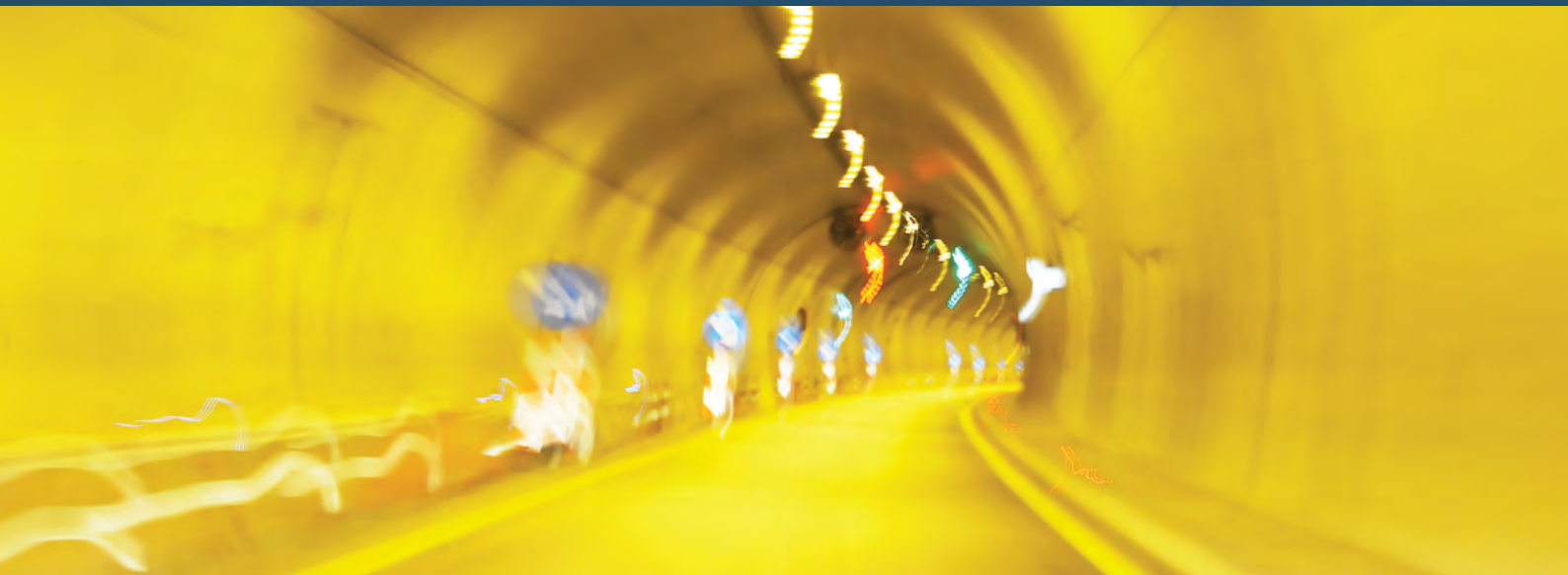
GSRT

GENERAL SECRETARIAT FOR
RESEARCH AND TECHNOLOGY

National Roadmap for Research Infrastructures

2014

HELLENIC REPUBLIC
Ministry of Education and Religious Affairs
General Secretariat for Research and Technology



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General Secretariat for Research and Technology (***GSRT***) of the Ministry of Education and Religious Affairs is the main public agency responsible for the design and implementation of Research, Technological Development and Innovation Policy and for the administration of the Greek R&D system.

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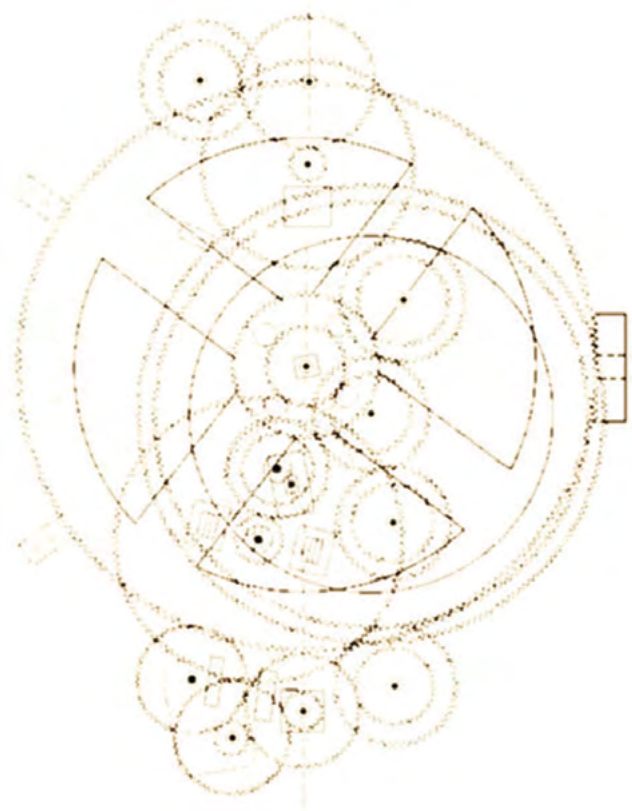
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Foreword





Greece has a long and successful record in the European and global scientific and research landscape. Despite the low levels of public and private spending for R&D in Greece, over the last few decades, the Greek research community has had a distinctive presence among the global Research Infrastructures (RIs). In parallel, Greece has established a good position within the EU Research Infrastructures programme, both through integrated activities - bringing our research ecosystem closer to the vision of a European Research Area – and via active participation in ESFRI projects and e-infrastructures.

Yet, the visibility and competitiveness of Greek RIs in the broader European and global research arena need to be further improved; their synergies with the 'baseline conditions' of a knowledge-intensive, R&D-driven economy should be enhanced. Policy coordination is key, while strong links to strategic priorities are necessary conditions for ensuring coherence to funding decisions, so that funding could be directed to facilities that carry out the best research and provide the most prominent socio-economic benefits.

A visionary National Roadmap for Research Infrastructures will signal a long-term commitment of the Greek government for the systematic support of strong research and innovation hubs in Greece, striving for the development of RIs of more than national relevance, in highly competitive and innovative scientific and technological areas, which will allow the Greek research ecosystem to be shaped into a gateway for global research challenges.

Greek Research Infrastructures aim to act as enablers for the establishment of poles of excellence for applied research with innovative power in the country and beyond, emphasizing the presence of Greek research in the international research arena and enhancing, in parallel, their impact – through further synergies and spillover effects – on the national and regional economy.

The roadmap-drafting process has been coordinated by GSRT in a continuum since the beginning of 2013, initially using a bottom-up approach and then peer-reviews involving experts of international standing and also advisory input from prominent representatives of the Greek academia, research and industry ecosystem. This roadmap aims to provide an optimal coverage of the strategic priorities in R&D in Greece and will unquestionably foster a national and regional economic recovery based on scientific excellence and innovation.

Dr. Christos Vasilakos,
Secretary General for Research & Technology

1. Introduction



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Research Infrastructures (RIs)[1] play an increasingly important role in the advancement of scientific and technological knowledge. They are key instruments in bringing together a wide diversity of stakeholders to unravel complex scientific questions and look for solutions to many of the challenges society is facing today. Furthermore, Research Infrastructures constitute a vital element of the European Research Area, offering unique research services to users from different countries, attracting young people to science, shaping multidisciplinary scientific communities and nurturing innovation and economic development.

RIs are crucial for all research disciplines and a most valuable tool for connecting education and innovation with research within the knowledge triangle (Education – Research – Innovation). Their role in preventing brain-drain, especially of highly-skilled scientific and technical personnel, is catalytic.

Since the beginning of 2013, the General Secretariat for Research & Technology (GSRT), supported by the National Council for Research and Technology (NCRT), has endeavoured to develop a long-term, visionary **National Strategy for Research, Technological Development and Innovation (2014-2020)**, which will build on the competitive position of Greece in specific research areas - at the EU and international level - and will maximize its potential, through R&D investment *on strategic areas of national priority*, identified on the basis of the principles of Smart Specialization (RIS3)[2], fostering innovation and entrepreneurship. Through this strategy, GSRT aims to increase public and leverage private R&D funding, highlighting the pivotal role of RIs as 'building blocks of innovation', facilitating the translation of national research and innovation policy objectives into specific actions, boosting the internationalisation of Greek research and increasing competitiveness at the regional, national and international level.

Considering the current, challenging economic climate in Greece, planning for a long-term investment in research and innovation may seem an ambitious objective. Nevertheless, this 'crisis' – a word originating from the Greek word 'krisis', meaning 'a decisive moment' or 'turning point' – may act as a magnifying lens, helping us to set clear priorities. This is the reason why GSRT has initiated the setting-up of a **National Strategy** and a **National Roadmap for Research Infrastructures**, taking into account the orientations set out by the Europe 2020 strategy and its two flagship initiatives: the **Innovation Union** and the **Digital Agenda**, as well as the priorities identified through the **Smart Specialisation Strategy**.

The **Innovation Union** Commitment n. 4: "*Opening of Member State operated research infrastructures to the full European user community*" will be addressed, in particular, through a strategic planning which will fundamentally support the integration of existing, high-calibre research laboratories and academic institutions at the national level, fostering the creation of new ones, where necessary, to provide quality services to both national and international research and innovation ecosystems. This will be implemented via the National Roadmap for Research Infrastructures

The need to include the **Digital Agenda** in all scientific endeavours will be addressed through the **coordination and** support of **e-infrastructures**, as an integral part of the RI ecosystem and as enablers of a knowledge-intensive economy.

The need to address the challenge for prioritisation and resource allocation decisions to strategic areas of national priority will be met through RIs aligned to the **Research & Innovation Strategy for Smart Specialization** (**RIS3**)

[1] *Research Infrastructures (**RIs**) are facilities, resources, and related services that are used by the scientific community to conduct top-level research in their respective fields and covers: major scientific equipment or sets of instruments; knowledge-based resources such as collections, archives or structures for scientific information; enabling ICT-based infrastructures, or any other entity of a unique nature essential to achieve excellence in research. Such infrastructures may be 'single-sited' or distributed, that is, an organized network of resources.* ***A new vision for global RIs focuses on the key role of research infrastructures for innovation***.

[2] ***RIS3***: *Research & Innovation Strategy for Smart Specialization*

2. Building a National Strategy for Research Infrastructures; an "investment for the future" at a turning point for Research and Innovation in Greece



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2.1. The importance of Research Infrastructures for the National R&D Ecosystem

A vision of shaping a strong National R&D ecosystem needs a robust policy framework for **establishing Research Infrastructures of strategic importance in Greece** as accessible hubs for research, synchronized with international standards and responding to public and private research needs.

These infrastructures are expected to:

- Create an attractive environment for highly-skilled scientific, technical and administrative personnel and facilitate the access of Greek research teams to global research infrastructures.
- Act as enablers of regional development with long-term socio-economic benefits for the host regions through the creation of jobs, training and specialisation of human resources.
- Foster an entrepreneurial climate favourable to industrial investment on research and innovation, with a direct impact across society (e.g. through spin-offs, new market opportunities related to procurement / equipment supplies and new, innovative products and services).

Many Greek research and academic organizations participate in collaborative RI projects that aim to support the European Strategy Forum for Research Infrastructures (ESFRI) or other large-scale European collaborative efforts on research infrastructures, contributing to scientific breakthroughs in a landscape of increased interdisciplinarity and international collaboration of researchers[3].

Greece fuels the global and national research infrastructures ecosystem with highly-skilled human resources (researchers, scientists and engineers). Both the existing and emerging capacity of adequately-skilled and trained human resources and the significant success rate of Greek research and academic organisations in relevant calls of the previous EU Framework Programmes, Joint Programming Initiatives and the European Flagship Initiatives constitute a very competitive R&D ecosystem in Greece, also in ICT/e-infrastructure-related areas.

This process enabled considerable integration of the Greek research facilities within the European Research Area (ERA) and scaled up their capacity. Furthermore, a large investment – mainly via complementary funding through Structural Funds and competitive EU grants – has also been oriented to the development of e-infrastructures (*including high performance computing networks, storage resources & cloud infrastructures, data management, access to and development of scientific data repositories, visualisation and simulation tools, future internet technologies etc.*).

[3] *Up to now, Greek research teams participate in 16 ESFRI preparatory projects of the first ESFRI roadmap (2006) in the fields of biological and medical sciences, social-sciences and humanities, physical sciences and engineering, environment and e-infrastructures. Furthermore, Greece participates in 5 additional projects (in the areas of BMS, energy and environment) in the subsequent editions of the ESFRI roadmap (2008, 2010).*

These e-infrastructures function horizontally, serving the growing needs of the research and academic community in Greece, as **eScience**[4] becomes increasingly integral to all scientific disciplines, dramatically changing the way research is being conducted.

During the previous Programming Period (2007-2013), more than 30M Euros (mainly from European Community Structural Funds) have been earmarked for improvements in and the consolidation of Greek research organisation networks, in order to achieve the maturity and capacity needed to support Greek participation in the construction phase of 14 Research Infrastructures of the 2006 ESFRI roadmap.

Additional support has been given in many other Greek networks for participation in the preparatory phase of the Research Infrastructures of the ESFRI roadmap, to facilitate access to top-calibre research infrastructures for the Greek scientific community and boost cooperation with the best international research groups.

As considerable investments[5] have already been made in the development of research facilities and e- infrastructures, it is clear that they should be utilised by broad user groups, with access policies and sustainability plans in place for the benefit of collaborative research activities that will have a substantial impact on the national and regional economy.

Within the present Programming Period (2014 - 2020) a culture of sharing expensive scientific equipment and e-infrastructures, capitalising on cross-border collaboration and human potential, will be gradually developed, providing the resources and competences for supporting a strong research and innovation profile in Greece. The strategic decision to shape a Greek R&D ecosystem around nuclei of excellence with considerable capacity and the need for conducting applied research in a competitive, state-of-the-art, internationalised environment makes the establishment of **a long-term National Strategy for Research Infrastructures** indispensable.

[4] **eScience**, *denoting the collection, processing and use of scientific information in computerized form, is the fastest growing field in modern science. 'Computationally intensive' science, carried out in highly distributed network environments, is a competitive platform for the exploitation of advanced computational resources, data collections and scientific instruments which will drive our society faster to a future scientific discovery process, as the 'Scientific Renaissance' did, in setting the foundation for modern science.*

[5] *Both in terms of **facilities** and **human resources***

2.2. The National Strategic Framework for Research and Innovation

The key objective of the National Strategy for Research, Technological Development and Innovation (**NSRTDI 2014-2020**) and a long-term challenge in our country is '***to set the knowledge triangle (Education - Research - Innovation) and the production and exploitation of knowledge as a major priority in order to overcome the current economic crisis, address societal challenges and contribute to the restructuring of the Greek economy'***. The above challenge will be addressed through three main policy pillars:

Pillar 1: Growth based on Knowledge and Specialisation

Pillar 2: Excellence in research and development of the human research potential

Pillar 3: Societal Challenges

The current, challenging economic climate intensifies the need for intelligent strategic planning, based on substantial engagement of stakeholders from the public and the private sector, allowing the emergence of innovative, spillover effects and enhancing competitiveness through new products and services.

This strategic planning process:

- focuses research and innovation investments in key priority areas
- builds on existing strengths, competitive advantages and emerging excellence
- supports innovation
- aims to increase the private sector demand for R&D

At the national level, the **NSRTDI 2014-2020** includes 8 areas of focus for investment in research and innovation, identified through RIS3:

i. Agro-food
ii. Energy
iii. Environment and Sustainable Development
iv. Health & Pharmaceuticals
v. Information and Communication Technologies (ICT)
vi. Transport & Logistics
vii. Materials - constructions
viii. Tourism, Culture & Creative Industries

Research Infrastructures are recognised as **key structural elements** of the National Research & Innovation ecosystem. They have a prominent role within the NSRTDI 2014-2020, being recognised as 'enablers of innovation', via interdisciplinary synergy effects they create within the knowledge triangle. Therefore, research infrastructures contribute to all three priority pillars of the National Strategy of R&I, while they are also closely linked with Horizon 2020.

2.3. The National Strategy for Research Infrastructures

The National Strategy for Research Infrastructures shapes a holistic approach towards research and innovation, covering the whole spectrum from basic research to innovation, forming a sustainable RI ecosystem with targeted investment in national-scale, world-class facilities, securing our long-term prosperity.

A new development model will be pursued, allowing the formulation of federated schemes and progressive partnerships, supporting the strategic strengthening of broader research fields, with an interdisciplinary perspective.

Upgrading and integrating existing RIs and the establishment of new ones (where necessary) will be developed, via a long-term strategic planning and prioritisation process, with visible impact on the Greek economy.

Main principles of the National Strategy for Research Infrastructures:

- Creation of – and capitalization on – critical mass in areas of excellence related to national strategic priorities, in order to support the emergence of RIs of high added value that are able to attract, recruit and retain the best talents in science from the national and international research arena, allowing the development of competitive human resources and the creation of jobs for highly skilled personnel.
- Adoption of a **coherent participation model in European and global RI initiatives**, further supporting Greek researchers to do world-class research.
  - This will include priority-setting related to mature, ESFRI-related RIs, where Greece has specific associations, related to the national interests and priorities (which should be regularly assessed).
- Implementation of RIs based on **multi-annual investment plans** with sustainability principles for gradually coordinated procurement, to avoid redundancies & exploit synergies and complementarities.
  - Priority should be given to opening up RIs for use, as well as further networking / clustering of RIs, promoting interdisciplinarity and the emergence of spillover effects for the national and regional economies.
  - Support open access & usage models for state-of-the-art technologies and facilities, allowing high visibility, high impact and sustainability of investments.
- Nurturing **strong & continuous collaboration** among academia/research & industry, through a long-term continuity pact for a reliable and intensive 'share & exchange' model within the knowledge triangle.
  - To guarantee the best use of available funds and optimum access to international infrastructures, it is crucial that future resource-intensive investments related to RIs should reinforce effective networking and collaboration among all stakeholders of the Greek R&D ecosystem.
- Fostering the sustainability of investments which will underpin Greece's capacity to innovate, through **well-structured and operational governance models**, aligned to international standards
- Support RIs in the framework of **regional support policies** – taking into account the regional dimensions of national investment
- **Harmonization of investment in e-infrastructures, as key enablers** of a **knowledge-intensive economy, for** and **of** eScience. A coordinated policy framework of e-infrastructures – including fast networks, storage, high-performance computing (HPC), data access and management structures and services – will be established.

2.3.1. Policy coordination for eScience

National coordination for **eScience** is a central element of the National Strategy for Research Infrastructures.

It is broadly acknowledged that **eScience**, as a **collaborative environment for science** empowered through the deployment of research infrastructures, relies on the analysis of massive data sets and the use of distributed resources (*e.g. adequate computing facilities for the analysis of results and storage of data*).

The vision for a **nation-wide e-infrastructure** includes the well-orchestrated development of *physical* and *virtual* infrastructures, under a coordinated, community-centric scheme of different pillars – cooperating both on policy implementation and on functional issues (e.g. knowledge exchange, service provision and joint research). This will be the foundation for a sustainable investment for both research infrastructures – which will have a horizontal support for eScience issues – and for e-infrastructure development per se.

The formulation of a National Strategy for long-term investment in multi-disciplinary research infrastructures — as well as for the current National Roadmap — provides an **opportunity** for national e-infrastructures to maintain their key role as **enablers in the new knowledge-based economy** and a big challenge for advances to match the pace of those in other European countries. The emphasis to further increase the added value and competitiveness of the e-infrastructure ecosystem in Greece will be combined with a more powerful presence at the European and global level, fortifying strong connections with the ESFRI RIs, such as PRACE and other EU and global initiatives (GÉANT, EGI, RDA, OPENAIRE etc.).

This conceptual framework will be the baseline for an emerging 'umbrella e-infrastructure' – with virtual consolidation of resources and competences of distinct organisations that will support eScience in Greece – which will enhance its dynamics through a framework of anticipated change, capitalising on the competitive advantages available in the Greek e-infrastructure ecosystem, while further familiarising scientists and engineers with research infrastructure installations in the digital era and bringing the scientific developments of Greece to the world.

Policy coordination for eScience will include:

- Solid governance and a sustainable funding model for e-infrastructures, to address the increasing needs of all scientific communities at the national level. Governance and access models of the e-infrastructures will make sure that clear and efficient arrangements for the exchange of data between the private and public sectors will be settled, allowing appropriate returns to both, in order to gain from the innovative power of industry and enterprises (both within the country and abroad).
- Support policies for increased use of eScience over time (promoting usage of e-infrastructures) aiming to result in considerable cost reductions in the research process – e.g. remote access to scientific equipment through the simulation & elimination of expensive experiments.
- Support actions for implementing and visualizing 'science engineering', through trustful, data-centric processes and seamless access to physical and technical infrastructure. Those actions will help avoid redundancy of resources and excessive public spending while supporting community-building among scientific communities – thus assuring the inclusiveness and sustainability of the relevant services.
- Actions to highlight new methods to create further economies of scale, including open access and user involvement, with the involvement of the broader public and private sector (may be also linked to incentives for the further adoption of green technologies)
- Policies to realise the principles of open science and open data through e-infrastructures, at the same time supporting a **Research Data Infrastructure** to harness the accumulating data and knowledge produced by the different research communities.
- **Encouragement of cross training** as a straightforward way to train a new generation of scientists and broaden public understanding on this kind of investment, responding to the increased demand for user support and training for the many researchers working in sciences that have not traditionally employed eScience tools.

3. The role of a National Roadmap in setting up a Greek Research Infrastructures ecosystem



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3.1. Main objectives

The main objectives of the National Roadmap for Research Infrastructures are:

1. **To support the decision-making process in compliance with strategic priorities in research, aiming to enhance the effectiveness of investment planning for research infrastructures, at national and regional levels**
2. **To support the development of an evidence-based national strategy in the framework of international negotiations, linked to EU priorities and, where appropriate, the European Strategy Forum on Research Infrastructures.**

The National Roadmap will be the basis for a long-term plan that aims to establish research infrastructures in Greece as a foundation for excellent research and to internationally position Greek research in a coordinated manner. In parallel, this Roadmap responds to the ex-ante conditionality for the allocation of EU Structural and Investment Funds for the period 2014-2020.

The National Roadmap emphasizes the need to build on the existing strengths and potential of the Greek research ecosystem around **national strategic priorities** that enhance its synergies with the global research and innovation ecosystem and contribute – *through a variable geometry funding model* – to the implementation of the **ESFRI roadmap**. The National Roadmap will not only provide strategic advice, signalling priorities for research infrastructures which are essential to support and enhance the robustness and innovativeness of the Greek R&D system, but will also designate long-term engagements in global and European RI initiatives.

The research infrastructures included in the National Roadmap are **aligned** with the objectives of the **NSRTDI** (**2014-2020**), representing well-coordinated 'blocks' of cutting-edge research facilities and e-infrastructures with high added-value (at sectoral and cross-sectoral level), designed to support the scientific, technological & industrial communities and government, while boosting innovation. Investment in the development of those RIs will be strategically associated with economic value (including the mobilisation of private funding) as well as the creation of jobs and will aim to contribute viable solutions to societal problems.

Agro-food	Environment & Sustainable Development	Health & Pharmaceu-ticals	ICT	Tourism – Culture & Creative Industries	Energy	Transport & Logistics	Materials - Constructions
RIs for biodiversity High added value natural products, plant / forest health & preservation Marine ecosystems	RIs for biodiversity, Blue Growth RIs for Earthquake monitoring and protection RIs for climate change and observation of the atmosphere	Key Research Infrastruc-tures for Biosciences (biobanks, e-infrastruc-tures) Research Infrastruc-tures for Translational Research / Personalised medicine RIs for the Pharma sector (new molecules, drug screening & retargeting)	National Digital Infrastructure for Research E-infrastruc-ture for Life Sciences	RIs for Digital Humanities, Arts & Linguistics RIs for Blue Growth & Marine ecosystems RIs related to cultural heritage preservation	RIs for Sustainable and Renew-able Energy RI for Future vehicle and fuel technolo-gies	RIs for Marine Observing and Forecasting, Marine Structures	RIs for Nano-technol-ogies & nanostruc-tures RIs for Laser research, technology & applications

Figure 1 : Research Infrastructures in the National Strategy for Research, Technological Development and Innovation (NSRTDI 2014-2020)

Correlation of RIs included in the Roadmap with thematic priorities of RIS3

- 'linking' excellence to socio-economic challenges
- 'enabling' innovation



Figure 2: Initial mapping of regional distribution of RIs per thematic area

3.2. Setting up a process for the National Roadmap for Research Infrastructures (2014-2020)

Initial efforts to connect national priorities with those of the European Research Infrastructures (ESFRI roadmap) started with the formulation of the 1st National Roadmap on Research Infrastructures, developed in 2007, right after the announcement of the first ESFRI roadmap (2006), which delivered a *priority list for research infrastructures in Greece*. Despite the fact that top priority research areas were identified, the proposed roadmap was not implemented since funding allocation and coordination issues were not addressed.

The current National Roadmap has been elaborated by GSRT through a **bottom-up process** and covers 7 thematic areas, following those of the ESFRI Roadmap. This process provided the Greek R&D system with the opportunity to express its needs and present ideas in a highly competitive manner, while enabling potential synergies.

To be included in the National Roadmap, research infrastructures should fulfil the following prerequisites:

- **National relevance**

1. Address a broad national interest to the benefit of the society and economy (*as defined in the national strategy for research and innovation planning and in the multi-annual Partnership Agreement 2014-2020 with the European Union*)
2. Enable cutting-edge research at the national level, with international visibility
3. Promote innovation at national and regional levels
4. Form part of a coherent structure, with nodes available at one or more locations in Greece, in terms of distributed research installations or access points
5. Provide access to researchers, industry and the broader public domain within the country and internationally

- **Effective Networking and Synergies**
  To be included in the Roadmap, research infrastructures should facilitate an effective coordination and networking among relevant research teams and establish critical mass in the corresponding research fields.

Therefore research infrastructures should:

A. Integrate similar research infrastructures into one network or fusion scheme

and

B. Be consistent with the strengths and priorities of the research & innovation ecosystem as identified through the Research & Innovation Strategy for Smart Specialisation (RIS3)

- **Scientific & technical excellence AND strategic importance**
  To be included in the Roadmap, a research infrastructure should respond to the state of the art in the relevant field of science. Furthermore, selected research infrastructures with strong links to international leadership projects, including the RIs of the ESFRI Roadmap will be prioritised and supported either through membership in organizations established at the European level or by strengthening the role of Greek participation via the establishment of ESFRI-related national hubs.

3.3. Selection of proposals for inclusion in the National Roadmap

In a first step, a bottom-up approach for setting up the National Roadmap for Research Infrastructures was followed by GSRT. Selection involved peer review for the evaluation of the scientific excellence and innovation potential of the proposed research infrastructures and for the integrated assessment of their strategic importance.

The 1st Phase of the Call, launched in February 2013 (Call for Expressions of Interest), resulted in **138 applications**, submitted mainly by academic and research institutions, distributed among all scientific fields.

The **2nd Phase** (**submission of full proposals**) was completed in **July 2013**, based on the Expressions of Interest of the 1st Phase. Major revisions and consolidations of the aforementioned Expressions of Interest were encouraged, according to the recommendations given through the Guideline and FAQ[6] documents as well as the detailed guidance given by GSRT representatives through two open workshops organized by GSRT (February 21st & April 26th 2013). This Phase resulted in the submission of **75** proposals.

The selection framework, in line with relevant practices followed internationally for the evaluation of RIs, comprised of peer review, strategic prioritisation and subsequent clustering, where appropriate, to maximize critical mass and avoid duplication of investments.

Particular attention has been given to socio-economic aspects in view of the possibility to allocate funding from European Investment and Structural Funds for establishing strong National Research Infrastructures of world standing that are linked to ESFRI priorities, where appropriate (including the establishment of Regional Partner Facilities[7]), for the next programming period 2014-2020 and beyond.

This process led to the selection of **26** RIs in the National Roadmap and a secondary list[8] of **7** RIs

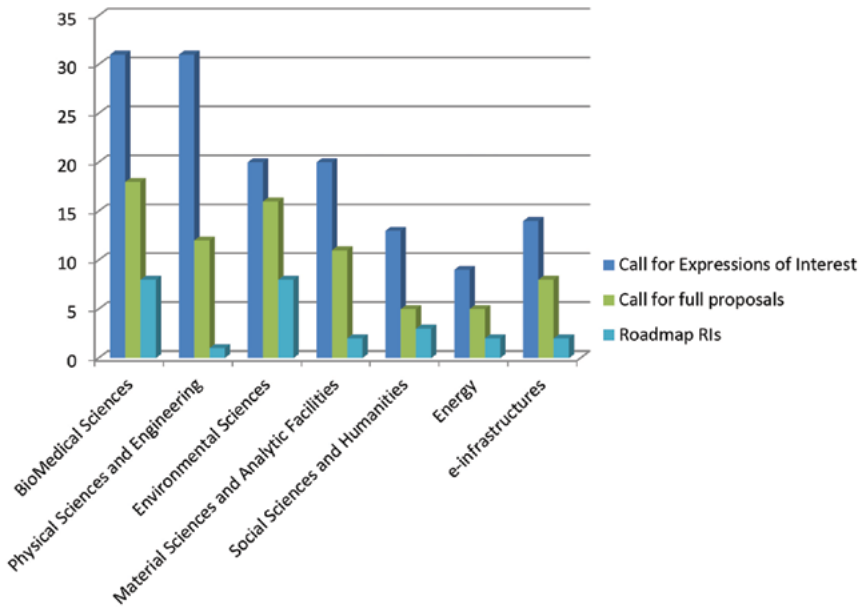


Figure 3: Proposals submission process

[6] *http://www.gsrt.gr/News/Files/New713/RI_Roadmap_Guidelines_Phase2_Final%28rev3%29_2013_06_07.pdf*

[7] *Definition: Regional Partner Facility (RPF) is a Research Infrastructure of significant national or regional importance in terms of the socio-economic benefits, training and attraction of researchers and engineers, acknowledged as a 'cooperative infrastructure' towards a pan-European ESFRI infrastructure or an international Research Infrastructure. The quality of the **RPF**, taking into account the level of its scientific services, management and access policy, should have the same standards as those met by the European-level Research Infrastructures.*

[8] *RIs of the secondary list succeeded in the peer review process, but they did not fulfil certain criteria of the strategic prioritization (such as compatibility with RIS3 and/or ESFRI priorities, critical mass, and optimal use of existing investments). Those RIs will be considered in the forthcoming revision of the National Roadmap, as well as in new clustering/fusion initiatives.*

The 26 prioritized RIs included in the National Roadmap are presented in Annex I (with individual templates describing their research objectives, their relevance to the national priorities, their maturity status and their links to European and global RIs).



3.4. The role of the National Roadmap

The National Roadmap ensures that funding allocation to research infrastructures will be efficiently and transparently managed. This should be done through an evidence-based overview of the needs of the research and innovation ecosystem.

Decisions on investments in research infrastructures of national relevance will be taken in the context of the National Strategy for Research Infrastructure (see main principles, Section 2.3).

The level of funding for the selected RIs will be further elaborated according to the available funding sources.

The National Roadmap will be followed by a **multi-annual investment plan** for the whole period 2014-2020.

The **multi-annual investment plan** – with funding envisaged through European Structural and Investment Funds (ESIF), but also from other potential funding sources – will be provided upon completion of the respective individual investment plans of the selected RIs. Funding through ESIF will take into account the limitations of the relevant national Operational Programme 2014-2020, along with the regional dimension of the RIs.

Through this process, it will also be possible to identify areas where research facilities will create innovation alliances and strategic partnerships for joint research programmes and innovation initiatives (including international strategic cooperations, European Technology Platforms, the Joint Technology Initiatives, Public-Private Partnerships, clusters, centres of competence and other service-oriented research undertakings).

Accordingly, the National Roadmap for Research Infrastructures will be an **instrument for blueprinting future calls** for investment in collaborative research infrastructures of national relevance – including (mainly) major upgrades, but also covering the integration of existing RIs (or new ones, if necessary), following a stepwise process. For RIs that have already received funding through the Operational Programme 2007-2013, an assessment of the outcome of the current funding cycle will be undertaken prior to the allocation of new funds.

The successful implementation of the National Roadmap is closely linked to its impact at a scientific, technological, socio-economic and policy level. **The roadmap implementation plan**, described in the following section, should ensure that the Greek research, academic and industrial communities have access to state-of-the-art infrastructures that facilitate high-calibre research, while addressing major innovation challenges that are critically linked to the Greek economy and to funding decisions based on better usage and prioritised needs. The implementation of the roadmap process will be monitored by GSRT within the framework of the broader monitoring plan for the next programming period 2014-2020 (including a Registry for Research Infrastructures), aiming to maximise the impact of the investment for our society and the economy.

4. Implementation plan and support measures



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4.1. Implementation plan

An **implementation plan** will provide the framework for the gradual funding of research infrastructures, through specifically-designed funding mechanisms towards their maturity and self-sustainability, when feasible. A schematic representation of the implementation plan is given in Figure 4: Implementation plan).

The implementation plan of the National Roadmap aims to bring research infrastructures to maturity in order to create the expected added value in the national economy and reflect the important role of nation-wide research infrastructures in Greece in the international science arena.

> For ESFRI-related RIs, the implementation plan will support the gradual reinforcement of the role of the Greek hub. For the non-ESFRI-related RIs, the aim is to boost high-level applied research by bringing together all relevant resources, to create critical mass and to further promote interdisciplinary correlations in scientific fields of strategic importance for the Greek R&I ecosystem.

For RIs that have already received funding during the present programming period (2007-2014) an assessment of the outcome of the current funding cycle will be undertaken **prior** to the allocation of new funds. Since funding has already been provided for substantial parts of some of the research infrastructures of this roadmap – supporting their 'preparatory phase' for an improved participation of the Greek RIs in the construction phase of the relevant ESFRI RIs – the implementation plan will take into account and assess previous funding commitments.

In the time-frame for funding presented schematically in Fig.4 below, research infrastructures that already have a funding commitment are assigned to **Category I**, whereas the rest of the RIs of the National Roadmap are assigned to **Category II**. GSRT is going to schedule the investment plan for the RIs of Category II, taking into account the actual allocation of funding stemming mainly from the European Structural and Investment Funds of the Partnership Agreement 2014-2020 (Thematic Objective 1).

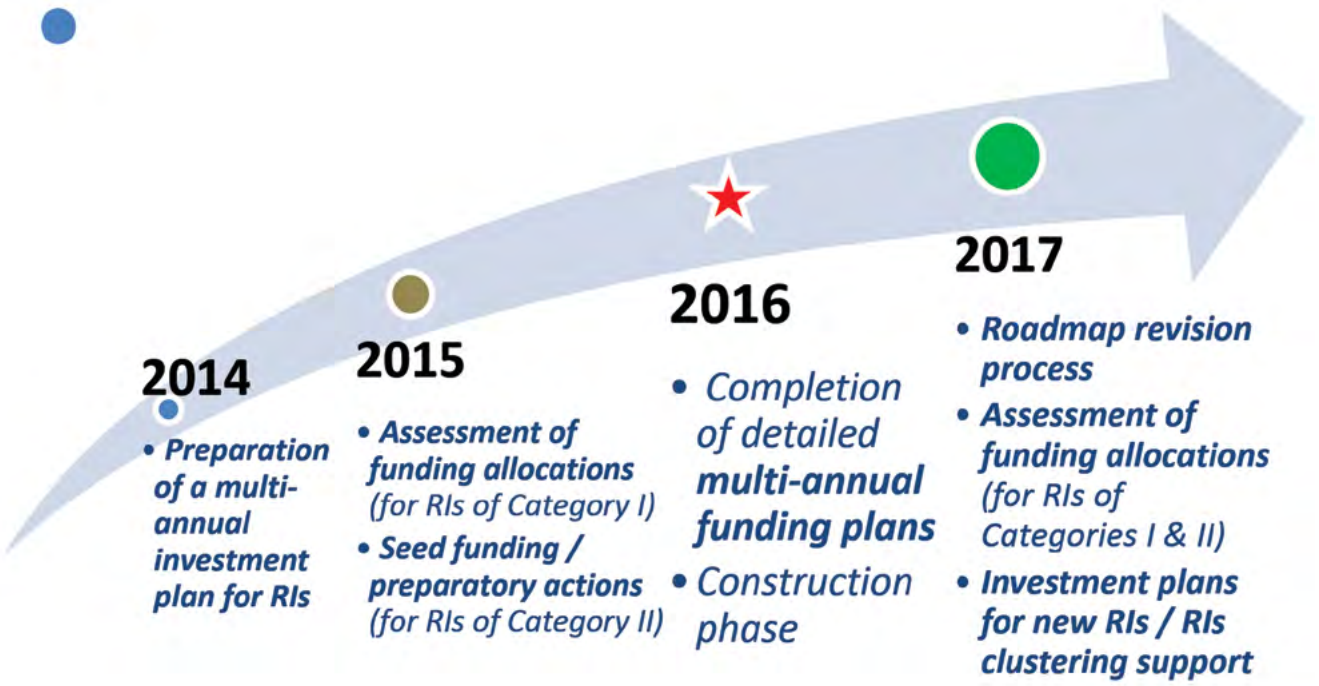


Figure 4: Implementation plan

The National Roadmap will not be a static document; it will be revised and updated regularly (the first update is envisaged for 2017).

The strategic basis underlying GSRT's orientation in relation to the National Roadmap is open to discussion and will be continuously evolving, according to the main principles of the National Strategy for Research and Innovation.

4.2. Support measures

Parallel **support measures** included in the implementation plan are: assessment, access to RIs and networking / clustering, as presented in following figure:

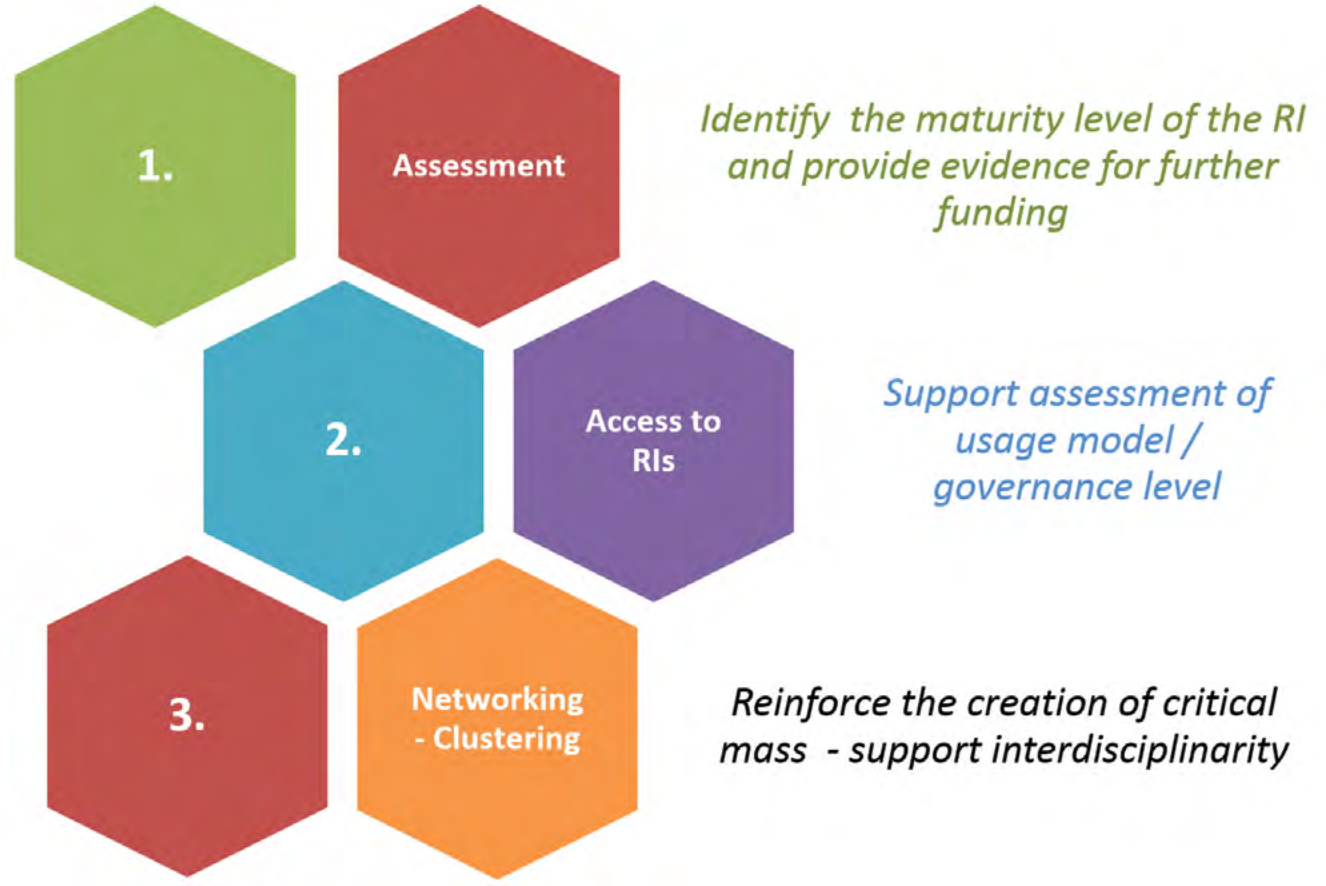


Figure 5: Main types of support measures

More specifically:

A critical **milestone** for all research infrastructures of the National Roadmap in Category I is their **assessment**, upon completion of the relevant funding through Structural Funds and Public funding for the period 2011-2014. The assessment will take place in 2015 via a review panel consisting of international experts. This will be a 'pilot' in order to identify the way the RI has responded to the roadmap assessment criteria so far, as well as possible relevant recommendations of the evaluation process of the 1st thread of the current roadmap process. This process will be completed prior to any future funding allocation, as identified in the proposal's plan, and will certainly support the identification of the specific role of the Greek hub in the European/ESFRI RI.

Open access principles for research infrastructures will be encouraged: as a general rule, RIs should prove there is demand for their use or access by the national and international community, whereas a minimum of 20% of their capacity should be available to external users (with use requests evaluated and prioritised according to the criteria of excellence).

- GSRT will provide support for access to mature RIs, with the emphasis on accelerating transnational access, while expanding cooperation between research organisations, the wider public sector and the private sector on the basis of shared infrastructures.
  - Pilot access programmes will provide a framework for the assessment of the existing or prospective user approach (especially towards the private and wider public sectors). Emphasis will be put on supporting access to nodes of existing I3 projects and ESFRI RIs in Greece, specifically to enhance transnational access.

- Stimuli for networking RIs further – even if not yet mature or in a preparatory phase – will be provided to achieve further critical mass through targeted funding, related to the concept of 'coordinated usage'.

- Support and facilitation of the broader thematic clustering and RI interrelationship will be realised through extensive networking activities, fostering interdisciplinarity. In the case of new RIs, it is especially important to nurture the development of governance schemes and scientific programmes together so that support measures towards a coherent and stepwise development of RIs (with intermediary assessment) will be supporting evidence of spillover effects[9].

- Thematic networks for the exploration of common data strategy models and the development of a regulatory framework for the use of infrastructures such as biobanks, seismic and environmental data as well as social data.

- Additionally, GSRT will provide support for targeted studies to evaluate proposed PPP schemes in relation to stakeholders' engagement in RIs, as well as business plans to highlight the more effective PPP models. The innovative aspects of the investment as well as the non-scientific benefits (e.g. employment creation or the delivery of services to citizens), which could be leveraged from research infrastructure partnerships, will be monitored regularly through appropriate indicators.

The main benefit from investment in research infrastructures will be the support of human capital development, including the prevention of brain drain. By acknowledging the role of research infrastructure partnerships as a vehicle for researcher employment, training and mobility and as support for programmes promoting public awareness and an understanding of science (with a special emphasis on science education for the youth), a new potential will be created through the development of a dynamic human 'ecosystem' of research and innovation.

[9] *GSRT will engage in further dialogue with the individual consortia with a view to strengthening the projects' national coverage and accessibility*

Annex I - National Roadmap RIs

Social Sciences and Humanities

No	Acronym	Title	ESFRI relation	RIS3 & societal relevance
1.	**CESSRI** *	Greek Research Infrastructure for Social Sciences	CESSDA, ESS	Evidence base for RIS3, skills, demographic change
2.	**GR-SHARE-ERIC** *	Greece in SHARE-ERIC	SHARE	Health & Ageing
3.	**APOLLONIS** *	Greek Infrastructure for Digital Arts, Humanities and Language Research and Innovation	CLARIN, DARIAH	Culture, Tourism, ICT

e-infrastructures

No	Acronym	Title	ESFRI relation	RIS3 & societal relevance
4.	**HELIX** *	National Digital Infrastructures for Research	PRACE	ICT
5.	**ELIXIR-GR**	Managing and analyzing biological data	ELIXIR	Health, ICT

Energy

No	Acronym	Title	ESFRI relation	RIS3 & societal relevance
6.	**PROMETHEUS**	A Research Infrastructure for the Integrated Energy Chain	ECCSEL / EU-SOLARIS	Energy, Environment & Sustainable Development
7.	**FUVEP**	Centre of Excellence for Future Vehicle Environmental Performance		Energy, Environment & Sustainable Development, Transport

Biological and Medical Sciences

No	Acronym	Title	ESFRI relation	RIS3 & societal relevance
8.	**INFRAFRONTIER-GR / Phenotypos** *	The Greek Research Infrastructure for Molecular and Behavioural Phenotyping of biological model organisms for chronic degenerative diseases	INFRAFRONTIER	Health & Pharmaceuticals
9.	**INTEGRA-Biomed** *	Integrated Greek Infrastructure for Biomedical Research	BBMRI - EATRIS	Health & Pharmaceuticals
10.	**BioImaging-GR**	A Greek Research Infrastructure for visualizing and monitoring fundamental biological processes	EURO-BioImaging	Health & Pharmaceuticals, ICT
11.	**INSPIRED**	The National RIs on Integrated Structural Biology, Drug Screening Efforts and Drug - target functional characterisation	INSTRUCT	Health & Pharmaceuticals
12.	**Openscreen-GR**	An Open-Access Research Infrastructure of Chemical Biology and Target-Based Screening Technologies for Human and Animal Health, Agriculture and the Environment	EU OpenSCREEN	Health & Pharmaceuticals
13.	**pMED-GR**	The Greek Research Infrastructure for Personalised Medicine Towards more accurate and cost-effective health management for the Greek citizen		Health & Pharmaceuticals, Personalised Medicine

** Research Infrastructures (or part of them) that already have a funding commitment are designated Category I. The remaining RIs of the roadmap are designated Category II.*

14.	**OMIC-ENGINE**	Synthetic Biology: from omics technologies to genomic engineering		Agro-Food, Health
15.	**NRI-CADSOL**	National Research Infrastructure for Coronary Artery Disease		Health & Pharmaceuticals, Personalised Medicine

Materials and Analytical Facilities

No	Acronym	Title	ESFRI relation	RIS3 & societal relevance
16.	**HELLAS-CH** *	The HiPER, ELI and LASERLAB Europe Synergy & IPERION-CH.gr	ELI, HiPER	Materials, Culture
17.	**INNOVATION.EL**	National Infrastructure in Nanotechnology, Advanced Materials and Micro / Nanoelectronics		Materials, ICT

Physical Sciences and Engineering

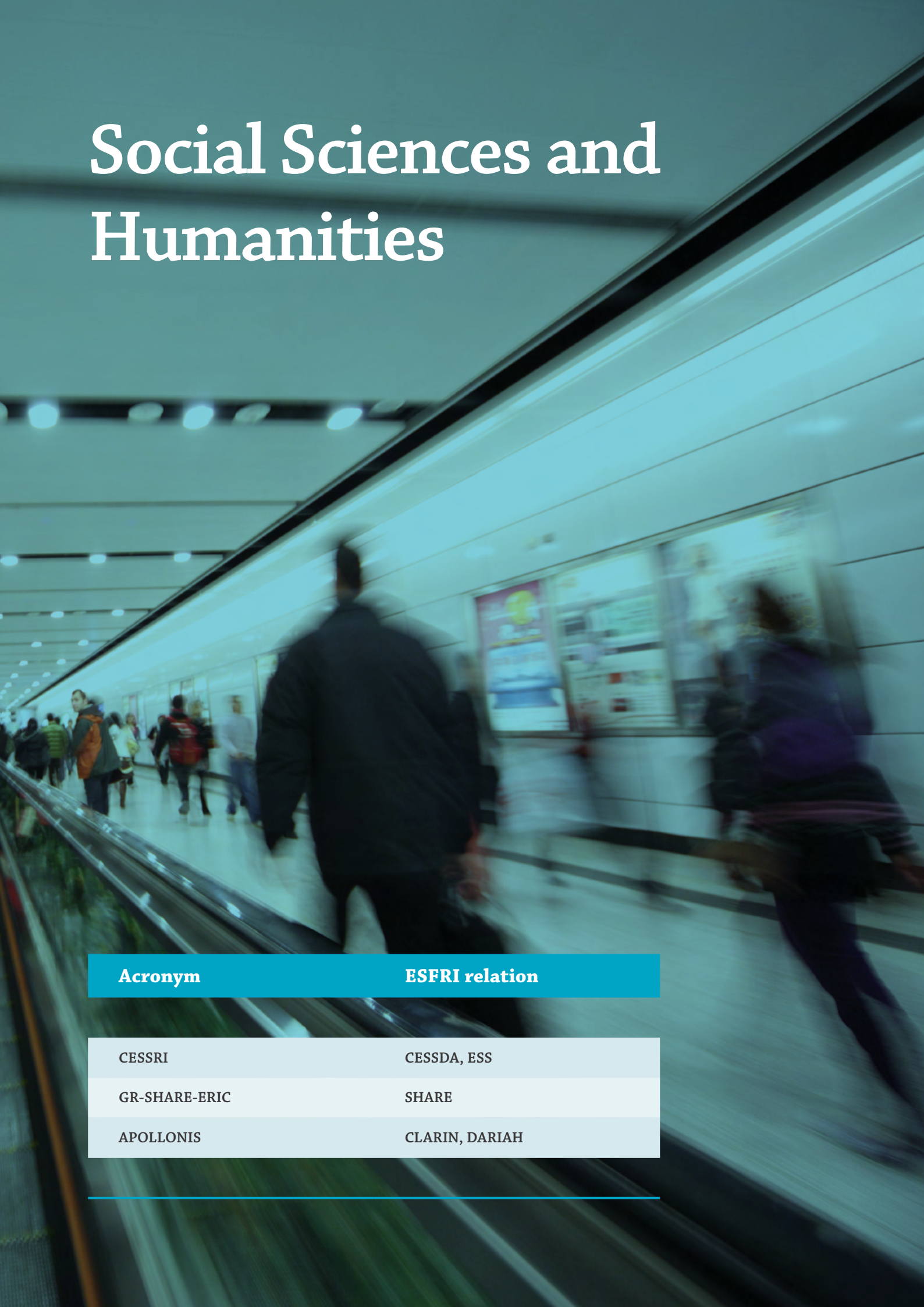
No	Acronym	Title	ESFRI relation	RIS3 & societal relevance
18.	**NuSTAR**	Nuclear Science, Technology and Applications Research Infrastructure	ESS	Health & Pharmaceuticals, Environment & Sustainable Development, Energy, Materials

Environmental Sciences

No	Acronym	Title	ESFRI relation	RIS3 & societal relevance
19.	**HELPOS**	The HELlenic Research infrastructure within the EPOS project	EPOS	Environment & Sustainable Development, Security
20.	**HIMIOFoTS** *	Hellenic Integrated Marine-Inland waters Observing Forecasting and offshore Technology System	Euro-ARGO, EMSO	Environment & Sustainable Development & Blue Growth
21.	**CMBR** *	Centre for the study and sustainable exploitation of Marine Biological Resources	EMBRC / Lifewatch	Biodiversity, Environment & Sustainable Development, Blue Growth, Agro-food
22.	**PlantUP**	Upgrading the Plant Capital		Agro-food, Biodiversity, Health & Pharmaceuticals, Environment & Sustainable Development
23.	**Hellenic Research Fleet**	Towards an Innovative Hellenic Research Fleet (Hellenic-Fleet)		Environment & Sustainable Development, Blue Growth
24.	**PANACEA**	PANhellenic infrastructure for Atmospheric Composition and climatE chAnge	ICOS	Environment & Sustainable Development & Climate Change
25.	**FAROS**	Facility for Airborne Research Observation and Sensing	COPAL	Environment & Sustainable Development & Climate Change
26.	**INVALOR**	Research Infrastructure for Waste Valorization and sustainable management of resources		Environment & Sustainable Development, Waste Management


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Social Sciences and Humanities



Acronym	ESFRI relation
CESSRI	CESSDA, ESS
GR-SHARE-ERIC	SHARE
APOLLONIS	CLARIN, DARIAH

National Research Infrastructure for Social Studies (CESSRI)

Globalization increases the need for transnational research, whilst European integration makes systematic comparative research among EU countries imperative. Indeed, social research has studied multiple social phenomena that emerge within a variety of social formations. Moreover, the contemporary Information Society helps to develop a comparative approach through the collection and meaningful processing of large datasets which enhances the development of empirical social research.

In order to respond to these challenges, CESSRI was built as a combined Research Infrastructure comprising of two distinct, distributed entities, each encompassing the relevant national, ESFRI-related networks (namely the ERIC networks of ESS-ERIC-GR and So.Da.Net-CESSDA).

Through ESS-ERIC-GR, Greece will reinforce its involvement in European Social Survey (ESS) studies (mapping stability and change in social structures, conditions and attitudes in Greece, ESS standards & indicators, and following comparative quantitative measurement & analysis), enabling active participation in all future rounds of the ESS and in parallel dissemination activities through the coordination of all networking and research activities at national level. This will improve the visibility and outreach of data on social change among academics, policy makers and the wider public, both within the country and at cross-national level.

So.Da.Net will implement a National Documentation System for Social Sciences as a grid of interoperable data repositories hosted by institutional nodes, coordinated by the National Centre for Social Research (EKKE) as the Greek National Node of CESSDA. It will support the operation of the National Registry of empirical research and the central Data Depository and will also operate as a Register of Empirical Research and Data Sets as well as a National Depository of Social Data.

Further spillover effects from the development of computer science and linguistics in the social sciences will be exploited by developing an e-learning environment and digital content for training and educational purposes. So.Da.Net will thus continuously support the needs of the scientific community and/or third parties (conducting surveys through CAWI systems) while further improving its services, as well as developing and promoting training data documentation and educational activities for students (graduates, doctoral and post-doctoral students).

The expected benefits of CESSRI address both society itself (through the wider public's access to accumulated and homogenised research & operational data) and to the scientific community, providing a framework for organising research, such as cognitive schemes (necessary for the production and analysis of new social data) as well as processed data and indicators delivered as products of secondary analysis. CESSRI can also play other crucial roles such as inform about data distributers and the type of data they have, and offer services for the completion and qualitative examination of data produced.

As globalization and European integration proceed, the need for countries and regions to have access to data from third parties increases dramatically and the role of research infrastructures becomes critical. The opening-up of data for secondary analysis allows the monitoring of data by third parties, and specialised scientists in particular, thereby increasing both the validity and reliability of the data.

Greece in SHARE-ERIC



The Survey of Health, Ageing and Retirement in Europe (SHARE) is a multi-disciplinary, cross-national, and longitudinal survey measuring the combined health, economic and social living conditions of persons aged 50 and over. It serves as the foundation of empirical research on ageing - harmonised across countries - for many disciplines including demography, economics, epidemiology, gerontology, biology, medicine, psychology, public health, health policy, sociology and statistics.

For more than a decade, SHARE has been providing important research breakthroughs by focusing on multiple interactions between individual and socio-economic factors. These interactions are crucial to understand individual and population ageing. By the way of example, researchers have specified the following five broad issues in need of more research, based on a representative European population sample:

- Interactions between health, gender, economic and socio-psychological status
- Data on savings behaviour and labour market participation
- Longitudinal data about labour force participation and the process of retirement
- Variations in disability insurance uptake rates across EU member states
- The impact of social policy on potential family support.

The key output of SHARE has been and will continue to be high quality individual- & household-level panel data of an interdisciplinary nature. This fact alone involves major advancements and gains for the scientific and research community, addressing the opportunities and challenges of ageing.

The contribution of SHARE for policy-relevant research in the ERA is evidenced by the strong support of the DG of Employment, Social Affairs and Equal Opportunities, and the DG of Economics and Financial Affairs. In the European countries where SHARE has already been established, SHARE has served as a centre of gravitation for excellent ageing researchers coming from various scientific fields. Fruitful interdisciplinary collaboration has been initiated and fostered in the unique research environment created, and has altered the perception of ageing in many ways. Moreover, as a study designed by researchers for researchers, SHARE focuses on the needs of users encompassing a data release policy that gives speedy and convenient access to all scientific users world-wide (subject to EU data confidentiality restrictions).

Until now, SHARE has implemented 5 consecutive research waves and 6 more are planned for implementation by 2024 under the EU body SHARE-ERIC, with Greece as a member.

Greece was one of the first European countries to contribute data when SHARE started and has taken part in the first 3 research waves (2003-2009) under the coordination of a Greek team headed by the Panteion University of Social and Political Sciences. The participation of Greece in the current phase ensures its inclusion for (at least) a seven-year period. However, Greece is particularly valuable to the overall study, given the investment in the longitudinal sample since 2003 as well as the current deep socioeconomic crisis and the orientation in policies that this entails. Greek SHARE data will not only enable the period leading up to the crisis (2003-2009) to be traced but will also allow routes out of the crisis to be monitored and is expected to generate considerable researcher interest worldwide

Greek Infrastructure for Digital Arts, Humanities and Language Research and Innovation (APOLLONIS)

Arts and humanities data and digital content resources are widely distributed among diverse Greek institutions, including government agencies and departments, public and private museums, archives and libraries, as well as academic and research units, associations and research projects. APOLLONIS brings together the leading strengths and capacities in the field by providing high-level computational tools, interoperable datasets and services. It consists of two ESFRI-related national networks in the Social Sciences and Humanities area, CLARITAS and DARIAH-DYAS, creating bridges where commonalities are observed. CLARITAS is the Clarin-related Greek network dedicated to providing language technology-aware ICT-empowered access to digital data, tools and services, whereas DARIAH-DYAS (the DARIAH-related Greek network, a founding member of DARIAH-ERIC) serves the Arts and Humanities research community. Together, they will foster synergies towards interdisciplinary research and transnational co-operation, thus improving the visibility and participation in ESFRI and other international scientific networks and initiatives. Above all, operating within the strategic context of relevant ERIC organisations (namely DARIAH and CLARIN), APOLLONIS will integrate its activities with those of the European RIs.

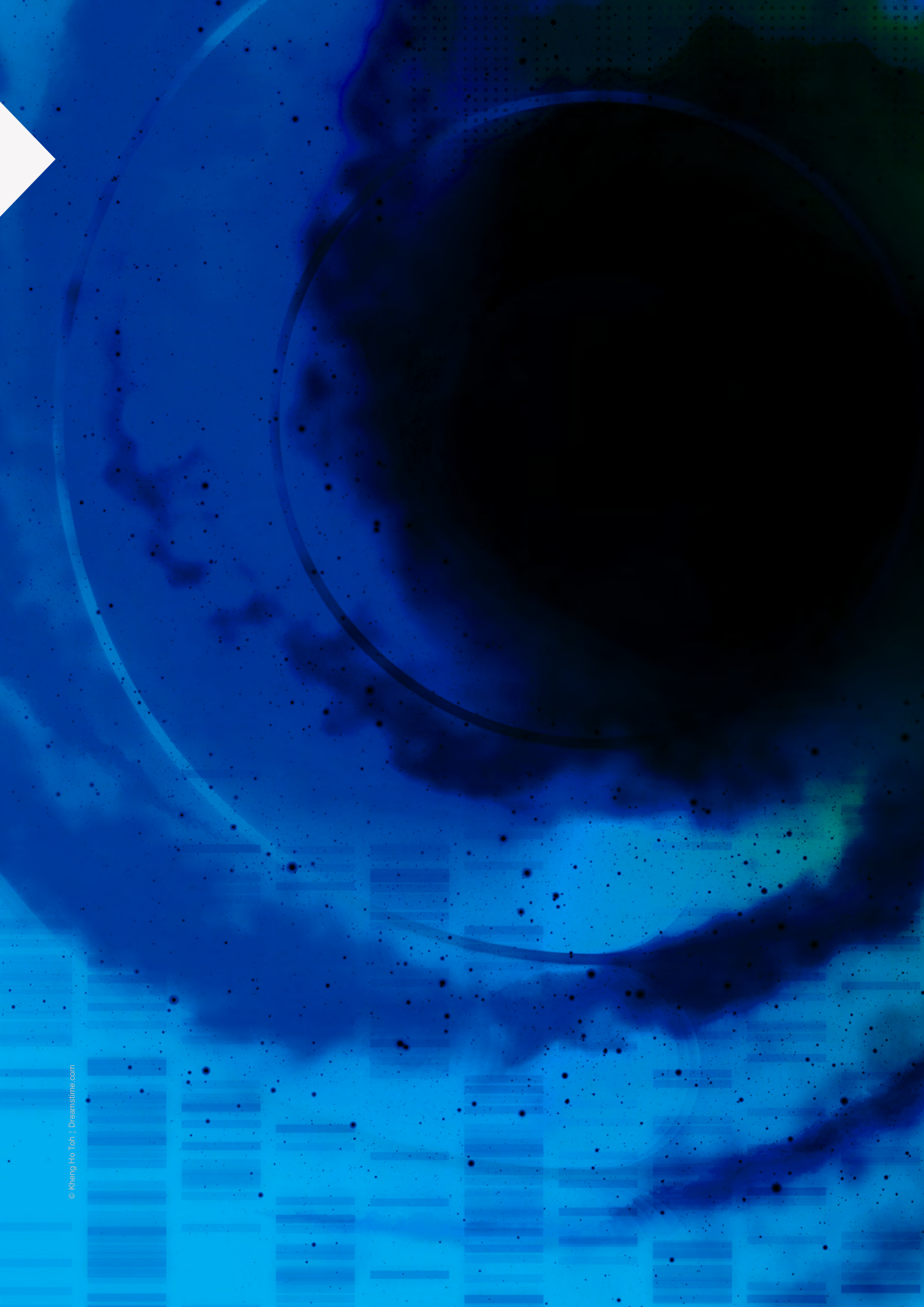
APOLLONIS will build on existing cooperation initiatives, optimising the use of existing resources and access to new research opportunities. Data sharing will be complemented with a state-of-the-art holistic support of digital resources. Computational infrastructure for the collaborative creation, documentation, annotation and processing of resources at various levels will be offered, accompanied by broader resource development means and practices, such as standards, tools for the interoperability of resources, intellectual property management and human resources development. The RI will highly contribute to the promotion and leveraging of R&D initiatives in the fields of language and content processing. Furthermore, a Digital Humanities Observatory will be developed as an evidence-based research instrument on digitally-enabled humanities research in Greece, including monitoring, outreach and dissemination activities. The foreseen networking, education and capacity-building services will raise awareness and leverage interdisciplinarity among scientists of diverse fields, and facilitate collaboration across disciplines and between scholars and industry.

Indeed, this RI plans to make its datasets, services, tools and activities available to the various communities making use of digital technology for research and innovation purposes (including professionals in Cultural Heritage, the Arts, Language, ICT, Data Provision, Software application development and integration, the Tourism industry and the Electronic and digital media publishing industry).

Through APOLLONIS, the research community will have integrated access to a vast number of collections of seamlessly interoperating digital research and cultural resources, with innovative tools to process them in virtual workspaces, thus enabling data-intensive science and digital scholarship on an unprecedented scale. Intelligent access methods will enable researchers to explore resources in innovative ways and to combine different resources into virtual collections. Thus, information 'hidden' within unstructured



material (textual, audio, video, multimodal and multimedia documents) can be disclosed and analysed in combination with structured databases. The new Research Infrastructure battles against the obsolescence of data through the digital preservation and curation of data, coupled with the digitization of research methodology and practice; that is, from the use of smartphones for recordings to the use of language technology/ICT for accessing and searching the data to the fully digital collaborative processing of large collections of multilingual multimodal data.


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e-infrastructures

Acronym	ESFRI relation
HELIX	PRACE
ELIXIR-GR	ELIXIR

National Digital Infrastructures for Research (HELIX)



HELIX is a convergence-building instrument for the coordination of research-oriented eInfrastructures in Greece. It comprises two independent and complementary entities - NNCRI and OpenAIRE-D - that will respectively address the increasing horizontal 'big computing/networking' and 'big data' needs of the Greek academic & research community. Overall, it will form a single national ecosystem within which it will provide research and advisory services, support training activities, and offer relevant expertise on the combination of high-end communications, high-performance and high-throughput distributed computing, elastic cloud resource provisioning, and scalable data processing & analysis. It will instrument several 'as a Service' offerings where part of the management capabilities is handed over to researchers, thereby facilitating innovation on novel frameworks delivering advanced researcher-controlled capabilities.

NNCRI (National Networking and Computing Research Infrastructure), includes all academic and research institutions and will be coordinated by GRNET, pioneer in research networking in SE Europe. It will significantly augment and extend the existing infrastructures of GRNET, a massive national e-Infrastructure that operates large datacenters and provides a variety of e-services to the Greek academic & research institutions. Furthermore, it will incorporate HELNET, a national infrastructure for experimental networking research lead by the University of Thessaly, with its NITOS testbed facility and integrated experimental facilities of several research institutions across the country. With GRNET being a member of GIANT Association (the pan-European R&E communications infrastructure) and PRACE (the pan-European HPC infrastructure) and by motivating a vast assembly of research and academic partners, NNCRI will play a leading role in the field of networking and cloud brokering/ middleware infrastructures and work with other e-infrastructure providers around Europe to gain insight into new networking requirements posed by cloud computing, the data deluge and HPC developments. The national HPC system as foreseen by the NNCRI will also be integrated with the Tier-1 European HPC ecosystem strengthening Greece's role in PRACE. Boosting complementarity and fostering linkage of research networking and future internet communities, NNCRI will capitalise on HELNET's federated and highly heterogeneous and large-scale experimental facility, which will offer 'Testbeds as a Service' , with a wide range of technologies including 4G/3G cellular networks, wireless Internet, Software Defined Networking, cloud networking and Software Defined Radios. The HELNET experimental facility will empower innovation at national and international level and significantly upgrade the competitive advantage of the Greek institutions and facilities for the industrial development and innovation.

OpenAIRE-D will provide a cost-effective scalable cloud-based data infrastructure in support of the entire life cycle of data-intensive research, spearheading Greek research activities in the areas of Big Data and the Data Economy, outlined by the EC in the Digital Agenda. OpenAIRE-D will be coordinated by the ATHENA Research Center and will involve several core Academic and Research partners as service & technology integrators. It will offer services for storing, managing, discovering, processing, analyzing, visualizing, and archiving diverse scientific data that will be shared and reused in a collaborative fashion across domains and disciplines. Further, in close interaction with the Research Data Alliance (RDA), it will capitalize on open data and their liaisons to relevant EU initiatives, linking corresponding infrastructures for open government data of heightened research interest. In addition, OpenAIRE-D will assume the role of the EU infrastructure OpenAIRE for Greece, implementing specific EU-initiated Open Access policies, interlinking research data and publications, and maximizing visibility and marketability of scientific output. OpenAIRE-D will thus assist in defragmentation of national research efforts by introducing policies and regimes for data intensive cross-domain research and collaboration, establishing Greece as the leading regional data-intensive research hub.

HELIX will boost innovation by contributing to the formulation and implementation of a consolidated e-Science strategy in Greece that will ensure cost-effective solutions and support for training and advisory activities in line with advances in the field. This large scale federated research infrastructure, will provide powerful tools for the design and deployment of the network of the future and big-data processing allowing for unprecedented levels of flexibility, adaptability, elasticity, and eventually cost reduction. It will significantly enhance the competitive advantage of Greek institutions and facilities in line with the principles of the Innovation Union and the Digital Agenda.



Managing and analyzing biological data (ELIXIR-GR)

The Infrastructure addresses the needs of the Greek research community and other stakeholders of the public and the private sector such as hospitals, diagnostic centres and biotech companies, for open, integrated and state-of-the-art bioinformatics and biocomputing resources. Its main missions are to (a) secure storage of and access to very large datasets such as primary high throughput nucleotide sequence data and imaging data in a way that guarantees protection of sensitive personal data and of data ownership; (b) provide computational power for the analysis of very large datasets; (c) integrate available and develop new tools for analysis of biological data, based on the needs of its users; and (d) provide training in bioinformatics.

ELIXIR-GR will develop the Greek Node of ELIXIR. The latter operates a distributed ESFRI Research Infrastructure based on ELIXIR nodes (at national level) which are connected to the ELIXIR Hub at the European Bioinformatics Institute (EBI) in order to provide infrastructure for data, tools, standards and training, as well as support for other ESFRI biological and medical science infrastructures. Through its connection to ELIXIR, ELIXIR-GR will ensure best practices and interoperability with other biological and medical science infrastructures; it will also help to open further the Greek bioinformatics community to Europe and beyond, by facilitating the integration of resources developed in Greece, such as analysis tools and databases, into ELIXIR-EUROPE.

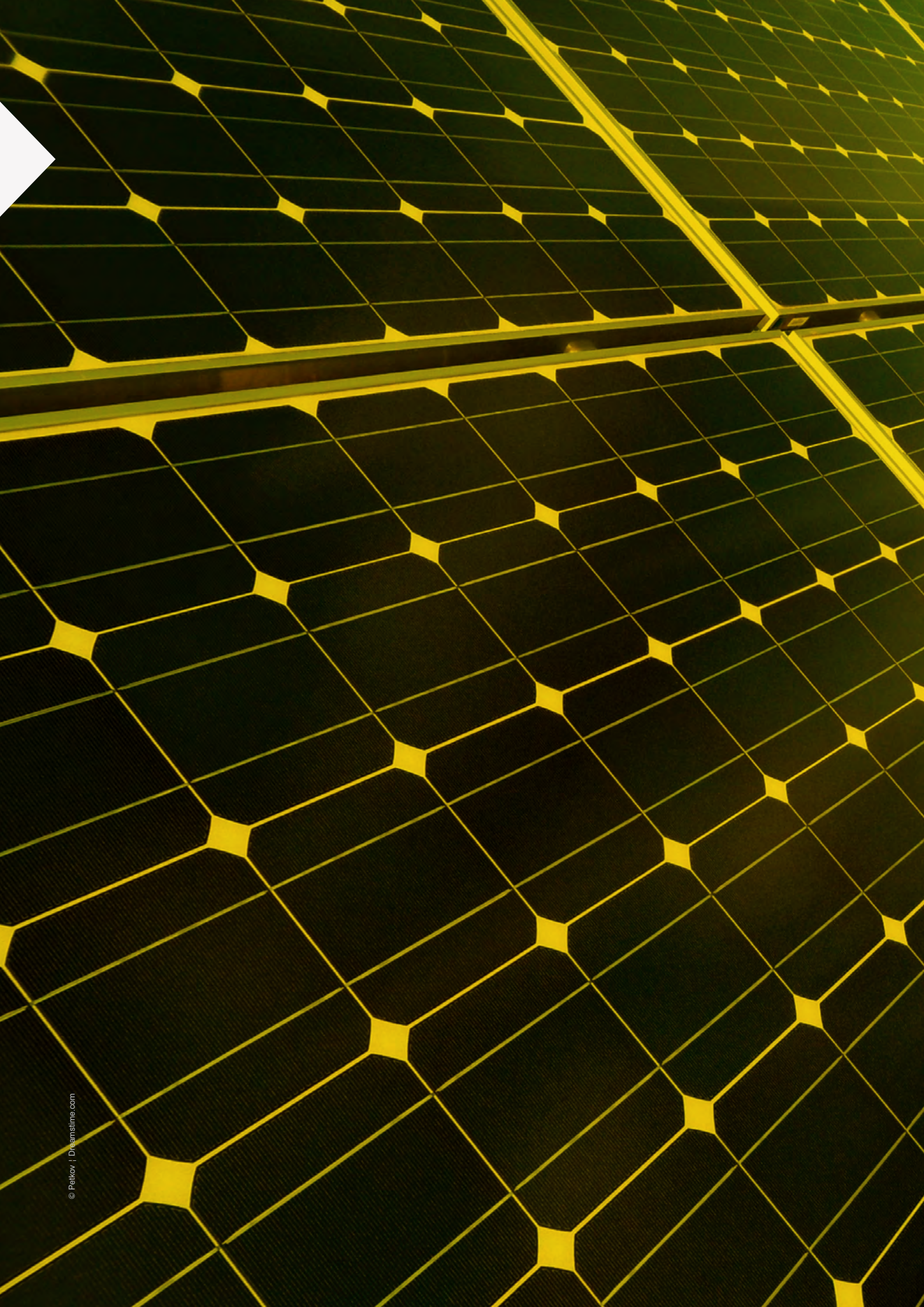
The Infrastructure will provide large-scale computing resources with computational power which will enable bioscientists, industry and health services in Greece to analyse multiple versions of big scientific databases and big user uploaded datasets, such as molecular sequence and bioimaging and medical imaging data. It will also provide data resources with large storage capacities for data generated by high throughput sequencing projects and by state-of-the-art bioimaging facilities in Greece. In collaboration with other ELIXIR Nodes and the ELIXIR Hub, ELIXIR-GR will offer a catalogue of tools and services provided by the scientific community for biological data management and analysis.

It will also provide best practices to set up and maintain tool functionality and interfaces, taking into account real user needs, and will develop and adopt methodologies to address the interoperability and sustainability of tools offered, as well as their benchmarking. In collaboration with the ELIXIR Hub and other Nodes, ELIXIR-GR will provide training for life scientists and other stakeholders in using the bioinformatic and biocomputing services available at ELIXIR and other international RIs, aiming to ensure maximum accessibility to the vast international biological information resources and related in silico analysis tools.

ELIXIR-GR is a distributed infrastructure with 13 participating institutions comprising 6 research centres, 6 universities and a scientific society, and is coordinated by the Biomedical Sciences Research Centre "Alexander Fleming".






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Energy



Acronym	ESFRI relation
PROMETHEUS	ECCSEL / EU-SOLARIS
FUVEP	

A Research Infrastructure for the Integrated Energy Chain (PROMETHEUS)



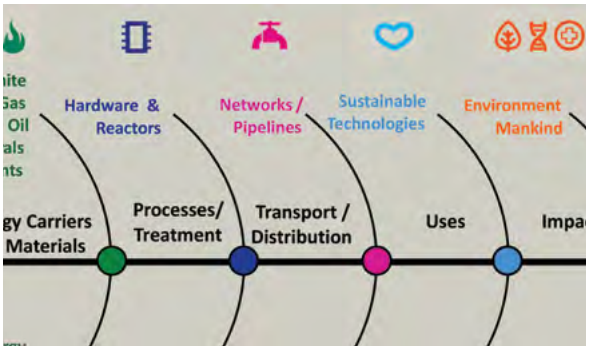




Figure 1. The Concept of the Integrated Energy Chain

The Research Infrastructure (RI) "PROMETHEUS" represents a unique research facility that will become the reference point for the investigation of the Integrated Chain of "Sustainable Energy Carriers - Transformation Processes - Transport & Storage Applications - End Uses/Impact" in Greece. Key elements of PROMETHEUS are: (i) Solar-based and Solar-enabled/"Solarized" Process Technologies realized in state-of-the-art Solar Thermal and Thermochemical Facilities employed for the production of renewable energy and energy carriers in the form of electrons, gas and liquid solar fuels, chemicals, and energy storage solids, exploiting optimized concentration devices, thermodynamic cycles and carbon-neutral / low-carbon resources (water, carbon dioxide, biomass and wastes), (ii) Advanced Material technologies for producing key components of the integrated chain, such as high temperature reactors, catalysts, fuel cells, batteries, membranes, thermal carriers and heat storage materials, receivers, reflection & absorption surfaces, etc. and (iii) Application-oriented testing of components and sub-systems of the entire chain and techno-economic assessment of innovative technological solutions with the emphasis on Green Mobility (clean and efficient vehicle technologies, intelligent transport systems and smart logistics) and Clean Energy (power, heat, clean water and combinations).

Thus, PROMETHEUS will provide the basis for an interdisciplinary platform with a broad range of candidate technology developers and end-users - both academic/research and industrial ones. The PROMETHEUS scientific areas concern well-established technologies/concepts, technologies starting to gain industrial relevance (e.g. CO2 capture & storage) and new emerging research areas (e.g. solar fuels). PROMETHEUS is a value-adding chain of hubs (Figure 1) containing several interlinked nodes consisting of existing and future laboratory facilities, with specific support by a network of specialized laboratories/research groups, collaborating industries and aligned regional authorities and organizations.

PROMETHEUS partners are already members/facilitators of important relevant networks at the national (e.g. CHORUS Energy Cluster) and international level (e.g. the ESFRI related EU SOLARIS RI network and the European Carbon dioxide Capture and StoragE Laboratory Infrastructure/ECCSEL). PROMETHEUS will be immediately incorporated as a key component in such networks.

PROMETHEUS will utilize the existing partners' facilities as seeding cores for the implementation of the integrated RI. A number of additional units will be implemented to facilitate activities towards cost-efficient, more flexible, readily available and reduced-carbon, environmental and health-benefiting renewable energy technologies.

PROMETHEUS will bring added value to the regional, national and International research area by: (i) Promoting networking opportunities (exchange of ideas, collaborative projects, etc.) among interested partners, (ii) offering a test bed for alternative materials, fuels, processes and end-user applications, (iii) offering the possibility for technology integration, (iv) enabling the development of complete Life Cycle Analysis and impact assessment of different alternative energy pathways, and (v) offering solid ground for defining future key energy-related research areas.

The uniqueness of the infrastructure and the ability to offer high-level applied research will attract the interest of academic organizations and enterprises at an international level resulting in measurable regional and national benefits and setting a paradigm for the implementation of other similar RIs in other sectors.

Centre of Excellence for Future Vehicle Environmental Performance (FuVEP)



The aim of the proposed RI is to provide the automotive industry and public authorities, both national and international, with scientific research and technologies for the optimum environmental performance of vehicles.
FuVEP intends to link industry and science on a series of common projects converting results from basic and applied research into innovative methods, tools and products.
FuVEP focuses on the optimisation of the complete vehicle/powertrain through simulation and experimentation and will eventually become a specialised research and innovation centre on a global scale. To achieve its goal, FuVEP will maintain the existing and establish new relationships with the automotive, oil and engineering service industry in close cooperation with universities and research partners.

The proposed RI creates a strong research group, bringing together scientists and experts primarily with an engineering background. FuVEP will more than double the capacity of the existing facilities in order to cope with the demands of current and future state-of-the-art technologies. It will also target the transition to an economy of scale, further expanding its activities, creating a significant number of jobs and substantially increasing the potential for innovation.

The coordinating body will be the Laboratory of Applied Thermodynamics (LAT), Aristotle University, engaging its spin-off companies, Exothermia and Emisia. LAT will build FuVEP with the contribution of the Laboratory of Fuel Technology and Lubricants (LFTL), NTUA, and the Laboratory of Thermodynamics and Thermal Engines (LTTE), University of Western Macedonia. The network of collaborations of the three FuVEP partners includes international institutions, such as the Joint Research Centre's Vehicle Emissions Laboratory and the TU Graz's Laboratory of Internal Combustion Engines, as well as technology associations, like the European Automotive Research Providers Association (EARPA), the technology platform ERTRAC, where automotive industry is highly active, and the European Research for Mobile Emissions Sources (ERMES). This network is expanded also to standardisation bodies, like the European Committee for Standardisation (CEN) on Automotive Fuels, as well as to non-European institutions, such as the Argonne National Laboratories in USA.

Besides the obvious benefits for the researchers and the academic community, FuVEP is expected to visibly contribute to the regional and national economy since:

- It builds upon and further develops an already successful model of bringing together scientists highly reputed for extroversion and innovation, with a keenly interested and progressive private sector.
- It uses the accumulated know-how as a basis for a much stronger collaborative effort to address the ever-increasing need for environment-related research in the transport sector.
- It amplifies the potential of international funding from both the public and private sector. A number of international companies, including Stoneridge (USA), Toyota Motor Europe and AVL Graz, expressed their interest to support FuVEP with direct funding, projects and contracts. They will further enhance FuVEP partners' track record of successful performance in funding and working with clients like Toyota, Daimler, Peugeot-Citroen (PSA), Concawe, Honda and other well-known companies.



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Biological and Medical Sciences

Acronym	ESFRI relation
INFRAFRONTIER-GR / Phenotypos	INFRAFRONTIER
INTEGRA-Biomed	BBMRI - EATRIS
BioImaging-GR	EURO-BioImaging
INSPIRED	INSTRUCT
Openscreen-GR	EU OpenSCREEN
pMED-GR	
OMIC-ENGINE	
NRI-CADSOL	

The Greek Research Infrastructure for Molecular and Behavioural Phenotyping of biological model organisms for chronic degenerative diseases (INFRAFRONTIER-GR/Phenotypos)

(www.infrafrontier.gr)

INFRAFRONTIER-GR/Phenotypos is an expansion of INFRAFRONTIER-GR, the Greek node of ESFRI Infrafrontier: The European Infrastructure for phenotyping and archiving model mammalian genomes. INFRAFRONTIER-GR is a sustainable, open access pan-Hellenic Research Infrastructure that provides access to mouse tools and resources necessary to unravel the role of gene function in human health and disease and to translate this knowledge into therapeutic approaches and disease prevention strategies. The Infrastructure offers services for the generation, distribution and disease-oriented phenotyping of mutant mouse genomes and is a full member of INFRAFRONTIER's archiving node, the European Mutant Mouse Archive (EMMA) - a major European biomedical repository that provides collection, archiving and distribution services of mutant mouse strains to the biomedical research community. INFRAFRONTIER-GR currently provides specialist secondary phenotyping services in the field of immunological diseases and cancer. In its next phase of development ("Phenotypos"), the Infrastructure will expand its current services to include: (a) macroscopic and analytical platforms for detailed description of complex disease phenotypes in mouse models that is required for the clinical/ biomarker description of human disease; and (b) animal modeling and phenotyping of additional important disease areas in which Greek research is also highly competitive, including metabolic and neurological diseases.

This second phase will complement the "mouse clinic" initiative of INFRAFRONTIER-GR by renewing, upgrading and expanding its current capacities and establishing new facilities that will allow the integrated study of additional biological parameters towards the generation of comprehensive phenotypic profiles. This will be achieved through the incorporation of systematic screens for an organism's metabolites and the macroscopic behavioural patterns altered during disease development. The expanded facility will offer state-of-the-art, standardized services for biomedical discovery to national and European stakeholders, both from academia and industry, through the phenotypic analysis of mouse models of chronic degenerative diseases, such as type 2 diabetes, atherosclerosis, dementias and cancer, which are now recognized as worldwide epidemics.

INFRAFRONTIER-GR/Phenotypos aims to enhance research excellence by networking expertise and technological platforms currently located in different research centres and industry, and is expected to boost Greek research productivity and innovation in biomedicine. INFRAFRONTIER-GR/Phenotypos places particular emphasis on enhancing territorial development and cooperation through the generation of regional outposts in distant peripheries of Greece, thus facilitating entry points for access to the RI's service pipelines. This will have significant benefits towards reducing regional disparities, upgrading less-favoured territories and contributing to knowledge-based regional deverlopment. The creation of a Northern outpost will also serve as an access point and interface for cross-border activities and the attraction of additional regional users from the Balkans and surrounding areas, thus setting a foundation for transnational and inter-regional clusters and networks. Furthermore, as a full partner of the ESFRI Infrafrontier, INFRAFRONTIER-GR has direct connectivity and strategic partnerships to Global Projects and Consortia on mammalian genetics and phenotyping, including the International Knock-out consortium (IKMC), the European conditional mutagenesis program (EUCOMM), the International Mouse Phenotyping Consortium (IMPC) and others.



Integrated Greek Infrastructure for Biomedical Research (INTEGRA-BIOMED)



INTEGRA-BIOMED is a sustainable, pan-Hellenic state-of-the-art integrated platform of research infrastructures (BBMRI-GR, EATRIS-GR) serving biobanking, translational research and systems biology approaches. The aim of this 'catalytic' clustering is to enhance research excellence in these areas and achieve functional optimisation which, in addition to economy of scale, will foster synergistic interactions and added value between these distributed RIs through effective management and coordination of nodes throughout Greece, and efficient storage and transfer of knowledge (electronic data; e-infrastructure).

The objectives of INTEGRA-BIOMED are:

- To offer users a single centralised access-point to a large number of complementary research infrastructures, refined biological samples and cutting-edge specialised technologies using standardised and harmonised experimental procedures. This will forge effective partnerships between the users of both academia and industry (mainly pharmaceutical and biotechnology companies).
- To allow the users to gain access to various complementary infrastructures acting in a synergistic fashion to: drive research projects effectively; increase research quality, while reducing redundancy; and effectively catalyse the identification of funding sources (state and private).
- To develop and deliver advanced training programmes meeting the current standards and needs.

The BBMRI-GR and EATRIS-GR components of INTEGRA-BIOMED have already completed their preparatory phases and have entered construction phases. BBMRI-GR consists of a central node and 7 peripheral nodes (located in practically all Greek Medical Schools) collecting human biological specimens and biomolecular resources with detailed assorted information stored and processed electronically. EATRIS-GR, operating with the participation of all Greek Universities and Research Institutes, aims to: rapidly and efficiently transform basic biological discoveries into innovative clinical applications by performing clinical trials; reduce attrition in drug development; and promote the cost-efficient development of novel approaches to disease prevention, diagnosis and treatment. ISBE (Infrastructure for Systems Biology Europe), which is now in a preparatory phase, aims to provide highly interactive, high-throughput experimental platforms (genomics, proteomics, metabolomics, etc.) and computational electronic networks, to enable the research community to approach complex biological processes and disease mechanisms through mathematical modelling, and to further exploit this information for its socioeconomic benefits in health care, agricultural science and the environment.

BBMRI-GR will be the basic resource for the collection and distribution of high quality biological samples used by the other components of INTEGRA-BIOMED to: elucidate the pathogenesis of multifactorial diseases; develop models of genetic disease risk and drug efficacy; and identify Biomarkers and drug-development targets.

Two of the components of INTEGRA-BIOMED are ESFRI-related infrastructures: BBMRI-GR is a member of BBMRI-ERIC and EATRIS-GR will join EATRIS-ERIC shortly (emerging member)

Researchers from academia, industry and SMEs will benefit from the effective networking and user/client matchmaking and specifically-designed services provided under the auspices of INTEGRA-BIOMED. Streamlined services to execute projects in a timely and cost-effective fashion will be offered by highly-trained research personnel with several types of complementary expertise. It is anticipated that the national investment in INTEGRA-BIOMED will have a significant and long-lasting impact on Greek research productivity, growth and innovation in biomedicine through the economic effects of job and business-generating activities such as patents, licensing fees, spinoff companies etc. and also through the accumulation of new knowledge, data & biomaterials, software development, new skills, new methods, new products & services and new collaborations supporting public/private partnerships.

A Greek Research Infastructure for Visualizing and Monitoring Fundamental Biological Processes (BioImaging-GR)

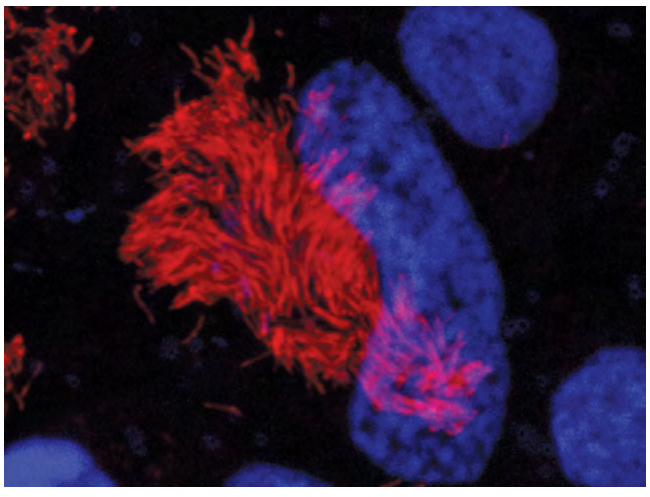
BioImaging-GR is Greek a state-of-the-art Biological Imaging infrastructure, within the framework of Euro-BioImaging, the associated pan-European ESFRI Research Infrastructure (www.eurobioimaging.eu). BioImaging approaches are becoming widely used and are greatly appreciated as cutting-edge tools for dissecting complex biological phenomena, for understanding cell structure and dynamics, and for extracting biological information of clinical relevance. Recent advances in imaging technologies and the development of several innovative microscopy modes have opened new vistas in the field of Biological Imaging that is rapidly gaining critical importance in the area of Life Sciences. BioImaging-GR aims to create a strongly interlinked and geographically distributed infrastructure for general-access, high-end biological imaging providing a range of imaging methods to scientists, interested stakeholders, SMEs and enterprises in Greece and neighboring countries. Moreover, BioImaging-GR will seek to acquire and provide access to "beyond state-of-the-art" imaging technologies, which are not easily accessible to the broader imaging community. In addition to the acquisition and upgrade of facilities, BioImaging-GR will introduce new expertise, relevant to biomedical imaging through recruitment and training of resident personnel. Through BioImaging-GR, the national investment in imaging infrastructure will be used in the most cost-effective and efficient way by applying the highest quality standards in management, access and service of imaging facilities. Modernizing BioImaging infrastructure and acquiring or generating the necessary expertise will allow Greece to maintain a competitive position in the field of Biomedical research, and provide cutting-edge facilities to the broader research community in south-east Europe.

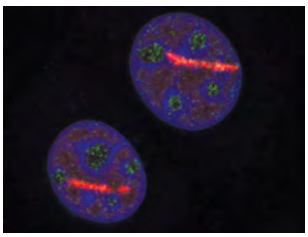
Objectives

BioImaging-GR, coordinated by FORTH, aims to create a distributed infrastructure for general access, high-end biological imaging providing a range of imaging methods to scientists in Greece and neighboring countries by pursuing the following goals:

1. Expand existing and establish new BioImaging facilities, such as next-generation fluorescence microscopy, electron microscopy (conventional TEM and SEM, as well as CLEM), PET, Micro-CT, fMRI, intravital imaging, microfluidics, ratiometric imaging, super-resolution microscopy and others.
2. Provide training and imaging services to the research community and industrial users in Greece and neighboring countries using cutting-edge BioImaging technologies.
3. Enhance the research and innovation potential of the Greek biomedical research community by networking and coordinating existing facilities, which operate at different centers, towards maximum complementarity and minimum redundancy.

BioImaging-GR is a distributed RI (with 21 partner Research Institutes and University Departments), with a central coordinating Hub (FORTH), serving as a single point of entry to the national infrastructure, and distributed partner Nodes that provide access to high-end BioImaging instrumentation and services.



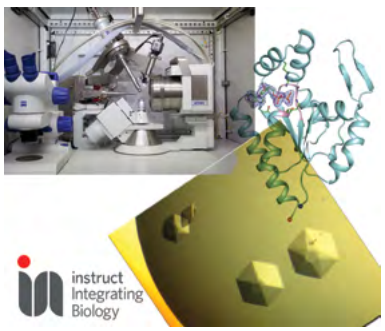


The National RIs on Integrated Structural Biology, Drug Screening efforts and Drug-target functional characterization (INSPIRED)

Modern Structural Biology and cell biology have made an immeasurable impact on biomedicine and biotechnology, benefiting public health, the environment and the economy. Knowledge of the 3D structure of macromolecules has improved our understanding in structure-function relationships, strengthening drug discovery and screening efforts. INSPIRED provides a multifaceted, powerful and unique S&T platform for research activities and access/ services to academic and industrial stakeholders, SMEs, active in the Life Sciences field. The RI comprises two infrastructures: INSTRUCT-EL & UPAT-RISF. By integrating all the Structural Biologists of the country, INSTRUCT-EL (coordinated by the National Hellenic Research Foundation) has achieved a critical mass of accomplished researchers and in recent years has made significant advances in expanding the existing RI and maintaining the facilities as state of the art. INSTRUCT-EL functions as a national distributed RI, managerially and administratively in tune with INSTRUCT-EU, offering a complete set of platforms for integrated Structural Biology. Current facilities host sample preparation, biophysical characterization, structural analysis & data analysis. The aim of INSTRUCT-EL is to build scientific capacity for growth & breakthrough research accomplishments in Structural Biology in South-East Europe & Cyprus via the scientific integration & training of end users from the wider region so as to attract a pool of emerging industrial & academic partners to the region. UPAT-RISF (coordinated by the University of Patras) combines the innovative technology & state-of-the-art infrastructure of regional academic entities mainly located in Western Greece for in-depth structural and functional analysis of drug targets & drug lead characterization. The regional RI contributes a range of facilities for drug targets and pharmaceuticals such as high-field BioNMR and powder diffraction equipment, advanced microscopy infrastructure, state-of-the-art cell-based analysis techniques, broad cell & molecular biology-based technology, proteomics and genomics facilities as well as experimental animal model units (for drug target validation and diagnosis).

Joint Research Activities (JRAs) will be carried out at the interface of the RI's two components, aiming to deliver solutions to academic and industrial users, driven by the regional needs for innovative services and products. These will include the optimization of in-cell NMR methodologies for structure determination, molecular dynamics and protein-drug interactions. These will be complemented by the development of functional imaging techniques to study dynamic interactions at a cellular level as well as drug responses. Also, the JRAs will include the design of mutated crystallization-prone constructs for structural studies, novel crystallization techniques, and the improvement of drug target sample production for structural studies by NMR and other spectroscopic techniques, X-ray protein crystallography & SAXS. An open data infrastructure that will accommodate a central repository for structural data on biomolecules & associated services will also be created to develop advanced data systems, enhanced visualization tools, appropriate data analysis algorithms and sophisticated user interfaces.

The RI is linked to the following ESFRI and other EU/ International facilities: INSTRUCT-EU, BioStruct-X, LaserLab, BioNMR, EastNMR as well as the complementary RIs ELIXIR, INFRAFRONTIER, BiomedBridges, EATRIS, ISBE, OPENSCREEN, OpenAIRE & EU Synchrotron Radiation sources (EMBL-Hamburg Unit-DESY, Diamond, Grenoble, Berlin, ALBA, PSI, ESRF), NMR facilities (CERM; the Slovenian NMR centre; CRMN-CNRS & University of Lyon, France; BMRZ – Goethe University of Frankfurt, Germany; the Bijvoet Centre for Biomolecular Research, Utrecht, NL) and Genomics Core Facilities (EMBL-Heidelberg Unit).





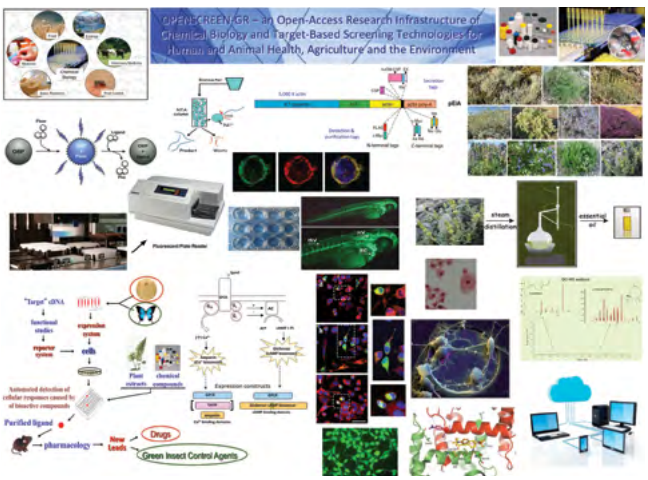
An Open-Access Research Infrastructure of Target-Based Screening Technologies and Chemical Biology for Human and Animal Health, Agriculture and the Environment (OPENSCREEN-GR)

OPENSCREEN-GR is an open-access research infrastructure (RI) for discovery of bioactive molecules using molecular target-based screening technologies. It offers access to large collections of small synthetic molecules and natural products as well as instrumentation and technological expertise for the undertaking of target-based screening programmes for identification of compounds with desired functionalities. OPENSCREEN-GR also characterises identified hits in order to validate biological function and assess cytotoxicity & bioavailability using relevant in vitro and in vivo models. Bioinformatic tools are used for modeling the binding of hit compounds to their targets, while the synthesis and analysis of hit derivatives (lead compounds) in the screening systems facilitate structure-activity relationship studies. All relevant data are entered into data depositories for easy user access. OPENSCREEN-GR will impact significantly on scientific areas and applications related to Chemistry, Biology, Human and Veterinary Medicine, Agriculture, Chemical Ecology and Biotechnology and, thus, benefit commensurately the Pharmaceutical, Agri-food and Environmental Protection sectors. It aims to provide coordinated expert services as well as access to resources that include novel screening tools, synthetic and natural compounds, high-tech facilities and experienced personnel, as well as relevant training opportunities. The IR's activities conform fully to Greece's RIS3 (Research and Innovation Strategies for Smart Specialisation) mission by addressing major national R&I priorities in the sectors of health-pharmaceuticals, agri-biofood and the environment. The multidisciplinary effect of OPENSCREEN-GR is enhanced by the collaborations of academic scientists with those of the private sector and is expected to grow substantially through the expanded linkages of the Greek research communities to it.

These include: chemists and biotechnologists who will undertake projects targeted at the discovery of new products; biologists, pharmacologists and bioinformaticians who will benefit from the availability of better tools for developing novel pharmaceuticals; and the medical, veterinary and agricultural communities, who will benefit from activities leading to the development of targeted and more effective treatments for several human and animal diseases and better control of crop-damaging agents.

OPENSCREEN-GR develops new technologies and also provides access to the service, application and product-developing sectors of the national economy as well as spinoff companies, SMEs and larger companies interested in producing innovative products and applications in collaboration with academic researchers in order to become more competitive in Europe and globally. Thus, by enhancing interactions and promoting collaborations between the academic and industrial communities, to which it also offers extensive training opportunities, OPENSCREEN-GR bridges the gap between basic and applied research and promotes effective technology transfer for the further development and commercialization of innovative solutions to specific problems in human & animal health and agriculture.

OPENSCREEN-GR is a full partner of EU-OPENSCREEN, the larger ESFRI counterpart. Its collaborative connections to other national RIs such as INSTRUCT, EATRIS-GR, BIO-IMAGING-GR, BBMRI and ELIXIR-GR and their European counterparts bring additional value-added benefits to all parties involved.



The Greek Research Infrastructure for Personalised Medicine (pMedGR)

Following recent technological breakthroughs, such as rapid sequencing of the human genome, the concept of personalised medicine/health has become key in understanding, classifying, preventing and treating human disease. Capitalising on top clinical and basic research teams, the pMedGR infrastructure aims to support research towards patient stratification, biomarker development, tailored healthcare interventions and personalised treatment strategies to help bridge the gap between genomic information and clinical practice. pMedGR is particularly significant for the Greek population and neighbouring countries, which represent a genetic pool that differs from Central and Northern European populations, thus offering unique potential for the development of targeted therapies and diagnostic modalities specifically for this population.

The objectives of the new pMedGR infrastructure are to: (a) support research aiming at the transition from traditional symptom-based healthcare models to omics-based approaches for health and disease; (b) allow the in-depth description of individual phenotypes at a systems level by providing access to cutting-edge technological platforms, clinical data and biological specimens; (c) generate technological ICT solutions that facilitate the processing, integration and modeling of the output of several technological platforms; (d) train the next generation of physicians and bioscientists that will develop and implement personalised medicine; and (e) lead industrial innovation towards novel diagnostic and therapeutic modalities and advanced knowledge for personalised healthcare.

pMedGR will have close contacts with BBMRI-GR, the biobanking RI, in order to align activities in providing access to biological specimens and data. The ICT modules of pMedGR, which will be responsible for data analysis, integration and model building, will cooperate closely with ELIXIR-GR, the data storage infrastructure. Key interactions will be pursued also with INFRAFRONTIER-GR/Phenotypos, the mouse archiving and phenotyping infrastructure, which is expected to provide preclinical platforms and proof-of-principle projects for further clinical development. Lastly, pMedGR will cooperate with BioImaging-GR for the development of advanced imaging platforms with clinical applications for personalised medicine. pMedGR will also liaise with the European counterparts of these and other ESFRIs in order to establish an international network of partners that can provide relevant know-how and expertise.

pMedGR will provide a hub for the implementation, coordination and integration of personalised medicine approaches in the region and as part of a pan-European and global network, thus offering centralised information on patient stratification efforts, susceptibility factors and response to treatments for the regional population. This hub will effectively serve as a single entry point for researchers and industry interested in this area. Furthermore, Greece's strategic geopolitical position together with the region's genetic characteristics render pMedGR an ideal paradigm for personalised approaches that target an extended regional area, including southern Italy, the Balkans & Turkey. Through pMedGR, Greece has the potential to become a South-East European Node for Personalised Medicine, linking Europe to emerging markets such as Asia, Africa and the Middle East.







Synthetic Biology: from omics technologies to genomic engineering (OMIC-ENGINE)

Synthetic biology is the design and construction of novel biomolecular components, networks and pathways for useful purposes. It is an area of biological research and technology that combines science and engineering, encompassing a variety of different approaches, methodologies and disciplines. Synthetic biology re-engineers organisms that may radically impact many fields in the near future, from energy to health, providing solutions to a number of climate and environmental problems. It is a rapidly developing field which will have major relevance to enhancing not only the Greek but also the European industrial base. Synthetic biology is a field which naturally lends itself to the creation of new knowledge-based industries as well as the enhancement of existing ones.

OMIC-ENGINE will develop an integrated platform technology and infrastructure for synthetic biology and will place Greece in the international map of synthetic biology centres. It will bring together biologists, engineers, mathematicians, physicists, chemists and computer scientists from institutions around Greece in order to design and construct a broad range of biological tools, targeted to the agro-biotechnological industry.

The four main objectives of OMIC-ENGINE are (a) to create new research infrastructures and facilities for cutting edge analyses and provide access to the new technologies both to scientists and the private sector; (b) to develop in silico modelling capabilities to guide the rational design of biological building blocks and appropriate production systems in order to address practical issues of the agrobio-market of national and European relevance; (c) to expand the network of partners, increase interaction between the researchers and other stakeholders and identify new markets and sources of public and private funding ; and (d) to generate a regional centre of excellence in dedicated synthetic biology education programmes and relevant training to build an energized synthetic biology community.

OMIC-ENGINE will coordinate national and regional research and industrial activities on Synthetic Biology, in an effort to overcome fragmentation in this research area. Through OMIC-ENGINE the most advanced instrumentation and the familiarisation of new routes to translational technology transfer will be achieved for all scientists and industry in Greece but also in other countries.

Expected breakthroughs include (a) Enzymes for environmental clean-up, decontamination of polluted water resources and novel metabolic pathways for pollutant biodegradation; (b) Biorefineries towards the production of a broad range of chemical products (including fuels, fine chemicals and advanced materials) using sustainable processes; and (c) Disease-process oriented (and not symptom oriented) drug development, using in vitro synthetic biology platforms.

Furthermore, Greece is part of the ERASynBio ERA-Net in Synthetic Biology that was launched in 2012 under the 7th Framework Programme. To date, OMIC-ENGINE has secured involvement and collaboration with leading Synthetic Biology Centres in Europe.



Research Infrastructure for Coronary artery disease (NRI CADSOL)

Coronary artery disease (CAD) is the single most common cause of death in the developed world, responsible for about 25% of deaths. The objective of the NRI CADSOL is to integrate currently existing centres in order to develop a national Research Infrastructure (RI) so as to perform cooperative leading innovative research in clinical management and the treatment of CAD. The proposed RI will incorporate the accumulated knowledge, the data and the expertise and experience of the partners into a common framework, creating critical mass in the field. This unification is expected to maximise the generation of scientific knowledge as well as contribute to growth in the domestic economy.

The main aims of the proposed RI are to:

- Enable the assessment of new diagnostic and therapeutic technologies and clinical guidelines on CAD and risk factor incidence, prevalence, clinical management, and patient outcomes over time
- Strengthen research on developing new diagnostic strategies for CAD beyond the current state of the art and move forward to discover novel ways for patient management
- Investigate the impact of CAD in longevity, having the 'Ikaria Project' as a baseline
- Combine expertise in the fields of Cardiology, Radiology, Genetics, Medical Physics and Computational Flow Dynamics
- Create a common national database, where the scientific community will be able to share data, knowledge and scientific expertise
- Support medical staff in decision-making for managing heart disease
- Support scientists to conduct research in the medical field and health care industry
- Improve patient care, decrease the radiation exposure of patients and staff, predict disease susceptibility and therapeutic safety (pharmacogenetics), and accelerate diagnostic decisions.
- Develop the domestic economy by reducing hospitalisation expenditures and shortening hospitalisation times
- Promote research on clinical practice and quality of care
- Enrich the national healthcare system with information derived from Greek data and not just through international research
- Inform the public and media on heart health

For that purpose, the most renowned national Cardiology and Radiology Departments doing research in the field are included in this infrastructure, assuring that it will become the largest node in Greece capable of conducting cutting-edge research at a national and international level.




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Materials and Analytical Facilities

Acronym	ESFRI relation
HELLAS-CH	ELI, HiPER
INNOVATION.EL	

The HiPER, ELI and LASERLAB Europe Synergy & IPERION-CH.gr (HELLAS-CH)

The HELLAS-CH is a cross-disciplinary National Research Infrastructure (NRI) offering access to a) advanced experimental facilities capable of supporting frontier research on Laser science, technology and applications, and b) versatile integrated tools and technologies for addressing demanding research challenges in the field of Cultural Heritage (CH) science. HELLAS-CH aims to establish itself as a Regional Facility of the European RI ecosystem.

The Laser-NRI constitutes a coherent synergetic action of existing, high-profile initiatives of 13 specialised and complementary academic and research institutions in Greece that will implement — through the relevant national networks, ELI-GR and HiPER-GR — a distributed research infrastructure directly related to the ELI and HiPER projects of the ESFRI roadmap, encompassing the Ultraviolet Laser Facility (ULF) that has been operating successfully at FORTH as a European Laser Facility since 1990, currently member of LaserLab Europe. Laser-NRI will offer — in a coordinated fashion and through FORTH and TEI Crete — access opportunities across a wide variety of state-of-the-art laboratory facilities such as laser sources, secondary radiation and particle sources, with a broad spectrum of operational parameters, supported by specialised workstations, advanced instrumentation facilities and highly qualified human resources (renowned scientists and engineers in the field).



The Laser-NRI will aim to advance the state of the art in scientific methods and techniques so as to develop and offer innovative, reliable and efficient tools that will enable users to pursue cutting-edge research (in fields such as atomic molecular and optical Physics, Attosecond Science & High Field Physics, Laser-material interactions and processing, Laser Plasma Physics and applications, (bio) photonics, material sciences & tissue engineering), allowing the international, national and regional scientific & technological community and the private sector to join the efforts, breakthroughs and innovative accomplishments of the consortium, granting them high visibility and competitiveness, while minimising the fragmentation of national research efforts and resources.



Iperion.CH: The goal of this component is to integrate — within a portable, ICT-enabled instrumentation — advanced facilities and specialised laboratories at FORTH & the Ormylia Foundation for servicing the Cultural Heritage (CH) science and research community at a multi-dimensional level, based on a global concept that is best-described by three keywords: micro — macro — info.

Micro reflects methods & tools appropriate for analytical studies of CH objects and materials, namely at the microscopic level (incl. novel laser-based techniques for compositional analysis & mapping of materials on works of art, advanced methods for studying archaeological DNA & modern laser-based technologies for conservation and restoration). Macro describes the use of non-invasive geophysical & geochemical measurements for surveying & mapping macroscopically the landscape of archaeological and historical sites, including underwater ones. Info refers to the development of innovative e-tools that enable efficient handling of experimental data, permitting user groups and broader communities to exploit the complex interrelated (complementary) information gathered via micro or macro studies.

National Infrastructure in Nanotechnology, Advanced Materials and Micro/Nanoelectronics (INNOVATION.EL)

INNOVATION.EL is an open-access national research infrastructure addressing the needs of nanoscale science, technology and engineering towards an innovative ecosystem that will contribute to smart, sustainable and inclusive growth in Greece and Europe. It aims at promoting world-class multidisciplinary Research and Innovation (R&I) as well as supporting technological breakthroughs in the selected Key Enabling Technologies (KETs) of Nanotechnology, Advanced Materials, Photonics and Micro-Nanoelectronics. By offering efficient access/services to a network of geographically distributed cutting-edge facilities and highly-creative human capital in materials synthesis/functionalization/ characterization, micro-nanofabrication, device/system development, all complemented by multiscale computer simulations and theory, it will provide scientists and engineers from the academic, industrial and government sectors with the necessary means to achieve scientific excellence and develop knowledge-intensive products.

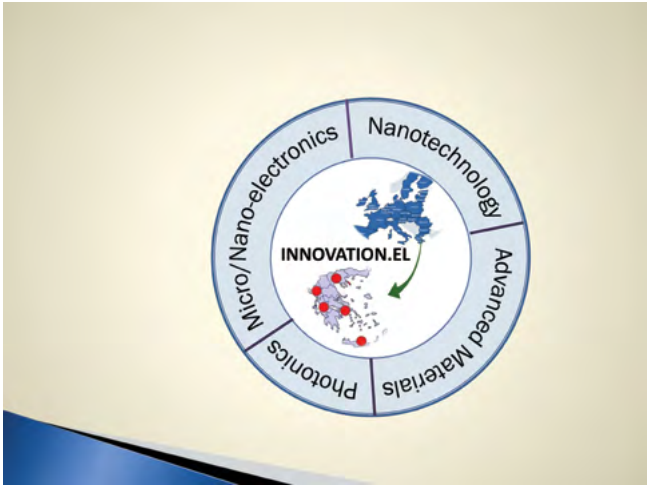
INNOVATION.EL is based on a Core Partnership of eight Research and Higher Education Institutions distributed across five regions of Greece. Additional partners will contribute, with their expertise and in collaboration with the core partners, to the continuous improvement of the quality of the access/ services offered by the infrastructure via their participation in the Joint Research Activities (JRAs). INNOVATION.EL users will also benefit from the experience of the core partners through their participation to Large European infrastructures like H2FC, ENI2, SiNANO, ESMI, LASERLAB EUROPE, the ESFRI infrastructure ELI and Europe's 10 year Future and Emerging Technology 'Graphene Flagship'.

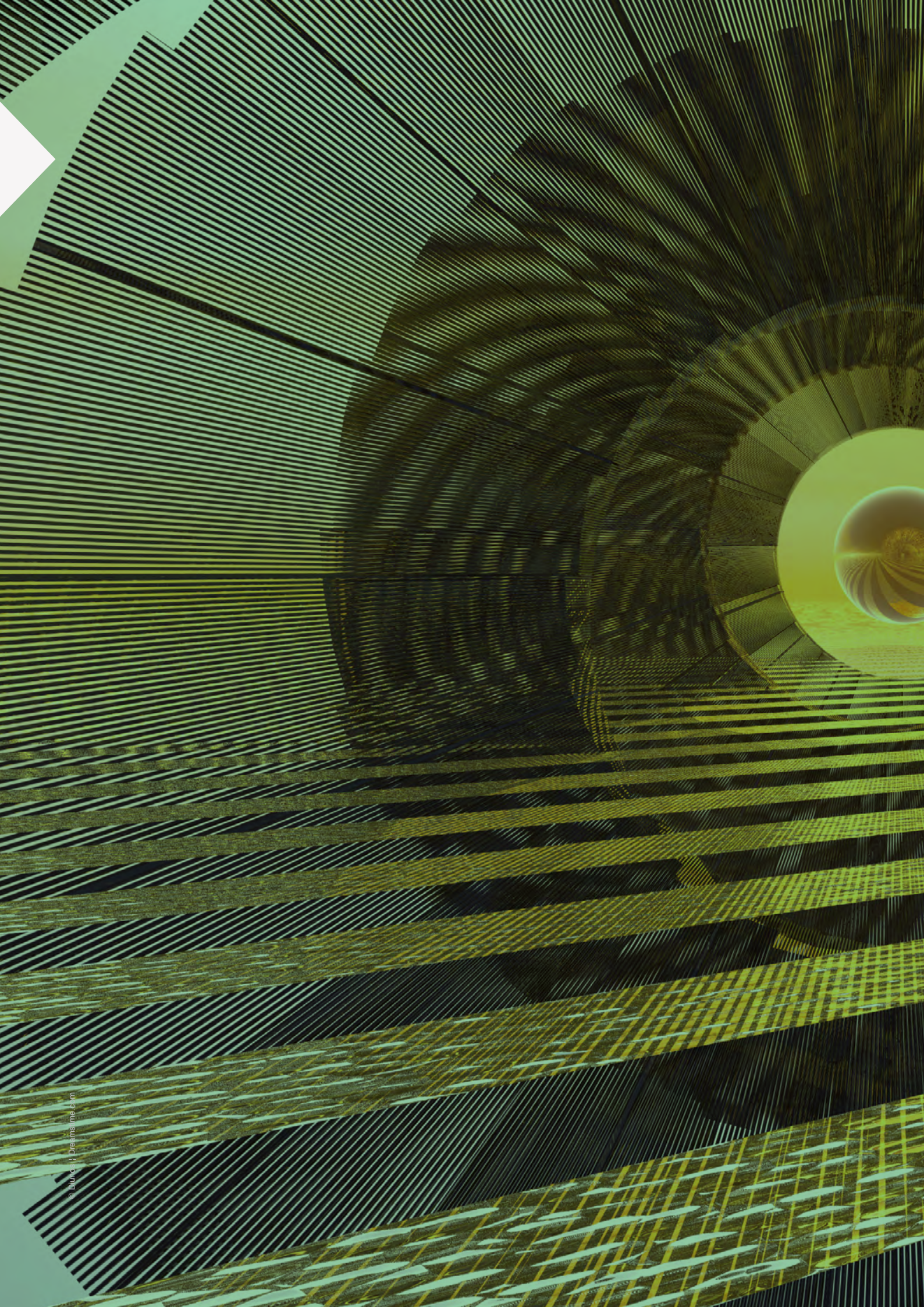
INNOVATION.EL provides a holistic approach to research and innovation needs, offering a unique environment for the discovery and development of smart materials, new processes and innovative micro/nano devices and systems, bringing together most of the best relevant resources available in Greece. The infrastructure is expected to respond to a number of national challenges and, in doing so, will strongly contribute to the breakthroughs needed by 2020 in a number of key research priorities at national and European level, such as ICT, Energy/Environment, Healthcare/ Pharmaceuticals, Agriculture / Food safety, and Materials/Construction.

INNOVATION.EL will also contribute to National Security and Defense, strongly enhanced by the participation of HNA and HAFA as infrastructure partners. Along similar lines, the infrastructure will assist academia and industry active in space-related research, thus also assisting in strengthening the role of Greece within ESA.

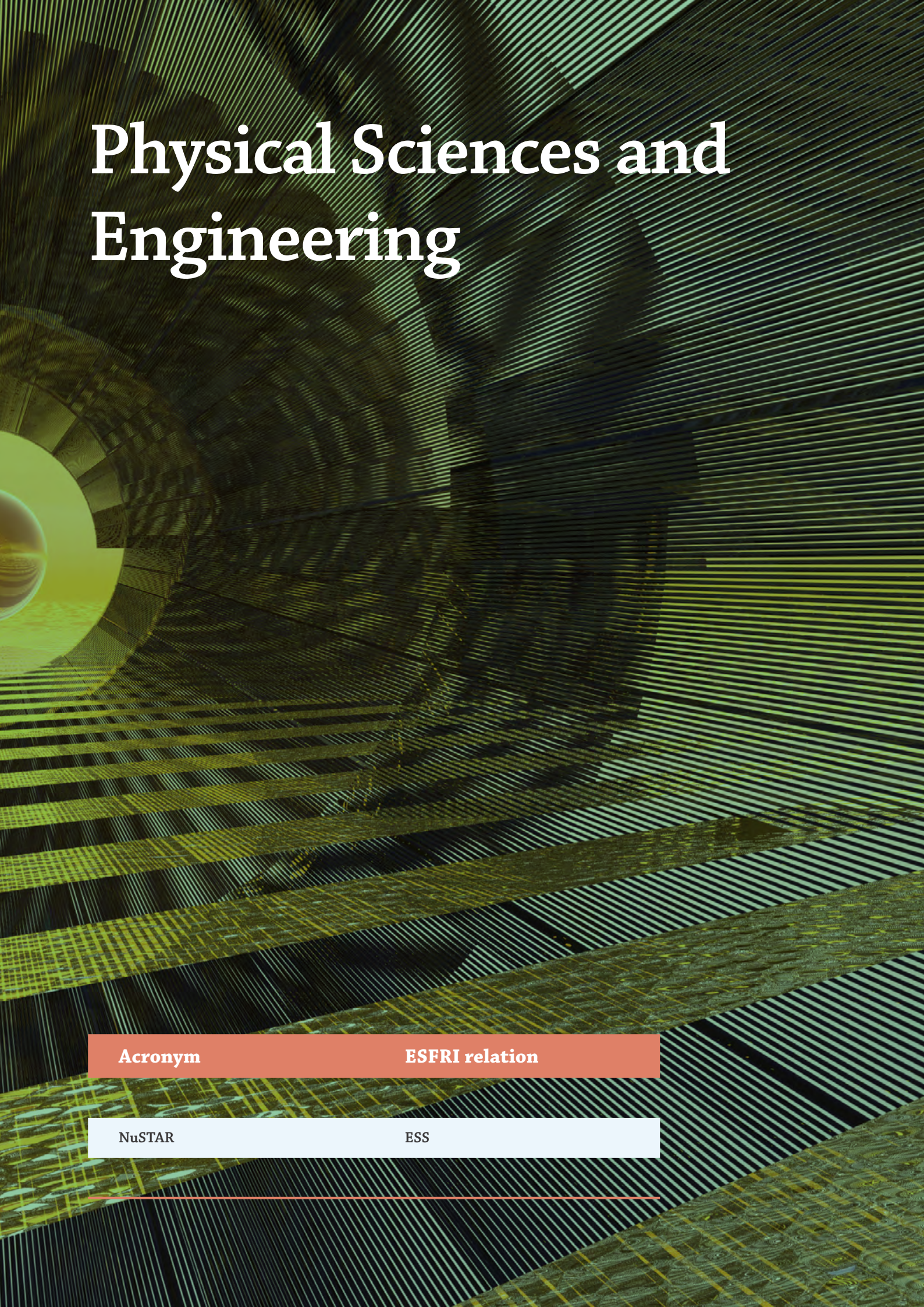
Within the Integrated Infrastructure Initiative (I3) model, Services, Networking and Joint Research Activities (JRAs) intend to improve the quality, range and innovative nature of the access/services offered to national and transnational Users whereas they will assist INNOVATION.EL to stay competitive at European level. The JRAs cover domains such as Novel Materials Synthesis, Innovative Nanofabrication, Material & Device Characterisation and Theory & Multiscale Modeling. The networking activities of INNOVATION.EL will boost progressive R&D and Web portal services, encourage transnational, national and regional R&I initiatives in the selected KETs, foster cooperative projects to network industry (in particular SME's) with nanotechnology, nanoelectronics and advanced materials, strengthen innovative thinking and multidisciplinary collaborative approaches, and provide high-level scientific and technical training for companies and individuals. Ultimately, this will lead to an increase in entrepreneurial bottom-up initiatives, in creative capacities, and in the transfer of R&D results into knowledge-intensive products that have applications in prioritised industrial sectors.

INNOVATION.EL is in a preparatory phase with a temporary governance structure consisting of an Executive Committee headed by INN/NCSRD, which is supported by a Technical Committee headed by IESL/FORTH.




Nature | Dreamsmaker

Physical Sciences and Engineering



Acronym	ESFRI relation
NuSTAR	ESS

Nuclear Science, Technology and Applications Research Infrastructure (NuSTAR)

NuSTAR is an all-encompassing open-access multidisciplinary research infrastructure for research and innovation. It will operate and exploit a cluster of three electrostatic accelerators and a cyclotron, and at a later stage a nuclear research reactor, all grouped into three strongly interacting laboratories. NuSTAR will deliver a wide variety of ion beams (≈4000 hours/year) as well as neutron beams and builds on a tradition of excellent scientific multidisciplinary research being performed at the existing 5MV Tandem Accelerator Laboratory (TAL) and the 5MW Research Reactor (GRR) of the National Centre for Scientific Research 'Demokritos' (NCSRD) Athens, Greece. The maturity level of NuSTAR is high: It is a combination of upgrading and expanding existing fully operational facilities. A blueprint for the accelerator infrastructures is available, which discusses in great detail all technical aspects of the infrastructure and its implementation in time.

NuSTAR will allow the pursuit of cutting-edge science in fundamental nuclear and atomic physics, nuclear technology and their multidisciplinary applications in: health, including radiopharmaceuticals; the development and testing of structural materials for fusion energy; nanotechnology; environmental studies; detector R&D, and cultural heritage. NuSTAR will also deliver high-level training and education, and will provide Greece with an all-inclusive facility for excellent scientific endeavour — the first of its kind in the country — that will also play a leading role within the European Research and Innovation Area. It is worth noting that NuSTAR has already received more than 40 letters of intent for collaboration from European and regional research institutions.

The potential for innovation and technology transfer through the construction and operation of NuSTAR is very high. The cross-fertilisation of multi-disciplinary research and deployment of state-of-the-art equipment with novel techniques will lead to increasing the potential for innovation. The application and exploitation by the private sector/industry of technology or knowledge developed at NuSTAR will also see a qualitative improvement and increase after its realisation compared to the present situation.

Technology transfer can also be effectuated by NuSTAR providing very specialised services to the private sector, which could help increase the competitiveness of the local economy.

The degree of interdisciplinarity of NuSTAR is outstanding as, among other things, it covers: the production of radioisotopes for health, the inclusion of Greece in a rich international network of cultural heritage and archaeometric studies, the analytical characterisation and modification of materials, and environmental studies. Moreover, NuSTAR will further stimulate the development and testing of advanced materials, sensors, and detectors. Breakthroughs in many other interdisciplinary research programmes within the field of operation of NuSTAR are to be expected because of the excellent experimental facilities that will become available and the stimulating scientific atmosphere that will prevail.




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Environmental Sciences

Acronym	ESFRI relation
HELPOS	EPOS
HIMIOFoTS	Euro-ARGO, EMSO
CMBR	EMBRC / Lifewatch
PlantUP	
Hellenic Research Fleet	
PANACEA	ICOS
FAROS	COPAL
INVALOR	

HELlenic Plate Observing System (HELPOS)
The Hellenic Research infrastructure within the project EPOS

Summary - Objectives

HELPOS is an initiative responding to the current Greek and European need for a comprehensive and integrated solid Earth and Earthquake Engineering RI. It aims to integrate the currently scattered, internationally viewed and highly advanced Hellenic Earth Sciences and Engineering Facilities into one distributed but coherent multidisciplinary Research Infrastructure. This action will enable sustainable long-term Earth science and earthquake engineering research strategies and an effective coordinated monitoring facility. HELPOS will be an open access, not currently available, distributed network of geosciences and earthquake engineering observations, coordinated by the Greek Research Institutions and Universities.

HELPOS, coordinated by National Observatory of Athens, complies with the concept for European Distributed Research Infrastructures as this has been developed in ESFRI. This is because:

- It has a governance structure including among others a Strategy and Development Plan and one access point for users although its research facilities have multiple sites.
- It provides unique laboratories and facilities with user services for the efficient execution of top-level European research, ensuring open access to all interested researchers based on scientific excellence thus creating a substantial added value with respect to national facilities.
- It brings significant improvement in the relevant scientific and technological fields, addressing a clear integration and convergence of the scientific and technical standards offered to the European users in its specific field of science and technology.

HELPOS management will follow the EPOS model.

Keywords
Research Infrastructures, Greece, EPOS, seismic hazard, volcanic hazard, tsunamis, vulnerability, risk, geodynamic networks, laboratory seismology, strong ground motion networks, structural monitoring, early warning, natural hazard education, earthquake engineering and databases.

General Scope
To understand the physical processes responsible for earthquakes, volcanic eruptions, landslides, surface and tectonic processes, tsunamis and seismic response of engineering structures, using long term high quality data and accurate predictive modeling of their temporal and spatial evolution.

Core Partners
For the first time ever in the Greek Earth community, forty three (43) Research Units are involved in the HELPOS project. These are operated by two Research Centers, five Universities, one Public Organization, two Volcano Observatories and one private enterprise.

Links to ESFRI
HELPOS is the solid Earth science and Earthquake Engineering Greek component, complementing other large scale RI as the European Plate Observing System (EPOS) studying the planet Earth in the GEO (SS) initiative as well as NERA, SHARE, ASTARTE, SYNER-G, REAKT.



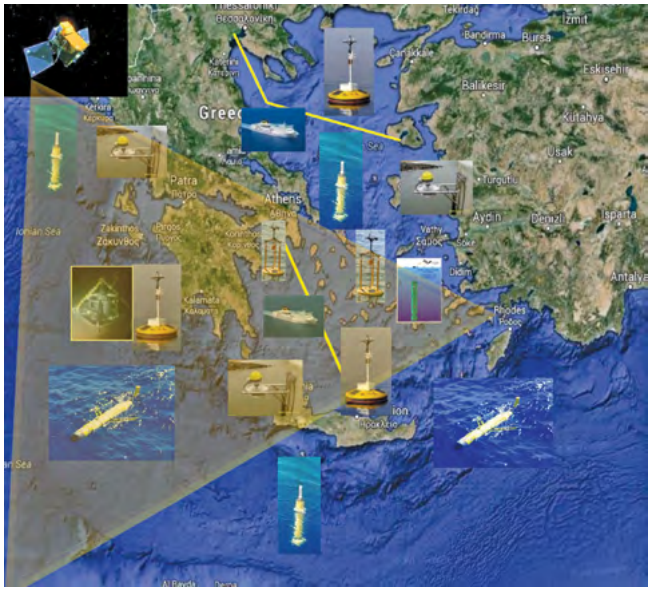


Hellenic Integrated Marine and Inland water Observing, Forecasting and offshore Technology System (HIMIOFoTS)

The Hellenic Integrated Marine Inland water Observing, Forecasting and offshore Technology System (HIMIOFoTS) includes integrated approaches in Marine observation and forecasting systems, coastal monitoring, an innovative Hydro-Environmental Monitoring and information Network and also a world class Marine land-based facility for testing and marine engineering (deep water multifunctional tank). The infrastructure incorporates three interrelated components:

1. The Hellenic Integrated Marine Observing and Forecasting System (HIMOFS) is essentially a cluster of already-existing (or under-implementation) observation offshore and coastal systems (buoys, profilers, gliders, Ferrybox systems, HF radars, drifters, sea level stations, cabled platforms) coupled with a full range of forecasting operational models. HIMOFS will be coordinated by the Institute of Oceanography of the Hellenic Centre for Marine Research (HCMR), which operates the POSEIDON Operational Oceanography System for almost fifteen years and participates in European Infrastructure networks such as the ESFRI's EUROARGO floating drifters and the EMSO cabled seabed observatories with the relevant Greek nodes (Greek Argo, Hellenic-EMSO). A coastal component (Environmental Monitoring and Management of Coastal Zone) intends to compile an effective and readily available monitoring and sampling system. The overall challenge is the creation of a solid and transparent organisation towards an operational service for the timely, continuous innovative observation and sustainable delivery of high quality environmental data, forecasting capabilities and information products related to the offshore and coastal environment of the East Mediterranean Sea.
2. The Open Hydrosystem Information Network will integrate and harmonise the information provided by the National Hydro-Environmental inland water Monitoring Network (NHEMN) under an open-access platform with appropriate web services with semantic intelligence, accompanied by web applications with GIS functionality for data visualization, processing and modelling. Under this platform that focuses on inland water resources, existing measuring systems, currently operated by authorised organisations and individuals will be integrated, and also new stations will be deployed by taking advantage of modern, low-cost technologies for remote control. These will be strategically distributed to provide critically needed but scarce data, especially for the implementation of the legal obligations of Greece towards the EU (e.g. river flows, lake and reservoir stages, inflows from transboundary basins, and water withdrawals across major hydrosystems).
3. A world class Marine land-based offshore basin testing facility (deep-water multifunctional wave tank) for marine and offshore technology applications to cover scaled-down physical model test campaigns that are required to produce new solutions, both for the marine research and the marine & offshore technology fields of application (including maneuverability and sea keeping of special-purpose ships) in a multi-disciplinary and holistic design approach which will be developed.

The RI is linked to the ESFRI-EU facilities of EMSO and EuroArgo, and also to the I3 facilities of JERICO and FixO3. Additionally, HIMIOFoTS will make a significant contribution to the RD&I ecosystem since the observation systems and forecasting models will be upgraded to carry out excellent science through the adoption of cutting-edge marine technologies, innovative sensors and methodological approaches. The RI will further enhance the RD&I ecosystem through its implementation of EU policies such as Horizon 2020, WFD, MSFD and ICZM.



Centre for the study and sustainable exploitation of Marine Biological Resources (CMBR)

CMBR is an integrative large-scale facility for Blue Growth supporting access to, and the study & sustainable exploitation of, marine biological resources in the Eastern Mediterranean. With terrestrial resources approaching their physical limits, the sea is increasingly being considered as a last resort for a number of vital resources ranging from food, health, biomass, energy and minerals, to planet equilibrium. The sea has always been a vast resource for food, materials and services, but its tremendous potential for new biotechnological products and for the sustainable use of open-sea products and industrial applications has been largely untapped. Old practices have reached a plateau and there is an urgent need for the integration of key scientific and technological breakthroughs in order to make full use of the wealth provided by the marine world.

Among the main goals of CMBR is the development of biotechnological applications for the production of bioactive compounds (pharmaceuticals, cosmetics, enzymes, etc), mainly by exploiting the as-yet-largely-unexploited biodiversity of microorganisms, especially those living in extreme marine environments. The development of an innovative multi-use offshore sea platform, with aquaculture being the core activity but also including applications related to renewable energy, is a central part of the infrastructure. Other important components of CMBR refer to the upgrading and expansion of a mesocosm infrastructure, an underwater biotechnological park, biofermentation facilities, new generation facilities for the collection and analysis of molecular information and -omics technologies, an energy-efficient computing centre, and new modern aquaculture facilities, including those dedicated to behaviour, physiology, biological quality, algal culture for bioremediation, and the isolation of substances.

CMBR builds upon the participation of HCMR teams in pan-European infrastructures and networks, such as ESFRI (EMBRC, LIFEWATCH) and I3 (MESOAQUA, AQUAEXCEL), as well as on the coordination of the national Greek node of LIFEWATCH (HelBioNet).

The CMBR infrastructure, based on the world-class facilities of high-calibre research institutes on the island of Crete and elsewhere in Greece (Athens – Lesbos island) , aims to become an internationally competitive infrastructure for the efficient and sustainable exploitation of the huge potential of the marine world. Through a combination of a complementary array of modern and advanced approaches, CMBR will offer expertise in marine biology and aquaculture, will provide access to marine organisms and ecosystems, and will make large-scale marine infrastructures available to research and industrial users in Greece and abroad.





Upgrading the Plant Capital (PlantUp)

PlantUp aims at the introduction and development of an integrated and cutting-edge infrastructure for the preservation and exploitation of the wealth and heritage of the Hellenic plant biodiversity, while assuring consumers' health and environmental protection.

The implementation of PlantUp will reinforce existing infrastructures and is expected to produce a number of significant results, including: the preservation of biodiversity and the conservation of plants' genetic resources; efficient plant health maintenance; a safeguard against any invasive, non-indigenous harmful organisms (HOs) in new plant species; certified domestic plant propagating material; the introduction of new plant species and cultivars into cultivation; the development of modern, advanced and more sustainable technologies in cultivation practices; the discovery of natural products (NPs) of pharmaceutical, nutraceutical, cosmeceutical and agrochemical interest; as well as the development of high-added-value products.

More specifically, PlantUp forms a distributed RI of 5 core nodes providing accessible facilities & based on a Pan-Hellenic network comprised of two existing networks: NatPro-GR (coordinated by the Faculty of Pharmacy, NKUA) and SHAFE (coordinated by Benaki Phytopathological Institute, BPI).

The key RD&I objectives of PlantUP aim to address the various obstacles that hinder biodiversity preservation, plant health protection, NP exploitation and further development not only in Greece but also at European level, thus establishing a unique framework for the development of innovative strategies for the effective protection of the plant capital and biodiversity in Southern and South-Eastern Europe. It will lead research initiatives and provide cutting-edge scientific facilities, services and training in the research areas of plant genetic resources, plant health and diagnostics, toxicology / ecotoxicology and risk assessments as well as NPs and their exploitation thereof, thus advancing already-developed strategic partnerships with numerous EU and international collaborators.

PlantUp will capitalise on these partnerships with top-level universities and academic institutes, renowned private sector partners (from the pharmaceuticals, agriculture and cosmetics industries), as well as European organizations, e.g. EFSA, EPPO, and worldwide scientific societies dedicated to NP research, establishing complementarity with ESFRI institutions such as HTTP (part of the European Plant Phenotyping Network, EPPN). A mature PlantUp RI of high-quality standards will be established, providing scientific and technological cutting-edge excellence at European and international level and attracting additional EU-derived funding that will enable the PlantUp RI to reach self-sustainability, with multiple mutual benefits through the exchange of knowhow and valuable data. Particularly in the areas of agriculture, alternative crop protection methods and nutrition – which are recognised amongst the EU grand challenges – PlantUP is able to play a critical role with clear national and pan-European added value, thus providing a solid basis for establishing an EU-PlantUP RI that is consistent with the ESFRI initiative.

In line with EU priorities that place research and innovation at the core of Horizon2020 strategy, PlantUP will establish new roadmaps for securing biodiversity and crop production, further promoting the exploitation of national flora through the development of NPs – activities that are expected to enhance the national economy within a global challenging innovative framework.



Towards an Innovative Hellenic Research Fleet (Hellenic-Fleet)



The General Secretariat of Research and Technology (GSRT) acknowledges the need for a comprehensive modernization and upgrade of the Hellenic Research Fleet. The Hellenic Research Fleet is essential for the implementation of research activities and services in the Greek Seas regarding oceanographic operations and fisheries research in a holistic manner.

The modernization and upgrade of the Hellenic Research Fleet is expected to substantially enhance the research capacities and to boost scientific excellence of the national Marine Research Community placing Greece among the scientifically and technologically most advanced countries of Europe and worldwide while substantially extending the marine operational capabilities in regional seas and oceans.

Greece will be able to meet the requirements and address the challenges posed by National and EU policies for the sustainable management of marine resources and environment, like the Blue Growth Policies, the Marine Strategy Framework Directive (MSFD, 2008/56/EC), the Common Fisheries Policy, the Data Collection Framework (DCF, EC 199/2008), and the Water Framework Directive (WFD, 2000/60/ EC).

In the international level, it is anticipated that the state of the art research fleet will strengthen the role of Greece in the Mediterranean, in the Black Sea and the Red Sea and possibly in the Atlantic and Indian Oceans. It is envisaged that the upgrade of the Hellenic Research Fleet will be considered within the context of the European research fleet and designed to complement existing capabilities.

In this context, the GSRT will initiate a design study based on a full, wide discussion with National authorities and all potential stakeholders, commercial and academic, in order to take into consideration their requirements.

The design study will involve an early networking phase with potential stakeholders involved in instrumentation and vehicle development for marine research. Given the substantial investments required, the design study should include a comprehensive trade-off exercise between the envisaged operational capabilities of the modernized fleet and cost.

PANhellenic infrastructure for Atmospheric Composition and climatE chAnge (PANACEA)

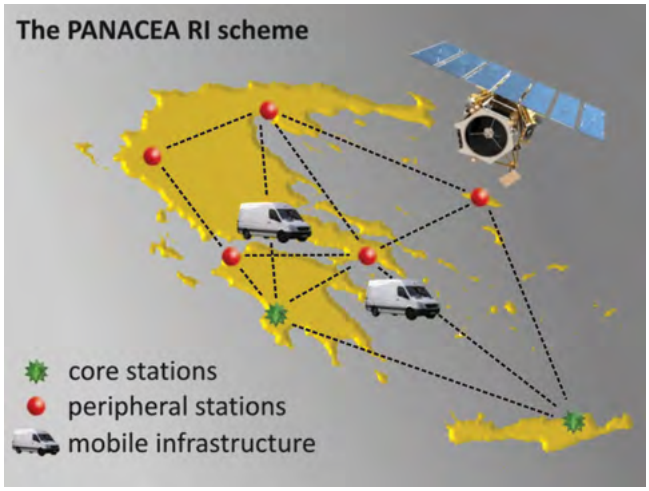
PANACEA (an Integrated National Research Infrastructure for Atmospheric Sciences and Climate Change co-ordinated by the National Observatory of Athens) aspires to create a coordinated system for monitoring atmospheric composition, solar radiation variations, climate change and related natural hazards in Greece. This will be achieved through merging, enhancing, and coordinating all existing Greek ground-based stations and networks (e.g., in-situ gas and aerosol, LIDAR and AERONET stations, RADARs and solar radiation networks), but also Earth Observation facilities, under a single, integrated RI. Competitive advantages include the existence of several excellent Greek research groups in the areas of atmospheric chemistry, physics and remote sensing, the availability of state-of-the-art instrumentation and the recently signed agreement between ESA and the National Observatory of Athens (NOA), for the Hellenic ESA Mirror Site.

Two of the existing ground based monitoring stations are earmarked to become 'world class' sites, or Core Stations (CS), which will be equipped with an ensemble of advanced atmospheric probing instrumentation and will follow international standards and existing European network protocols (e.g. ACTRIS, ICOS). Additional existing peripheral stations, operated by the participating organizations, will be integrated and optimized to provide essential measurements for nationwide spatial coverage and diverse environments. Existing and new mobile infrastructure will be added to the RI, enhancing mobility and flexibility in the case of 'special events' (e.g. pollution emergencies, accidents, wildfires) or research campaigns. Satellite data processing, strengthened through the Mirror Site operation, will enhance Earth Observation-based monitoring of crucial environmental parameters (with emphasis on Natural Disasters) and the capacity for cal/val activities. Exploiting the new generation of ESA satellites (Sentinels) and NASA NPOESS ground segment, real time monitoring in Greece and SE Europe under the GMES system (Global Monitoring for Environment and Security) will be enabled.

PANACEA combines the critical mass with the required quality to become a centre of excellence at international level. The consortium has Pan-Hellenic range, bringing together more than 90% of the scientists from almost all research institutes and university departments active in atmospheric sciences.

The consortium has a strong multi-disciplinary character that will allow the performance of world-class research. The coordination, enhancement, and long-term support of the proposed activities will allow the best use of the significant investments made to date by the European Union and Greece.

Among the overarching objectives of PANACEA are to: (a) create a centre of excellence in atmospheric sciences that will catalyze collaboration at national and international level, enhancing mobility through intra- and trans-national access; (b) develop synergies through the integration of multidisciplinary research tools that fully exploit multiple atmospheric characterization techniques; (c) promote the development of new technologies for the atmospheric observation (in-situ and remote sensing) of aerosols, clouds, radiation, greenhouse and trace gases, in close partnership with national and EU SMEs; and (d) provide state-of-the-science expertise, assisting policy making on issues such as climate change, natural hazards, air quality and long-range transport of pollutants.



Facility for Airborne Research Observation and Sensing (FAROS)

FAROS (based at the "Athena" – Research and Innovation Center in Information, Communication and Knowledge Technologies of Xanthi) is an integrated but distributed National Research Infrastructure for the atmospheric sciences and climate change in Greece, using airborne and remote sensing platforms and a ground-based station. It provides facilities for research groups across the country to accomplish excellence in national and international fora. It concentrates in carrying out research on:

1. Atmospheric quality, composition and physicochemical processes
2. The change of the local and global climate
3. Weather science, extreme and hazardous weather, weather modification
4. Technologies for the observation, remote sensing and modeling of the nationally prevailing atmosphere

It provides a modern, newly instrumented aircraft as a national and regional research platform, a state-of-the-art ground-based 'atmospheric monitoring tall tower' and a Space Internet Communication Centre for online communication with any satellite of interest. The mission of FAROS is to pursue and support internationally-leading research and to advance the application of atmospheric science for the benefit of society.

It undertakes and leads fundamental and applied research, provides facilities and training to support atmospheric and wider interdisciplinary environmental science, applies expertise and exploits facilities to support business and government, and it provides the national and international scientific community with the capacity and advice to lead the field. The coordination, enhancement, and long-term support of its activities allows for the best use of the significant investments made to date by the European Union and Greece.

The new infrastructure includes facilities for airborne studies of fluxes and physicochemical processes, as well as Lagrangian atmospheric observations and monitoring by a modern, modified aircraft. Through its airborne platform, FAROS is able to address local or regional observational and operational tasks such as that of extended wildfires, specific pollution events (e.g. urban smog), industrial or other accidents, weather modification for the protection of agricultural crops, floods, coastal erosion, sea oil sleeks and oil or gas pipeline leaks. Furthermore, it benefits fisheries research through the sensing of phytoplankton and fish shoal movements. It also assists in the assessment of real fluxes of pollutants in pollution hotspots and of greenhouse gases, thereby validating both models and emission inventories.

FAROS has associations and collaborations with national and international programs and activities such as: EUFAR (European aircraft Fleet for Airborne Research), the GLOBAL CARBON PROJECT of the WMO, (http://www.europe-fluxdata.eu/home/sites-list), ICOS (Integrated Carbon Observation System, ERIC project) and AERONET (AErosol RObotic NETwork of NASA).



Research Infrastructure for Waste Valorization and Sustainable Management of Resources (INVALOR)

The main vision of the proposed distributed Research Infrastructure 'INVALOR' is the production, acquisition and use of knowledge through research, information, education, training and technological development, and the foundation of a 'knowledge society group' based on the concept that by-products (wastes) should be considered as potential National/ European Resources.

The main objective is strategic research into the valorization of biomass, industrial, food, agro-industrial and municipal solid wastes and by-products with the aim of producing new, high added value eco-friendly materials, 2nd generation biofuels and energy, as well as a sustainable means of managing resources.

INVALOR builds on major national facilities which are already in place, and on the extensive coordination amongst its partners. The INVALOR members (39 in number), emanating from seven universities, an intra-university network (WasteValor — the nucleus of the project) and a research institute, cover wide fields of engineering science and technology (chemical, biochemical, mining, mechanical, environmental) and the sciences (chemistry, biology, physics). Consortium members have been actively involved in applied research related to the treatment and management of wastes and by-product streams. All members are university faculty members and established researchers, constituting the national frontline in issues associated with the INVALOR areas of interest.

The proposed RI will perform applied research in an area with tremendous potential for growth and wealth generation by fostering results of fundamental research and exploiting synergies. Indeed, high-quality RIs are essential for attracting the talented researchers necessary to achieve sustainability in the innovation process at a national level. Knowledge in general, and scientific knowledge in particular, form the basis of competitive, modern economies. Europe's ability to sustain a competitive edge in knowledge creation and innovation is, for example, at the core of the Lisbon Strategy for Growth and Jobs.

Thus, it is of key importance to develop national research and innovation RI structures that can respond to real (existing and future) industrial and societal needs. The proposed RI aims at producing innovative products and services from, what is currently considered as, industrial waste streams, with potentially harmful effects to humans and to the environment and are characterized by increasing disposal costs and strict management rules and regulations.



Annex II – References / Additional information

- **Assessment criteria**
- **Prioritization process for roadmap revision (flowchart)**

Assessment criteria

1st thread: Evaluation of the scientific and technical merit and innovation potential of the proposals has been implemented through peer review by high-ranking experts of international standing on the basis of the following **set of criteria**:

1. **Scientific, technological potential & maturity of the RI**
2. **Effective networking & synergies within the knowledge triangle**[10]
3. **Access policy, governance and sustainability**
4. **Innovation potential and socio-economic benefits**

Each proposal has been evaluated individually in each of the above criteria as well as in comparison to other proposals.

An Advisory Committee (including representatives from the National Council for Research and Technology, NCRT[11]) has overseen the whole evaluation process, working closely with the appropriately-formed GSRT Working Group — which will advise GSRT on the membership of the evaluation panels, in cooperation with NCRT — and aiming at the optimal planning and execution of the evaluation.

[10] *The National **RIs** may be single-sited or distributed over many sites. However, they should promote synergies within the knowledge triangle in the following ways:*
- *They should be able to sustain **Service Activities** to enable seamless access to **National** and (in some cases) **Transnational Access users** (scientists from Universities, Research Centres and Industry). The **access rules** for selection should be well-defined and transparent*
- *They should develop **Networking Activities** for promoting the frontiers of various scientific fields*
- *They should establish **Joint Research Activities** for improving the scientific quality of their services.*

[11] ***NCRT** (National Council for Research & Technology) is the high-level Advisory Body of the Ministry of Education and Religious Affairs for Research, Technological & Innovation Policy.*

The scientific evaluation has been conducted by thematic Evaluation Committees (comprising of a minimum of 3 experts each) covering the main research fields - as identified from the initial stage of proposal submission. Each proposal was individually evaluated by three (3) experts on the basis of an evaluation form that has been provided to them by GSRT.

Evaluation of the individual proposals started upon completion of the on-line submission process.
Upon completion of this step, the thematic evaluation committee formulated a consensus opinion for each proposal and also submitted a recommendation regarding the placement of the proposal in the National Roadmap.me

GSRT's Research Infrastructures are unique infrastructures that are totally or partially open to use by the entire scientific, technological and industrial community, both national and international.

More specifically, the main **evaluation criteria** were:

1. Scientific, technological potential & maturity of the RI
- The significance of the Research Infrastructure for specific research fields addressed, including:
  - Scientific objectives, main concept of the RI
  - Current state of the art
  - Expected benefits for the Greek research system as a location for conducting cutting-edge research at an international level
  - International reputation and visibility of the research team, involving the partners and key investigators
  - Impact of combating the brain drain of highly-skilled human resources (research & technical staff)
- Degree of interdisciplinarity
  - The effect of the RI on strengthening interdisciplinary research in Greece
- Perspectives for scientific & technological breakthroughs in the field of operation of the RI
- Maturity of the RI proposal
  - Proven ability to continuously follow the state of the art, and maintain experienced human resources & operational readiness

2. Effective networking & synergies within the knowledge triangle
- Competence complementarity of the partners and added value of the national RI network at the regional, national and international level
- Degree of networking and creation of critical mass
- Extent and types of the user community
- Potential for increasing existing / creating new research groups in the field of operation of the RI
- Education and training for students, researchers, technicians, engineers and administrators of the RI
- Synergies and networking capacity in relation to other Research and Innovation initiatives at the national and international level (with the emphasis on ERA integration effects, e.g. ESFRI participation)

3. Access policy, governance and sustainability
- Access policy for researchers
  - Transparent policy, incl. transnational access activities, conditions for providing access, addressing remote access needs in relation to availability of e-infrastructures and data management issues
- Access policy for industry (addressing IP rights (if applicable), fees and confidentiality issues)
- The management structure & governance of the proposed RI
- Technical feasibility, incl. human resource issues & cost-effectiveness of the proposed infrastructure, based on:
  - Level of requested funding and envisaged sources of funds
  - Multi-annual financial plan with funding sources information, as per:
    - Cost of investment
    - Operational Cost
    - Cost of decommissioning
    - SWOT analysis
    - Long-term sustainability plan of the investment

4. Innovation potential and socio-economic benefits
- Contribution of the RI, through its construction and operation, to an increase in the national potential for innovation and technology transfer, based on expected results and spillover effects of the RI
- Addressing major societal challenges
- The integration of the RI into the scientific, business and social environment in Greece and expected socio-economic benefits at the regional and national level.

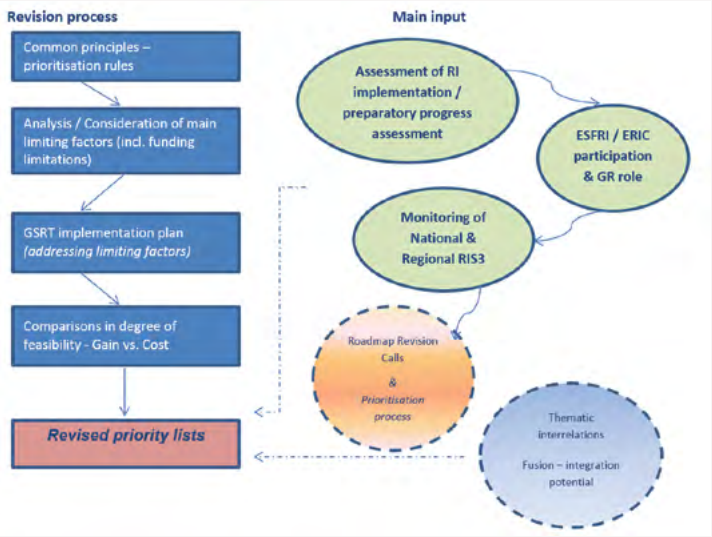
2nd Thread: Strategic prioritization of the proposed RIs, as set within RIS3 at the national and regional levels and the National Strategic Framework for Research and Innovation, as drafted through GSRT's coordination, with the guidance of the National Council for Research and Technology (NCRT). The strategic prioritization was based on:

1. **Expected economic and social benefits for Greece as a location for conducting cutting-edge research at a national, regional and international level, considering also the importance of cross-border cooperation**
2. **The relevance of the RI to the national strategic priorities for Research & Innovation**
3. **Its expected impact on national and regional development and competitiveness.**

The assessment of the strategic importance of the proposed RIs (coordinated by GSRT, in consultation with relevant policy bodies, as well as national and regional authorities) also took into consideration the expected impact of the RIs on additional socio-economic issues (e.g. employment, environment, related commercial/business activities) on the national & regional economy.

Prioritization process for roadmap revision (flowchart)

The prioritization process within the framework of roadmap revisions is described in the diagram below:



Annex III – Secondary list of RIs

Thematic area	Research Infrastructures	Short description
e-infrastructures	**NRESIS**/ National Research Sensors Infrastructure at Schools	The scope of the proposal is the development, operation and support of a new distributed RI to fulfill the needs of diverse research teams. This new RI will exploit the Greek School Network (GSN) infrastructure enabling innovative research at national level, with international visibility through the potential collaboration with academia worldwide. The development of this RI includes the following: · Installation of seismic sensors. A number of seismic sensors will be installed at schools especially at critical areas for seismological and structural monitoring. · Installation of meteorological stations. This action includes the installation of meteorological stations at schools for monitoring and recording various environmental parameters. · Installation of power meters. This task includes the installation of power meters at schools for energy consumption monitoring and studies related to smart buildings. · Installation of cognitive radio equipment. This action involves the installation of wideband, wireless, programmable transceivers at schools to be used for spatio-temporal spectrum cartography. Installation of an OpenFlow-enabled Virtualized Data Centre and Interconnection Network. This activity concerns the installation of an OpenFlow-enabled Virtualized Data Centre and Interconnection Network that will be used by the research teams and for storing the data collected through the proposed network of sensors. · Implementation of Visible Light Communication system for wireless indoor coverage. The final activity concerns the installation, channel modeling characterization and radio channel measurements of a Visible Light Communication complete indoor solution. The data collected through the sensors will be transferred using the GSN at a central node, from where the researchers will have access using various services. The impact of this new RI is not limited to the aforementioned scientific communities, but also includes the citizens (i.e. civil protection) and the school community by strengthening the conceptual view of science and research through the processing and assessment of real data.
	DIAS-4D/Data and model e-infrastructure for HF communications and trans-ionospheric satellite operations	The strategic goal of DIAS4D is to establish a unique e-infrastructure in Europe and worldwide for the monitoring, specification, forecasting and prediction of the ionosphere-plasmasphere-thermosphere environment for both scientific and operational applications. DIAS-4D is a major enhancement of the DIAS system (the European Digital Upper Atmosphere Server) that has been operated by the National Observatory of Athens since 2006, with data streaming in real-time from European Ionospheric Observatories. DIAS-4D will make Europe a prime player in issuing innovative services to support critical infrastructures from space weather-induced effects through a set of value-added services (specification of electron density at all ionospheric layers from the E region up to the plasmapheric heights, tracking of ionospheric irregularities, calculations of the neutral density of the atmosphere to estimate the atmospheric drag, etc), while assisting in enabling, supporting and performing the development and validation of next-generation ionospheric prediction models and tools, based on the analysis of near-Earth space data from ground and space observing platforms. DIAS-4D will be set up as a distributed infrastructure consisting of its main platform located in NOA and of data and model nodes operated at the main ionospheric observatories in Europe. An important aspect of the project is the interoperability with the main platforms for accessing near-Earth space data, such as ESPAS (EU-FP7), EISCAT (EU-ESFRI), IUGONET, GIRO and the ESA SSA Space Weather Portal.
	DeTAnet / Detector Development and Technologies for High Energy Physics and Applications	The current project proposes the upgrade of the electronics and detector development infrastructure, which is currently distributed across several laboratories in universities and research institutes, in order to support R&D activities in advanced instrumentation for the benefit of Greek High Energy Physics (HEP) groups and ultimately the Greek industry. The groups involved are based at the University of Athens (NKUA), the National Technical University of Athens (NTUA), the Institute of Nuclear and Particle Physics at NCSR Demokritos (INPP), the University of Ioannina (UoI) the Aristotle University of Thessaloniki (AUTH) and the University of the Aegean (UoAE). Organizationally, this 'Detector Development and Technologies for High Energy Physics and Applications' RI is coordinated by the Institute of Accelerating Systems and Applications (IASA), a research institute that belongs jointly to the NKUA and NTUA. The main goals of the proposal are 1. To support all instrumentation-related activities of the Greek HEP groups up to 2020. 2. To introduce new technologies that have been and are currently developed in HEP for the Greek industry. 3. To involve Greek companies in research and construction projects at CERN which are subcontracted to member states such as Greece. The aim of this is to increase the return to Greece of the state funds contributed to CERN. The above are directly aimed at maintaining Greece as a partner in the European Strategy for particle physics, which was approved by the Summit of the European Ministers for Research, in Brussels in May 2013.
Physical Sciences and Engineering	**HIMAST**/ Hellenic Institute of Marine Structures	The proposed Research Infrastructure (RI) concerns a modern, innovative institute of marine structures in Greece (Hellenic Institute of Marine Structures, HIMAST), aiming at the further growth of related research and technology with the simultaneous development of methodologies/tools of direct application to the design and construction of marine structures. Individual recent research advances in the last decade, such as high-fidelity numerical models utilizing high-performance computing, large-scale laboratory experimentation, field testing and real-time monitoring have undoubtedly increased our level of understanding of marine structures' behaviour. However, these advances are not effectively harnessed in a manner that leverages all relevant developments and translates them into predictive tools that can be directly used by stakeholders; the RI aims to improve the performance of marine structures. Motivated by this realization, the main feature of HIMAST is the integration of computational models, experimental tests and field tests, as well as the structural health monitoring associated with the required research. The mission of HIMAST is the development and application of an integrated scientific knowledge and technology for analyzing, designing and operating novel marine structures addressing new needs and challenges (e.g. renewable energy) in an intensely evolving environment and for harmonizing the design and operation of existing marine structures in evolving environmental conditions (e.g. deep water depth, climate change). HIMAST will be the first of its kind in Greece and its vision is to redefine and strengthen the role of the Greek research community in the field of marine structures at European and world level. The combination of the location (S.E. Europe) of HIMAST and the superb technical capabilities to be offered indicates that this RI will constitute internationally one of the most competitive infrastructures for developing and applying scientific knowledge and implementing related research in order to analyze, design and monitor any kind of marine structures.

Physical Sciences and Engineering	**DIONAS** / Deep Ionian Observatory for Neutrinos and Associated Sciences	ESFRI has placed the KM3NeT (km3 Neutrino Telescope) Research Infrastructure (RI) on the Road Map of Major European RIs. KM3NeT will be a European RI distributed across three locations (Installation Sites) in the Mediterranean Sea: in the South of France, Southern Sicily in Italy, and in the Western Peloponnese, close to the Hellenic Trench, in Greece. With this proposal we request to keep a KM3NeT-Gr facility, which is the KM3NeT infrastructure at the Greek Installation Site (IS), on the National Road Map for Large Scale Research Facilities, as part of a National Research Infrastructure, the Deep Ionian Observatory for Neutrinos and Associated Sciences (DIONAS RI). The neutrino telescope facilities will be constructed by the KM3NeT-Gr Network, that is, the consortium of Greek research teams participating in the European KM3NeT project, according to the results and technological solutions described in the Technical Design Report, delivered to the EC in the context of the KM3NeT Design Study. The KM3NeT-Gr installation will have the potential to achieve discoveries that will shape our understanding for the evolution of our Universe. Moreover, the proposed DIONAS RI will provide unique facilities for the real-time, continuous measurement of Geodynamic, Environmental, Oceanographic and Marine Biology parameters to the Earth and Sea Sciences consortium of research teams (ESS Network), which participates in this project.
Biological and Medical Sciences	**EMORI**	The concept of EMORI is to provide a sustainable infrastructure for the implementation of high-standard, highly competitive and cost-efficient clinical and translational cancer research in Greece, for the benefit of cancer patients, clinical practice and science. Partners in this effort are the Hellenic Foundation for Cancer Research (HeFCR) and Hellenic Cooperative Oncology Group (HeCOG) with the Molecular Oncology Laboratory; the Molecular Diagnostics Laboratory at 'Demokritos'; the University Department of Medical Oncology, Crete (Laboratory of Tumor and Cell Biology); and IBMCB (National Hellenic Research Foundation). The network has been very efficient and self-sustained in scientific research for the last 20 years. The proposal comes to meet the demands of current scientific paradigm shifts, such as the recent exponential accumulation of cancer-related genomic and phenotypic data; the parallel explosion in the development of new technologies for genomic research and new anticancer drugs; the established necessity for personalizing treatment for cancer patients; and the socio-economic crisis affecting Europe, especially Greece. OBJECTIVES: to strengthen and expand clinical cancer and translational research in Greece; to produce innovative tools for clinical applications; to link activities with European Networks and Infrastructures in Greece, (ELIXIR-GR); to strengthen the academic excellence of Greek researchers; to provide continuous education for researchers and practitioners in Oncology, Pathology, Medical Genetics, Laboratory Medicine, Molecular Biology, Bioinformatics, Biostatistics; to provide high-standard treatment to cancer patients in Greece without burdening the health system. ANTICIPATED BENEFITS: innovative anti-cancer treatments and efficient, standardized biomarkers for application in personalized medicine; the creation of a national registry for cancer genotypes; increased and efficient feedback between pharma, biotech and research groups in Greece; the sustainability of the infrastructure; the alleviation of health system costs for anti-cancer therapies and genetic testing; increased visibility of Greek clinical centres as partners for multi-national clinical trials; the alleviation of brain-drain; improved clinical service for society.
Energy	**HPCC-REA**	The establishment of a high performance computer cluster is proposed, one that can be used by groups involved in Renewable Energy Sources (RES) research and applications. RES and especially wind, solar, wave, tidal and currents require significant computer resources. State-of-the-art model simulations require computer power of thousands of CPU-cores and storage of hundreds of TB. The mapping of available renewable energy potential and associated extremes is a task with demands beyond the existing infrastructure of each partner. Generator siting requires CFD codes that are place high demands on computer resources. Studying generator characteristics and efficiency is an equally demanding problem (improved characteristics, new material use, material fatigue and other aero-elasticity problems). Offshore energy production is a more complicated problem of multidisciplinary type. Managing the produced energy and adapting it to electrical grids is a complicated issue that requires considerable computer resources. The proposing groups usually have relatively small infrastructures at their premises. Data transfer between the groups that work complementarily to each other is a major issue (size, time needed). The proposed RI is considered as an extension to existing ones (group level) but also something new (a uniform cluster) with the capacity to host activities that cannot be hosted in existing infrastructures or in other HPC centres. Involved groups have significant activities in real-time operations that are equally demanding and cannot use existing HPC centres for many reasons. The proposed RI will concentrate all these activities in a single place, the resources will be optimized because the involved disciplines work complementarily. Existing operations will be hosted in a secure and efficient way. The proposing groups will be able to participate in European-scale alliances such as the European Energy Research Alliance (EERA), DERri, DERIlab, ERA-Net and other HORIZON2020 projects. Without this infrastructure it is almost impossible to participate in such activities.


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