2014 -2020

National Strategic Framework for Research & Innovation
Εθνικό Στρατηγικό Πλαίσιο Έρευνας & Καινοτομίας (ΕΣΠΕΚ)

National Council for Research & Technology

Εθνικό Συμβούλιο Έρευνας & Τεχνολογίας

ΕΣΕΤ (2010-2013)

ΕΘΝΙΚΟ ΣΥΜΒΟΥΛΙΟ ΕΡΕΥΝΑΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ (ΕΣΕΤ)
NATIONAL COUNCIL FOR RESEARCH & TECHNOLOGY (NCRT)
2010-2013

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Glossary – Acronyms

NCRT	National Council for Research & Technology
ΕΣΕΤ	Εθνικό Συμβούλιο Έρευνας και Τεχνολογίας
GSRT	General Secretariat of Research & Technology
ΓΓΕΤ	Γενική Γραμματεία Έρευνας και Τεχνολογίας
DSC	Disciplinary Science Councils
ΤΕΣ	Τομεακά Επιστημονικά Συμβούλια
ESPEK	National Strategic Plan for Research & Innovation
ΕΣΠΕΚ	Εθνικό Στρατηγικό Πλαίσιο Έρευνας και Καινοτομίας
GDP	Gross Domestic Product
ΑΕΠ	Ακαθάριστο Εθνικό Προϊόν
R&D	Research & Development
Ε&Α	Έρευνα & Ανάπτυξη
OECD	Organization on Economic Cooperation & Development
ΟΟΣΑ	Οργανισμός Οικονομικής Συνεργασίας και Ανάπτυξης
CSF	Community Support Framework
ΚΠΣ	Κοινοτικό Πλαίσιο Στήριξης
GERD	Gross Expenditures on Research and Development
ΑΕΔΕΤΑ	Ακαθάριστη Εγχώρια Δαπάνη Έρευνας και Τεχνολογικής Ανάπτυξης
AITC	Association of Informatics and Telecommunications Companies
ΣΕΠΕ	Σύνδεσμος Εταιρειών Πληροφορικής και Τηλεπικοινωνιών
ICRTI	Inter-ministerial Committee for Research Technology and Innovation
ΔΕΕΤΕΚ	Διυπουργική Επιτροπή Έρευνας Τεχνολογίας και Καινοτομίας

1.0 Foreword

When the NCRT (National Council of Research and Technology - ESET) was convened in September 2010, it became evident that there was a need for a long-term national strategic plan for R&D, as is commonly practiced in the EU, US, Japan, and most other advanced countries. Strategic plans are used to scope out the strengths and weaknesses of the R&D enterprise, identify areas where critical mass exists to enable rapid progress, promote and strengthen connections of the research establishment with the entrepreneurial community, and allocate investments in a fair and competitive manner. Such plans are designed to promote advancement of science, technology and innovation in any knowledge-based society that aspires to high level technological accomplishments and rapid and sustained economic growth. NCRT recognized that a long-term (about 5-10 years) strategic plan is absolutely essential as a prudent policy tool, especially in a country where changes in political leadership are frequent and disruptions in R&D activities are known to be detrimental to the whole enterprise. Work on the Ethniko Stratigiko Plaisio Erevnas kai Kainotomias (ESPEK)-National Strategic Framework for Research and Innovation document began in early 2011 with the enthusiastic support and encouragement of then Minister Anna Diamantopoulou and was concluded at the last meeting of the ESET council in October 2013.

The plan laid out in this document is the result of many inputs, including the expertise provided by the Disciplinary Science Councils (DSC – TES- Tomeaka Epistimonika Symvoulia), broad-based consultations with the scientific, technological and entrepreneurial communities, and the discussions, both formal and informal, of all members of NCRT with professional colleagues both in Greece and abroad. The responsibility for the result, however, rests squarely with the members of NCRT, so any comments, observations, and criticisms should be directed to us.

Finally, we note that a Strategic Plan per se is not of much use unless it is followed by an Implementation Plan, as described in section 6.3 of this document. It is up to the successor NCRT-ESET to oversee the construction of such a plan and assist the General Secretariat for Research & Technology (GSRT-GGET) in establishing the management structures necessary for carrying it out successfully.

Needless to say, this work would not have been possible without the dedicated efforts of Dr. Maria Christoula, Executive Secretary of NCRT, and also the assistance of Mr. Vasilis Gogolides, Mr. Panagiotis Hatzinikolaou and their colleagues at GSRT.

Stamatis Krimizis,

Chairman of NCRT (2010-2013)

Executive Summary

Strategic plans are used to scope out the strengths and weaknesses of the Research & Development (R&D) enterprise, identify areas where critical mass exists to enable rapid progress and innovation, promote and strengthen connections of the research establishment with the entrepreneurial community, and allocate investments in a fair and competitive manner. Such plans are designed to promote advancement of science, technology and innovation in any *knowledge-based society* that aspires to high level technological accomplishments and rapid and sustained economic growth.

The NCRT identified the development of a Strategic Plan as an important priority upon its appointment in the fall of 2010 and a draft plan was completed in the fall of 2013. The principal goal of the strategic plan is the identification of areas of strength and excellence that can be further advanced and can become engines for progress and growth. The guiding principles used for prioritization are the following:

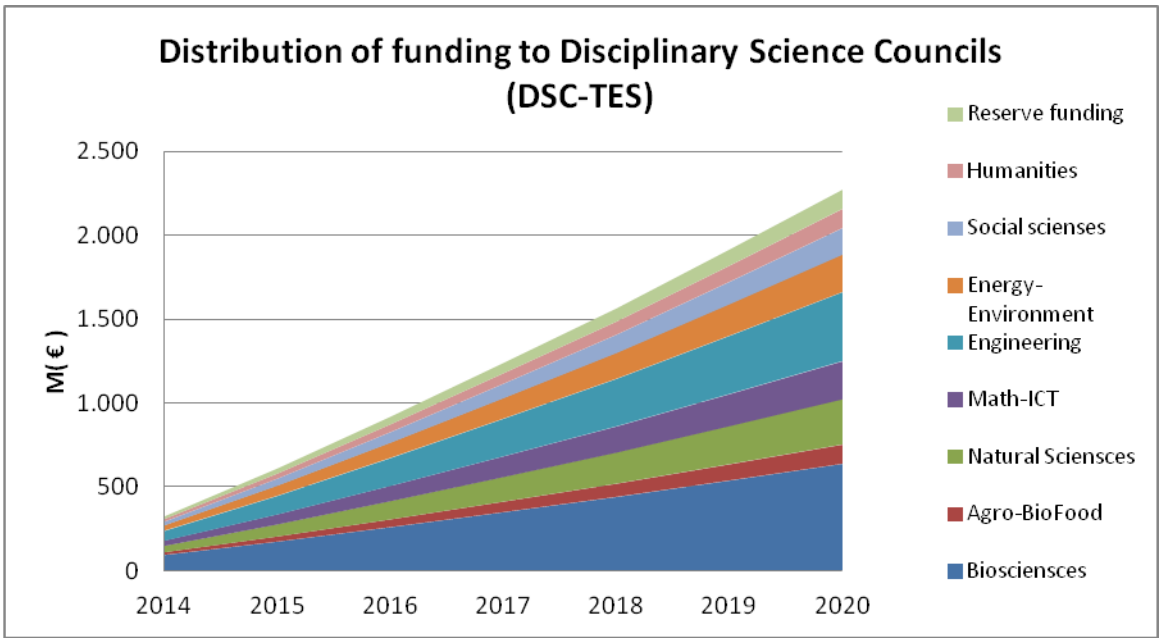
1. Areas of traditional strength (examples: shipping, tourism, energy).
2. Areas of recent successes in terms of critical mass and on-going activities (examples: IT, pharmaceuticals, engineering, energy).
3. Areas of high added value and able to deliver major economic benefit and employment prospects (examples: energy, nutrition – food sciences).
4. Areas of major national interest (examples: food production, archaeology, culture, energy, defense, biomedicine).

An additional consideration was to enable and nurture the emergence of new areas that may have significant potential to advance science and scientific applications and to contribute to the national well-being.

The specific plans developed by each Disciplinary Science Council (DSC/TES) with input from a joint study of the Hellenic Federation of Enterprises (HFE-SEV) in collaboration with the Foundation of Research & Technology – Hellas (FORTH) were considered by ESET in plenary, and then prioritized in such a way as to conform with linear growth in the R&D and innovation budget *from the current 0.61% of GDP to the goal of 1.5% of GDP by 2020*. The 1.5% goal is about half of the 3.0% of GDP set by the EU for the same time interval (see section 4.3 of this document). It is projected that 60% of the funds would come from national and EU sources while 40% would come from the private sector (compared to the current 30%). The relative contributions to R&D in EU, US, and Japan is nearly reversed, i.e. 66% private and 33% public.

The proposed programs in each of eight disciplinary areas consist of specific projects/actions with implementation timetables and estimated costs for each. The

detailed descriptions of these proposals are given in section 5.0, together with their projected funding profiles, and can be seen in the chart below:



ESPEK must be considered as an essential part of the strategic plan for Greek development. ESPEK focuses on R&D actions as part of the overall development plan. It is clear that these actions are closely related to, and their effectiveness depends on, the state of Greek public administration, the tax environment and tax incentives, the legal/regulatory environment and labor regulations and cost. Therefore, effective implementation of ESPEK requires addressing specifically:

(a) Actions to improve the public administration of R&D

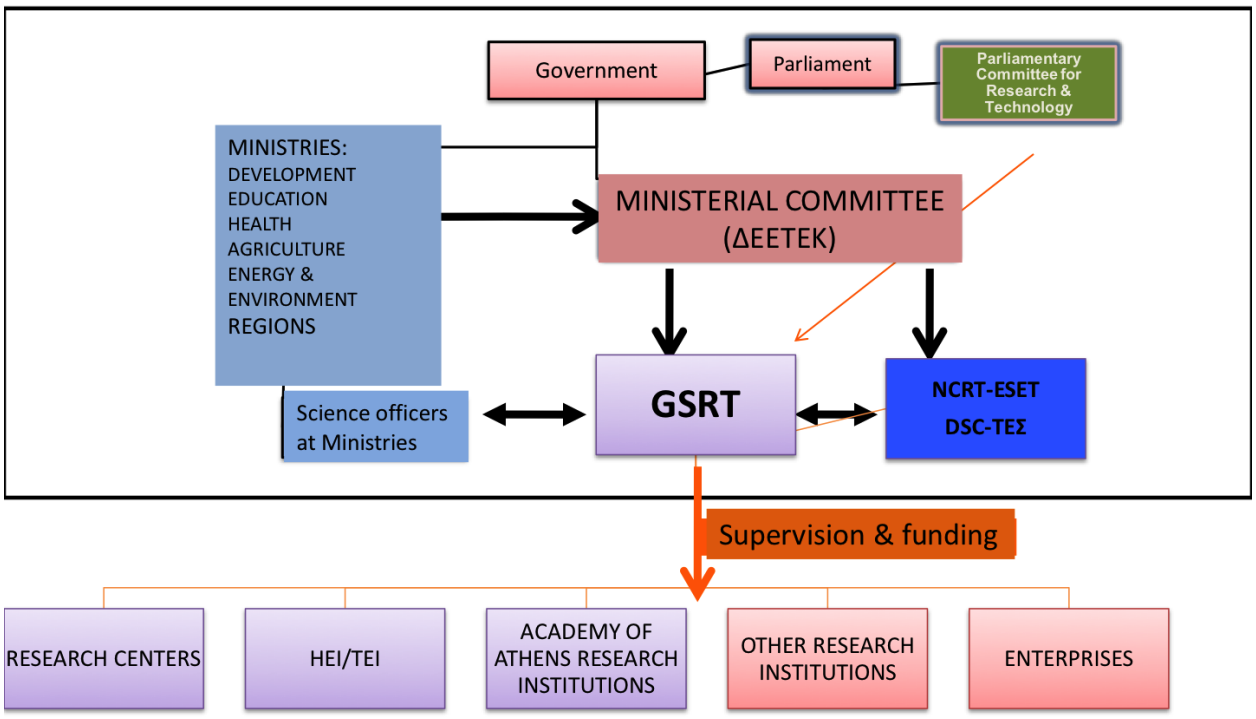
(b) Improvement specifically of administrative structures to facilitate distribution of public funds and evaluation of their use

(c) Establishment of stakeholder and advisory bodies necessary for generation, implementation and evaluation of R&D plans and actions

(d) Actions on educational reform necessary to support R&D

(e) Effective funding mechanisms, tax incentives and rebates supportive of R&D

For these actions to become effective, NCRT/ESET proposes restructuring the overall management of Research, Development and Innovation as shown in the organization chart below with GSRT assuming a central, coordinating role. A detailed discussion is found in section 6.3 of this report. It is noted that similar organizational structures are common in essentially all EU countries, the US, and Japan.



The adoption and implementation of this Plan can signal a decisive shift to a stronger and more sustainable growth path for Greece, with R&D supporting a commitment to a knowledge-based economy that fosters innovation. It can also promote parallel reforms that will impact on governance and management; public expectations; and social inclusion.

The obstacles to the realization of these goals – stemming from accumulated problems of the past and intensified by the current crisis– are considerable. Short-term pressures can generate distractions from the objective of creating a productive and innovative base and even encourage recourse to drift. Their achievement will require a change in structure, processes and resources, as indicated in Section 6.4.

Yet, the gains for Greece from the kind of investment outlined in Section 4.3, and detailed elsewhere in this Plan, are considerable:

- The recovery of the nation's economy, consistent with the well-established nonlinear relationship between research and innovation activities and GDP growth.
- The emergence of new industrial and entrepreneurial activity and of clusters with high added value.

- The deceleration – and possibly arrest – of the wave of emigration of the youngest (and often most qualified) members of the scientific and technical community abroad.
- The renewal and replenishment of the crucial human resources required for such an economic model.
- The creation of a research base that will guide and support the design of economic and social policy.
- The expansion of opportunities to address issues of social inclusion, environmental balance, and regional innovation.
- The promotion of our cultural heritage and identity, and increased awareness of how this relates to the European identity.

Such gains are consistent with the experiences of our European partners, as well as internationally.

This plan outlines the path to a different economic model and research environment. It has been designed to break with the flaws inherent in the present system: the declining education system; the confusion and weaknesses of R&D governance and management; the discontinuities and inefficiencies of resource allocation and investment; the lack of adaptation to clearly-defined national priorities; and the inadequate opportunities and funding for high-quality research and development to flourish. The Plan identifies the need for prioritisation and efficient allocation; the stability of the policy frame; the predictability of planning; the provision of opportunity; the recognition of excellence; and responsiveness to current and future needs.

Finally, a Strategic Plan *per se* is of little value, of course, unless it is followed by an Implementation Plan (see Section 6.3 of this document). We hope that this initial effort for a Strategic Plan will continue, expand and improve, and that the administration will establish the management structures and the funding necessary for its realization.

2.0 Introduction

Few would doubt the need for Greece, at this difficult time, to map out a new way forward. In developing this Plan, NCRT-ESET has endeavored such a break in two fundamental respects: to outline a different growth strategy for the country and to engage in a more open and sustained process of policy planning. In both tasks we have drawn upon inputs from across Greece, but also from international experiences and best practices.

Greece must exit a recession that exceeds in magnitude that experienced by the USA during the Great Depression of the 1930s. Some argue that growth – in investment and exports – will be achieved through sizeable drops in wages and salaries. In fact, Greece has already experienced dramatic reductions in unit labour costs without a noticeable effect on investment or export demand (Herrman and Kritikos, 2013). Instead, Greece has suffered a massive flow of skilled young professionals to foreign countries reported to be some 120,000, since the start of the financial crisis in 2010, that can better utilize their knowledge and talents. The NCRT-ESET is well aware of this 'brain drain' and not only from the young. These are serious impediments to the country reviving its economy on the basis of entrepreneurship, smart specialization, and the utilization of its comparative advantage.

A sustainable long-term growth path for Greece will require investment in the creation of knowledge and the stimulus to innovation. Reviving GDP via a consumption-led boom will not meet the new European and international challenges that Greece faces nor represent the necessary break with past vulnerabilities. This ESPEK must be seen as an integral part of a new 'smart' growth model – that is why NCRT - ESET advances the need for a substantial increase in the share of GDP devoted to R&D in the 2014-2020period, together with a range of targeted initiatives for research and innovation. This is not a matter of ideals, but rather of practical necessity: there is ample economic evidence of the role of investment in R&D as a key driver to sustainable, long-term growth. Over the last decade, Greece has been an outlier from this equation of R&D investment and overall growth: graph 2.1, for example, shows the levels of R&D investment amongst our EU partners and those of GDP growth in 2010.

Investment in R&D : a key step for overcoming the crisis

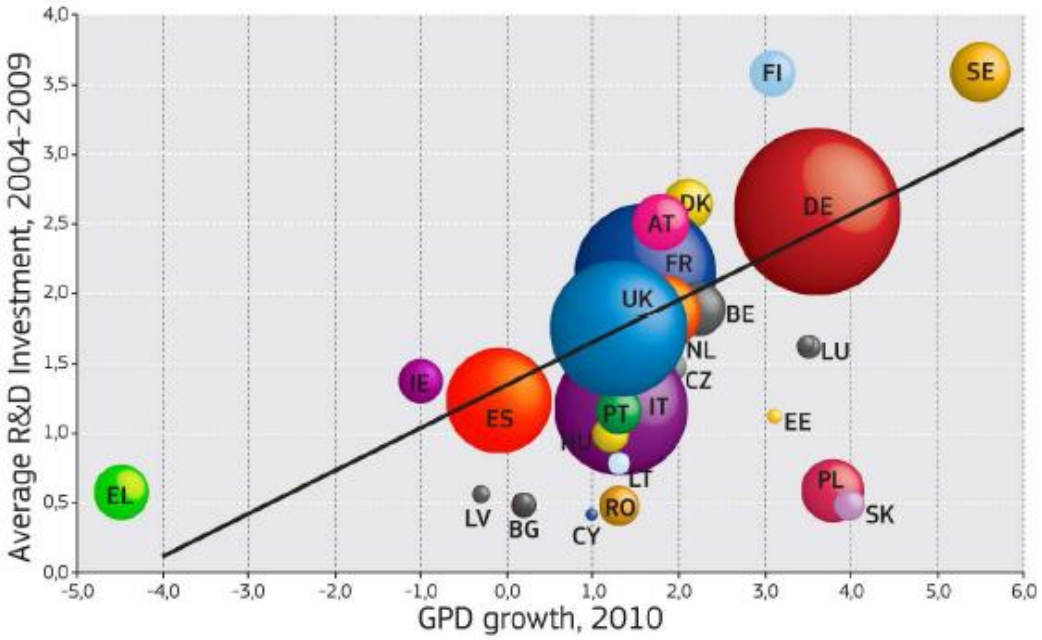


Figure 2.1. Levels of R&D Investment and GDP growth (2010)
Source: European Commission

An effective R&D strategy requires long-term planning and stability. Its full yield will come from the connectivity between enterprise, research excellence, and growth, as one feeds off the other. This Plan acknowledges the remarkable scientific potential of our country that can be unleashed, the need to stimulate and guide this through the recognition of excellence in performance, appropriate funding, and the dynamic contribution this can make to a new long-term growth strategy.

Enterprises – Research Potential – Development

Any effective planning process requires wide and expert consultation and inputs. This ESPEK is the result of wide consultation between ESET and relevant stakeholders: the research communities, not least via the Disciplinary Science Councils (DSC-TES); Representatives of business; Social organizations; and Think-Tanks~~]~~. In addition, ESET has presented its work and obtained feedback from Parliament [Permanent Parliamentary Committee on Research & Technology] and from various professional conferences. The gestation of this ESPEK began in earnest in early 2011 and has continued through different ministers, secretaries-general, and governments.

We must note, however, that this Plan has had to be developed within a number of significant constraints. NCRT-ESET lacked some basic data on current conditions and performances. This is symptomatic of the limitations of primary data often evident in the nation's public policy deliberations. NCRT-ESET did not always receive the full range and quality of inputs it regarded as important to its deliberations; though others (collectively and individually) made contributions well beyond our expectations. With the help of the latter, ESET has done the best it can to establish an informed, coherent and effective strategic plan for the country.

The Plan that follows has been created as an integrated whole, with priorities set to complement national needs and to provide a balanced programme of research development. It is not to be read as an 'a la carte' menu of expenditure items. Action of this kind would merely exacerbate the inherited problems Greece has

faced: of a disconnected, discontinuous, and distorted pattern of research activities and investment. We have attempted to break with this past: to outline a way forward on the basis of an informed and coherent plan. It draws on international models and best practices. As such, it can be supported by Greece and its partners as a stronger, credible prospectus for future development.

3.0 Overview

3.1. Evolution and framework of Research and Technology Policy in Greece[1,2]

The first steps in the development of Research & Technology policies date back to 1964, when the Greek government asked the OECD to assess the Greek R&D system, to recommend policies and to identify an appropriate governance model. In the period 1982-1985 a Ministry of Research and Technology was established, which subsequently became the General Secretariat for Research and Technology (GSRT) under the Ministry of Industry, Energy and Technology. The merging of several Ministries in 1996 resulted in the creation of the Ministry of Development, which covered the sectors of Industry, Research and Technology, Energy, Trade & Consumer Affairs.

In 2009 GSRT became part of the Ministry of Education and Religious Affairs signaling the State's intention to create synergies between Education and Research & Innovation. The GSRT is currently the main authority in Greece competent for the formulation and implementation of Research & Technology policy. A more detailed timeline for the development of the legal framework governing Greek RTD is provided as Appendix I.

Since the early 1990s RTD in Greece has been funded mostly through the structural programmes of the European Commission (Community Support Framework, CSF) along with the relevant contribution from the Greek State. The only purely national funds come from the Regular Budget for Institutional funding of Research Centers and Universities along with very limited funds of the Public Investment Program.

The overall funds allocated to Research & Technology funded through the CSFs of the EU during the last three cycles are listed in Table 3.1 below. At present the Operational Programs of the 4th Community Support Framework (2007-2013) are under their final implementation phase, whilst the formulation of the strategy and preparation of the Operational Programs for the next programming period (2014-2020) are well under way.

[1] Parts of this section draw from the GSRT background document submitted to OECD in 2007 and from A. Χατζηπαραδείσης, 2009, Το Ερευνητικό Σύστημα της Ελλάδας και η εξέλιξή του. Επιστήμη και Κοινωνία, τεύχος 22-23, Φθινόπωρο 2009] as well as from a description of the historical evolution of the GSRT available at www.gsrt.gr]

[2] Lena Tsipouri and Mona Papadakou, "Profiling and Assessing Innovation Governance in Greece: Do increased funding and the modernisation of governance co-evolve?", OECD 2005 – Governance of Innovation Systems, Vol. 2, pp 23-42

From this analysis it is clear that the funds provided by the Operational Programs are critical for Greek RTD and care should be taken that these funds are deployed rapidly and efficiently and used wisely to support the RTDI effort.

Table 3.1. Research Policy Pillars funded by GSRT under 3 Community Support Frameworks (1994-2013)

(RESEARCH POLICY PILLARS FUNDED BY GSRT UNDER THE 3 CSFs)								
	A/A	POLICY PILLAR	EPET II (2° CSF) [1994-1999]		EPAN (3° CSF) [2000-2006]		ESPA (NSRF)* [2007-2013]	
			(€)	%	(€)	%	(€)	%
	1	LINKING RESEARCH WITH BUSINESS SECTOR	135.881.805	33%	100.951.317	17%	226.795.327	21%
	2	INNOVATION	43.276.332	11%	112.578.605	19%	180.657.751	17%
	3	HUMAN RESEARCH POTENTIAL	62.218.632	15%	220.466.133	38%	440.777.924	41%
	4	RESEARCH INFRASTRUCTURES	120.948.904	30%	93.722.367	16%	149.225.790	14%
	5	EUROPEAN AND INTERNATIONAL COOPERATION	8.267.959	2%	41.281.937	7%	77.514.077	7%
	6	SCIENCE AND SOCIETY/RESEARCH POLICY SUPPORT	35.577.236	9%	17.896.052	3%	7.029.969	1%
		TOTAL	406.170.867		586.896.411		1.082.000.838	

*Source : GSRT - * for ESPA(NSRF) numbers refer to budget as per the 3rd quarter of 2012 (12/7/12).*

3.2 Goals and Objectives

The basic goal of this ESPEK is to provide guidance for practical actions for the next period (2014-2020) aiming to improve society and economy through R&D and to the further development and implementation of the knowledge society.

There was never in the past a better educated Greek population and this must be used as an engine for new development and ending the crisis.

The importance of developing, maintaining, and utilizing a strong knowledge base for the well-being and improvement of society has been amply documented. In the present economic situation, it is imperative for Greece to design and implement a realistic yet ambitious plan to address Development. Of central importance in this plan are the Research and Development activities, because it is only through expansion of the knowledge society and through the implementation of knowledge in the improvement of economy and society that significant progress can be made.

The inevitable expansion of globalization trends and the communications/ information technology revolution provide immense challenges, but also great opportunities. Greek society is exposed to globalization in multiple ways. A major Greek industry, international shipping, is fully globalised. Tourism is also a global activity, bringing millions of people from the entire planet to Greek communities small and large every year. The huge Greek Diaspora developed by multiple immigration waves has various degrees of contact with Greece and is used to operating globally. The immigration tradition should also warn Greek society about an «easy» way out of the crisis, which is under way and will hurt the developmental prospects of Greece through brain drain. An optimal approach would be to devise ways to ensure that the most educated and skilled Greek generation remains in Greece and supports development.

ESPEK must be considered as an essential part of the strategic plan for Greek development. ESPEK focuses on R&D actions as part of the overall development plan. It is clear that these actions are inter-related to, and their effectiveness depends on, the state of Greek public administration, the tax environment and tax incentives, the legal/regulatory environment and labor regulations and cost.

Although improving public administration, the tax system, etc, are mostly beyond the scope of the ESPEK planning of GSRT/ESET, the implementation and effectiveness of ESPEK depends on all these factors; they cannot be addressed separately. Therefore, effective implementation of ESPEK requires addressing specifically:

(a) Actions to improve the public administration of R&D

(b) Improvement specifically of administrative structures to facilitate distribution of public funds and evaluation of their use

(c) Establishment of stakeholder and advisory bodies necessary for generation, implementation and evaluation of R&D plans and actions

(d) Actions on educational reform necessary to support R&D

(e) Effective funding mechanisms, tax incentives and rebates supportive of R&D

Areas of focus

A goal of the strategic plan is the identification of areas of strength and excellence that can be further advanced and can become engines for progress and growth.

These areas are selected based on criteria outlined in section 6.1 on the basis of track record, future promise, and potential contribution to Greek society.

Support mechanisms for the areas of focus must be implemented and interconnections between them must be facilitated so that maximum benefit is derived.

A second goal is to explore synergies and propose methods and actions for implementation of interventions that achieve maximum benefit. The proposed actions should also promote connections among areas required so that maximum benefit is realized and new opportunities are explored. For example in the sector of IT, interfacing IT with Biology/Medicine to generate strength and new applications for Bioinformatics and Medical informatics; IT to enhance tourist experience by improving advertising, booking, planning, site information, virtual reality experience, global communications, logistics, entertainment, telemedicine applications in shipping; nutrition/medical diet programs for specialized medical tourist packages.

Interactions and collaboration between academic/educational institutions and business is mostly lacking and needs to be strengthened.

A basic postulate of the strategic plan is that the Greek scientific potential is strong and internationally competitive in several areas, but this has to be translated into tangible applications and results for the economy. While indices measuring effectiveness of Greek science show areas of excellence, the international competitive status of the country continues to decline.[3]

To reverse this situation, the right mix between academic research activities and development of applications of cutting edge research has to be agreed upon by all sectors and new methods of support and implementation have to be developed. Connecting the scientific personnel to the real economy presents difficulties due to weaknesses of Greek companies, but also due to the attitude and set of values of the scientific community and of the society at large. For a long period the business community has been seen as incompatible with the education process. This attitude needs to change, because a major goal of education is to develop productive and useful members of society. It is not acceptable that business activities are demonized and are considered incompatible with universities and the educational process by part of the Greek society.

Administration of short-term and interim implementation plans

It is essential that the strategic plan address the immediate problems in strengthening R&D that were generated by the crisis. It is important that EU funds during the next period be used rapidly and efficiently, because they will be a major part of the Greek R&D investment. Strengthening and modernizing administrative structures is considered essential. EU guidance requires the involvement of the 13 Greek regions in the implementation of the Development plan. While Greece must

[3] (Greece is the 100th position according to the Global Competitiveness index of the World Economic Forum)

work for strengthening Regional administration, ESPEK considers that the state of affairs and the lack of specialized administrative structures for R&D activities in some regions require that Greece be considered as a single region for the purposes of R&D activity planning and coordination. The GSRT and, hopefully, all central administrative structures will work in collaboration with the regions with the long-term goal to develop regional and specialized R&D activities.

Due to the present state of affairs and the difficulties in coordination of the state institutions and stakeholders, it is proposed that the strategic plan focus on shorter term issues, in order to optimize use of available funds during the next EU funding period and to support the Greek exit from the crisis. A strategic plan with longer-term goals should be worked in parallel, drawing from the accumulated experience.

3.3 Summary of Recommendations

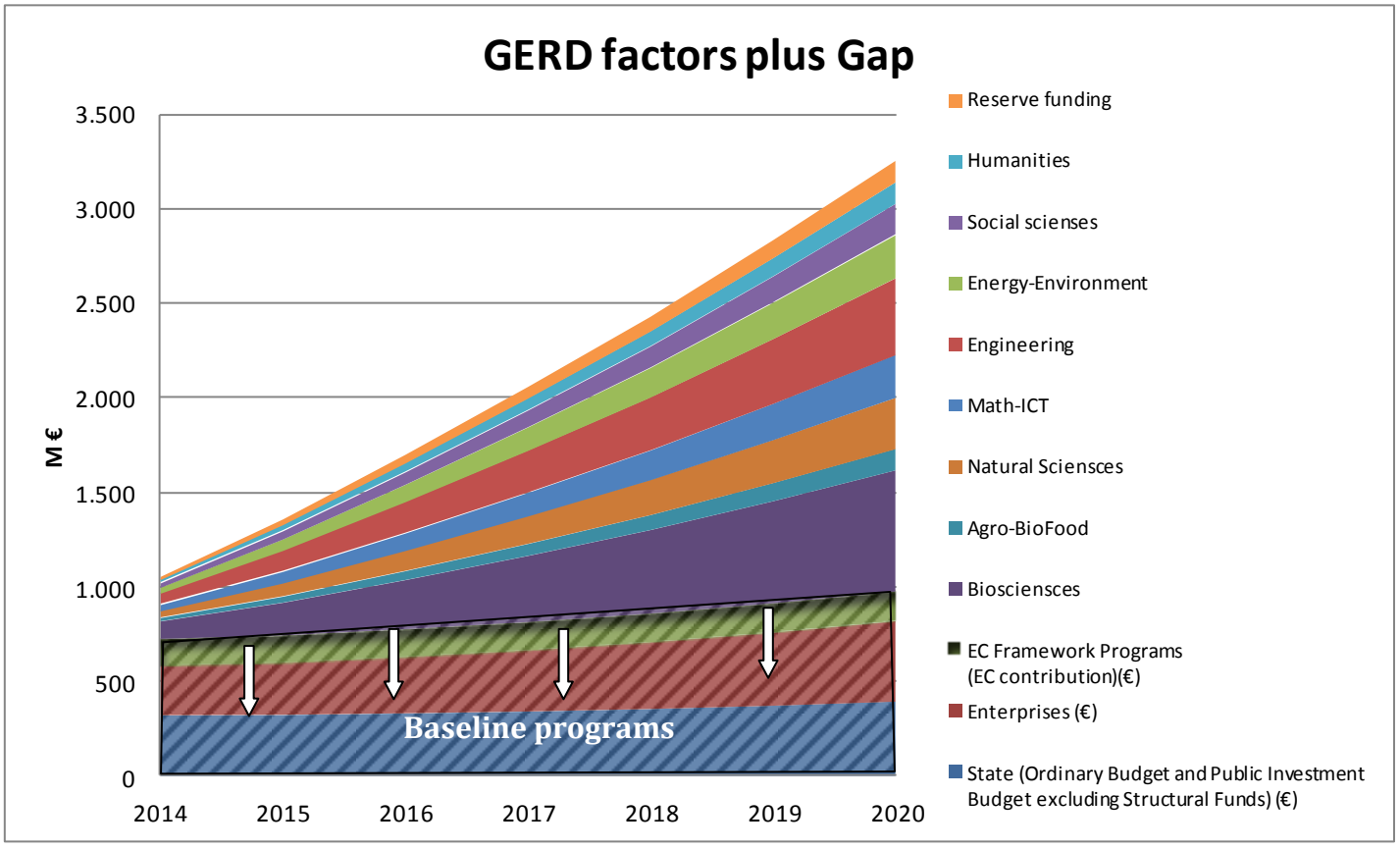
Section 3.2 discussed the Goals and Objectives built into the strategy, namely the mix of cutting-edge, critical mass, basic and applied research and innovation tightly connected to entrepreneurship and the economy at large. In section 5.0 the plan describes the prioritized specific actions required in each discipline area, together with the budgets and associated timetables to enable progress in each. The prioritizations represent the consensus of most stakeholders, collected and organized by the DSC -TES working together with GSRT, with input from the R&D community including the Hellenic Federation of Enterprises (HFE-SEV), enterprises, non-profit organizations, and others. The resulting priorities were debated by the ESET in plenary, and then ordered in such a way as to conform with linear growth in the R&D and innovation budget from the current 0.61 % of GDP to the goal of 1.5 % of GDP by 2020, as enunciated by the Government. The 1.5 % goal is about half of the 3.0 % of GDP set by the EU for the same time interval (see section 4.3 of this document).

Chart 3.3-1 shows the proposed funding levels for the period 2014-2020, separately for each discipline area. It is noted that it includes the current baseline programme of expenditures for R&D at Universities, Research Centers, plus structural funds, enterprises, and EC framework programmes (the lower three profiles in the chart, totaling about 726 M). This level constitutes the ~ 0.61 % of GDP in 2013 referred to above. The additional funding required to evolve toward the 1.5% level by 2020 is what will be needed, from all sources. To illustrate the point more clearly, Chart 3.3-2 shows this «gap» in funding for each year, between 2014 and 2020. Thus, 326M of new funding from all sources will be needed for 2014 to enable the initiation of projects in the various discipline areas detailed in section 5.0 of this document. Since most of the new funding for R&D is anticipated to come from the new Partnership Agreement (PA), an urgent recommendation is to secure enough funding in the proposed plans so that the 1.5% goal becomes realistic by 2020. For this target to be achieved the participation of the private sector is essential. The

state can support this target by removing bureaucratic burdens, improving the tax system, improving public administration, and fighting corruption.

Details of the prioritization for each area are not readily apparent from these charts. For that, the reader must go to the individual descriptions for each area in Section 5.0. From those descriptions one will recognize that there is a plethora of high priority projects in each area, all of which are feasible and doable. They are feasible because a critical mass of trained personnel exists to implement them, the country's competitive position vis-a-vis others is good-to-very good for each, pathways to applications and entrepreneurship are obvious, and many address key sectors of the economy such as tourism and shipping. The plan offers just the kind of prescription that the Greek economy needs to embark on a new path of solid growth fostered by the knowledge economy that promises to sustain this growth for many years to come.

Figure 3.3.1. Baseline and additional yearly funding required from all sources, in million €, to achieve the 1.5% of GDP by 2020 for each discipline area, so as to enable the projects prioritized in section 5



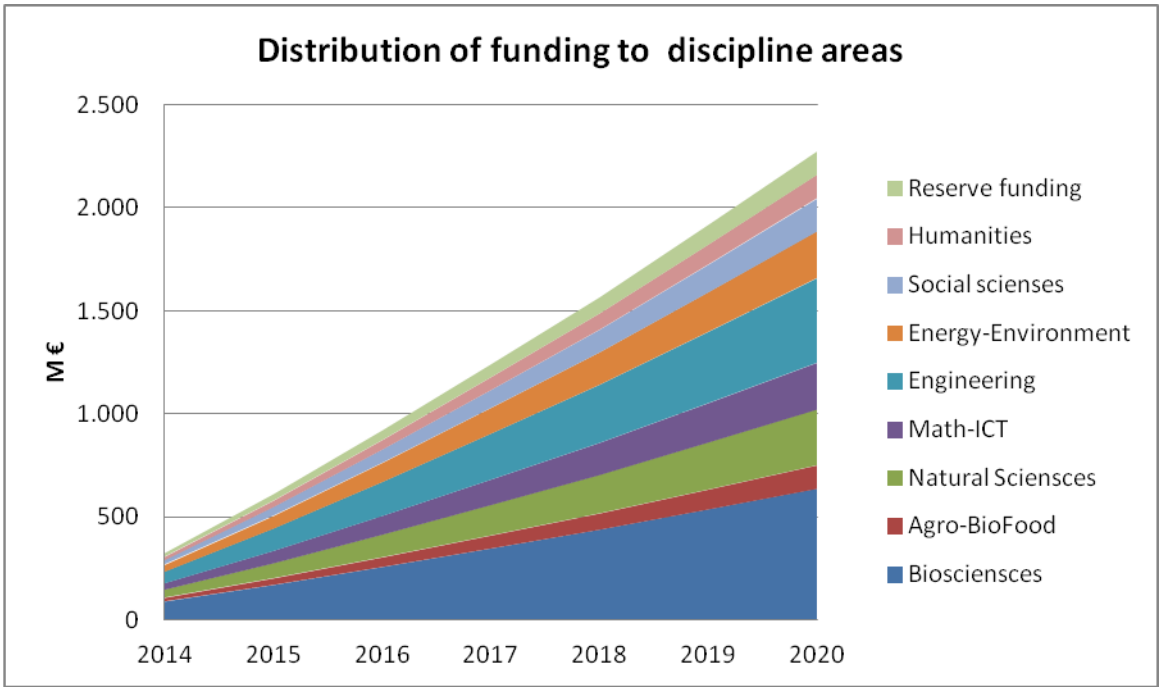


Figure 3.3.2. Additional yearly funding required from all sources, in Euros, over and above the current baseline, to achieve the 1.5% of GDP by 2020 for each discipline area, so as to enable the projects prioritized in section 5.

4.0 Process, Assumptions and Policy Guidance

4.1. Open consultation, recommendations from the Disciplinary Scientific Councils (TES) and the Hellenic Federation of Enterprises (HFE-SEV).

In January 2012, the General Secretariat for Research and Technology, following an initiative of the National Council for Research and Technology, announced the conduct of an open consultation for the formulation of the National Strategic Framework for Research, Technological Development and Innovation - ESPEK. The consultation was published on the GSRT website (www.gsrt.gr) and on the official consultation website (www.opengov.gr), on January 31, 2012 and remained open until March 5, 2012.

The aim of the bottom-up consultation was to solicit ideas and proposals from the scientific, academic and business community of the country on the main thematic priorities and policy measures of the Strategic Plan for Research, Technology and Innovation. According to the guidelines of the consultation, interested parties were requested to submit their proposals in the form of short reports based on a standard questionnaire designed for this purpose by the NCRT and the Policy Planning Directorate of the GSRT.

The consultation resulted in the submission of 120 proposals. The distribution of proposals per theme and per proposing organization status is shown in the following figures:

Figure 4.1.1. Results of open public consultation. Distribution of proposals per thematic field.

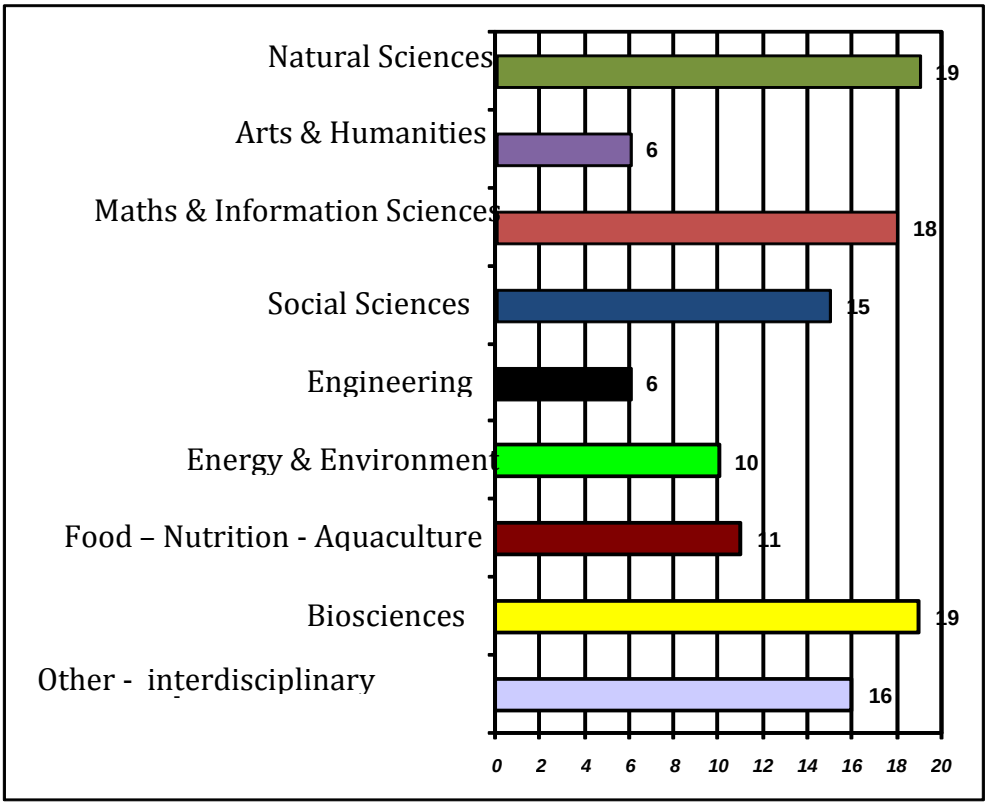
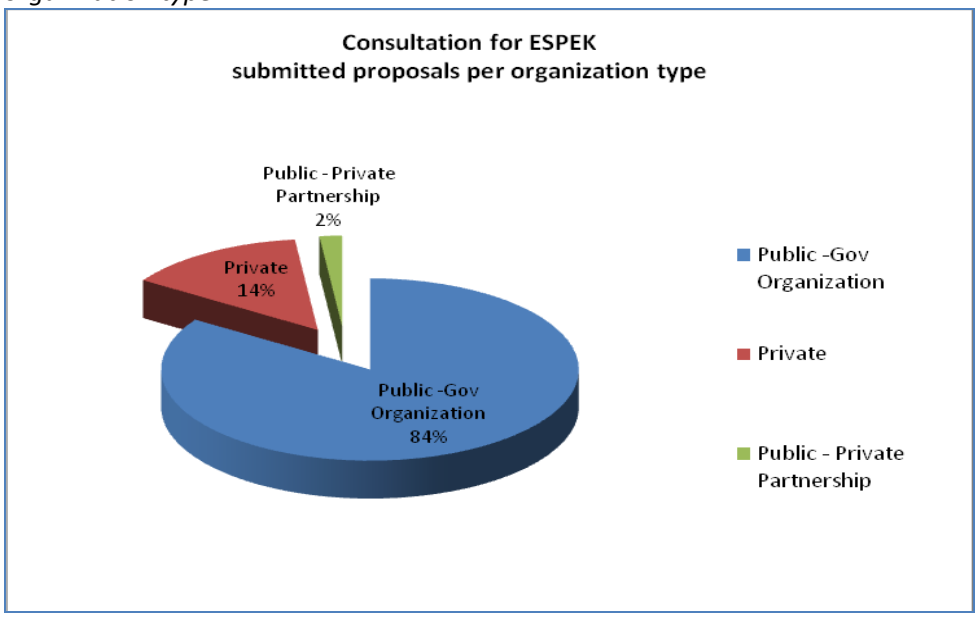


Figure 4.1.2. Results of open public consultation. Distribution of proposals per submitting organization type



Upon completion of the consultation, the submitted proposals were conveyed to Disciplinary Science Councils (DSC-TES) to provide input and feed the reports (thematic strategic plans) that they were asked to produce for each sector. The main task of the DSCs was to identify in their reports specific and prioritized thematic fields and actions which should be included in ESPEK (2014-2020) with specific time schedule and budget.

The main issues the Disciplinary Science Councils were asked to address in their reports were the following:

1. Brief overview of the sector (description of the present situation, SWOT analysis)
2 . Main objectives for the sector: a) to produce new knowledge and b) to promote innovation in the field
3. Main priorities and policy instruments proposed for the sector (strengthening of human resources, infrastructures, synergies between research & private enterprises, international cooperation)
4. Identification of thematic sub- priorities of the sector to implement projects focused on areas that support the needs of society and the economy and in which the country has a comparative advantage. (in relation , if possible, with the national strategy for "smart specialisation")
5. Identification of specific and prioritized actions and financial tools in order to achieve the above goals.
6. Proposed allocation of funds.
7. Proposed actions for non targeted research.
8. The final result of the processing of points 3-7 should be reflected in the form of a diagram showing the proposed allocation of funds as a function of time (2014-2020).

The Disciplinary Science Councils drafted their reports[4] along the lines set by the NCRT, but they also pointed out that most of the proposals submitted through the open consultation process by the research and business community did not have the necessary breadth or vision for Research and Innovation. They also emphasised that the number of proposals was very limited and did not provide useful and insightful recommendations for targeting thematic priorities of the Strategic Plan. The proposals submitted through the open consultation process related primarily to highly focused research topics addressing mostly the specific research interests of the proposers.

To complement the reports and recommendations of the Disciplinary Science Councils, GSRT and the NCRT organised in July 2012, a joint meeting with the Disciplinary Councils, the GSRT and selected representatives of the private sector and research centres. This meeting provided the opportunity for in depth discussion and exchange of views on the priorities of the Strategic Plan but also on the

[4] The reports from the Disciplinary Science Councils have been uploaded to the GSRT web site http://www.gsrt.gr/central.aspx?sId=120I466I1249I646I494779&olID=824&neID=824&neTa=24&ncID=0&neHC=0&tbid=0&lrID=2&oldUIID=aI824I0I120I466I1249I0I2&actionID=load

problems and obstacles that hinder the effective linking of the research and the business sectors.

Furthermore, the NCRT took into consideration the results from a study carried out at the initiative of the Hellenic Federation of Enterprises (HFE-SEV) in collaboration with the Foundation of Research & Technology – Hellas (FORTH) on *"Cutting Edge Technologies within the Greek Business Sector".*

The study was undertaken by a network of 60 expert scientists and entrepreneurs. Its main aim was to monitor, identify and analyse the main technological advancements in critical technology areas for the Greek economy and entrepreneurship.

The technological areas identified in the study are:
- Health & Biotechnology
- Food Technologies
- Information Technology & Communications
- Nanotechnology
- Materials & Processes
- Energy Technologies
- Environmental Technologies
- Transport Technologies

The study resulted in the identification of 55 cutting-edge technologies based on the following criteria:

1. Existence and size of the relevant market.
2. Research undertaken in the sector (main research players, level of research nationally and internationally)
3 . Enterprises (firms with a declared interest in the sector)
4. Existence of new products, services, patents
5. Maturity of the sector
6. Greek interest (added value that this technology could bring to the Greek economy).

At a plenary meeting of the NCRT, in December 2012, the Council took into consideration a first synthesis of the proposals of the Disciplinary Scientific Councils and the advanced technologies identified through the HFE-SEV&FORTH study. However, as the recommendations of the Disciplinary Scientific Councils refer to research and scientific areas of priority while the HFE-SEV – FORTH study refers to technologies, it is not always possible to provide comparisons. Furthermore, certain research fields (Arts & Humanities, Social Sciences) are not covered by the SEV – FORTH study, whereas certain technologies identified by the SEV study (such as transport) are not covered by the competences of the Disciplinary Scientific Councils.

A first synthesis of the findings of the two studies (Disciplinary Science Councils & HFE-SEV) showed that in certain fields, such as Biosciences, there is strong alignment of the research priorities proposed by the Research Council and the cutting edge technologies emerging from the HFE-SEV study. However, in other fields the approach of the Disciplinary Science Councils and HFE-SEV differs. In most cases the areas proposed by the Disciplinary Scientific Councils are wider, while those proposed by the HFE-SEV study are more focused on specific technologies that the study proposes as cutting-edge.

4.2 Assumptions on discipline balance

In an effort to provide a concise proposal for the allocation of funds to the various disciplines, the NCRT took into consideration the allocation of funding in the ARISTEIA-EXCELLENCE-I programme, as it provides a good reflection of the current strengths of the various disciplines.

The allocation of funding in the programme ARISTEIA-I (EXCELLENCE –I) is presented in the following table.

Biosciensces	Agro-BioFood	Natural Sciences	Math-ICT	Engineering	Energy-Environment	Social Sciences	Humanities
28%	5%	12%	10%	18%	10%	7%	5%

This distribution is used to allocate indicative funds for every research thematic priority for the new programming period 2014-2020 in order to reach the 1,5% GDP target.

4.3 Policy guidance on GDP percentage for R&D

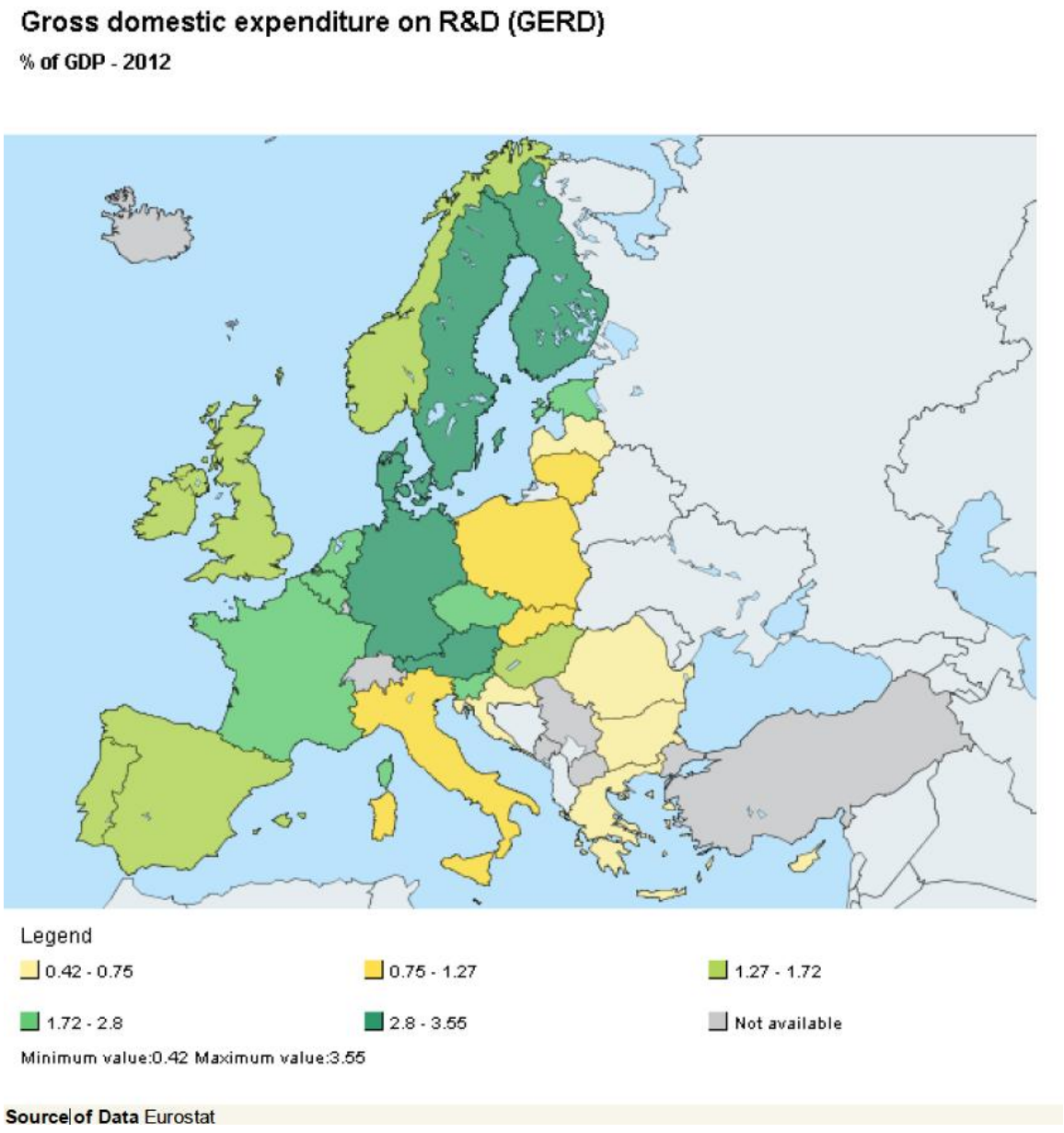
Greece currently faces a most vexing problem: The nation's economy must be steered toward a sustainable path of growth in the face of a prolonged and debilitating recession that leaves little room for long-term planning and investment.

The NCRT has argued consistently over the years that essential to the achievement of growth objectives is investment of a significant part of (the severely limited) available resources toward the creation of knowledge and encouragement of innovation. Ever since the mid-1980s, economic research has increasingly recognized the role of research, development, and innovation as a key driver of sustainable long-term growth. Greece now finds itself in a recession, with 30% of its labor force (including two thirds of its younger members) unemployed, and a sizeable proportion of the most promising university graduates and young researchers considering emigration. Spending on research and innovation would encourage young researchers to stay in Greece, and motivate entrepreneurs to set up export-oriented, knowledge-based, dynamic enterprises that would increase

productive investment and create the potential for exports and for import substitution, thus fuelling economic growth.

Indeed, statistics comparing Greece to EU and to other developed countries suggest that, in order to reduce the gap that currently separates us from our partners and competitors, Greece must increase R&D spending considerably, as well as strengthen the contribution of high technology sectors to exports. According to Eurostat, the share of GDP devoted to Gross Expenditures on Research and Development (GERD) was above 2% in EU countries on average in 2012, as shown in Figure 4.3.1.

Figure 4.3.1. Gross domestic expenditure on R&D (GERD) in the EU



GSRT's corresponding estimate of around 0.61% for Greece means that Greece surpassed only Romania and Cyprus, among 30 OECD countries, when compared in

terms of this share. Moreover, according to Eurostat data, the share of high-tech exports[5] in total Greek exports fell from about 6% prior to the economic crisis to only 3.3% in 2012, while the EU-27 average stood at 15.6% in 2012.

The European Union has set '3% of GDP' as the target that each of its Member States should achieve by 2020 for funding of research and innovation activities. The GSRT, on the other hand, has estimated in a recent analysis that, in view of the prevailing economic realities, the GERD will amount to only 0.67% of GDP by 2020 – essentially the same percentage as today – under 'business-as-usual' policies. This analysis was based on projections of current trends and economic outlook. Adoption of this target would essentially amount to a prolongation of the existing unacceptable state of affairs.

One of the few competitive advantages that Greece still enjoys is the availability of a remarkably large number of individuals in universities, research centres and in the private sector who excel in basic or applied research. Evidence of this is provided by the disproportionately large share of funding (compared to the size of the country) that Greek researchers are able to obtain from a wide range of highly competitive EU research programmes. As well, the past decade has seen a truly dramatic improvement in the international standing of the Greek research community, as measured by the numbers of scientific publications and citations – a development that has taken place despite the multiple difficulties and adversities that this community faces.

Investing as a nation in research and innovation will exploit this competitive advantage and benefit greatly the country. Specifically, it will contribute decisively to:

- The recovery of the nation's economy, as a consequence of the well-known nonlinear relationship between research and innovation activities and GDP growth.
- The emergence of new industrial and entrepreneurial activity clusters with high added value.
- The deceleration – and possible halt – of the wave of emigration of the youngest (and often most qualified) members of the research community.
- The renewal and replenishment of the extremely valuable human resources involved.

The NCRT believes that persistently low funding of research and consequent impoverishment of researchers are not paths leading to growth, either in the short or in the long run. It is for this reason that **NCRT advocates a gradual, but substantial increase in the share of GDP devoted to R&D in the 2014-2020**

[5] High Technology products are defined as the sum of the following products: Aerospace, Computers-office machines, Electronics-telecommunications, Pharmacy, Scientific instruments, Electrical machinery, Chemistry, Non-electrical machinery, Armaments.

period. NCRT recommends a target for the total GERD dedicated to research and innovation activities of roughly '1.5% of GDP' – consistent with what has been the NCRT's position over the past three years. We believe that this target is both necessary and realistic, despite the prevailing adverse conditions. We also note that it amounts to only 50% of the target set by the EU. The 1.5% target assumes that 60% would be funded from public investment (national and EU sources) while 40% would be contributed from private R&D activities (up from the current 30%). It is noted that the relative contributions in EU countries, US and Japan is reversed, i.e. 67 % private and 33 % public.

The size and range of the targeted areas for research and innovation presented in this document are consistent with the '1.5% of GDP' target. The adoption of this target by the government would undoubtedly be seen as a clear statement of political will to make research and innovation one of the driving forces of Greece's economic recovery.

5.0 Program Descriptions by Discipline Area

5.1 Biosciences

Biomedical sciences are going through an explosive growth period. Many scientific advances and new technological developments from medical treatments to crop management have taken place and progress is expected to accelerate in the near future, leading to dramatic new applications that affect all aspects of human life and society. International investment in the biological sciences has also been accelerating. Due to the tremendous breadth of this field and of its many inherent niche environments, the opportunities for Greek participation are bright. Greece has significant scientific personnel in the areas of Biology and Medicine, and additional strengths derived from scientists of the Greek Diaspora who hold important positions in European and American Institutions. Greek scientists in the Biomedical sectors compete well in the European environment. This has been, therefore, identified as an area of significant importance for development.

Further development of the Biomedical sector has a huge potential to support economic development. The applied part of this area is, of course, primarily the health sector, which is of obvious importance for the health and wellbeing of the Greek population. Greeks have been greatly affected by chronic non-communicable disorders, such as anxiety and depression, obesity, metabolic syndrome, type 2 diabetes, atherosclerosis, cardiovascular diseases, obstructive lung disease, and cancer. Childhood obesity in Greece is at top levels internationally. Thus, a strong and efficient health sector is of paramount national interest. Translational research, early clinical research studies and development, and production of pharmaceuticals are areas in which there is more that a critical mass of scientists in Greece. Furthermore, given the advanced state of computer science and mathematics in the country, bio-computing and development of "omics" (transcriptomics, proteomics,

metabolomics etc.) are already growing fields and Greece will be ahead with both Systems Medicine and Personalized Medicine.

In addition, Greece has a considerable and export-oriented Pharmaceutical Industry sector, which is in need of further growth and development. The interactions of the Pharmaceutical Industry with the Biomedical academic research sector is way below the desired levels and is also affected negatively by bad practices of the past. This is an area in which many beneficial actions can be implemented. The new advances in Biological sciences can also affect greatly another established important Greek productive sector, the Food Industry. Below we describe the priorities defined by the TES and ESET and the particular advantage that Greece has on Translational Research.

R&D Priorities for Biosciences

Cutting-edge technologies with significant opportunities for future applications and high added value

- Pharmaceutical Discovery and Development and Drug Delivery Technologies
- Genomics, Epigenomics, Proteomics, and Molecular Diagnostics (biomarkers)
- Stem cells, regenerative medicine

Opportunities for cooperation/synergy with other high technology sectors

- Bio-imaging / biomedical imaging
- Bioinformatics, computational Biology
- Advanced micro/nano biomedical systems and devices

Translational Research

- Opportunities due to existing human potential, sizeable market and well developed pharmaceutical industry (new formulations,
- Invest in the biological exploration of biodiversity and the biochemical and pharmacological characterization of natural products with commercial value
- Targeted investment in the development of translational clinical research – clinical trials
- Invest in infrastructures to advance partnership and collaboration with the international pharmaceutical and biotechnology industry (out-sourcing: collaborative development of new medicines and biomaterials)

The total budget allocated to the Biological Sciences Sector for the 7-year period between 2014 and 2020 is 2.479 Billion Euros, which corresponds to the 28% of the full ESPEK budget. The budget is distributed between 4 main Pillars (fig. 5.1.1). The first pillar comprises open, investigator-initiated programmes. These programmes are addressed to a wide spectrum of researcher levels, including graduate student and postdoctoral fellowships, junior and senior investigator grants, as well as, Excellence research grants. The funding of these schemes is envisaged to cost 435 million Euro over the7-year period of ESPEK. The key strategic goal of these programmes collectively is first, the retaining of highly talented young scientists in Greece, who would otherwise seek research opportunities abroad, contributing to the perilous trend of "**brain drain**" that depletes the country of its most valuable workforce segment. An equally important strategic goal is the repatriation of outstanding Greeks scientists of the diaspora, who would enrich and propel national research activities into the future.

The second main pillar of the Biological Sciences budget is dedicated to the funding of large national collaborative research networks of excellence. The allocated amount is 480 million Euro for the 7-year period. The main aim of these networks is to foster collaborative efforts towards tackling important problems of broad scope or large-scale endeavors in biomedical research. Moreover, this scheme is anticipated to mobilize the Greek scientific community and facilitate the exchange of information and expertise. Additionally, acquisition and access to state-of-the-art technologies and equipment with increase international competitiveness of Greek research institutions and will facilitate their partnership with the international scientific community and biomedical and pharmaceutical industry.

The third funding pillar is designed to support institutional proposals for strategic development and restructuring. The amount allocated in such activities equals 140 million Euro. Chief among the objectives of this programme is the modernization and consolidation of the Greek Biological Sciences research grid. An additional desirable outcome is the expansion of existing biomedical research institutes into rapidly developing research areas through the acquisition of critical infrastructure and personnel.

Finally, a fourth funding pillar is committed to the support of applied and translational research programmes, including but not limited to demonstration projects and start-up companies. The total funds available for this segment are 220 million Euro. The strategic aim of this pillar is the ultimate exploitation of the research outcome, to the benefit of the society and the national economy.

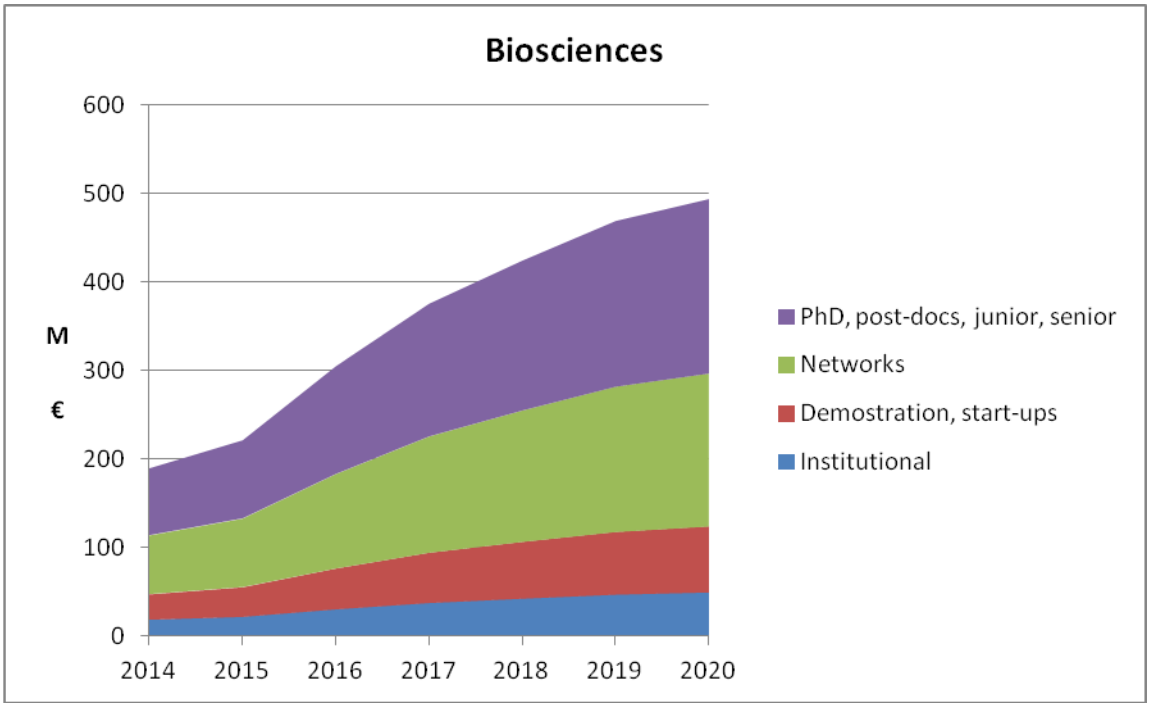


Figure 5.1.1. Proposed distribution of funds over time for Biosciences

5.2 Agro-biotechnology-Nutrition

Nutrition is the most important modifiable factor for human health and development and for this reason the research involving diet, food, aquaculture and agro-biotechnology is essential to strategic planning.

The following research recommendations represent a composite of the views of the Working Group of ESET on Nutrition, Food Sciences, Aquaculture and Agro-biotechnology chaired by Dr. Artemis P. Simopoulos and co-chaired by Dr. John Sofos, The Food Industry and HFE-SEV (Hellenic Federation of Enterprises).

R&D Priorities for Agro-biotechnology & Nutrition

Nutrition

- Composition of tables of ingredients of indigenous Greek food
- Study of genetic variants in the metabolism of essential nutrients (Nutrigenetics) as well as study of the role of nutrients in gene expression (Nutrigenomics)
- Study of the toxicity of heavy metals in the Greek diet
- Endocrine disrupters

Food

- Rapid detection techniques and hazards management and

authentication of food and its qualitative characteristics

- Smart Packaging of Food
- Analyses and other actions for certification and recognition of food designation of origin from Greece - branding

Aquaculture

- Identification of new types of fish feeds (e.g. seaweed) and accurate analyses of aquaculture products for ingredients such as omega- 3 and omega - 6 fatty acids and proteins
- Hatcheries - Predictability through genetic selection
- Genetic selection for increase of growth, disease resistance etc.
- Evaluation of environmental impact

Agro - biotechnology

- Manufacture/production of competing indigenous products (vegetables, fruits, herbs, wild plants etc.) and genetic studies to safeguard them as Greek through DNA identification - Genetic classification, and codification of the Greek genetic biodiversity
- Research and innovation for the production of unique products with high added value for specific domestic and quality export markets, while taking into account environmental sustainability, protection of water resources and climate change
- Research and innovation for the production of bio - active ingredients of high nutritional value (phenolics) for healthier diets

Primary agricultural production in both animals and plants.

• Agricultural production

• Livestock,

i. Livestock feeds to be consistent with the evolutionary aspects of diet composition, search for new powerful features of animal feeds with the focus on enhanced use of local sources, etc.

ii. Addressing mortality from diseases

iii. Ensuring sustainability in animal production

• Forests/ Forestry

• Water

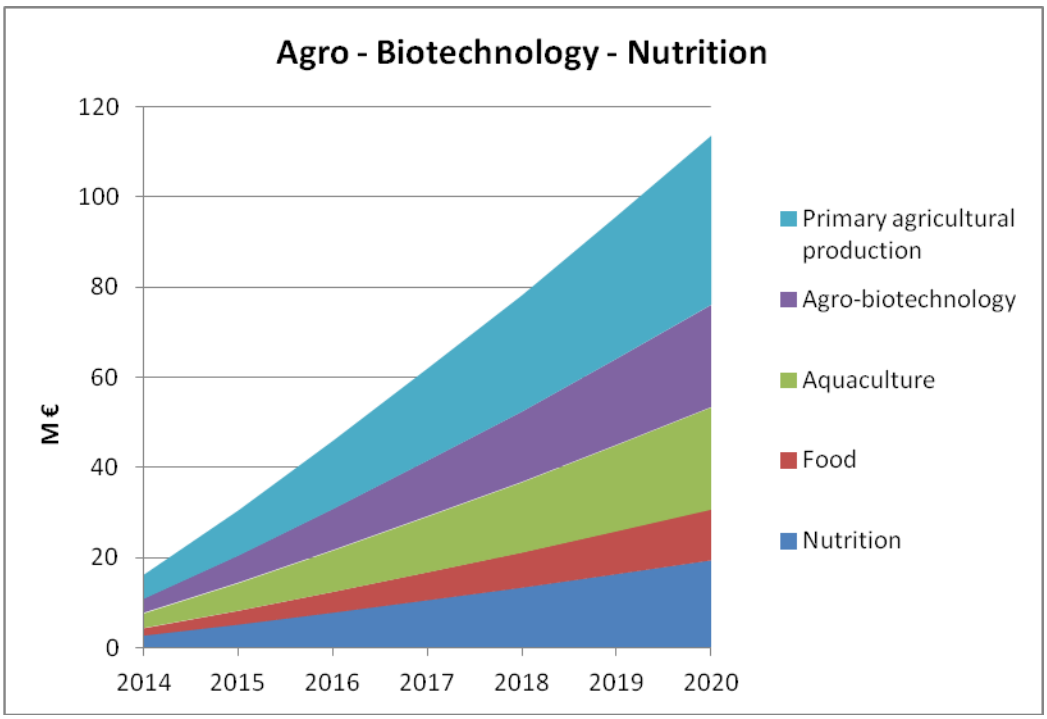


Figure 5.2.1. Proposed distribution of funds over time for Agro-biotechnology –Nutrition

Studies to date have shown that the traditional Greek diet before 1960, is the healthiest diet model in the world, differentiated from other Mediterranean diets. Greece must lead the effort to promote its own food and culture to confirm their uniqueness. The Greek diet is arguably the best brand of Greece. To create and place this brand in scientific terms, it is necessary to create a foundation on nutrition, which will gather academic institutions, the food industry and the state in a joint unit, in order to implement joint programs that will help the country improve the population's health and development objectives. The creation of Nutrition Centers in selected parts of the country is a goal with strong social and developmental impact. These Centers will establish research departments in Genetics, Nutrition and Fitness for Health and will provide counseling on physical exercise, in order to maintain the fitness of the population. At the same time, these Centers will be offering individual nutrition advice for the prevention of obesity and chronic diseases based on the individual's genetic predisposition.

5.3 Energy and Environment

Energy and the environment are mutually coupled and strongly and multiply interconnected. No other factor has influenced the environment more than the production and use of energy. On the other hand, no other resource is more crucial for the standard of living and quality of life of a country than energy; and Greece is no exception. Sustainable energy sources are needed which are affordable, environmentally

friendly and can support societal progress in the long-range. The energy sources of Greece are (1) energy conservation, (2) fossil fuels (presently lignite and, in the future, possibly hydrocarbons) and (3) renewable energy sources (presently hydro, wind and solar and in the future possibly geothermal). These indigenous energy sources have to be fully developed and must become sustainable. The priorities described in this section on energy and the environment have these key elements in mind; they are pragmatic, targeted, and focus on significant areas which can make a difference and on which the country can build and expand. The same logic is followed in the area of the environment.

R&D Priorities for Energy & Environment

A. Energy

1	**Efficient Use of Energy in Buildings** • Structural Materials • Bioclimatic architecture • Low enthalpy heating systems • Cooling systems with high coefficient performance (COP)
2	**Reduction of CO2 emissions** • Development and application of solar heating in pre-drying of lignite and pre heating of water in electric power stations • Use of water and flue gases -CO_2 from thermal power plants in greenhouse cultivations • Development of small co-generation units based on natural gas for domestic or commercial use in the framework of decentralized electric power generation system • Development of heat pumps for heating and cooling • Development of electrical technologies for means of transportation in cities
3	**Renewable Energy Sources** • Photovoltaics • Thermal solar systems • Wind energy • Biomass • Geothermal Energy • Concentrating Solar Power Technologies-CSP • Technologies for storing energy from Renewable Sources • Lithium Batteries and Fuel Cells

4	**Smart Grid Systems for Production and Distribution of Electrical Energy** • New tools and new architectures for the design of smart grid distribution systems • New tools for studying the efficient incorporation of scattered and sporadic power production and consumption. • New control structures and strategies to promote penetration of scattered energy production, storage, and demand management. • Application of Information and Telecommunication technologies for on-line processing of large data (decentralised systems, EMS-DMS, remote control, development of open systems). • Development of new markets for the client-consumer (Operational models for Customer Driven Markets). • Management of energy transport and distribution infrastructures. • Auxiliary services at all system levels (risk management systems considering the possibilities of scattered production and flexible load for supporting the network, reliability and enhancement of the quality of power at interconnection points between distribution networks). • Advanced techniques for the prediction of production and consumption for System operation (connection with meteorological prediction systems, correlations between relevant variables, etc.)*. • Architectures and Tools for the operation, recovery, and protection/defense of the System (on-line assessment of safety, self-healing networks, error handling with automatic recovery of the System with emphasis on utilising scattered production and flexible consumption). • Advanced System operation at all voltage levels (development of smart devices for controlling the energy flux - PST, HVDC, FACTS, superconducting current limiters), new technology for voltage control, systems for simultaneous measurement of vectors for monitoring and protecting the System (PMUS, WAMS, WAPS).
5	**Complementary Programmes in order of priority** **a. New Technologies for exploration and detection of petroleum and natural gas deposits** **b. "Large scale" projects in the thematic sector of**

Renewable Energy Sources

- Design and construction of floating structures to carry wind generators
- Design and construction of concentrating hybrid photovoltaic unit 5 and 100 kWe
- Greek geothermal heat pump of medium and large size, designed for Mediterranean climates
- Construction of small electric vehicle prototypes for urban use and development of relevant technologies
- Development and production of smart load controllers for decentralised control of power consumption

c. Transportation Research

d. Monitoring of radioactivity in the environment

(Possibly appropriate sector for Public-Private Partnership actions)

B. Environment

1 Study of the consequences of natural disasters and anthropogenic erventions on the environment

- Soil and water reservoir remediation*
- Air pollution control*

2 Research in solid and liquid waste management

- Liquid waste reuse
- Treatment and disposal of sludge, development of new systems of sludge management with simultaneousous exploitation in power generation.
- solid waste treatment (separation, compression, disposition, ecological combustion, recovery of useful side products)*

-Advanced anaerobic processes for waste treatment
- Aerobic processes for waste treatment
- Thermal treatment of wastes
- Advanced approaches for mechanical recycling
- Methods for rendering hazardous wastes inert
- Physico-chemical methods for waste water and waste liquid treatment

3 Study of water resources

- Reduction of the flow of liquid streams and reduction of the natural enrichment of water reservoirs as a consequence of reduced

precipitation and hydrologic enrichment of drainage basins.,

- Reduction of available quantities of fresh water and deterioration of the water quality of reservoirs due to increased anthropogenic pressures and reduction of precipitation.

4 Specialised Research for the study of marine climate changes and natural disasters in the Greek domain

- Development of systems for the observation, simulation, and experimental study of processes in the marine environment, with emphasis on climate changes and natural disasters.

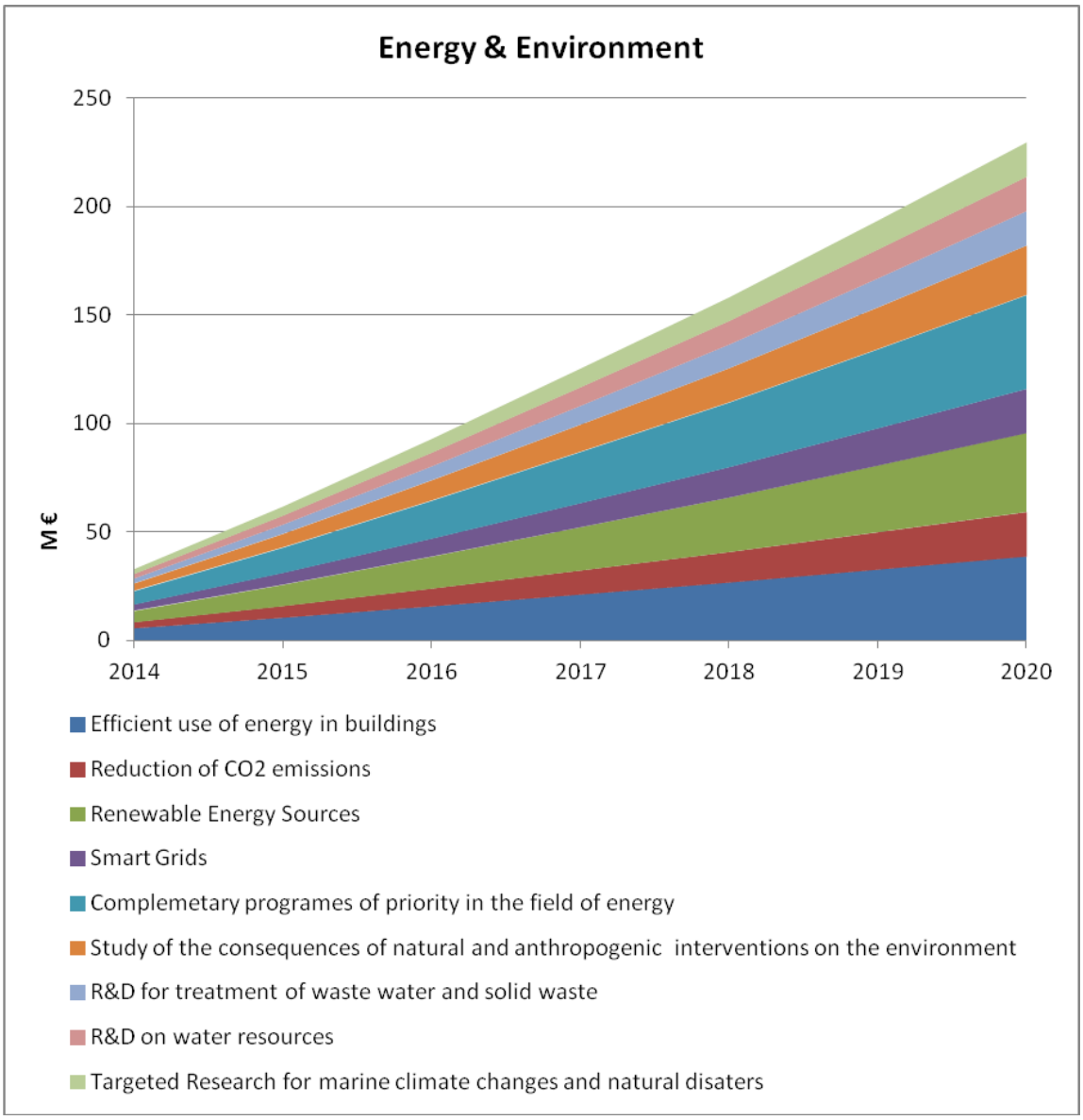


Figure 5.3.1. Proposed distribution of funds per thematic priority, over time for the Energy & Environment sectors

5.4. Computer Science and Mathematics

This sector covers Mathematics, Computer Science and the technologies of Informatics and Telecommunications.

The sector is exceptionally well developed in Greece. There are roughly 55 University Departments that address aspects of this sector, as well as 6 Research Institutes that report to GSRT, 4 other Research Institutes that report to the Ministry of Education, many Technological Educational Institution (TEI) Departments, several related institutions (e.g., National Network for Research and Technology, EDET), and at least 7 technology parks (such as those in Patras, Lavrion, and the Corallia cluster in Athens). As important, a large number of companies (probably several hundreds) are active in this general area and are estimated to employ as many as 100,000 people with an annual turnaround roughly equal to 4.5% of Greece's GDP, according to the Association of Informatics and Telecommunications Companies (AITC-SEPE). Moreover, the sector is augmented by a large and distinguished community of Greek researchers and scientists who work at universities and research centers abroad.

The Greek Computer Science and Mathematics community contributes a large number of publications to the best professional journals of the field and enjoys international respect and recognition. Greece ranked 7th among the 27 nations of the European Union in terms of receiving competitive research funding from the 7th Framework Programme (2007-2011), obtaining 207 million euros (or 4.16% of the total) and holding a clear advantage over such technologically advanced nations as Austria, Sweden, Finland and Denmark. Greek researchers participated in 23.5% of all funded projects!

The NCRT recommends vigorous, continuous and consistent support of basic research in this area. In addition to funding targeted research areas (see below), this support should extend to: programs aimed at promoting excellence in research in general (such as the current ARISTEIA programs); scholarships, fellowships and post-doctoral opportunities for young researchers; and investments in research infrastructure ("e-infrastructure").

The NCRT, in consultation with the relevant Sectoral Scientific Council (TES), has identified six priority research areas that are particularly promising for receiving targeted funding. These priority areas were selected because they satisfy the criteria of: (a) existence, within Greece, of a critical mass of internationally competitive research groups with outstanding expertise in the subject matter; and (b) the possibility of exploitation of research results from these areas by the industrial sector of the country.

The six priority areas also coincide with targeted areas identified by the Horizon 2014-2020 of the European Union. Moreover, in a separate and independent report issued by the Hellenic Federation of Enterprises (HFE-SEV) and FORTH -ITE, these

areas – or close approximations to them – were identified as particularly promising for public-private sector cooperation. (The SEV-ITE proposals are more narrow and focused on applications and commercial exploitation, but there is nonetheless remarkable agreement between the two sets of proposed thrusts.)

The six proposed areas are presented in the table below in order of priority (1-6):

	R&D Priorities for Computer Science and Mathematics
1	**Future Internet** (Networks, software and services, cyber security, privacy and trust, wireless communication and all optical networks, immersive interactive multimedia and connected enterprise)
2	**Content technologies and Information Management** (Technologies for language, learning, interaction, digital preservation, content access and analytics; advanced data mining, machine learning, statistical analysis and visual computing)
3	**Next generation computing** (Processor and system architecture, interconnect and data localisation technologies, cloud computing, parallel computing and simulation software)
4	**Components and Systems** (Smart embedded components and systems, micro-nano-bio systems, organic electronics, large area integration, technologies for Internet of Things, systems of systems and complex system engineering)
5	**Advanced interfaces and robots** (Service robotics, cognitive systems, advanced interfaces, smart spaces and sentient machines**)**
6	**Micro-nano electronics and photonics** (Design, advanced processes, pilot lines for fabrication, related production technologies and demonstration actions to validate technology developments and innovative business models)

It is also important to note that the DSC-TES proposals place particular emphasis on the additional contributions that computer and information sciences, mathematics and information and telecommunications technologies can make to addressing fundamental challenges in such vital areas as:

1. Health, demographic change and well-being.
2. Food security, sustainable agriculture, marine and maritime research, and the bio-economy.
3. Secure, clean and efficient energy.
4. Smart, green and integrated transport.

5. Climate action, resource efficiency and raw materials.
6. Inclusive, innovative and secure societies.

We stress that the budgetary proposal presented below does NOT include funding for the above more general activities, which fall at the interface between the Computer Science and Mathematics sector and several other sectors of research and development.

The requested budget for 2014-2020 is based on an allocation to the Computer Science and Mathematics sector of approximately 10% of the total of € 8,853 million estimated by the Policy Planning Directorate of the GSRT as the amount that should be made available under the "1.5% of GDP" scenario. The amount requested below is € 952 million (or 10.8% of the total budget). The details of the proposed allocation are presented below.

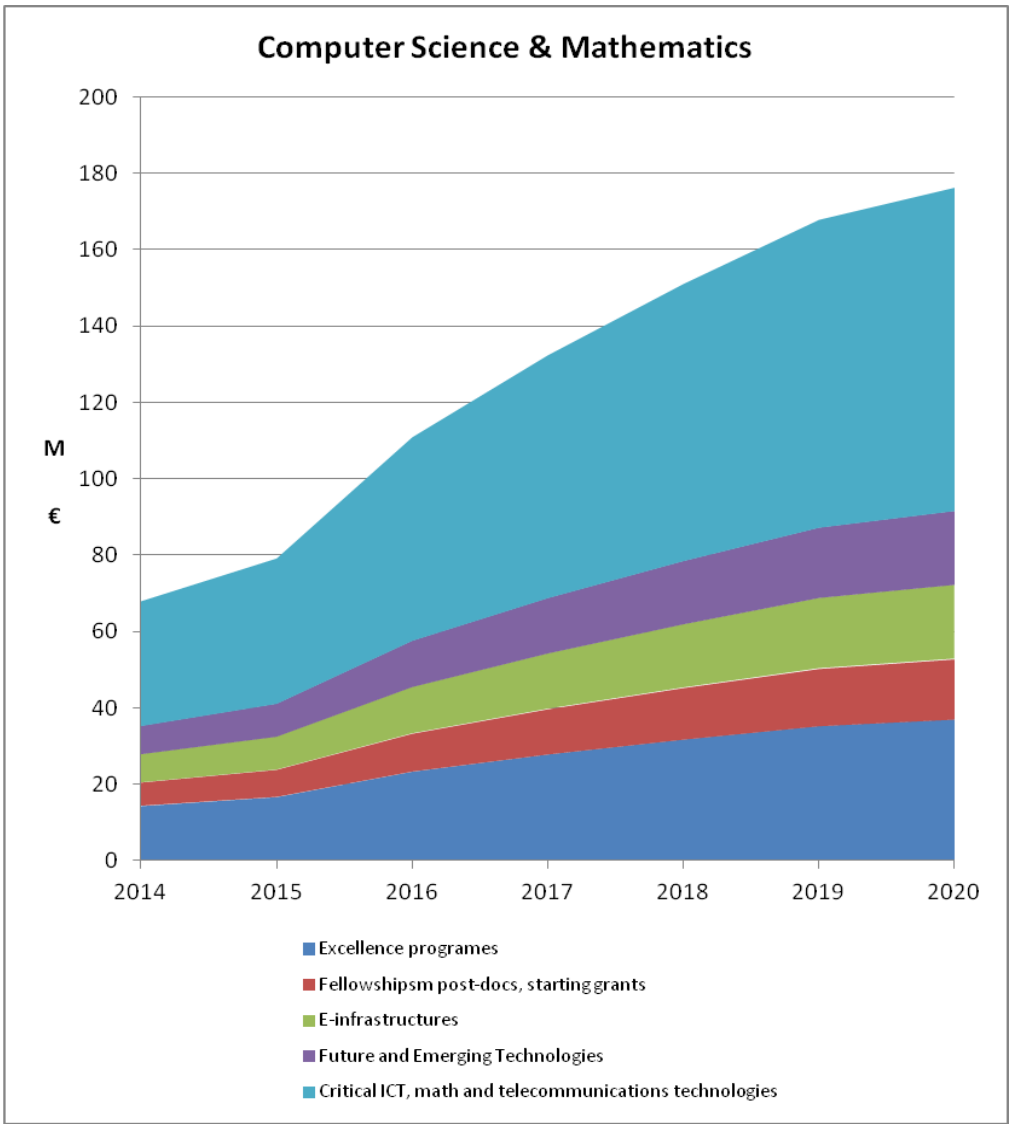


Figure 5.4.1. Proposed distribution of funds, over time for the Computer Science and Mathematics

5.5 Physical Sciences

The NCRT recommends continuous and consistent support of basic research in the Physical Sciences, with the aim of further promoting research quality and checking the massive exodus of able scientists from the country that we are witnessing as a result of the financial crisis. International experience shows that maintaining a community of well educated, active and resourceful scientists with a strong knowledge base in mathematics and the physical sciences is a prerequisite for the emergence of new, competitive entrepreneurial ideas and technological achievements. The "ARISTEIA" action, designed by the NCRT and implemented successfully in collaboration with the GSRT, can serve as primary instrument for supporting basic research in the natural sciences. This action includes a rigorous evaluation procedure with excellence being the sole selection criterion. "ARISTEIA" calls could be announced in regular time intervals, e.g. every two years, with a budget of approximately 100 M€ for all disciplines.

In addition to supporting basic research in all fields of the physical sciences, the NCRT proposes as priority areas some areas which emerged during the deliberations of the relevant Disciplinary Scientific Council (TES), with the following criteria: (a) the existence, within Greece, of a critical mass of internationally competitive research groups in these areas, as evidenced, for example, by analyses carried out by the National Documentation Centre; (b) the possibility of exploitation of research results from these areas by the industrial sector and of support of entrepreneurial activities.

1. Polymers, colloids, polymer-matrix composite and nanocomposite materials

Since a long time, there has been successful industrial activity in Greece in the field of processing plastic packaging materials for food, pharmaceuticals, cosmetics, plastic pipes and hose systems ("Heliflex" pipes, patent to A.G. Petzetakis in 1960), plastic nets for gathering olives, containers and miscellaneous plastic products for agricultural applications. More recently, Greece has witnessed the emergence of small enterprises producing polymeric products of high added value. Some of these enterprises started as spinoffs from Greek universities with products such as polymer electrolyte membranes for use in fuel cells, paints and adhesives, flexible organic semiconductors, "smart textiles," and nanoparticles for controlled drug delivery. The Greek research community in the fields of polymers, polymer composites, colloids, and nanostructured organic materials is strong in materials synthesis, characterization, measurement, prediction and optimization of rheological, mechanical, interfacial, electrical, permeability and other properties. There are active, internationally competitive research groups in Athens (University

of Athens, National Technical University, National Hellenic Research Foundation, NCSR "Demokritos"), in Thessaloniki (Aristotle University, CERTH), in Patras (University of Patras, ICE-HT/FORTH), in Ioannina (University of Ioannina) and in Crete (University of Crete, IESL/FORTH). Thus, there are bright prospects for the development of new products made of such materials and of processes for manufacturing these products in such a way that they fulfil specific needs of the domestic and international market. Innovative materials design could be based on in-depth understanding of structure-property-processing-performance relations through research. This area presents possibilities of synergy with research and development in the sectors of life sciences (drug delivery, biocompatible materials, artificial organs); food, nutrition, agro-biotechnology and fish farming (food packaging, replacement of synthetic by natural polymers, biodegradable materials); energy (polymeric electrolytes for fuel cells and batteries, construction materials for wind generators); environment (separation materials, water purification processes); information science (directed self-assembly of copolymers in conjunction with lithography for "bottom up" fabrication of miniaturised electrical circuits, plastic electronics); and engineering sciences (product and process design).

2. Graphene and other carbon-based nanostructured materials

Nowadays, carbon-based nanostructured materials constitute a hot research topic internationally. The discovery of fullerenes (Kroto, Curl, Smalley, Nobel prize in chemistry 1996) and of carbon nanotubes, and the isolation of graphene (Geim and Novoselov, Nobel prize in chemistry 2010) have boosted the development of the relatively young fields of nanoscience and nanotechnology. Carbon-based nanostructured materials have remarkable mechanical, thermal, electrical, and optical properties and can serve as components of new nanocomposite systems and devices with high added value. They are investigated very intensely internationally, mainly at the basic research level, while applications have started emerging in diverse areas such as energy conversion and storage, electronics, optics, optoelectronics, photonics, catalysis, pollution abatement, biosensors, and biomedical engineering. In Greece the entrepreneurial activity in this field is limited for the time being, mainly undertaken by spinoffs of research centres. Greek researchers, however, contribute competitively to international developments in the field. For example, ICE-HT/FORTH is coordinating Greek participation in the "Future and Emerging Technologies Flagship" of the European Union on graphene, which is expected to receive funding at the level of 10000 M€ over 10 years. Greece, therefore, could develop a competitive advantage in this emerging area.

3. Advanced structural materials

The cement industry has a long history in Greece, since the beginnings of the 20th century. Today there are Greek enterprises in the areas of iron, aluminum, cement, and reinforced concrete with significant exporting activity, which provide for the construction sector, a traditionally strong sector of the Greek economy.

Strengthening research and innovation is often mentioned as one of the prerequisites for the survival and growth of these enterprises. Internationally, one can see significant attempts towards better scientific understanding of structural materials and optimization of their performance though design of their chemical constitution and microstructure, as well as of the processes whereby they are produced. (e.g., Concrete Sustainability Hub at MIT). By appropriately cultivating the connections of research teams with local and international industry, Greece could play a significant role in these efforts. The area of advanced structural materials presents possibilities of synergy with the sectors of energy and the environment ("The house of tomorrow").

4. Catalysts, nanostructured materials for catalysis

Catalysts, i.e., substances capable of accelerating chemical processes without being consumed by them, play a pivotal role in contemporary chemical industry. Traditionally, the area of catalysis has been characterised by a large degree of empiricism. Today the development of new catalysts is based more and more on understanding the basic mechanisms of catalytic reactions and rational design. In Greek universities and research centres one can find internationally competitive research being done on many problems in heterogeneous catalysis (e.g., metallic catalysts supported by porous ceramic materials, metal oxides, zeolites), homogeneous catalysis, electrocatalysis, as well as organocatalysis and biocatalysis (e.g., enzymes). In some cases, this research has led to the formation of startup companies, e.g. for the catalytic production of hydrogen from ethanol and natural gas. The area of catalysis is directly related to "green chemistry", as well as to materials and nanotechnology, and presents the possibility of synergy with the sectors of engineering sciences, energy, the environment, and life sciences.

5. Instrumentation for Sensors

In Greece there is a strong community of elementary particle physicists and nuclear physicists, many of whom have participated successfully in the development of sensors for large experiments conducted at CERN (e.g., LHC), or of instrumentation for medical diagnosis and therapy. The background and knowhow that these scientists possess could be valuable in enterprises for the production of sensors and, more generally, of instrumentation for specialised applications. End users of this instrumentation could be large research facilities, hospitals, industrial units, but also households. This area presents opportunities for synergy with the sectors of information technology, but also of life sciences, food, energy, and the environment.

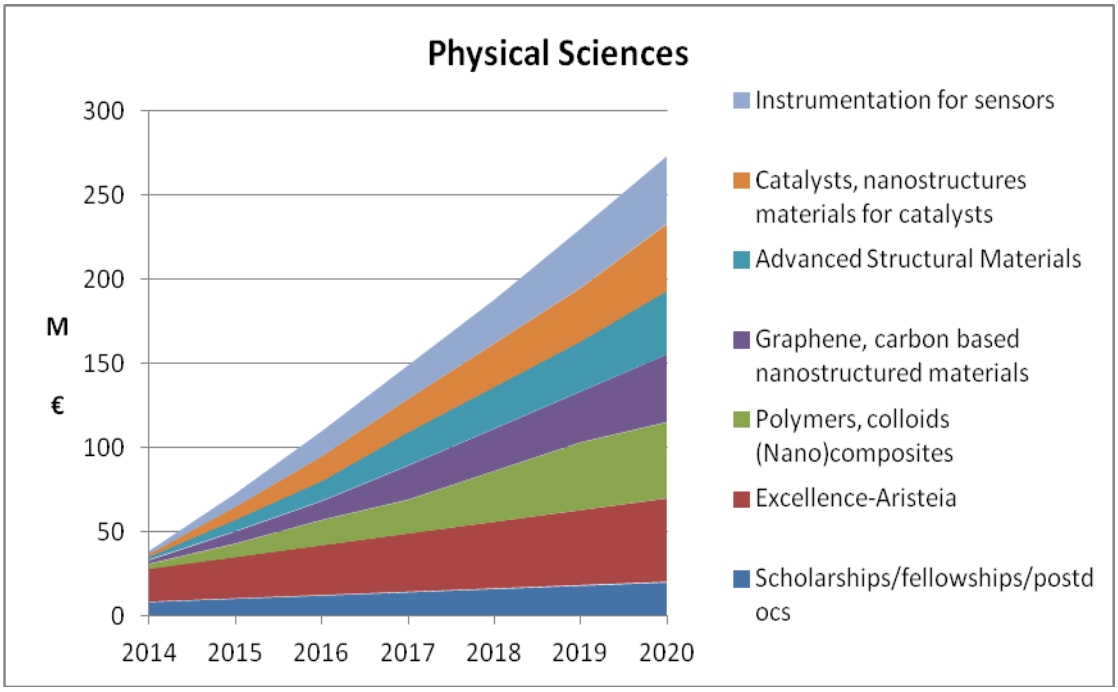


Figure 5.5.1 Proposed distribution of funds over time for Physical Sciences

5.6 Engineering Sciences

Engineering Sciences have traditionally been a very strong sector of the Greek research community. For many years, Greek research engineers have succeeded in attracting and securing significant funding for their work through competitive programmes of the European Union (e.g., framework programmes) and through other sources (e.g., international private companies).

In the sector of Engineering Sciences one can discern many islands of excellence in Greek universities and research centres, but also entire departments which rank very highly in international evaluations. It is not coincidental that, in recent rankings, 9 out of the 10 Greek departments listed among the top 150 internationally in their discipline belong to Greek engineering schools. Some engineering research institutes (e.g. CPERI/CERTH, ICE-HT/FORTH) have been remarkably successful in attracting funds for their research and in carrying out research of the highest calibre (cf. Descartes Prize to CPERI/CERTH, participation of ICE-HT/FORTH in FET flagship on graphene). Furthermore, the majority of ERC Grants that have been awarded to Greece are in areas of Engineering. Engineering, therefore, enjoys a competitive advantage in Greece, which should be preserved at all costs. Providing adequate funding to the Greek engineering research community through "bottom up" programmes announced at regular intervals, such as "ARISTEIA", would be beneficial. So would be scholarships and fellowships in support of excellent doctoral candidates and post-docs in Engineering disciplines.

Many of the priorities for Research, Technological Development and Innovation that have been identified by the Disciplinary Science Council (DSC-TES) on Engineering Sciences coincide with priorities that have been proposed by the TES on Energy and the Environment. These priorities will not be repeated here. We briefly propose some additional priority areas.

1. Computational Engineering

Greek engineers, both within the country and in the diaspora, have demonstrated remarkable talent in formulating mathematical models and in developing computational methods invoking these models for the prediction of the behaviour of physical, chemical, materials, and biological systems; for the design of products based on these systems; and for the development of processes that manufacture or use these products. This comparative advantage in modelling and computation has its roots in a long and strong tradition in mathematics (represented in the modern era by scientists such as N. Katathéodory, N. Metropolis, J. Argyris).

Today, the role of computational methods in engineering design is becoming more and more significant, thanks to unprecedented developments in computer hardware and, even more impoirtantly, in algorithms which make optimal use of this hardware to solve complex problems. A central goal of engineering research internationally is the development of efficient and reliable methods for modelling systems at various scales of space and time ("multiscale modelling", compare 2013 Nobel Prize in Chemistry to M. Karplus, M. Levitt and A. Warschel). For example, to establish quantitative connections between molecular structure and macroscopic properties of materials one may invoke quantum mechanical electronic structure calculations, statistical mechanics-based molecular simulations, mesoscopic simulations of coarse-grained molecular models, and macroscopic analyses of continuum models; all these models must be connected together in a consistent manner, with minimal loss of information. Computational engineering requires a strong background in mathematics, in the physical sciences and in computer programming; a synthetic ability for the construction of models that describe phenomena at various length and time scales successfully; original, structured, and critical thinking; and intellectual discipline. These abilities were traditionally cultivated by the Greek educational system, at all levels. The ultimate objective of computational engineering is design, which may concern any sector of technology: materials, industrial processes, construction, vehicles, electrical circuits, pharmaceuticals, artificial organs, etc.

This area presents synergies with all sectors of Research, Technological Development and Innovation, and especially with that of information science (software development). Today one finds in NTU Athens and in the engineering schools of all major Greek universities first-rate groups specialising in all aspects of computational engineering. One also finds engineering software companies with original products and strong exporting activity. Furthermore, computational engineering is an area that will never go out of fashion.

2. Food Technologies

Today Greece has a robust and extroverted food industry with innovative quality products, many of which are inspired by the traditional Greek diet (dairy products, olive oil, wine etc.) There are both large companies and SMEs with significant exporting activity. It is estimated that the Greek food industry represents approximately 21% of the Greek manufacturing industry, comprising more than 1300 enterprises and employing approximately 70000 people. Products of the Greek food industry with protected title of provenance are sold all over the world. On the other hand, Greek universities house internationally competitive applied research groups, which have a healthy tradition of collaboration with Greek food companies.

Engineers have a lot to offer in the design of physical, chemical, and biochemical processes for the production, improvement, preservation, and quality control of foods and beverages. Food engineering develops obvious synergies with the sector of food, nutrition, agro-biotechnology and fisheries and the life sciences in general (e.g., microbiology), but also with materials (e.g., packaging), physics and chemistry.

3. Pharmaceuticals and Cosmetics

Greece has established internationally competitive pharmaceutical companies with patented products, a large production in generic drugs and significant exporting activity. Some of these companies invest a lot in research, even under the adverse conditions of the financial crisis. In addition, there are cosmetic companies with innovative products based on the Greek flora, which make good use of the unique biodiversity of Greece and have established healthy ties with the agricultural sector. On the other hand, in Greek universities and research centres there are internationally competitive groups in departments of pharmacy, chemistry, and chemical engineering which can support industrial research and innovation efforts. Links between academia and industry will have to be strengthened. There are obvious synergies between research in pharmaceuticals and cosmetics and the sectors of life sciences, chemistry, and materials (controlled drug delivery, packaging).

4. Technologies for the Hydrogen Economy

The “hydrogen economy” was proposed around 1970 as an alternative energy strategy that would solve the problems (e.g., pollution, climate change) associated with the use of fossil fuels, which is dominant today. To realise the hydrogen economy, the world has to deal with important technical problems associated with hydrogen production, storage, and distribution.

Large research programmes were initiated in many countries for the solution of these problems. Today research on the hydrogen economy has slowed down in view of the rapid development of technologies such as induced hydraulic fracturing (fracking) for the recovery of natural gas and petroleum from porous sandstone, limestone, or dolomite reservoirs. Thanks to fracking, energy costs in the USA have

been reduced spectacularly, providing a new competitive edge. Nevertheless, hydrocarbon deposits in the earth are not inexhaustible, and it would be wise to continue research on renewable energy sources in thematic areas where Greece has a competitive advantage. Hydrogen technologies constitute such an area, as evidenced by the award-winning research of CPERI/CERTH on hydrogen production through water splitting at high temperatures, achieved in monolithic reactors heated by concentrated solar energy (Hydrosol project); by research at the University of Patras on the catalytic production of hydrogen from organic liquids and ultimately from biomass; and by investigations of hydrogen storage in nanoporous materials at NCSR "Demokritos". This area offers possibilities of synergy with the areas of catalysis and polymers and with the sectors of physical sciences, energy and the environment.

5. Technologies for capturing and using CO_2 for the production of fuels

The abatement of carbon dioxide (CO_2) emissions into the atmosphere and the sequestration of emitted CO_2 are considered today as prerequisites for sustainable growth. Greece does not have significant participation in the large multinational companies which undertake the onerous task of CO_2 capture and sequestration. Nevertheless, Greek scientists can contribute to the solution of specific technological problems appearing in the processes used by these companies and in the design of new CO_2 capture methods. For example, in NCSR "Demokritos" and elsewhere new nanoporous materials are researched that can capture large amounts of CO_2 by sorption and release them by heating; CPERI/CERTH, on the other hand, is studying the idea of catalytically decomposing CO_2 into carbon monoxide (CO) and oxygen (O_2) with solar energy and reacting the CO thus obtained with hydrogen (H_2) (Sabatier or Fischer-Tropsch process) to produce hydrocarbons. The latter idea offers a pathway for simultaneous capture of CO_2 and "storage" of H_2 in the hydrocarbons produced.

The research area of CO_2 capture and utilisation for the production of fuels offers obvious possibilities of synergy with the sectors of environment, energy, and physical sciences (catalysis, nanostructured materials).

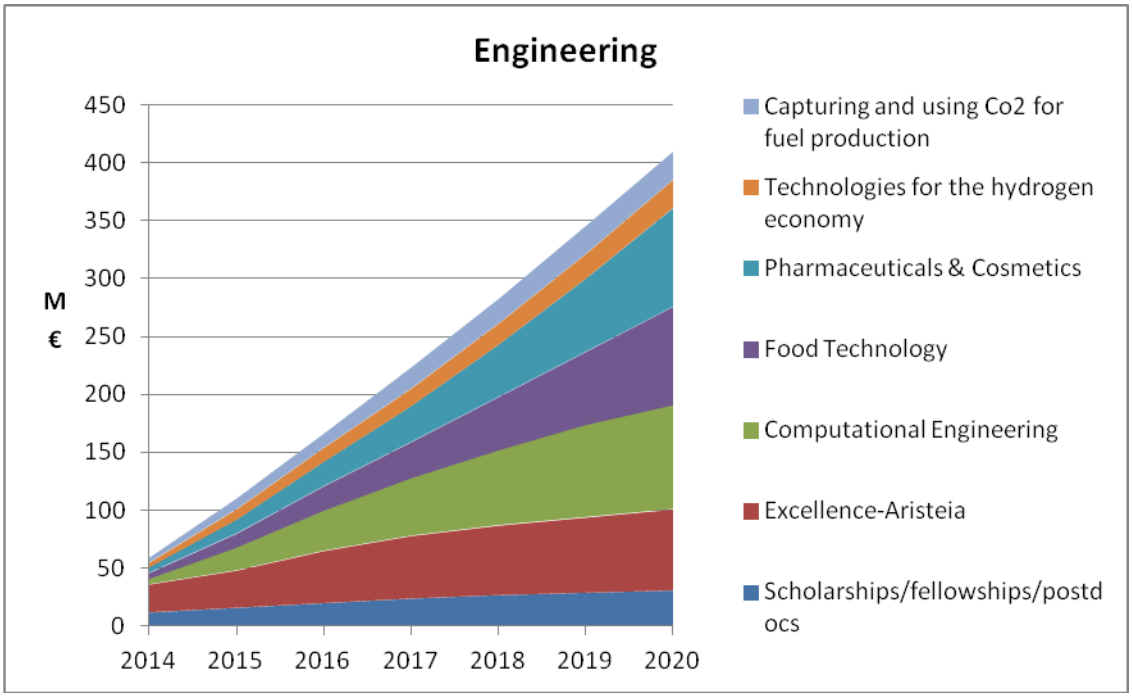


Figure 5.6.1. Proposed distribution of funds over time for the Engineering sector

5.7 Social Sciences

In addition to the more generic problems inhibiting high-quality research in Greece, research in the social sciences suffers from some specific weaknesses that we aim to address in this Plan. Unlike in many of the Sciences, where there is overlap across centers and a need for consolidation and streamlining, in the Social Sciences there is:

- lack or scarcity of organized research centers
- lack of primary data on which to base economic and public policy advice

Research Hubs. In times of crisis, the establishment of new centres may not be feasible or even advisable. Our proposal below is to build instead flexible, portable, and low-cost "research hubs" that serve to coordinate research activities, conferences, and interaction between domestic and international researchers. These will have limited core funding and will be relying primarily on competitive processes to run projects and associated research activities. The two priority areas in this regard are economic policy and public policy.

The notion of a research hub is a different model from the established research centres or institutes. The funding should be provided on a fixed-term basis (e.g. five years) with the scope for renewal on the basis of a performance review. There are models to follow here from other EU member states, such as the ESRC 'research centre' programme in the UK. With such funding, a university or an existing research centre may host one or more of the new research hubs. Such a format can be a stimulus and a focus for concentrated research activity and proposals to

establish or renew a research hub should rest primarily on the quality and impact of the research outputs. Applications should also be evaluated, in significant part, on the extent to which they can reasonably be expected to be open to both domestic and international collaboration. A competitive and open application procedure should be established to allocate and renew such funding. The model of a research hub should be considered for other research areas, as funding becomes available.

Primary Data. There are key areas of economic, political, and social life where there is a lack, or discontinuity, of high-quality primary data to enable research to analyse, track or probe important features and conditions of contemporary society with a view to informing public debate and policy.

Policy makers and government officials face measurement gaps and have access to incomplete advice in their efforts to design policy and to promote it through international negotiation processes (Troika, Eurogroup, etc.) on important matters. These include fiscal policy and budget management; market regulation; the labour market; and public policy (e.g. impact assessment, policy evaluation, and policy innovation with regard to key social objectives and implementation challenges, including public administration).

This Plan proposes as a funding priority specific provision for the origination and sustainability of high-quality databases of relevance to one or more of the social science disciplines and the participation of Greek universities and research institutions in international and European networks and programmes concerned with such data collection and analysis on a comparative basis. Such funding provision needs to be both adequate and stable to nurture appropriate primary data and to avoid discontinuities or gaps in coverage and in comparability to data available in our partner countries. Failure in one or both aspects will undermine the research potential and the contribution to public debate and policy. Moreover, the provision of such funding should be on the basis of periodic, open competition amongst prospective providers from universities and research bodies in Greece.

Key Research Areas. Beyond these major innovations in research structure and data provision, the strengthening of social science research in Greece will rest, in significant part, on the prioritisation and funding of key research areas on the basis of competitive awards.

Thus, this Plan proposes that new funding be provided for individual or group research projects, hosted within universities and/or research centres, that address one or more of the following priority themes:

	R&D Priorities for Social Sciences
1	Fiscal Policy , State & economic growth
2	Poverty, unemployment, social welfare, retirement preparedness, risk exposure and financial distress, social mobility, family, sociability , informal economy, social expression, education
3	Immigration, youth, local communities, immigrant integration policies
4	European integration, monetary union, national & international institutions, political representation
5	Markets, entrepreneurship, competition, regulation

Such funding should be made available on a stable, scheduled basis to individuals or groups. Completion of award reports and their evaluation should be used to inform future decisions on further applications by the same individual or centre.

The innovation here lies in the way in which such funding will be allocated. Specifically, funding allocations should serve the following objectives, in addition to promoting research in those areas:

- Funding of promising graduate students
- Funding of young researchers
- Motivation of all researchers to undertake high-quality research by international standards
- Motivation to carry out research on issues primarily relevant to Greece at a very high level

The sector financing proposed by the Disciplinary Scientific Councils (DSC-TES) for the period 2014-2020 amounts to € 692 million. This figure has been adjusted to 619 million to respect the aggregate budget constraint. The time profile of expenditures originally proposed by the TES was also adjusted to reflect the gradual evolution to the 1.5% target ratio of R&D to GDP. The resulting amounts are reflected in the following Figure (5.7.1).

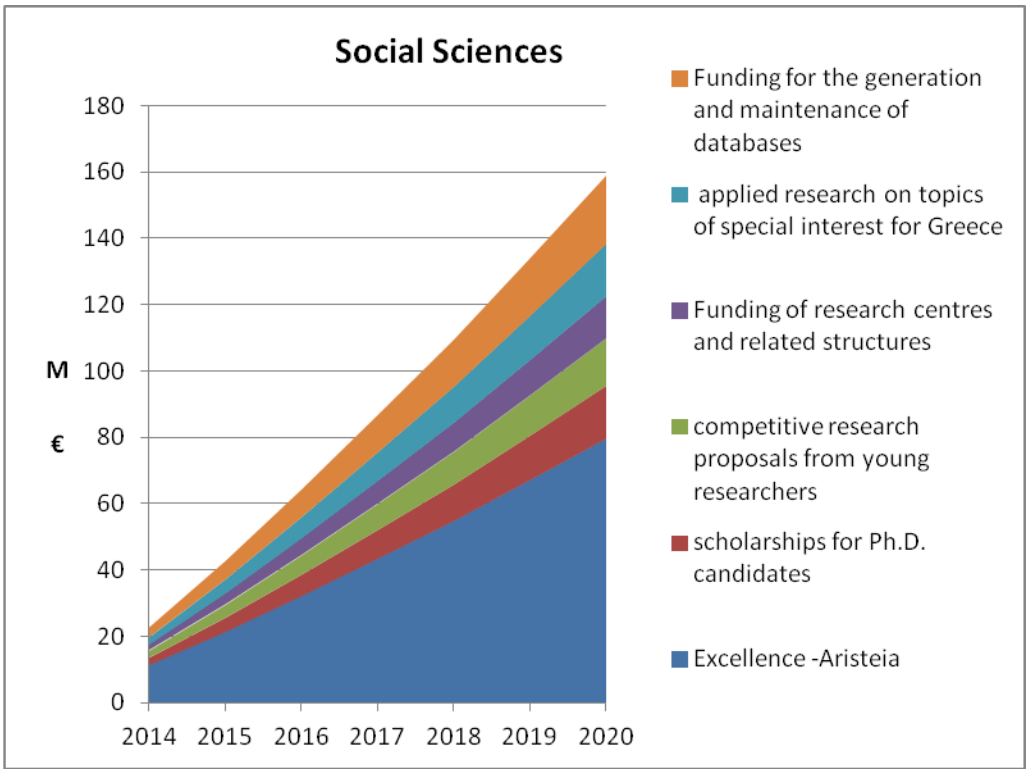


Figure 5.7.1. Proposed distribution of funds, over time for Social Sciences

5.8. Arts and Humanities

By any conventional measure of 'comparative advantage', Greece has an exceptional potential for research and spin-off activities in the area of the arts and humanities. Its rich cultural history in literature, drama, dance, and folk art; its glorious classical structures and archaeological sites; the originality and influence of its philosophers; the evolution and spread of its language; the shifts of population and the constructions of identities; the political life and military conflicts of the region in the context of changing empires and supremacies – these and many other topics illustrate that there are deep seams to explore for researchers and opportunities to exploit with myriad economic and social benefits.

Much of Greece's cultural inheritance is, of course, shared internationally. Indeed, it has helped to define the 'West' and its civilization. As such, it has long been a recognized and cherished référentiel for scholars across the world. This has facilitated international collaboration and foreign (research) investment in Greece.

As in other subject areas, however, the full exploitation of this potential has been hampered by problems of funding, institutional support, state regulation and, increasingly, 'brain drain' from Greece. The latter is of particular importance in the arts and humanities where research rests on individual and group leadership and endeavor and may not be so dependent on infrastructures and equipment.

As elaborated by the Ministry of Culture in its "Proposal for the design of a National Development Strategy in the area of Culture, 2014-2020", research and scholarship in the arts and humanities can serve a range of social, cultural, and economic needs. Research, as part of cultural policy, can serve wider developmental needs:

• Contributing to job creation;

• Promoting smart specialization;

• Helping to improve the competitiveness of the tourist industry;

• Serving the protection of the environment and urban renewal in the context of integrated sustainable urban development.

• Fostering equality of opportunity.

• Be a powerful factor in regional development.

There are, then, both specific problems and opportunities to address in the national research plan for the arts and humanities and wider social and economic imperatives.

In order to better exploit Greece's potential in research and development in this area, certain principles should underscore future action:

- To nurture increasing inter-disciplinary collaboration amongst scholars and institutions (inter- and intra-university; research centres; institutes and foundations, etc.) within Greece in order to make maximum use of existing strengths;
- To create new opportunities for international – not only European – collaboration between Greek scholars and institutions and their peers;
- To provide research funding that, in part, prioritizes certain key themes as a stimulus to inter-disciplinary collaboration, domestically and internationally.
- To consider ways of adapting to current and future needs by creating options for the support of new 'networks of excellence' amongst scholars and institutions, in Greece and in international collaboration.
- To develop new generations of scholars – the human capital of the future – by prioritizing investment in schemes to support them via research grants and post-doctoral fellowships specifically geared to these subject-areas.
- At the same time, each of the above should be considered within the frame of serving the wider social and economic objectives of Greece in the upcoming planning period.

The research planning priorities outlined here should be seen in conjunction with the objectives elaborated by the Ministry of Culture Proposal for the design of a National Development Strategy in the area of Culture, 2014-2020[6].

[6] http://ep.culture.gr/el/Pages/NewsFS.aspx?item=118

Key objectives

- Promote contact and research collaboration between excellent researchers located in different universities and research locations in Greece
- Promote contact of excellent researchers from different disciplines to encourage interdisciplinary research in Greece
- Promote interaction between Greek and foreign-based researchers across a broad range of disciplines, allowing foreign scholars to undertake research related to Greece or relevant for Greece (e.g. in Archaeology)
- Develop the economic potential of research in humanities and the arts, e.g. cultural tourism, film industry, digital imaging and archiving, arts and humanities summer schools and camps

For the 20014-2020 planning period, the following priorities are proposed for funding:

	R&D Priorities for Arts & Humanities
1	**(30% of Total Budget) Special funding for collaborative research projects, involving cross-disciplinary co-operation, that address key themes elaborated at specific stages of the planning period. Such themes could usefully include:** Exploring the construction of Greek identity and its relationship to the international context, including notions of 'Europe' and 'the West', but also in comparison to other major civilizations, such as those of the Far East. Translating cultures and the reception of the past. The transmission, interpretation and sharing of languages, values, beliefs, symbols, histories and narratives addressing issues in areas such as diplomacy; security and conflict; migration; multiculturalism; notions of gender; and popular culture and language. Digital transformations and broadening access in the arts and humanities. The representation, engagement and management of cultural heritages and sites in the tourist industry, including foreign cultural and educational programmes. Art and culture in the protection of the environment and in the social inclusiveness of the urban setting. Science and culture: addressing questions of the role culture, imagination, argumentation, creativity, discovery and curiosity play in scientific enquiry; the sciences as systems of knowledge from the perspective of their cultural context, development and impact; opportunities for enhancing public engagement in the sciences.

2 Structural support for research and development in the arts and humanities should include:

a. (5% of total budget) Support for key areas of the Greek heritage.

i. Priority funding should be given to research, technological development and innovation in relation to Greece's archaeological sites [see Ministry of Culture document] as a central part of the nation's inheritance and the contemporary understanding of it. Initiatives in this area will require better institutional management and easier access for researchers to such sites [see points 9 and 10 in the Ministry of Culture document].

b. (10% of total budget) Creating new networks of excellence.

ii. A pro-active lead in fostering collaboration across inter-disciplinary networks of established academic and research staff on priority research themes that take account of the major imperatives of this plan and require forms of international engagement.

c. (25% of total budget) International cooperation and engagement.

iii. The development of exchange programs and post-doctoral fellowships for Greek researchers with major international institutions, with special attention to the Far East;

iv. The organisation of symposia, conferences and summer schools for young scholars and students from Greece and abroad.

v. Support for foreign scholars to engage in research and graduate training in Greek universities and research institutes.

d. (30% of total budget) Nurturing a new generation of scholars with cross-disciplinary horizons.

The provision of post-doctoral fellowships in Greece (beyond those of IKY) that address one or more priority inter-disciplinary research theme, as elaborated by ESET and the TES.

Further support for research and development in the arts and humanities can come from the generic funding schemes elaborated in this national plan.

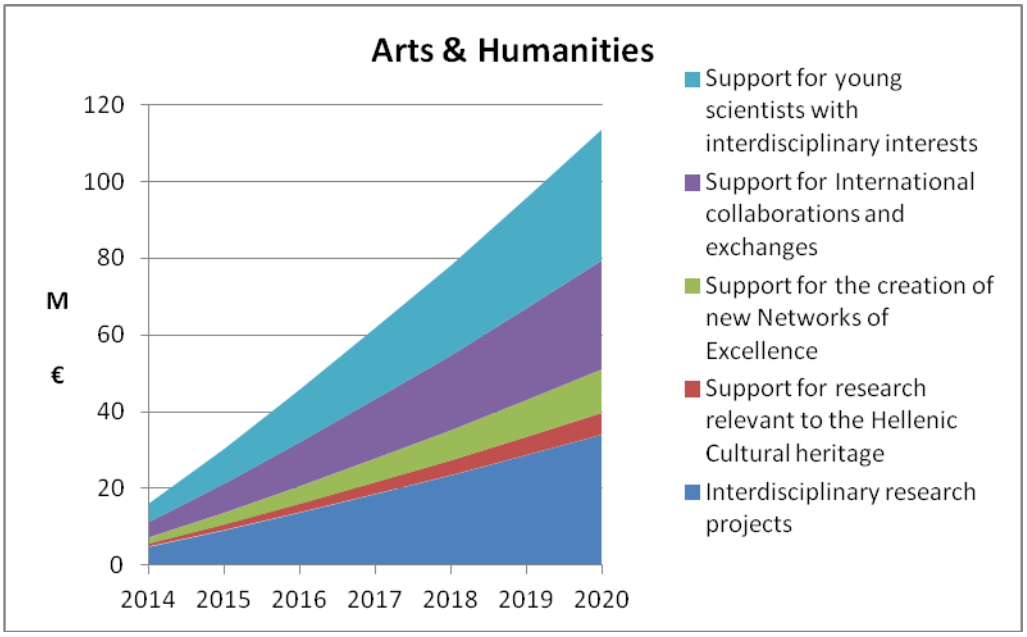


Figure 5.8.1. Proposed distribution of funds, over time for Arts & Humanities

6.0 Priorities for Implementation

6.1 Guiding Principles in Prioritization

The strategic plan must identify areas of focus based on well-defined criteria. As such, we propose the following: (traditional strengths, critical mass, potential for future growth).

1. Areas of traditional strength (examples: shipping, tourism, energy)

2. Areas of recent successes in terms of critical mass and on-going activities (examples: IT, pharmaceuticals, engineering, energy)

3. Areas of high added value and able to deliver major economic benefit and employment prospects (examples: energy, nutrition – food sciences)

4. Areas of major national interest (examples: Food production, archaeology, culture, energy, defense, biomedicine)

(plus : to enable and nurture emergence of new areas that have not been identified]

6.2 Programme evolution toward the 1.5% GDP goal

The setting of the national R&D target for 2020 consists in estimating the R&D intensity (i.e. total R&D expenditure as % of GDP-GERD) in 2020.[7]

According to a study conducted by the General Secretariat for research and technology in March 2013, the GERD estimation for the year **2020** is going to reach **0,67%** of the foreseen GDP which is considered as more consistent with the current trends and the economic outlook. For this purpose the structure of the R&D financing was examined; Gross domestic expenditure on R&D (GERD) has been broken down by its main sources of funding and then estimations were made concerning the evolution of the respective funds from 2005 (last reference year for which available data exist, according to the Statistic Indicators Department of the GSRT) till 2020, based on specific assumptions.

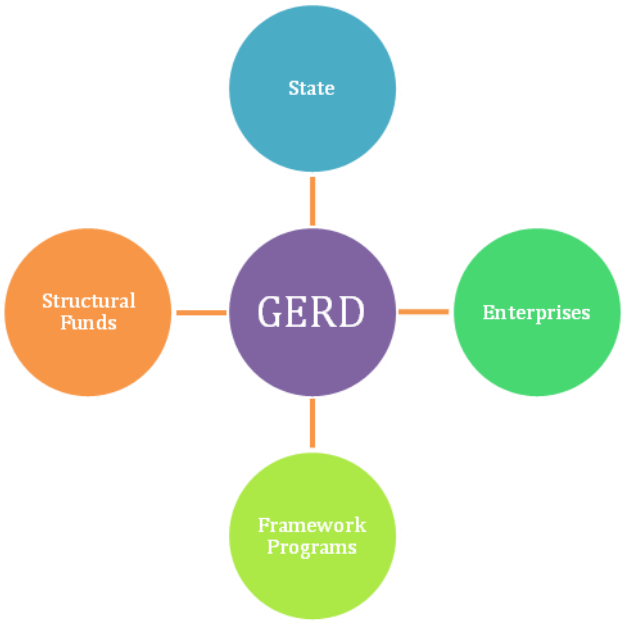
These basic assumptions concern mainly:

- The broad economic environment and economic policies implemented by the government.
- Specific policy measures planned and implemented by the General Secretariat for Research and Technology (GSRT) aiming at increasing the R&D investment in Greece and hence the exploitation of new knowledge for economic growth.
- Specific risks/challenges in implementing the above policy measures, which in any case should be avoided or palliated.

The 4 basic sources of funding of GERD which are being examined are as follows:

- State budget
- Business Enterprises
- EU Structural Funds (EU + national public funds)
- EU Framework Programmes for Research and Technological Development.

[7] It should be noted that for the above estimation, expenditures dedicated exclusively to innovation activities (without an R&D component) are not taken into account.



- State Budget (Ordinary Budget plus Public Investment Budget excluding Structural Funds). It concerns basically the financing of salaries and operating costs of public research organizations, universities, technological education institutes. Consequently the driving factor for the further development of the financing of GERD by the State Budget is the government's fiscal policy, described in the Medium Term Fiscal Strategy Framework (MTFSF) 2013-2016 (Law 4093/2012) and more specifically measures concerning the cut of salaries of researchers and academics, the cut of operating costs of public research institutions and the cut of subsidies of public sector bodies (under public and private law). The expected reduction of the number of researchers in the public sector due to brain-drain, retirement etc. was not taken into account in the estimations.
- Business Sector. The driving factor of the evolution of the financing of GERD by the Business Sector proves to be the recession and its impact on private investments, as well as the reduction of salaries in the private sector, according to the provisions of the Memorandum (Law 4046/2012).
- Structural Funds (including National contribution). The specific source of funding can be identified as the Public Investment Budget (PIB), taking into account that the national contribution to the PIB is gradually diminishing.
- Framework Programmes of EU. The competitive Framework Programmes (FP) of the EU contribute approximately 8% in GERD (data from GSRT's Statistic Indicators Dept., reference year 2005). Main assumption: Due to lack of official data from 2005 and on and in order to estimate the trend in funding from the FPs, data was used from e-CORDA (2003-2012) and specifically the annual signed Grant Agreements between the EU and Greek organisations. It is considered that this data can be used as substitute of the actual payments with a shifting in time (funding transforms to payments through time).

For the integrity of the analysis, data is also being used concerning other funding sources, such as private non-for-profit organizations and other funding sources from abroad (e.g International Organizations). The contribution of these sources is considered minor, fairly stable through time, so that no scenarios are being considered for these.

The synthesis of the individual scenarios for the components (sources of funding) that affect GERD, result in a GERD estimation for the year **2020** on the order of **1,5 bln €**, or **0,67%** of the foreseen GDP, taking into account the Medium Term Fiscal Strategy Framework (MTFSF) 2013-2016 (Law 4093/2012).

This estimation indicates that the successful implementation from GSRT of R&D policies that fully and effectively exploit Structural Funds of the EU (optimistic scenario), **merely manages to offset**

- the realistic estimations of the enforcement of the MTFSF, as far as the main funding source of GERD is concerned, which is the State budget
- the impact of the prolonged recession on the behavior of the private sector

Year	State (Ordinary Budget and Public Investment Budget excluding Structural Funds) (M€)	Structural Funds (KPS) (M€)	Enterprises (M€)	EC Framework Programs (EC contribution)(M€)	Other national sources of funding (Non-for profit organisations, own funds) (M€)	Other sources of funding from abroad (M€)	TOTAL (M€)	GDP (M€)	GERD (%)
2014	313.7	316.7	267.8	144.5	90.0	9.0	**1.141.8**	182.682.0	**0,63%**
2015	316.0	260.0	281.2	146.9	90.0	10.0	**1.104.2**	187.810.0	**0,59%**
2016	324.1	184.8	303.7	149.2	100.0	11.0	**1.072.8**	196.522.0	**0,55%**
2017	333.8	277.2	329.5	151.2	100.0	11.0	**1.202.8**	203.400.3	**0,59%**
2018	347.2	351.1	359.2	153.2	110.0	12.0	**1.332.7**	210.519.3	**0,63%**
2019	364.6	388.1	393.3	155.0	110.0	13.0	**1.423.9**	217.887.5	**0,65%**
2020	386.5	406.6	432.6	156.7	120.0	14.0	**1.516.4**	225.513.5	**0,67%**
	2.386	**2.184.4**	**2.367.4**	**1.056.8**	**720.0**	**80.0**	**8.794.6**		

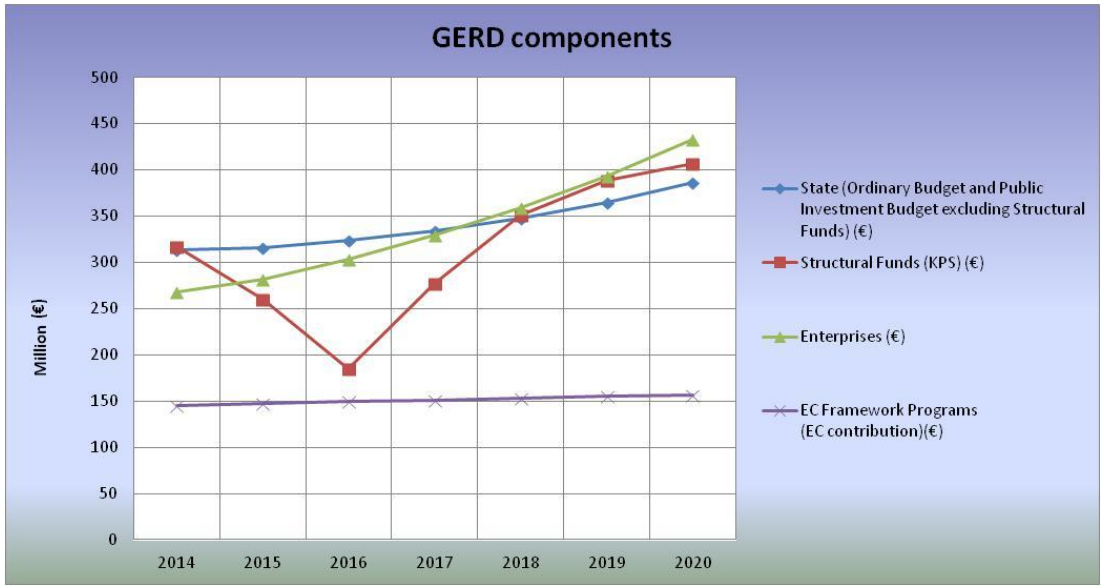


Figure 6.2.1. GERD components

To conclude, GSRT's goal for 2020 is to contribute in every possible way to the stabilization of the R&D intensity (i.e. total R&D expenditure as % of GDP) to the levels recorded before the recession. Taking into consideration the overall status of the Greek economy and the economic policy implemented by the Government, this scenario is considered optimistic. The attainment of a higher GERD/GDP percentage would require the exemption of research organizations from the Medium Term Fiscal Strategy Framework (MTFSF) 2013-2016 (Law 4093/2012) as a clear expression of political will to regard research as the driving force of the Greek economy.
For this reason ESET proposes that the country should set a target of 1,5% for GERD in order to boost the development of the country by commercialising the research results. According to the previous estimations, this results in a financing gap which the government should fill in order to achieve the target. This gap incorporates the expected funds from the new ESPA (see tables below).

Year	State (Ordinary Budget and Public Investment Budget excluding Structural Funds) (M€)	Enterprises (M€)	EC Framework Programs (EC contribution)(M€)	Gap (state funding including new ESPA) to reach 1,5% GERD target	TOTAL (M€)	GDP (M€)	GERD (%)
2014	313.7	267.8	144.5	325.8	1.150.9	182.682.0	0,63%
2015	316.0	281.2	146.9	611.3	1.455.6	187.810.0	0,78%
2016	324.1	303.7	149.2	920.0	1.808.0	196.522.0	0,92%
2017	333.9	329.5	151.2	1.240.6	2.166.2	203.400.3	1,07%
2018	347.2	359.2	153.2	1.565.7	2.547.3	210.519.3	1,21%
2019	364.6	393.3	155.0	1.916.5	2.952.4	217.887.4	1,36%
2020	386.4	432.6	156.7	2.272.9	3.382.7	225.513.5	**1,50%**
Total	**2.386.0**	**2.367.4**	**1.056.8**	**8.852.8**	**15.463.0**	**1.424.334.5**	

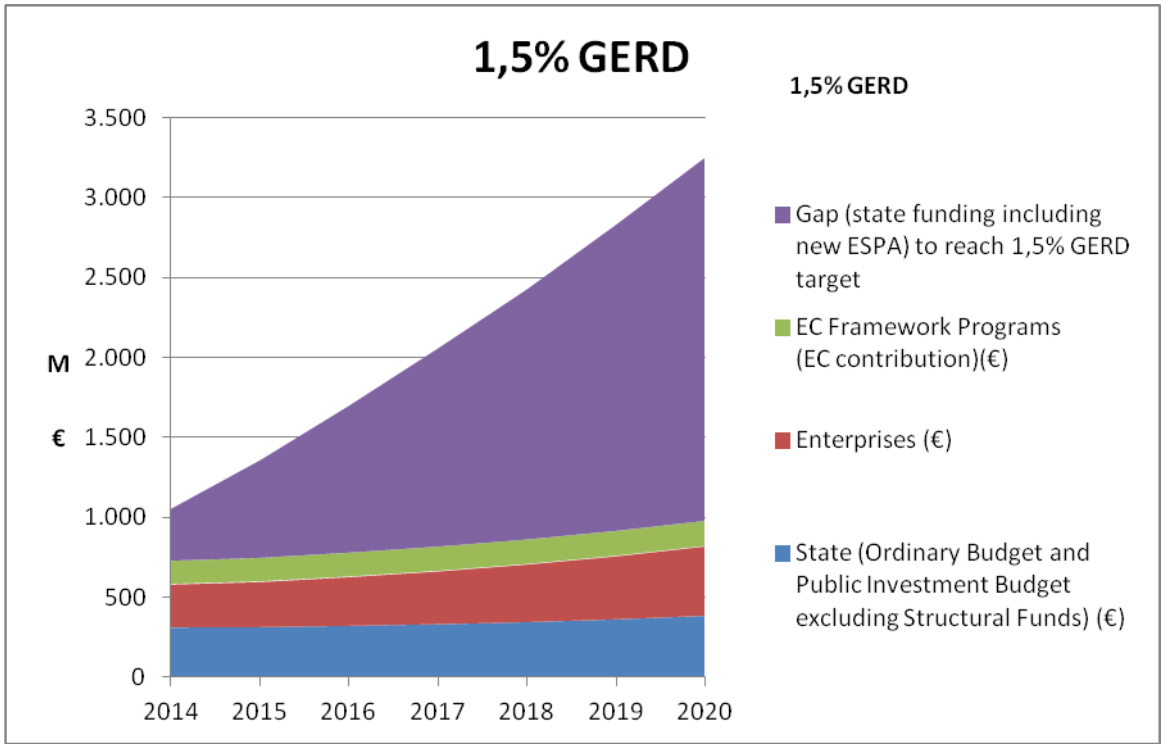


Figure 6.2.2. Funding sources (2014-2020) to reach the 1,5% GERD target

Year	Gap (state funding including new ESPA) to reach 1,5% GERD target	Biosciensces	Agro-BioFood	Natural Sciensces	Math-ICT	Engineering	Energy-Environment	Social scienses	Humanities	Reserve funding
		28%	5%	12%	10%	18%	10%	7%	5%	5%
2014	325.8	91.2	16.3	39.1	32.6	58.6	32.6	22.8	16.3	16.3
2015	611.3	171.2	30.6	73.3	61.1	110.0	61.1	42.8	30.6	30.6
2016	920.0	257.6	46.0	110.4	92.0	165.6	92.0	64.4	46.0	46.0
2017	1.240.6	347.3	62.0	148.9	124.1	223.3	124.1	86.8	62.0	62.0
2018	1.565.7	438.4	78.3	187.8	156.6	281.8	156.6	109.6	78.3	78.3
2019	1.916.5	536.6	95.8	230.0	191.6	345.0	191.6	134.1	95.8	95.8
2020	2.272.9	636.4	113.6	272.7	227.3	409.1	227.3	159.1	113.6	113.6
	8.852.8	**2.478.8**	**442.6**	**1.062.3**	**885.3**	**1.593.5**	**885.3**	**619.7**	**442.6**	**442.6**

6.3. Implementation management plan and assessment

A long-term strategic plan for research and innovation is absolutely necessary to progress, but by no means sufficient. It must be accompanied by a detailed Implementation Plan that sets specific objectives and milestones for deliverables for each element of the strategic plan; and to do so, the managing agency must possess the organization and personnel skills for appropriate oversight of the implementation of each project. In the case of Greece, we are faced with two issues: the first relates to the organization and management of the research enterprise; and the second to the experience of the agency that funds this research and development, and its ability to ensure that timely progress is made, milestones are met, and results are in line with expectations.

The NCRT-ESET has spent considerable effort over the past three years in examining the organization of research establishments overall, be they public or non-profit research centres or private entities affiliated with enterprises. In the process of consultation and discussions with colleagues and organizations, both foreign and domestic, NCRT- ESET has concluded that a radical restructuring of the current system is essential for the following reasons:

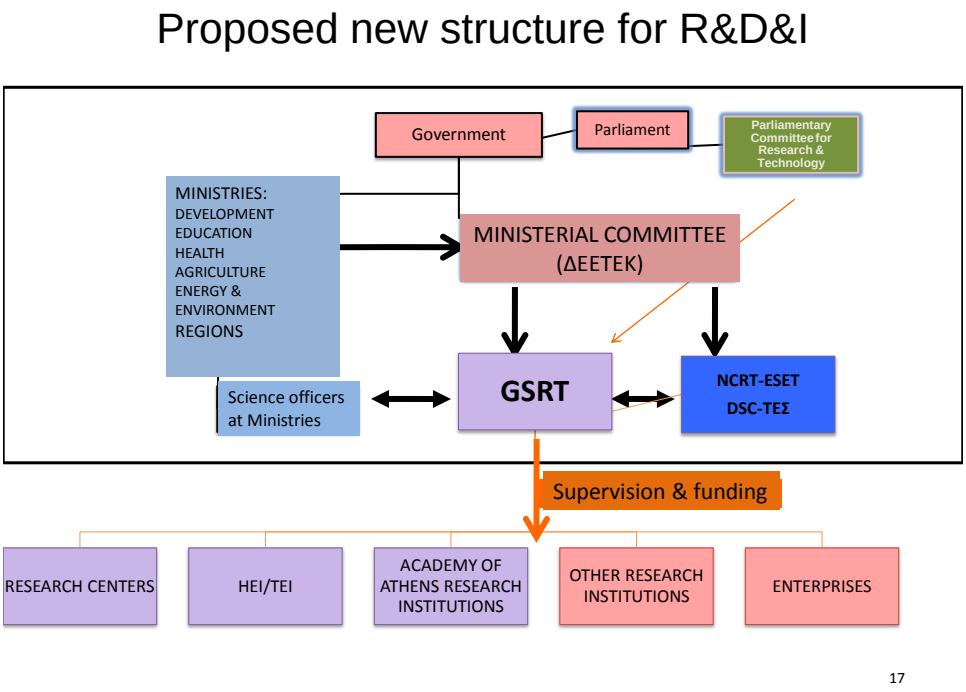
- The current management of R&T within the Greek government structure is vulnerable to a number of flaws:
    - Research centres responsible to different ministries; contrasts in legal status of research centres; discontinuities in leadership and resource planning; confusion and instability for research centres, etc.
- An improved structure should involve:
    - A centralised committee to give strategic direction across government (DEETEK - Δ.Ε.Ε.Τ.Ε.Κ).
    - A central agency (General Secretariat for R&D & NCRT-ESET) to develop and implement policy across and on behalf of government.
    - A greater independence in implementing decisions from political inputs; a distance between political budget decisions and the intended recipients; more stability of leadership personnel between governments.
    - More stability of R&D policy and more predictability of funding calls for the R&D sector.

- The reformed structure should take account of international models and practices: e.g. Office of Science and Technology Policy (OSTP) in the White House, USA; practice of a 'Chief Scientific Officer' as a liaison in each ministry.

The proposed structure is suggested in Figure 6.4.1, and is more or less self-explanatory.

Assuming that such a management structure is adopted, GSRT will be the implementing organization with the guidance of NCRT-ESET and utilising the Disciplinary Scientific Councils (DSC-TES) for detailed advice. We envision that NCRT ESET will require a small (a few persons) professional support staff to execute properly its role of framing the overall R&D recommendations for consideration by the DEETEK and advising GSRT on the implementation of the program.

Figure 6.3.1.Proposed new structure for R&D&I(see text for explanation)



The program implementation and oversight by GSRT must be executed in accordance with international management practices for such activities. These practices require a Program Manager at the agency level for each discipline area, as well as Project Managers for each task at the organisation implementing the work. Depending on task size, other personnel such as individual scientists or engineers could be overseeing/implementing each task. A sample organisation chart is shown in Figure 6.4.2.

The most important part of the management function is to assure that the proposed project is planned properly and progresses in accordance with the promised cost and schedule. To track progress in any programme, it is necessary to conduct reviews by experts in the field, working as a team, to not only examine preliminary plans for implementation, but also to follow progress periodically, investigate whether expenditure rates are commensurate with the attainment of scheduled milestones, and assure that the final deliverables meet the specifications of what was proposed. A typical overall process is illustrated in Figure 6.3.2. below

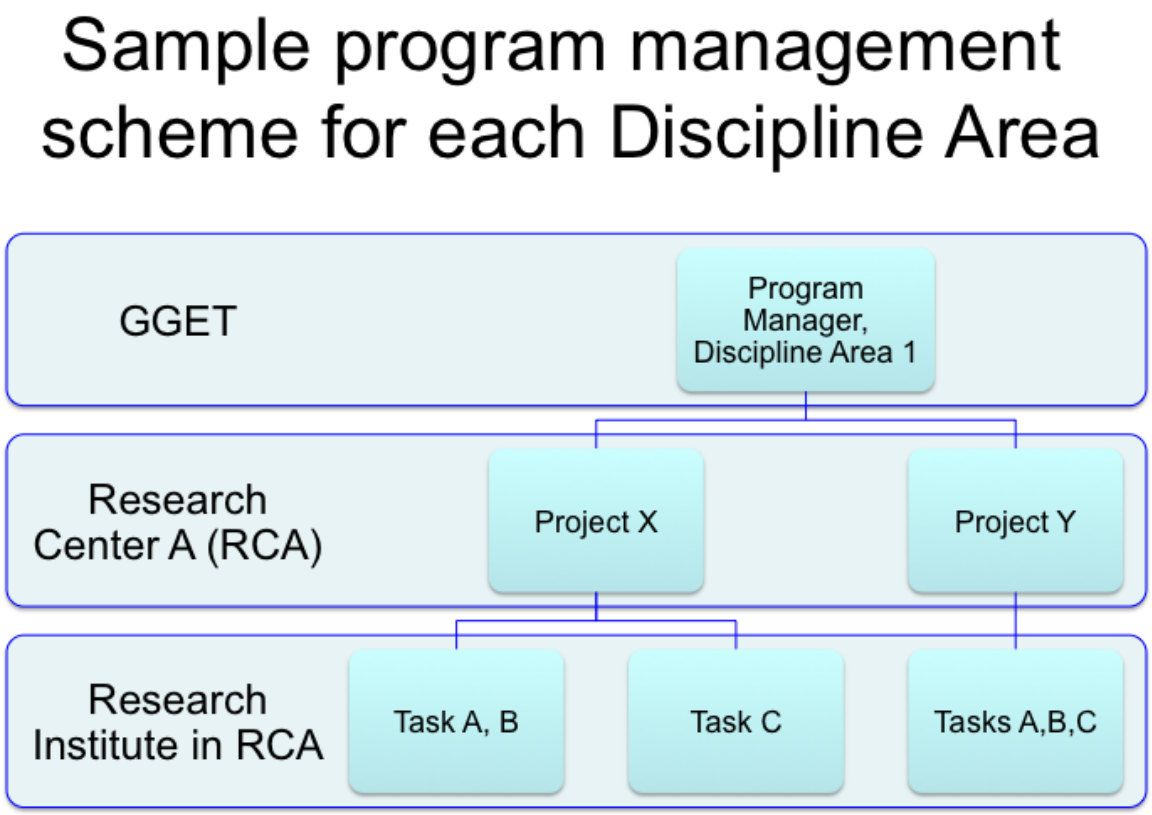


Figure 6.3.2 Sample program management scheme for each Discipline Area (see text for explanation)

Unfortunately, high level management practices in programme implementation are often not given appropriate weight, not only in R&D programmes but also in most other activities of the Greek state. Thus, funds are invariably late in being allocated to perform the work, progress in attaining agreed-to tasks is not tracked and in the end it is possible that resources are expended but results do not meet expectations. It is abundantly clear to NCRT-ESET that without proper management, the strategic plan outline in this document will not achieve its objectives. We recommend that the following steps be taken to insure success.

(a) The restructuring of the organisation for managing the research and development enterprise in Greece recommended in Figure 6.3.2.above be implemented as part of the new law for research.
(b) Current practices within GSRT-GGET in administration of contacts, often based on outdated laws and regulations, be drastically simplified.
(c) Appropriately-trained personnel in modern programme management and administration be retained to undertake the task of directing and overseeing the implementation of both current and future programmes.

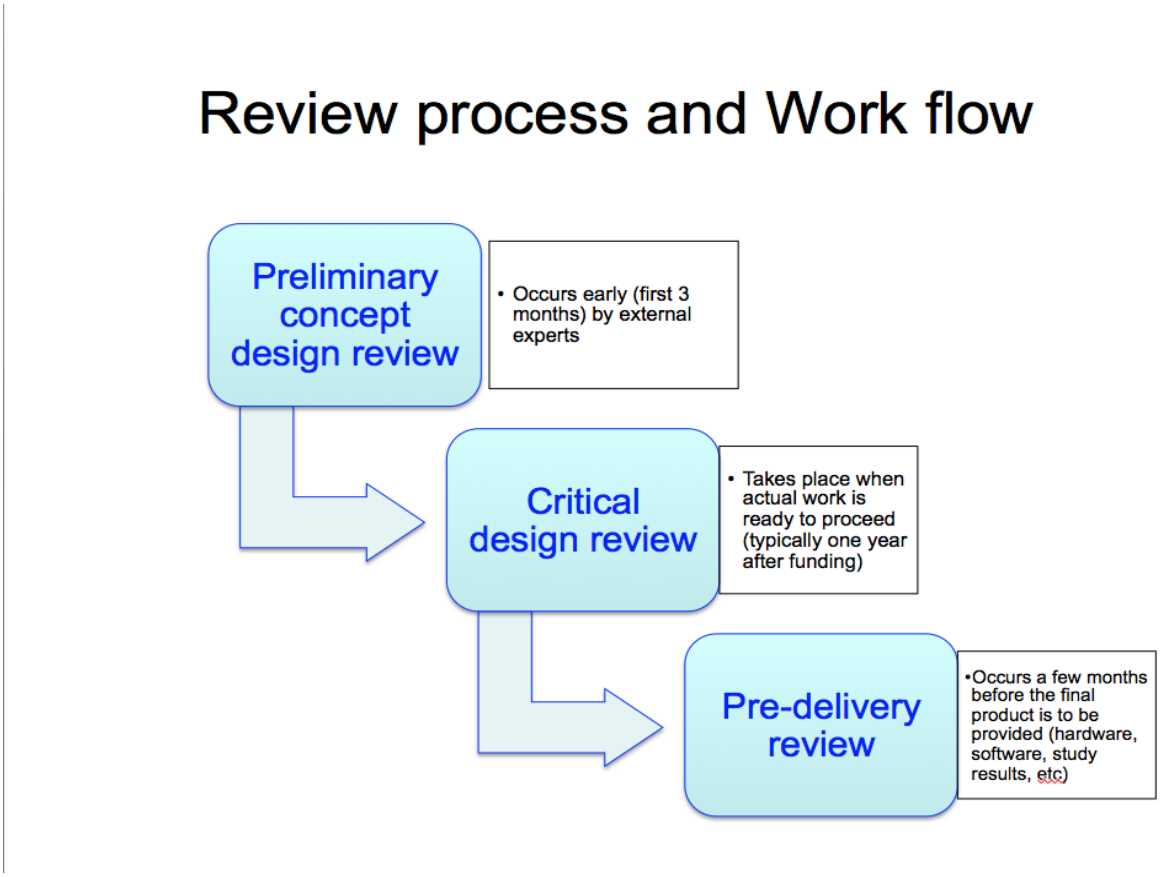


Figure 6.3.3- Proposed review process and work flow (see text for explanation)

7.0 Anticipated Results

The adoption and implementation of this Plan can signal a decisive shift to a stronger and more sustainable growth path for Greece, with R&D supporting a commitment to a knowledge-based economy that fosters innovation. It can also promote parallel reforms that will impact on governance and management; public expectations; and social inclusion.

The obstacles to the realisation of these goals – both from the current crisis and the accumulated problems of the past – are considerable. Short-term pressures can generate distractions from the objective of creating a productive and innovative base and even encourage recourse to drift. Their achievement will require a change in structure, processes and resources, as indicated in Section 6.4.

Yet, the gains for our country of the kind of investment outlined in Section 4.3, and detailed elsewhere in this Plan, are considerable:

- The recovery of the nation's economy, consistent with the well-established nonlinear relationship between research and innovation activities and GDP growth.
- The emergence of new industrial and entrepreneurial activity and clusters with high added value.
- The deceleration – and possibly arrest – of the wave of emigration of the youngest (and often most qualified) members of the R&D community abroad.
- The renewal and replenishment of the crucial human resources required for such an economic model.
- The creation of a research base that will guide and support the design of economic and social policy
- The expansion of opportunities to address issues of social inclusion, environmental balance, and regional innovation.

- The promotion of our cultural heritage and identity, and increased awareness of how this relates to the European identity

Such gains are consistent with the experiences of our European partners and also internationally. They are expected to contribute significantly to the creation of a productive, export-oriented base, which is a precondition for sustainable economic growth and for government debt repayment in the future. Research-based innovation holds the key to reversing the downward trend in investment as a share of GDP and the lack of improvement in the export share of GDP in recent years. A significant rise in the share of GDP devoted to research and development can also help utilise the substantial human capital that Greece possesses and correct the flight of highly skilled labour abroad. Such flight, if unchecked, can take place in limited time but cannot easily be reversed when economic conditions improve in the future.

This plan outlines the path to a different economic model and research environment. It has been designed to break with the flaws inherent in the present system: the confusion and weaknesses of R&D governance and management; the discontinuities and inefficiencies of resource allocation and investment; the lack of adaptation to clearly-defined national priorities; the inadequate opportunities and funding for high-quality research to flourish. The Plan identifies the need for prioritisation and efficient allocation; the stability of the policy frame; the predictability of planning; the provision of opportunity; the recognition of excellence; and responsiveness to current and future needs.

Underscoring these gains is a common theme of *confidence:* in our ability to make a decisive choice towards an economic and social model that is better adapted to international conditions; in our determination to prioritise and secure long-term planning objectives; in our realisation of a different mode of R&D governance and management; and, in our recognition and release of our national potential, especially via our young people. The crisis we are living through places a premium on such confidence, but it is a vitality commodity for Greece's future. Moreover, if we can display such confidence in our country, then we will also acquire – and deserve - a greater credibility with our European and international partners. We expect the plan will lead from the triangle of crisis (debt, deficits, absence of a strong productive base) to the triangle of knowledge (education, research, investments).

We submit this Plan as a better face to the future.

APPENDICES

Appendix I

Evolution and framework of Research and Technology Policy in Greece[8,9]

Governance - Structures

In terms of structures, the first steps in the development of Research & Technology policies date back to 1964, when the Greek government asked the OECD to assess the Greek R&D system, to recommend policies and to identify an appropriate governance model. The result was the establishment on 1971 of the National Council of Research and Development and of the Public Agency of Scientific Research and Development (YEEA[10]) under the then Ministry of Culture and Science.

In 1976, following a review of foreign experts, the Prime Minister established an Inter-ministerial Committee for R&D and an Advisory Council for R&D, which reported directly to the Minister of Coordination. YEEA was also put under the authority of the Minister of Coordination. In parallel, a project- funding philosophy was adopted for the first time.

In 1982, YEEA became an independent Ministry of Research and Technology with a broader mission. Elements such as the regional dimension of research, the professional status of researchers and the orientation of research towards areas of national priority were introduced in the R&D policy agenda of that time.

The Ministry of Research and Technology in 1985 became a General Secretariat for Research and Technology (GSRT) under the Ministry of Industry, Energy and Technology. The merging of several former Ministries in 1996, after a government reform, resulted in the creation of the Ministry of Development, which covered the sectors of Industry, Research and Technology, Energy, Trade & Consumer Affairs.

In 2009 GSRT became part of the Ministry of Education, Lifelong Learning and Religious Affairs (currently Ministry of Education and Religious Affairs) marking the State's willingness to create synergies between Education and Research & Innovation. The GSRT is currently the main authority in Greece competent for the formulation and implementation of Research & Technology policy.

Main Policy Milestones

Prior to 1978, Research, Technological Development and Innovation (RTDI) policy was limited to direct institutional funding of Universities and public Research Centers. All research organizations were under public law, applying restrictive management processes. Business RTD activities have been low.

During the period 1979-1982 the concept of project funding was introduced. The main recipients were Universities, which adopted an organizational reform to comply with the requirements of project funding. A mix of institutional and project based direct funding to Universities and public research centers were the main financial instruments of that time.

The framework Law 1514/85 for Research established the legal framework for R&D in Greece and provided for a 4 - year Program for the Development of Research and Technology (PAET), which defined the priorities and funding of RTD policy. Nevertheless, RTD and Innovation policy has been strongly influenced by the EC Structural funds and is formulated and financed through the successive Community Support Framework (CSF) Operational Programs.

In 1985, a specific legal framework allowing allocation of public subsidies to research undertaken by private enterprises through project funding was also introduced. New concepts in policy planning were introduced in 1989 within the 1st CSF and the STRIDE-Hellas[11] initiative: the establishment of Science & Technology parks by the government near the public research centers. Additional legal measures were introduced during the following years re-orienting the aims of research centers, promoting exploitation of research results, tax incentives and synergies with the private sector (L. 2919/01, Presidential Decree 274 and L. 2992/2002).

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[8] Parts of this section draw from the GSRT background document submitted to OECD in 2007 and from A. Χατζηπαραδείσης, 2009, Το Ερευνητικό Σύστημα της Ελλάδας και η εξέλιξή του. Επιστήμη και Κοινωνία, τεύχος 22-23, Φθινόπωρο 2009] as well as from a description of the historical evolution of the GSRT available at www.gsrt.gr]

[9] Lena Tsipouri and Mona Papadakou, "Profiling and Assessing Innovation Governance in Greece: Do increased funding and the modernisation of governance co-evolve?", OECD 2005 – Governance of Innovation Systems, Vol. 2, pp 23-42

[10] YEEA – Abbreviation in Greek for "Public Agency of Scientific Research & Development"

[11] STRIDE Hellas – Science & Technology for Regional Innovation & Development

Furthermore, the Greek government supported the Lisbon process of the European Union, despite the low national Research, Technological Development and Innovation (RTDI) performance compared to the European average. In 2000 Greece adopted the strategic goal to become a knowledge based economy and set a target to increase the GERD/GDP to 1.5% by 2010, with a business contribution of 40% (from 0.67% and 24% respectively in 1999). However this target was not met and the current level of GERD is still around 0.67% of GDP.

Since the early 1990s RTD in Greece has been funded mostly through the structural programmes of the European Commission (Community Support Framework -CSF) along with the relevant contribution from the Greek State. The only purely national funds come from the Regular Budget for Institutional funding of Research Centers and Universities along with very limited funds of the Public Investment Program.

Therefore, the Operational Programmes[12] of the Community Support Framework (CSF) are the main policy documents, since the R&D policy in Greece in the last decades is strongly influenced by the structural funds and is formulated and financed within their context.

From 1994 until today there have been three main cycles of Operational Programmes for Research & Technology which funded programmes and actions aiming to support human resources, research infrastructures, international cooperation. These actions focused mainly on strengthening synergies and cooperation with the private sector. The thematic priorities of these Programs included most research fields such as quality of life, life sciences, information technologies, new materials and methods of production and processing etc. The increase of the overall expenditure for R&D as a percentage of GDP was among the main aims of these Programmes, however this remained low, at approximately 0.67%, where it remains today.

The overall funds allocated to the main pillars of the last three cycles of Operational Programs for Research & Technology funded through the CSFs of the EU are listed in Table 1 below. At present the Operational Programs of the 4th Community Support Framework (2007-2013) are under their final implementation phase, whilst the formulation of the strategy and preparation of the Operational Programs for the next programming period (2014-2020) are well under way. From this analysis it is clear that the funds provided by the Operational Programs are critical for Greek RTD and care should be taken that these funds are deployed rapidly and efficiently and used wisely to support the RTDI effort.

[12] Operational Programmes, to a certain degree, substituted the Multiannual Programmes foreseen in L. 1514/1985. In the previous programming periods it was called Community Support Framework – CSF.

Appendix II

Synthesis of the Disciplinary Science Councils (DSC - TES)

2011- April 2014

Biosciences

Achilleas Gravanis, *Professor, University of Crete, Medical School (Chair)*

Efstratios Patsouris, *Professor, National Kapodistrian University of Athens, Medical School*

Argyrios Efstratiadis, *Professor, Columbia University, USA and Biomedical Research Foundation of the Academy of Athens, Greece***.**

Vassilios Pahnis, *Director of the Institute of Molecular Biology and Biotechnology of the Foundation of Research & Technology, Hellas.*

Ioannis Ioannidis, *Professor, of the University of Ioannina and University of Stanford, USA.*

Theodore Fotsis, *Professor, University of Ioannina*

Emmanuel Dermitzakis, *Professor, University of Geneva, Switzerland.*

Andreas Marioris, Professor, University of Crete

Aris Economides, *Senior Director, Regeneron*, USA

Nektarios Tavernarakis, *Institute of Molecular Biology & Biotechnology, of the Foundation of Research & Technology, Hellas.*

Vassilios Gorgoulis, *Professor, National Kapodistrian University of Athens, Medical School*

Rebecca Matsas, *Research Director, Hellenic Pasteur Institute***.**

Michael Koutsilieris, *Professor, National Kapodistrian University of Athens, Medical School*

NCRT liaison Members

George Chrousos, *Professor, Medical School, University of Athens,*

George Pavlakis, *Researcher, USA*

Artemis Simopoulos, *President of the Center of Genetics, Nutrition and Health, USA*

Physical Sciences

Nikolaos Hatzichristidis, *Professor, National Kapodistrian University of Athens, Dept. of Chemistry (Chair)*

George Fytas, *Professor, University of Crete, Dept. of Materials Science & Technology.*

George Floudas, *Professor, University of Ioannina, Dept. of Physics.*

Efstratios Kamitsos, *Director of the Institute of theoretical and Physical Chemistry of the National Hellenic Research Foundation*

Kanaris Tsinganos, *Professor, National Kapodistrian University of Athens, Dept. of Physics. Director of the National Observatory of Athens.*

George Tsakiris, *Max Planck Institute, Garching*

Paraskevas Sfikas, *Professor, National Kapodistrian University of Athens, Dept. of Physics.*

Spyridon Perlepes, *Professor, University of Patras, Dept. of Chemistry.*

Efstratios Manoussakis, *Professor, Florida State University, Dept. of Physics, USA*

NCRT liaison Members

Jean Iliopoulos, *École Normale Supérieure Paris, France*

Stamatios Krimigis, *Johns Hopkins University, USA and Academy of Athens*

Information and Communication Technologies and Mathematics

Nikolaos Kalouptsidis, *Professor, National and Kapodistrian University of Athens, Dept. of Informatics & Communications (Chair)*

Ioannis Tsitsiklis, *Professor, Massachusetts Institute of Technology-MIT, Department of Electrical and Computer Engineering*

Vassilios Dougalis, *Professor, National and Kapodistrian University of Athens, Dept. of Mathematics.*

Petros Maragos, *Professor, National Technical University of Athens.*

Elias Koutsoupias, *Professor, National and Kapodistrian University of Athens, Dept. of Informatics & Communications.*

Athanasios Tzavaras, *Professor, University of Crete, Dept. of Applied Mathematics.*

Leandros Tassioulas, *Professor, University of Thessaly, Dept. of Computer and Telecommunications Engineering.*

Antonios Melas, *Professor, National and Kapodistrian University of Athens, Dept. of Mathematics.*

NCRT liaison Members

Constantine Dafermos, *Professor, Brown University, USA*

Amedeo Odoni, *Professor, Massachusetts Institute of Technology, USA*

Engineering

Constantinos Vayenas, *Professor, University of Patras, Dept. of Chemical Engineering (Chair)*

Michael Fardis, *Professor, University of Patras, Dept. of Civil Engineering*

Nikolaos Moussiopoulos, *Professor, Aristoteleian University of Thessaloniki, Dept. of Mechanical Engineering.*

Emmanuel Sarris, *Professor, Demokriteion University of Thrace, Dept. of Electrical & Computer Engineering.*

Xenophon Verykios, *Professor, University of Patras, Dept. of Chemical Engineering*

Timoleon Sellis, *Professor, National Technical University of Athens, Dept. of Electrical & Computer Engineering*

Vassilios Maglaris, *Professor, National Technical University of Athens, Dept. of Electrical & Computer Engineering (member until June 2012 when he was appointed Secretary General for Research & Technology)*

Ioannis Bartzis, *Professor, University of Western Macedonia, Dept. of Mechanical Engineering*

NCRT liaison Members

Amedeo Odoni, *Professor, Massachusetts Institute of Technology, USA*

Doros Theodorou, *Professor, National Technical University of Athens, Dept. of Chemical Engineering*

Energy & Environment

Loucas Christophorou, *Academician (Chair)*

Christos Zerefos, *Academician, Professor at the National Kapodistrian University of Athens*

George Bergeles, Professor, National Technical University of Athens, Dept. of Mechanical Engineering

Christos Houssiadas, *Research Director at the National Center for Scientific Research "Demokritos", Chairman of the Greek Atomic Energy Commission*

Nikolaos Chatziargiriou, *Professor, National Technical University of Athens, Dept. of Electrical and Computer Engineering.*

Michael Stamatakis, *Professor, National & Kapodistrian University of Athens, Dept. of Geology.*

Anastasios Giannitsis, *Professor, National Kapodistrian University of Athens, Dept. of Economics Science (member until November 2011, when he was appointed Minister of Interior)*

Costantinos Synolakis, *Professor, Technical University of Crete*

Ioannis Agapitidis, *MOD S.A former Chairman of the Center of Renewable Energy Sources- CRES (2004-2010.*

NCRT liaison Members

Aris Patrinos, *Synthetic Genomics Inc, USA*

Stamatios Krimigis, *Johns Hopkins University, USA and Academy of Athens*

Arts & Humanities

Stylianos Virvidakis, *Professor, National Kapodistrian University of Athens, Dept. of Methodolgy, History and Theory of Science, Chair*

Ioli Kalavrezou, *Dumbarton Oaks Professor of Byzantine Art History, Harvard University, USA*

Dimitris Tziovas, *Professor of Modern Greek Studies, University of Birmingham, UK*

Lucia Athanassaki, *Professor, University of Crete, Dept. of Philology*

Panos Valavanis, *Professor, National Kapodistrian University of Athens, Dept. of History & Archaeology*

Constantinos Costis, *Professor, National Kapodistrian University of Athens, School of Economics & Political Science*

Athena – Rachel Tsaggari, *film director*

Alexander Nehamas, *Professor, Princeton University, Dept. of Philosophy*

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Appendix III - Data Tables

Proposed distribution of funds per discipline area, over time (2014-2020)

	Biosciences (proposed funding in M€)				
	Institutional	Demostration, start-ups	Networks	PhD, post-docs, junior, senior	totals
2014	18,90	28,37	66,19	75,65	189,13
2015	22,09	33,14	77,32	88,37	220,92
2016	30,48	45,72	106,67	121,93	304,82
2017	37,56	56,34	131,47	150,26	375,64
2018	42,45	63,68	148,57	169,81	424,53
2019	46,93	70,41	164,29	187,76	469,40
2020	49,41	74,12	172,95	197,66	494,15
Totals	**247,82**	**371,78**	**867,46**	**991,44**	**2.479**

	Agro-Bio-Technology - Nutrition (proposed funds in M€)					
Year	Nutrition	Food	Aquaculture	Agro-biotechnology	Primary agricultural production	Totals
2014	2,77	1,63	3,26	3,26	5,37	16,29
2015	5,19	3,06	6,11	6,11	10,10	30,57
2016	7,82	4,60	9,20	9,20	15,18	46,00
2017	10,54	6,20	12,41	12,40	20,47	62,02
2018	13,31	7,83	15,66	15,66	25,83	78,29
2019	16,29	9,58	19,16	19,16	31,62	95,81
2020	19,32	11,36	22,73	22,73	37,05	113,19
Totals	**75,24**	**44,26**	**88,53**	**88,52**	**145,62**	**442,17**

	Energy & Environment (proposed funds in M€)									
	Efficient use of energy in buildings	Reduction of CO2 emissions	Renewable Energy Sources	Smart Grids	Complemetary programes of priority in the field of energy	Study of the consequences of natural and anthropogenic interventions on the environment	R&D for treatment of waste water and solid waste	R&D on water resources	Targeted Research for marine climate changes and natural disaters	Totals
2014	55,39	2,93	5,21	2,93	6,19	3,26	2,28	2,28	2,28	32,58
2015	10,39	5,5	9,78	5,5	11,61	6,11	4,28	4,28	4,28	61,13
2016	15,64	8,28	14,72	8,28	17,48	9,2	6,44	6,44	6,44	92
2017	21,09	11,16	19,85	11,16	23,57	12,41	8,68	8,68	8,68	124,06
2018	26,63	14,09	25,05	14,09	29,75	15,66	10,96	10,96	10,96	156,57
2019	32,58	17,25	30,66	17,25	36,41	19,16	13,41	13,41	13,41	191,65
2020	38,64	20,46	36,37	20,46	43,18	22,73	15,91	15,91	15,91	227,29
totals	200,36	79,67	141,64	79,67	168,19	88,53	61,96	61,96	61,96	**885,28**

	Computer Science & Mathematics (proposed funds in M€)					
	Excellence (Aristeia)	Fellowshipsm post-docs, starting grants	E-infrastructures	Future and Emerging Technologies	Critical ICT, math and telecommunications technologies	Totals
2014	14,28	6,12	7,48	7,48	32,65	32,58
2015	16,64	7,13	8,7	8,7	38,02	61,13
2016	23,29	9,98	12,2	12,2	53,23	92
2017	27,79	11,91	14,56	14,56	63,52	124,06
2018	31,7	13,59	16,6	16,61	72,46	156,57
2019	35,22	15,1	18,45	18,45	80,51	191,65
2020	36,99	15,85	19,4	19,37	84,54	227,29
Totals	185,91	79,68	97,39	97,37	424,93	**885,28**

	Physical Sciences (proposed funds in M€)							
	Scholarships/fellowships/postdocs	Excellence-Aristeia	Polymers, colloids (Nano)composites	Graphene, carbon based nanostructured materials	Advanced Structural Materials	Catalysts, nanostructures materials for catalysts	Instrumentation for sensors	Totals
2014	8	20	3	2	2	2	2	39
2015	10	25	8	7	7	8	8	73
2016	12	30	15	11	12	15	15	110
2017	14	35	20	20	20	20	20	149
2018	16	40	30	25	25	26	26	188
2019	18	45	40	30	30	32	35	230
2020	20	50	45	40	38	40	40	273
Totals	98	245	161	135	134	143	146	**1062**

	Engineering (proposed funds in M€)							
	Scholarships/fellowships/postdocs	Excellence-Aristeia	Computational Engineering	Food Technology	Pharmaceuticals & Cosmetics	Technologies for the hydrogen economy	Capturing and using Co2 for fuel production	Totals
2014	12	24	5	5	5	4	4	59
2015	16	32	20	12	12	9	9	110
2016	20	45	35	21	21	12	12	166
2017	24	54	50	31	31	15	18	223
2018	27	60	65	46	45	18	21	282
2019	29	65	80	63	63	21	24	345
2020	31	70	90	85	85	24	24	409
totals	159	350	345	263	262	103	112	**1594**

	Social Sciences (proposed funds in M€)						
	Excellence - Aristeia	scholarships for Ph.D. candidates	competitive research proposals from young researchers	Funding of research centres and related structures	applied research on topics of special interest for Greece	Funding for the generation and maintenance of databases	Totals
2014	11,4	2,28	2,05	1,82	2,28	2,96	22,79
2015	21,4	4,28	3,85	3,42	4,28	5,56	42,79
2016	32,21	6,44	5,79	5,15	6,44	8,37	64,4
2017	43,42	8,7	7,82	6,95	8,68	11,29	86,86
2018	54,8	10,96	9,86	8,77	10,96	14,24	109,59
2019	67,08	13,41	12,07	10,73	13,41	17,44	134,14
2020	79,5	15,91	14,32	12,73	15,91	20,68	159,05
Totals	309,81	61,98	55,76	49,57	61,96	80,54	**619,62**

	Arts & Humanities (proposed funds in M€)					
	Interdisciplinary research projects	Support for research relevant to the Hellenic Cultural heritage	Support for the creation of new Networks of Excellence	Support for International collaborations and exchanges	Support for young scientists with interdisciplinary interests	Total
2014	4,89	0,81	1,63	4,073	4,89	16,29
2015	9,17	1,53	3,06	7,64	9,17	30,57
2016	13,79	2,3	4,6	11,5	13,8	46
2017	18,61	3,1	6,2	15,51	18,61	62,03
2018	23,48	3,91	7,83	19,57	23,49	78,28
2019	28,75	4,79	9,58	23,96	28,75	95,82
2020	34,09	5,68	11,36	28,41	34,09	113,64
totals	132,78	22,12	44,26	110,663	132,8	**442,63**