced materials and nanotechnology,
- energy efficiency and sustainable construction and geo-information sources,
- sustainable energy resources and environmental technologies,
- biotechnology, biomedicine and biological sources,
- high-performance computing and grids,
- analytical capabilities,
- digital national sources,
- RI for social sciences and humanities,
- RI for space applications,
- safe and healthy food.

Within the context of RISS implementation, the selection of these areas, which will be described in continuation, will be assessed and updated in the process of “smart specialisation”.

3.3. Priority financing – instruments

For the construction or set-up of research infrastructure in these areas, above all, the current financing instruments will be used, i.e. infrastructure programmes and co-financing of the purchase of equipment, adapted in a manner that will enable for priority financing and the continuous development of human resources and knowledge, indispensable for broader optimum use and development of national research infrastructure. If the present financing instruments are not adequate, the responsible ministry, in cooperation with the implementing agency, will examine the formation of new instruments, including the establishment of an appropriate legal framework for providing long-term operation, management and upgrade of the national research infrastructure.

In priority areas, the ministry will propose and actively promote connecting of all actors who are interested in sharing area research infrastructure. Consortia participating in the virtual infrastructure node will be formed, and the responsible minister will authorise them for delivery (binding) of an opinion on the proposal for priority financing of the purchase of high-value research equipment. In the long-term, these consortia will assume an important advisory role in the national policy of research infrastructure relating to the needs and manners of balanced development and operation of research infrastructure by area as well as relating to their evaluation and upgrading of national strategic plans within the management of the research and innovation system.

Priority financing will enable the purchasing of equipment or the setting up of high-value data infrastructure within budgetary possibilities, which will increase in the field of research infrastructure, and with substantially lower obligatory co-financing by the proposer. Only 10% of the proposer’s funds and only up to 1 million Euros will be obligatory for priority financing. Above this amount, the obligatory participation of the proposer’s funds will only be 10% of the maximum amount, i.e. EUR 100,000.

At the same time, the possibility of linking infrastructure programmes to the mentioned consortia of partners of the area research infrastructure, thus providing for a more flexible and area-adapted regulation for maintaining and upgrading the research infrastructure, will be examined.
In addition to the operation, management and maintenance, the objective in reforming the infrastructure programme system will be to provide for systematic support of research infrastructure consortia that will enable their successful operation (at their discretion and assessment, most often in the form of financing experts exclusively for providing support to various aspects of research infrastructure operation), long-term management and development of integrated services with regard to specific needs of particular areas, open access, necessary training of users, efficient use of equipment, and provision of support to users in interpreting the results.

The long-term objective in the field of national research infrastructure is to achieve critical mass and scientific excellence in at least one scientific area, thus connecting international partners in the formation of a large infrastructure centre at the highest global level in the territory of the RS and placing this research infrastructure on the agenda of research infrastructure development in Europe (ESFRI).

3.4. Description of priority areas

3.4.1. Advanced materials and nanotechnology

On the topic of advanced materials, research infrastructure development for research of materials will be promoted. In the process of preparing this Roadmap, around 85 subjects from all sectors were identified in which research activities are performed and between which synergic operation in developing the research infrastructure and in research activities would be possible. In this area, three centres of excellence have been co-financed in the 2009–2013 period: (1) the Centre of Excellence for Nanoscience and Nanotechnology (N&N), which has great potential to become one of the leading centres in this area in Europe and the world and that, in cooperation with other research organisations in Slovenia, connects with other related centres in Europe, e.g. within the NFFA project (Nanoscience Foundries and Fine Analysis), the Centre of Excellence for Advanced Non-metallic Materials with Technologies of the Future (NAMASTE) and the Centre of Excellence for Polymeric Materials and Technologies (PoliMaT). The development of infrastructure will be promoted in the following narrower areas particularly:

- infrastructures for synthesis, study, characterisation and control of substances or their characteristics at the level of atoms and molecules (“the nanolevel”), including laser-based methods, and infrastructures for researching the transport and localisation of nanostructured artificial and biological materials in relation to their interaction with organic nature. The estimated required value of upgrading the infrastructure in this area in the State is around 15–20 million euros, and its maintenance around 3–4 million euros annually;
- infrastructure for development, synthesis, and chemical and physical characterisation of new “smart” metal-based materials. Several research groups are active in this area in Slovenia, particularly within the Jožef Stefan Institute, the universities of Ljubljana and Maribor, and the Institute of Mathematics, Physics and Mechanics, whereby the research results have had an impact on technological development in a number of areas, among them, the energy sector (hydrogen technologies) and ICT. The required upgrade of the existing research infrastructure in this area has been estimated to 8 million euros and its maintenance, to 0.5 million euros annually;
- an integrative environment for implementing joint RR projects (industrial, higher education and research sectors) that can lead to technological breakthrough. The infrastructure in this area will provide for an interdisciplinary approach of actors with different backgrounds in order to direct business-oriented projects toward the development of (new) entrepreneurial organisations and business models, and thus toward transforming an innovative idea from state-of-the-art basic knowledge to an industrial prototype or a market product, and establishing spin-off companies. In this area in Slovenia. The Technology Network for Intelligent Polymer Materials and Technologies (TM IPMT) is already in operation and includes 16 public research organisations, 18 higher education institutions and 21 companies. The investment in equipment for carrying out research in various disciplines, from studying

characteristics, structures and behaviour of polymers under boundary conditions to medical and ICT equipment, has been estimated to around 10 million euros.

3.4.2. Sustainable energy resources and environmental technologies

Sustainable energy supply is one of the main social challenges that Europe and the world have recently placed in the foreground. Research infrastructure in this area is nationally significant within the context of developing knowledge and technologies that ensure the State's energy independence. In Slovenia, leaders in the field of developing energy technologies are not yet optimally interconnected, while the development of research infrastructure has to be provided for in the following areas:

- infrastructures for researching energy production, transport and conversion; emphasis will be placed on alternative and renewable sources of electricity, its conversion and final consumption. Thus, the infrastructure must provide for research of energy sources, development of technologies and equipment that will enable economic sustainability of the use of alternative energy sources, testing of this equipment and algorithms of their management with the aim to achieve high energy yield with the lowest possible burdening of the environment with CO_2 emissions. For upgrading the equipment of existing research capabilities in this area, the estimated investment amounts to 0.5 million euros and 100,000 euros annually for their maintenance.
- infrastructure in the field of nuclear reactor and other similar energy technologies; In Slovenia, this refers to the Reactor Infrastructure Centre with the TRIGA research reactor and the hot cell managed by the Jožef Stefan Institute. Because Slovenia produces more than a third of its electricity at the Krško nuclear power plant, a number that will increase if its second reactor block is build, the TRIGA reactor is already of exceptional importance for training highly qualified experts who oversee its safe and reliable operation as well as for continuous upgrading, and even more so for the development of new 3^{rd} and 4^{th} generation reactors with a much higher energy yield and the possibility of re-using long-lived radioactive waste and converting it to short-lived. For research, development and testing of new low-carbon energy technologies and approaches for creating and transferring knowledge to industrial production of these technologies, its upgrade and establishment of a technological polygon are required. For the latter, an investment of 3 million euros is required, and for the former, around 20 million euros. The average annual maintenance costs of this infrastructure are estimated to be 1 million euros.
- infrastructure for developing solutions that enable reliable and stable operation of electricity grids with a high share of *dispersed production of electricity* from alternative and renewable energy sources, where every consumer of electricity may also be a producer. The infrastructure in this area in Slovenia has only started being developed (the Infrastructure Centre for Energy Measurements – technological centre). From developing the equipment for transformation and management of energy flow, management algorithms, optimisation and protection, systems for data capturing and processing, and development of new services, which the units of dispersed production of electricity may provide to the power supply network, the estimated investment is around 0.2–0.4 million euros.
- infrastructure for solving environmental issues (environmental remediation or environmental chemistry); In Slovenia, such infrastructure is most developed at the Jožef Stefan Institute within research in the field of organic and inorganic analytical environmental chemistry and environmental impact assessment and environmental risk management. The existing equipment enables technological research of mass balance of pollutants in industrial process, fossil fuel combustion, circulation of elements and nutrients in purification facilities, technologies for removing pollutants from waste and contaminated areas, procedures for gas desulphurisation, monitoring and prevention of formation of harmful gases and their removal from incinerator emissions, re-use of waste material, etc. The upgrade of such infrastructures, which would provide for characterisation of pollutants and new laboratory simulations as well as development of technologies and methods for less pollution and depollution of the environment, has been estimated to 5 million euros and their operation and maintenance to 1 million euros annually. For an efficient and successful solving of environmental issues by using this infrastructure, a developed infrastructure of geological spatial data is necessary as well.

3.4.3. Energy efficiency and sustainable construction and geo-information sources

Sustainable construction is closely connected to energy efficiency, the latter also being a broader concept, which includes the development of energy efficiency methods and technologies that improve energy efficiency of processes, products and materials. In Slovenia, at least 100 actors from all sectors who conduct research and innovate in these areas were identified.

In the field of energy efficiency in construction and agriculture, the development of research infrastructure for introducing and testing innovative (eco) technologies and processes for sustainable management of materials will be promoted. Research infrastructure must enable the development of methods for increasing the utilisation of conventional energy sources (energy-generating products) and reducing the negative environmental impact of using these sources (environmental purity) and of technologies for sustainable construction and sustainable living. The investment in the research equipment in this area has been estimated to 5–7 million euros, and its maintenance, to 0.5–1 million euros annually.

Due to the natural conditions, Slovenia has a lot of infrastructure facilities of special significance, such as roads, bridges, tunnels, barriers, dams, industrial, communal and energy buildings, as well as natural areas, such as landslides, slumps and depressions. These facilities require a lot of money and energy; therefore, they must be appropriately monitored and maintained due to their important financial, social and safety aspects. The research infrastructure for inspecting and observing these facilities is deficient and dispersed, which makes optimised planning of measures even more difficult. The geo-information infrastructure (spatial data system in the fields of geology, geodesy, topography and other geo-sciences) has to be established for planning, research, analyses, statistics and monitoring the condition of infrastructure facilities that will enable a uniform classification of data with regard to the type of facility and the monitoring parameter, their placement in 3D space and remote multimedia access, a display on topographic and thematic maps, and a dynamic display in space and time. Such national infrastructure has to be capable of connecting to the other global spatial data systems. Therefore, it has to be based on an open design, if possible with the help of open-code solutions that support various platforms and use a standard that defines and arranges metadata with interoperability with other global systems. The required investment in the research infrastructure, which will support analysis and reduction of costs throughout the entire operating period of facilities, has been estimated to around 0.5–1 million euros, and its maintenance, to 100,000 euros annually.

3.4.4. Biotechnology, biomedicine and biological sources

In the area of life sciences and the use of their findings, the transition to the 21st century brought many completely new approaches and concepts in scientific and development research. The new age, entitled the post-genomic era, is built on the knowledge of the types of genomes, including the human genome, the development of computer science and materials and thereupon based new technologies. These contemporary technologies, knowledge and instruments used in research processes in the field of biotechnology, biomedicine and pharmacy contribute to an integrated understanding of life processes, protection against diseases and their effective and successful treatment, and solving of environmental issues. Contemporary research in this area connects knowledge and approaches of different kinds of sciences, from molecular, structural and cellular biology to biotechnology, including chemical and biological synthesis, light and electron microscopy, mass spectroscopy, x-ray diffraction, NMR and other analytical methods to functional genomics, proteomics, metabolomics and system biology/medicine with ICT (bioinformatics), while also requiring access to a broad and carefully arranged collection of biological sources.

Scientific discoveries in these fields are often transferred into industry or clinical practice, where the development of technologies importantly contributes to the higher quality life for individuals and to the protection of the environment. The process of transferring into practice can be quite long, however, it offers exceptional output and employment of highly qualified labour, and significantly contributes to the implementation of a low-carbon society. Since basic and development research uses the same technologies and knowledge, investments in the development of infrastructure in the following areas have priority:

- research infrastructure in the field of biomedicine (including post-genome infrastructure) and biotechnology; In the fields of biomedicine and biotechnology, two large pharmaceutical companies Krka and Lek operate in Slovenia that contribute an enormous share of private investments in research and development at the national level; furthermore, several high-technology small and medium-sized companies are quickly developing as well. In this field,

two centres of excellence have been co-financed in the 2009–2013 period: the Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins (CIPKeBiP) and the NMR Centre of Excellence for Research in Biotechnology, Pharmacy and Physics of Matter (CO EN-FIST). These centres will significantly strengthen the knowledge base and research infrastructure in this field in Slovenia on some of the branches of the former Centre of Excellence for Biotechnology with Pharmacy (2004–2008). The existing research equipment in this field is managed by the Jožef Stefan Institute, the National Institute of Chemistry, the National Institute of Biology, the Biotechnical Faculty, the Faculty of Pharmacy and the Faculty of Medicine of University of Ljubljana (Centre for Functional Genomics and Bio-Chips, the Medical Centre for Molecular Biology), and the Faculty of Medicine at the University of Maribor. Due to interconnectedness of various sciences in these fields, joint investments in the research infrastructure amounting to around 20–30 million euros are required, with the estimated operation and maintenance costs amounting to 2–3 million euros annually. The upgrade of physical infrastructure (research equipment), methods and interoperable and internationally connected solutions for acquiring, proper storing and linking of high-density data is required, as well as more intensive connection of biological, mathematical and information sciences in everyday work in these areas (bioinformatics), whereby a large unfulfilled gap of education and training of such interdisciplinary personnel exists. The upgrade of national research infrastructure in the field of biomedicine is being implemented within the context of integration in the international projects EATRIS and ELIXIR.

- biological sources; They are the basic resource of researchers in many fields of life and environmental sciences and they are also important for the pedagogical process. In Slovenia, the plant, animal and microbial sources, fungal and virological collections, herbaria, DNA collections from patients, their genes and products, and databases on *in-situ* living collections (e.g. forest gene reserves) are dispersed and poorly connected. They are managed by Biotechnical Faculty, the Agricultural Institute of Slovenia, the Slovenian Forestry Institute, the National Institute of Biology, the Faculty of Medicine and clinical institutions (UMC Ljubljana, UMC Maribor), and the Institute for Mediterranean Agriculture and Olive Growing at the Science and Research Centre of Koper at University of Primorska. These and other biological sources have to be connected, technologically upgraded and internationally integrated. They have to be technically and methodologically improved so that they will meet similar safety requirements and measures of the source operaters and the environment, while taking into account the valid ethical criteria. The required investments have been estimated to around 3 million euros, and the annual operation and maintenance costs, up to 0.5 million euros.

3.4.5. High-performance computing and grids

The quantity of digital data created and processed by the researchers in their work is sharply increasing in virtually all research areas. Thus, the available computing capabilities within particular institutions are mostly inadequate, while the setback in global development in this field has been determined at the EU level. On one hand, constant investments in computational capabilities are required, and on the other, investment in networks that link separately located units into an independent operating system of high quality or greater capabilities.

In Slovenia, individual institutions have high-performance computers or sources at their disposal (computing capacities, memory capacities, network capacities, etc.), but when compared to the European or global criteria, they do not come even close to the critical mass comparable to e.g. PRACE-1IP. In addition, increasingly more research organisations are determining that they need better high performance computing capabilities. Access to these capabilities has to be systemically regulated. The technologies in this area partly intertwine, and their suitability depends on the type of computing tasks:

- technology of parallel computing on a large number of interconnected units, i.e. “grid computing”; In Slovenia the national grid already exists, however, its permanent upgrade does not meet most needs of public research organisations for free access to computing capabilities for all public research organisations.
- becoming a member of the European research infrastructure in this area – PRACE (Partnership for Advanced Computing in Europe) could complement national computing capabilities, when they are inadequate, with their size and architecture, for solving the most demanding computing problems;

- the High Performance Computing Centre (HPC) for public research organisations may gradually develop in the future by upgrading the national systems or nodes in the national grid;
- for meeting the scientific-research needs, it is also possible to purchase computing capabilities in the market;
- cloud infrastructure can provide access to virtualised and very extensible resources to its users, thus also offering infrastructure interconnection of local and national cloud resources as well as European cloud infrastructures (e.g. StratusLab).

In accordance with the analysis of the most common computing problems in Slovenian public research organisations (a number of computing tasks and their complexity), the line ministry will prepare a national scheme of developing high-performance computing and providing access to these capabilities to all public research organisations on the model of PRACE by following the European trends of developing open and interoperable standards and solutions.

3.4.6. Analytical capabilities

For research of inorganic, but mostly organic materials, research infrastructure and methods that enable insight into their structure and chemical composition while at the same time not damaging them are required. Within this context, the development of research infrastructure in the following areas is needed:

- (scanning and transmission) electron microscopy; The advanced methods of electron microscopy and microanalysis are necessary for research and development of materials science and bioscience, but they are also applied in all other scientific disciplines (natural sciences, technical sciences, medicine, biotechnical science, social sciences, humanities). They enable the satisfactory explanation and understanding of the phenomena in materials and living systems that affect their physical and functional characteristics by acquiring all data on the studied object at micron, nanometre and atomic levels. Such equipment is available to the Jožef Stefan Institute, the National Institute of Chemistry, the National Institute of Biology, the Biotechnical Faculty and the Faculty of Medicine of University of Ljubljana, the Faculty of Mechanical Engineering of the University of Maribor and the Institute of Metals and Technology. For the study of metals, alloys, ceramics, composites, organic molecules, biological and medicinal preparations, active pharmaceutical ingredients, polymers, etc., their upgrade and integration is required. The gap is partly filled by the programme at the Centre of Excellence for Low-Carbon Technologies (CO NOT). The necessary investments in the purchase of such research equipment and its placement in the national research infrastructure have been estimated to 8–9 million euros, and the costs of its annual operation and maintenance, to 0.5 million euros.
- infrastructure of high-energy focused beams (ion accelerator); The use of an ion accelerator enables element and isotope mapping of biological tissue, research in the field of dynamics of hydrogen in matter, fusion research, research of characteristics of archaeological and artistic objects, etc. Controlled movement of the beam also enables processing matter at a nanometre level according to an elaborated plan in advance. The upgrade of this device, located at the Jožef Stefan Institute, will enable much more intense and better focused beams and, thus, observation of physiological processes in biological cells. The required investment in this infrastructure has been estimated to around 2 million euros, and its maintenance, to around 0.3–0.4 million euros annually.

3.4.7. Digital national sources

In the research process, large quantities of scientific data and publications are created. When research is supported with public funds, their results must be available to the public. In Slovenia access to research data is not systemically regulated but ad hoc by particular research institutions, when the authors must also enclose the research data when publishing a scientific article in a foreign magazine. Thus, this must be systematically regulated or upgraded and the research infrastructure has to be connected for:

- storage and access to scientific data (national repository); Integration of scientific data from research financed with public funds and their permanent storage and free access via the World Wide Web must be provided for. Such a central national repository system, which must have the ability to connect to SICRIS system, will connect to the repository integrations at the EU level, thus increasing recognisability and value (citation) of Slovenian science worldwide.

The required investment has been estimated to 1.5 million euros, and maintenance, to 0.5 million euros.

- storage and access to scientific publications; The National and University Library, which has been developing the Digital Library of Slovenia (dLib.si portal) since 2005 for accessing Slovenian written cultural heritage, has provided uniform open and free access to scientific publications since 2006. The uniform online access point to scientific publications and final reports of projects and programmes (co-)financed by SRA has been provided within the system of the Digital Library of Slovenia. The basic conditions for their permanent storage have been established as well. A portal for submitting electronic publications (SVAROG) to the repository has also been set up, but will have to be adapted to the needs of archiving the material of research and scientific institutions and universities. The Digital Library of Slovenia is already connected to the central bibliographic service COBISS and the system for monitoring the research activity SICRIS. The necessary investments for adapting the system to the needs of scientific and research institutions and universities and for ensuring permanent storage of their scientific publications in accordance with the standards have been estimated to 1 million euros, with maintenance and operation costs amounting to 0.2–0.4 million euros.

The connectivity of both systems with the SICRIS system will increase transparency and efficiency of valuating scientific works (immediate free accessibility of full texts of references in project applications). When they will be set up, the obligatory storage of publications and data from publicly financed research will be established as well.

3.4.8. RI for social sciences and humanities

Research in the field of social sciences, art and humanities with the use of information computer-supported technologies has been undergoing rapid development. With a fast expansion of the range of available research data and information, internationalisation of databases, standards and methodologies, and development of tools for processing, organising and connecting data and information, it is now possible to answer all research questions that could not even have been asked in the past. Research infrastructure has to be upgraded in the following areas:

- digital research infrastructure for social sciences; The national research infrastructure in this area will be strengthened within the context and in connection to participation in the international projects ESS, SHARE and CESSDA, whereby the solutions and standards developed in international partnerships will be used at a national level. An important contribution to the social sciences infrastructure is the development of digital sources (repository of data and publications). The investments in this infrastructure are part of the estimated investments in the aforementioned three international infrastructure projects described in the chapter on chosen international projects.
- digital research infrastructure for art and humanities; In this area the Institute for Contemporary History has already set up the online research and education portal, Sistory, that links researchers, material and technical infrastructure in the field of historiography. In addition, the Institute for Mediterranean Heritage and the Institute for Historical Studies at the Science and Research Centre of Koper at University of Primorska conduct interdisciplinary basic and applied research in the field of information computer-supported technologies for humanities and art at the regional, national and international levels. With the development of the topics and university programmes associated with heritage, history and humanities, and their innovative processing and valorisation in the broader sense, they have gained valuable experience in standardised processing of data and material from various fields. Such a national infrastructure in the field of art and humanities has to be connected, its content expanded, new functionalities added and integrated with the COBISS system. The pre-condition of digital research infrastructure is the digitalisation of material; therefore, it is necessary to continue with the activities connected to the extensive corpus (also older) of monographies, periodicals, magazines, other instruments and sources, and documentation at the national and regional levels. The content has to be in the form of multimedia, meaning that the material must be available interactively and visualised (sound, animation, music, images, graphics and video). The latter is especially important within the context of applying scientifically researched results in the pedagogical activity at all levels of education (e-learning) and their popularisation. Another aspect of developing digital humanities research infrastructure represents user-friendly software solutions, technological platforms for accessing various material, analytical tools and interpretative systems, which will be developed in the international partnership within the DARIAH research infrastructure with the

participation of all interested national institutions. In addition to the investments in the DARIAH project, the investments in this national research infrastructure have been estimated to 0.4 million euros, and its maintenance, to 0.2 million euros. We will strive for the technological solutions to be based on open and interoperable standards and open code, thus making their maintenance and integration into larger systems easier and cheaper.

- language sources and tools for the Slovenian language; In this area it is necessary to connect the organisations and centres engaged in the development and research activity in the fields of applied linguistics, corpus linguistics, development of language tools and databases, and machine translation. The research infrastructure, of which integral parts are the previously described large computing capabilities or networks, will provide for permanent and public access to the existing language, computing and other resources (text corpora, terminology bases, lexical bases, lexicons, lemmatisers, parsers, etc.), and develop new language-computing tools for developing new language resources, automatic preparation of language corpora, alignment of multi-language corpora, statistical and terminological analyses, machine translation, etc. The investments in this infrastructure are part of the investments within participation in the CLARIN project and high-performance computing, but additional investments will be required in the field of storing language sources (also possible within the context of digital national sources).

3.4.9. RI for space applications

The area of space technologies in Europe and worldwide is becoming increasingly more important. Their use has been expanding in the methods of their application as well as in the scope of users. Slovenia became a member of the European Space Agency (ESA), and as an EU member it also participates in the formation of space policy at the EU level and in the projects such as Galileo and GMES. In accordance with this trend in Europe, in Slovenia, companies are emerging and developing that either use the technologies provided by the space and the accompanying ground infrastructure or develop these technologies. In the latter context, the Centre of Excellence for Space has been co-financed in the 2009–2013 period.
Thus, research infrastructure at a national level is required that would connect the existing capabilities and knowledge and enable closer cooperation with the ESA, promotion and implementation of high-technology research, and development in Slovenia. It has to attain the critical mass of researchers, interdisciplinarity of research and connectivity with Slovenian industry and the ESA for more complex projects, and promote the establishment of new companies in this area.

In addition, the research infrastructure in this area has to enable (1) development and implementation of research equipment for simulating extreme physical conditions that apply in space (extreme temperatures, very high pressure and magnetic fields, and high frequencies), (2) research and implementation of new multifunctional materials interesting for space technologies (electrocaloric materials for an efficient cooling of instruments, materials combining magnetic and ferroelectric characteristics etc.), (3) development of new sensors, (4) development of advanced conductive composites, and (5) development of new techniques for satellite and stratospheric communication. The required investments in the construction of research infrastructure have been estimated to 6 million euros, and its operation and maintenance costs, to 1 million euros. In the medium-term, a significant share should be represented by Slovenia's actual contribution to ESA projects.

3.4.10. Safe and healthy food

Food safety and its impact on the health of consumers and the general health condition of society is becoming an increasingly more important, interdisciplinary area.
It opens up biological, sociological and anthropological issues that have high priority in Europe – in this field, two major research projects of the EU Member States are being created.
In Slovenia, a relatively large group of researchers and institutions that perform research activities in this area have to be connected, such as the University of Ljubljana (the Biotechnical Faculty, the Faculty of Health Sciences, the Faculty of Medicine, and the Veterinary Faculty and its National Veterinary Institute), the University of Primorska, the University of Maribor (the Faculty of Medicine, the Faculty of Agriculture and Life Sciences), the Jožef Stefan Institute, the National Institute of Chemistry, and the Institute of Public Health of the Republic of Slovenia, which will strengthen the capabilities of transferring and managing specific new technologies and developing new technologies and solutions in the field of food.

The research infrastructure has to enable research and development:

(1) of food quality and safety that will meet higher standards in the field of food and nutrition:
    a. development of functional food enriched with biologically active ingredients;
    b. development of methods for analysing the risks in food, including the methods for tracing and characterising risks in the animal production and supply chain, management of (micro)biological and chemical risks, and management of food safety from the sociological viewpoint;
(2) processes and bioprocesses with solutions for faster technological breakthroughs resulting in new products and services:
    a. passive management of contamination of pathogenic and harmful microorganisms – food preservation with microbial activity and increasing the durability and freshness of food with biological plant extracts;
    b. active management of contamination of pathogenic and harmful microorganisms – new encapsulation technologies and biological decontamination, and thus elimination of pathogens and spoilage bacteria/microorganisms;
(3) food in relation to consumers' habits for enabling new solutions for managing problems in the field of food and nutrition:
    a. human perception of food and food safety management;
    b. human satisfaction in relation to food and methods, measurement and evaluation of these processes for developing new products;
(4) food in relation to health, setting new paradigms of understanding food and promising new findings:
    a. study of digestive microflora and its immune activity in the human body and creating well-being;
    b. bioanalytics – tool for detecting the effects of food on the human body relating to tracing and evaluating the impact of bioactive food ingredients on microorganisms in the digestive tract and functioning of the human body.

The necessary investments in the research infrastructure that would suffice for all described functions have been estimated to around 2.5 million euros, with its maintenance costs between 0.2–0.5 million euros.

4. Joint Activities for Roadmap Implementation

There is no universal model for Roadmap implementation because the activities have to be adapted to the project itself.

The international projects, which Slovenia will strive to join, envisage very different ways of participation of countries. In some cases this means paying a membership fee, which brings certain rights and benefits, in others, countries may participate with a financial contribution, or with non-cash contributions, but most often, participation includes a combination of these types of contributions. Thus, for each of the projects mentioned in this document, the Slovene Government will examine the most appropriate form of participation, at which it will observe the following principles:

- Slovenia's input has to be used as much as possible in the Slovene economy or has to create direct return as soon as possible;
- the benefits of Slovenia's input in the international research infrastructure for Slovene science have to be greater than if these funds were invested in the national infrastructure in this area;
- long-term participation in the international research infrastructure will stimulate the reinforcement of capabilities in Slovenia.

It is also not possible to determine a uniform model for selecting Slovene institutions that will participate in the international infrastructure project as partners, with the most probable forms being an invitation to tender, a public call, a public contract or direct negotiations. For the most part, the selection of the most appropriate partner organisations will depend on this organisation's existing activities in the project, which Slovenia will join, and the Slovene Government will promote the connection of as wide a circle of research institutions as possible.

In implementing the Roadmap in relation to the construction or reinforcing of the research infrastructure in the chosen priority areas, which Slovenia will strive to join, connecting all stakeholders who are active in this area will be of key importance. In these activities, too, the Slovene Government or the responsible ministry will carry out invitations to tender, public contracts or other implementing activities, while observing the following principles:

- investment of funds in the research infrastructure in this field will significantly contribute to placing Slovenia among the leading countries in this area according to the international criteria;
- investments will contribute to further concentration of funds in the selected area (they do not represent dispersed financing) and, therefore, to attaining critical mass, quality and impact of economies of scale;
- the investments must also contribute to:
    - economic growth in Slovenia,
    - attracting the leading internationally renowned researchers,
    - scientific recognisability of Slovenia in this area.

For Slovenia's participation in the construction or upgrade of all international research infrastructures (including investments in the construction of the national infrastructure connected to the international infrastructure as its part) described in this document, around 35 million Euros are required, while the obligations arising from various memberships (membership fees, maintenance and operating costs, contributions to the central organisation for implementing the joint tasks, etc.) amount to around 3 million Euros annually. For implementing the construction or upgrade of national research infrastructures in accordance with the described priorities, a total of 110–130 million Euros would be required, and around 13 million Euros would be required annually for operating and maintenance costs. All objectives set in this document shall be valid by 2020, while the schedule and financial plan of their implementation or achievement will mostly depend on the budgetary possibilities and the state of public finance in the country.

5. Annex 1: Upgrading the Roadmap

Simultaneously with monitoring the implementation of the Research and Innovation Strategy of Slovenia (RISS) for 2011–2020, the implementation of the Research Infrastructures Roadmap 2011–2020 will be monitored. In accordance with the evaluation process of the impact of RISS measures and its updating in 2015, this Roadmap will also be updated if necessary.

Among the priority international projects that were not proposed during the preparation of the draft of this document, but during the public discussion, which prevented an expert assessment of the proposals under the same conditions and criteria that applied to other priority projects, are also the EPOS and BBMRI projects. An expert assessment of these proposals, from the viewpoint of including them among priority international projects, will thus be performed at the first revision of the Research Infrastructures Roadmap 2011–2020.

5.1. EPOS

European Plate Observing System

Description of infrastructure

EPOS research infrastructure will enable innovative approaches for better understanding of physical processes that cause and have an impact on earthquakes, volcanic eruptions, natural disasters and tsunamis, and the processes that have an impact on the movement of tectonic plates and the dynamics of the earth's surface. Understanding the Earth's complex system demands the linking of research and observation strategies and infrastructure for interdisciplinary monitoring of geographically extended units. Within this context, EPOS fills the gap of the Earth's research infrastructure consisting of infrastructures and initiatives for satellite observation of the Earth (GMES, GEOSS), as well as infrastructure for ocean observation (EMSO, ESONET).

Thus, the EPOS project will create a uniform, sustainable and extended infrastructure that will include field networks of geophysical and seismic monitoring, local observations (permanent field and volcano observatories) and experimental laboratories in Europe. Based on the scientific and technological instrumentation in this field in the last 50 years, an enormous quantity of geological and geophysical data has been gathered at national levels, which is used for creating and improving models for describing the processes causing earthquakes, volcanic eruption, landslides and tsunamis. Integration of national research infrastructures into one single infrastructure, which will enable all scientists across Europe to combine, model and interpret multidisciplinary ranges of data, is needed to exchange data, information, and modelling and monitoring tools. The primary task of EPOS will be the integration of a very heterogeneous geographic sample of observation and experimental data, while at the same time, e-infrastructures supporting and enabling its construction will have to be developed. Within EPOS, a programme of scholarships intended for young researchers has been planned, which will enable the new generation of researchers in this field to gain knowledge and skills for fully exploiting the potential of new research infrastructure.

Slovenia's activities to date

The project of establishing EPOS, in its preparatory phase, is mostly supported by funds from the EU's Seventh Framework Programme for research and development. It began on 1 November 2010, with the main partner being Istituto Nazionale di Geofisica e Vulcanologia (INGV) from Italy. The preparatory phase will last until 31 October 2014, while the construction phase will take place between 2015 and 2020.

Slovenia has the status of an associate member in the preparatory phase. It participates in all activities within the project and its main task is to connect all participating Slovene institutions in this area: the Karst Research Institute of the Scientific Research Centre of the Slovenian Academy of Sciences and Arts (the coordinator), the Slovenian Environment Agency, the Geological Survey of Slovenia, the Faculty of Civil and Geodetic Engineering of the University of Ljubljana, and the Jožef Stefan Institute.

The participating and Slovene institutions, including those participating through a consotium, have at their disposal research instrumentation for monitoring the movements of the Earth's crust (active ruptures, earthquakes, landslides, etc.). EPOS will upgrade and complement this infrastructure, thus connecting the Slovene partners even more. In Slovenia, the infrastructure in the field of seismology is well developed, the preparations for setting up the first underground earthquake observatory in Slovenia in the Postojna Cave are underway, and a GPS network is being established, which is one of

the country's more demanding tasks. Data gathering and processing will have to be unified based on the standards formed within EPOS.

Expected benefits of Slovenia's participation in the project
Slovenia lies on a tectonically active terrain at the contact between the smaller Adriatic Plate and the Eurasian Plate. Gathering data on seismic activities, tectonic plate movements and volcanic activities demands international connections. For understanding the causes of potential earthquakes, it is very important to monitor the movement dynamics of individual active rupture zones, which may be provided only by a well-organised network of various precise field and laboratory instruments and long-term data measurement and analysis.
In Slovenia, the planned research infrastructure of the EPOS project will significantly improve knowledge on active tectonic plate movements and potentially also on the ruptures where seismic activity may be expected. Participation of various Slovene partners in the EPOS preparatory phase will be a good basis for preparing the research infrastructure in Slovenia, including determining the most suitable field locations, preparing and performing GPS measurements, establishing or upgrading the earthquake observatory network, continuous radon measurement at active ruptures, etc. In addition, participating in the EPOS project will provide an answer to the question regarding the size and direction of movements at active ruptures, because the network of GPS measurements in Slovenia has so far been rare and a real assessment has not been possible. Understanding the size and direction at regionally significant ruptures in Slovenia is of great importance for planning construction and development in a certain area and for adopting measures to assess the threat to settlements in Slovenia in case of a catastrophic earthquake.

Financial aspect
The preparatory phase of the EPOS project is mostly financed by the EU's Seventh Framework Programme for research and development. The total value of the EPOS construction phase has been estimated to around 500 million euros. The costs of the necessary upgrade of Slovene research infrastructure in this area (during the construction and operation of EPOS between 2015 and 2020), including the costs of participation in EPOS, have been estimated to 0.4 million euros annually.

5.2. BBMRI

Biobanking and Biomolecular Resources Research Infrastructure

Description of infrastructure
The purpose of BBMRI is to establish a pan-European network of research biobanks and facilitate access to samples and exchange of samples. These biological samples (tissue, blood plasma, etc.) are the basis for high-throughput analyses that generate bioinformation data such as genome sequences.
BBMRI will contribute to scientific excellence in Europe by providing access to high-quality biological resources and data, supporting training of experts in biobanking, participating in current and future national and EU programmes in the field of health, enabling synergies between epidemiologists, clinicians, geneticists, pathologists and molecular biologists in national centres of excellence, and connecting the pharmaceutical, biotechnological and computer industries.
The key components of BBMRI are comprehensive collections of biological samples from different populations of Europe, which have to be linked with continuously updated data on the health status, lifestyle and environmental exposure of the sample donors. This can only be achieved in a federated network of centres established in most, if not all, EU Member States. Therefore, BBMRI has to be designed in the form of hubs, whereby the hubs coordinate the activities, including collection, management, distribution and analysis of samples and data for most areas.
The biobanks, biomolecular resources and technology centres, which are members of BBMRI, are associated with their specific area hub. A variety of public and private partners (e.g. universities, hospitals, companies) that provide biological samples, data, technologies or services may be associated with the BBMRI members, which are the main providers of resources and technologies. Associated partners and subcontractors provide certain resources (services, data, samples, materials) to BBMRI, whereby, for instance, a hospital or research institute that provides biological samples and data may be either reimbursed or compensated for its contribution by being granted free access to resources and technologies of the BBMRI. Associated partners may also be ministries, governments or research councils from interested countries, regardless of whether they support biobanks or biomolecular infrastructure projects. The BBMRI users may come from different fields of science and

industry. Their access to BBMRI will be provided with regard to a particular research project or on the basis of secured funding. Such a structure of BBMRI enables participation of new members and partners at any time and provides flexibility to the needs in biomedical research. The information infrastructure, which includes a federated database and grid computing technology, links the network of hubs, members and partners.
BBMRI will speed up development of personalised medicine and disease prevention and will embrace some of the needs of basic research as well as of the biotech and pharmaceutical industries. Thus, it will enable improvements in public health and will help some bottlenecks in the drug discovery and development process. BBMRI will strongly boost political and scientific momentum to harmonise ethical, legal and quality standards across Europe.

Slovenia's activities to date
Slovenia is an associate member in the 2008–2011 preparatory BBMRI period. The tissue bank of neuromuscular diseases of the Institute of Anatomy at the Faculty of Medicine at the University of Ljubljana is a member of the EuroBioBank network, which is a model for the biobank network in the field of rare diseases within the BBMRI. This network provides a critical mass of samples to researchers for research of neuromuscular diseases by combining samples that were dispersed in various biobanks.

Expected benefits of Slovenia's participation in the project
It is of great importance that the biobanks of small countries like Slovenia participate in the BBMRI, because they contain samples of a genetically-specific environment, which is particularly relevant for medicine regarding research and genetic causes of rare diseases or rare types of cancer.
The biological resources in Slovenia are very dispersed and poorly connected; therefore, their integration and technological upgrade is a national priority. Slovenia's link with the BBMRI may significantly contribute to the internationally suitable technical and methodological harmonisation thereof, while providing access to the other samples in the BBMRI.

Financial aspect
The membership fee in the BBMRI in the preparatory period has not yet been specified, but the investments in the upgrade and integration of national research infrastructure have been defined in the chapter on national priorities – 3.4.4 Biotechnology, biomedicine and biological resources.

6. Annex 2: Indicators, costs and financing sources

Indicators within Slovenia's budget linked to the research infrastructure's topic

Project or measure	Indicator	Unit	Starting year	Starting value	Year	Value
3211-09-0012 – PP for the development of CO in 2009–2013	Established centres of excellence	No.	2010	0.00	2011	8.00
					2012	8.00
3211-11-0028 – Infrastructural obligations and research equipment	Unit number of purchases of large research equipment	No.	2010	20.00	2011	20.00
					2012	10.00
	Number of implemented infrastructure programmes	No.	2010	30.00	2011	30.00
					2012	30.00
	Number of public research institutions whose fixed operating costs, management costs and real estate renovation are being financed	No.	2010	15.00	2011	15.00
					2012	15.00
3211-04-0039 – Research equipment	Number of research equipment purchases	No.	2010	20.00	2011	20.00
					2012	10.00

Indicative costs of implementing the Research Infrastructures Roadmap 2011–2020 and the financing sources (in EUR 1000)

Costs	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Construction - international	0	0	7,000	6,100	2,850	2,850	3,350	2,350	2,350	2,350
Operation - international	0	0	2,228	2,858	3,108	3,108	4,108	4,108	4,108	4,108
Construction - national	4,820	2,067	13,640	13,640	13,640	13,640	13,640	13,640	13,640	13,640
Operation - national	8,564	7,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000
Total costs	**13,384**	**9,067**	**35,868**	**35,598**	**32,598**	**32,598**	**34,098**	**33,098**	**33,098**	**33,098**

Financing sources (PP)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
5826 – Infrastructure programmes	4,820	2,067	22,868	22,598	19,598	19,598	21,098	20,098	20,098	20,098
5704 – Research equipment	8,564	7,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000
Total sources	**13,384**	**9,067**	**35,868**	**35,598**	**32,598**	**32,598**	**34,098**	**33,098**	**33,098**	**33,098**

* Additional funds will be required for implementing the Research Infrastructures Roadmap (11.6 million euros in 2011 and 32 million euros in 2012). In accordance with the Research and Innovation Strategy of Slovenia for 2011–2020, part of the funds will be provided from the European cohesion assets and part by increasing the national integral budget.