European Research Council
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SCIENCE BEHIND THE PROJECTS

RESEARCH FUNDED BY THE EUROPEAN RESEARCH COUNCIL IN FP7 (2007–2013)

Horizon 2020
European Union funding
for Research & Innovation

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Foreword

The European Research Council (ERC) was launched in 2007 to implement the “Ideas” specific programme of the European Union’s Seventh Framework Programme for Research and Technological Development (FP7), 2007–2013, a remit which is continuing as part of the “Excellent Science” pillar in the Horizon 2020 EU Research and Innovation Programme (2014–2020). Scientists and scholars of any nationality and in any discipline can apply to the ERC for a grant to undertake ground-breaking research at the frontiers of knowledge free of any thematic constraints in an EU Member State or an Associated Country. Researchers at a comparable career stage can compete for Starting, Consolidator or Advanced Grants — the sole criterion for receiving research funding is excellence.

At the transition between FP7 and Horizon 2020, with the ERC having funded over 4300 research projects from over 40,000 submitted proposals and with a budget of €7.5 billion in FP7, the time is ripe to report on what type of research was funded at European level in the context of FP7, and the “Ideas” programme in particular. With this in mind, we embarked on a comprehensive analysis of the scientific content of the ERC’s research project portfolio, a collective effort that became known as the ‘Science behind the Projects’ initiative.

Collecting structured information about the scientific content of all the projects funded by the ERC in FP7 was a major undertaking, for which a dedicated database was created. The data currently contained in the database relate to the baseline scientific information included in the research proposals, as the vast majority of the projects are still ongoing. This information was used to elaborate the 'Science behind the Projects’ report, which gives an idea of the breadth of analysis that can be performed using the vast wealth of data collected in the database.

This summary report provides a general overview of the research landscape of the projects funded by the ERC in FP7 in the domains of life sciences, physical sciences and engineering, and social sciences and humanities. One interesting analysis in the report concerns how bottom-up research funded by the ERC contributes to particular European thematic policy priorities — the examples given are nanotechnology, energy, health and migration. Other analyses that could be envisaged include how the scientific content of projects varies along the career stage of researchers (i.e. Starting Grant/Consolidator Grant versus Advanced Grant grantees). The data could also be used to localise clusters of excellence in particular research fields at a European level. The possibilities are almost infinite and provide an exciting avenue for further exploration.

I would like to extend my sincere thanks to our colleagues in the Scientific Management Department for all their hard work over the long winter months for making the ‘Science behind the Projects’ initiative a resounding success and thereby for strengthening the scientific dimension of the ERC Executive Agency.

Pablo Amor
Director of the European Research Council Executive Agency
October 2014

Introduction

The European Research Council (ERC) is responsible for implementing the "Ideas" specific programme under the European Union's Seventh Framework Programme (FP7, 2007–2013) and is part of the excellence pillar under the Horizon 2020 Framework Programme (H2020 2014-2020). It aims to enhance the dynamic character, creativity and excellence of European research at the frontiers of knowledge, and operates on a 'bottom-up' basis without predetermined priorities. Principal investigators (PIs) are free to choose their own research topics and methodologies, and the sole criterion for the funding of projects is scientific excellence. The evaluation of proposals is conducted by means of a structure of high-level peer review panels; the current ERC panel structure consists of 25[1] panels covering all fields of science, engineering and scholarship across three research domains: Physical Sciences and Engineering (10 panels, PE1–PE10), Life Sciences (9 panels, LS1–LS9) and Social Sciences and Humanities (6 panels, SH1–SH6). Although the panel structure is 'top-down', this does not affect which proposals and which thematic areas are selected for funding.

The curiosity-driven, competitive approach has allowed the Ideas specific programme to fund a broad project portfolio, including projects that address current grand challenges as well as fundamental questions (Annual Report on the ERC activities and achievements in 2013[2]). Several studies have looked into how this portfolio is contributing to emerging research areas and frontier research using bibliometric approaches and indicators, among others. There are also several other reports and publications[3] highlighting the contribution of the ERC project portfolio to different fields and presenting a selection of striking projects. Although these initiatives offer insights into the research that is being funded by the ERC, a global analysis covering the entire project portfolio is still lacking. With this in mind, we embarked on a comprehensive analysis of the scientific content of the ERC's research project portfolio, a collective effort that became known as the 'Science behind the Projects' initiative.

Collecting structured information about the scientific content of all the projects funded by the ERC in the Starting Grant (StG), Consolidator Grant (CoG) and Advanced Grant (AdG) calls launched in FP7 was a major undertaking, for which a dedicated database was created. The data currently contained in the database relate to the baseline scientific information included in the research proposals, as the vast majority of the projects are still ongoing. This information was used to elaborate the 'Science behind the Projects' report, which gives an idea of the breadth of analysis that can be performed using the vast wealth of data collected in the database.

Methodology

The analysis is focused on the 4352 research projects funded in the 13 StG, CoG and AdG calls launched during FP7 (i.e. 2007–2013). From 2010, the applications submitted to the StG calls were divided into two streams based on the career stage of the PI: 'starters' and 'consolidators'. In the 2013 Work Programme and due to the high number of applications received for the StG calls, these two streams were split into two independent calls: StG and CoG. However, for the purpose of this exercise, the 2013 CoG call will be treated with the StG data.

[1] In 2007, the ERC panel structure consisted of 20 panels, but in 2008 the number of panels was increased to 25 and this structure has remained stable since then.

[2] http://erc.europa.eu/sites/default/files/publication/files/erc_annual_report_2013.pdf

[3] http://erc.europa.eu/publications

The two main sources of information used to explore the scientific landscape of the Ideas project portfolio were: (i) the information provided by the PI of the project and (ii) input from ERC Scientific Officers responsible for the respective panels.

During the proposal submission phase, the PI chooses the most relevant ERC panel — the 'primary evaluation panel' (panel ID1) — for the evaluation of the proposed research. The initial allocation of the proposals to the various panels is based on the expressed preference of the PI. In the case of interdisciplinary proposals, the PI may indicate a 'secondary evaluation panel' (panel ID2). Additionally, PIs select one or more panel descriptors[4] (i.e. ERC keywords) that best describe their proposal. PIs are requested to choose a first mandatory keyword linked to the evaluation panel chosen for their proposal. They might select up to three additional non-mandatory keywords to fine-tune the field of research to which their proposal belongs. The role of the ERC keywords is to describe the subject of the research proposal and to help with the assignment of the proposal to the correct evaluation panel and reviewers.

Both the panel structure and content of the panel descriptors has changed over time and, therefore, only a few panel descriptors have retained the same code and content since 2007. Thus, the use of ERC keywords alone to identify the main thematic research areas funded in FP7 is limited. Additionally, applicants' interpretation of the panels' scope and descriptors varies widely. Some tend to provide over-complete information (e.g. choosing four descriptors when one or two would have sufficed) or to over- or underestimate the interdisciplinary character of their proposal. With over 4300 grants awarded, the level of variability introduced cannot easily be controlled for.

The input of the ERC's Scientific Officers was critical in harmonising these differences and gathering further information about the scientific content of the projects. The scientific teams that coordinate each of the 25 ERC evaluation panels carried out a detailed analysis of each of the 4352 projects funded in FP7, using a common methodology to enable comparable results. This approach inevitably implies some degree of subjectivity, but it was nevertheless considered the most appropriate in order to conduct the *ex-ante* analysis of the research funded in FP7 with a more consistent and clean dataset.

Scientific Officers collected this scientific information from the full project proposal and, if available, from the progress activity reports submitted by the PIs half way through and at the end of the project. For those projects that cover areas of research beyond those within the remit of each individual panel, the panel teams consulted the other relevant panels to ensure consistency in the treatment of these projects across panels.

The information collected was used by the panel teams to analyse the scientific content of the projects funded by the panel.

[4] The panel names are accompanied by a list of panel descriptors (i.e. ERC keywords) indicating the fields of research covered by the respective ERC panels.

THE RESEARCH LANDSCAPE OF THE IDEAS SPECIFIC PROGRAMME

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The Research Landscape of the Ideas Specific Programme

The budget of the Ideas specific programme implemented by the ERC was €7.5 billion over the 7 year period 2007–2013. This represents around 15% of the entire FP7 budget. In FP7, the ERC managed 13 calls for proposals for the StG, CoG and AdG schemes. In total, more than 40000 proposals were submitted, of which 4352 projects were selected for funding across the three research domains through a rigorous peer review process. These projects were hosted in almost 600 prestigious research institutions[5] in EU Member States and in FP7 associated countries[6].

This report includes a general overview of the outcome of the 13 calls at the domain level (General Background). This is followed by a section (Science behind the projects) that provides a succinct summary of the main scientific areas funded by the panels in each of the three domains, which complements the information given in the domain panel structure boxes. The final part (Cross-Panel/Cross-Domain Interactions) includes a section describing the research topics behind the cross-panel/cross-domain connections identified in the FP7 portfolio, and a section (Highlights of the ERC research landscape) focused on some examples that show the contribution of the ERC research landscape to some key challenges: nanotechnology, energy, health and migration. These highlights were selected as examples that enable the ERC project portfolio to be presented in the context of well-established priorities within the broader EU framework.

[5] http://erc.europa.eu/sites/default/files/publication/files/erc_annual_report_2013.pdf

[6] FP7 associated countries: Albania, Bosnia-Herzegovina, Iceland, Israel, Faroe Islands, Liechtenstein, the former Yugoslav Republic of Macedonia, Republic of Moldova, Norway, Republic of Montenegro, Serbia, Switzerland, Turkey.

LIFE SCIENCES

LS1 Molecular and Structural Biology and Biochemistry

LS2 Genetics, Genomics, Bioinformatics and Systems Biology

LS3 Cellular and Developmental Biology

LS4 Physiology, Pathophysiology and Endocrinology

LS5 Neurosciences and Neural Disorders

LS6 Immunity and Infection

LS7 Diagnostic Tools, Therapies and Public Health

LS8 Evolutionary, Population and Environmental Biology

LS9 Applied Life Sciences and Non-Medical Biotechnology

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Life Sciences (LS) domain

I - General Background

The Life Sciences domain encompasses a broad range of research fields that are organised into nine evaluation panels[7] (LS1–LS9). These panels cover all scales of biological organisation — from molecules to cells to organisms, species, populations and ecosystems — as well a wide range of diverse research and methodological approaches (Box 1, ref. ERC Work Programme 2013).

Box 1. LS domain panel structure

LS1 Molecular and Structural Biology and Biochemistry
Molecular synthesis, modification and interaction, biochemistry, biophysics, structural biology, metabolism, signal transduction.

LS2 Genetics, Genomics, Bioinformatics and Systems Biology
Molecular and population genetics, genomics, transcriptomics, proteomics, metabolomics, bioinformatics, computational biology, biostatistics, biological modelling and simulation, systems biology, genetic epidemiology.

LS3 Cellular and Developmental Biology
Cell biology, cell physiology, signal transduction, organogenesis, developmental genetics, pattern formation in plants and animals, stem cell biology.

LS4 Physiology, Pathophysiology and Endocrinology
Organ physiology, pathophysiology, endocrinology, metabolism, ageing, tumorigenesis, cardiovascular disease, metabolic syndrome.

LS5 Neurosciences and Neural Disorders
Neurobiology, neuroanatomy, neurophysiology, neurochemistry, neuropharmacology, neuroimaging, systems neuroscience, neurological and psychiatric disorders.

LS6 Immunity and Infection
The immune system and related disorders, infectious agents and diseases, prevention and treatment of infection.

LS7 Diagnostic Tools, Therapies and Public Health
Aetiology, diagnosis and treatment of disease, public health, epidemiology, pharmacology, clinical medicine, regenerative medicine, medical ethics.

LS8 Evolutionary, Population and Environmental Biology
Evolution, ecology, animal behaviour, population biology, biodiversity, biogeography, marine biology, eco-toxicology, microbial ecology.

LS9 Applied Life Sciences and Non-Medical Biotechnology
Agricultural, animal, fishery, forestry and food sciences; biotechnology, genetic engineering, synthetic and chemical biology, industrial biosciences; environmental biotechnology and remediation.

By the end of FP7, over 14000 proposals were submitted and evaluated in the LS domain, of which almost 70% were submitted to the StG calls (including the 2013 CoG call). The number of applications has increased over time, particularly in the StG scheme, with almost double the number of applications submitted to the 2012 call compared to those submitted to the 2009 call (Table 1). These applications are not evenly distributed across the nine panels: LS5 and LS7 are the largest panels, each with around 15% of the applications submitted to the LS domain; LS9 has the lowest

[7] In 2007, the LS panel structure consisted of 7 panels; in 2008, the number of panels was increased to 9 and this structure has remained stable since then.

application share among all LS panels, with around 8%, and all the other panels are in the middle range, with 10–11% of the application share.

Table 1. ERC calls for proposals 2007–2013: LS domain data

Calls	Evaluated proposals (eligible)			Funded LS		
	Total number	LS domain	% Women	Domain Grants	Domain budget (M€)	% Women
StG 2007	8787	3475	34%	105	130	21%
StG 2009	2392	883	34%	82	127	23%
StG 2010	2767	982	33%	154	221	24%
StG 2011	4005	1413	33%	171	259	23%
StG 2012	4652	1620	34%	209	310	27%
StG 2013	3255	1038	38%	113	168	31%
CoG 2013	3604	1165	35%	114	223	21%
Total StG + CoG	**29462**	**10576**	**34%**	**948**	**1439**	**24%**
AdG 2008	2034	713	19%	98	216	17%
AdG 2009	1526	494	16%	93	208	16%
AdG 2010	1967	611	13%	101	238	9%
AdG 2011	2245	781	18%	109	264	16%
AdG 2012	2269	760	17%	118	281	19%
AdG 2013	2408	772	20%	106	261	16%
Total AdG	**12449**	**4131**	**17%**	**625**	**1469**	**16%**
Total all Calls	**41911**	**14707**	**30%**	**1573**	**2908**	**21%**

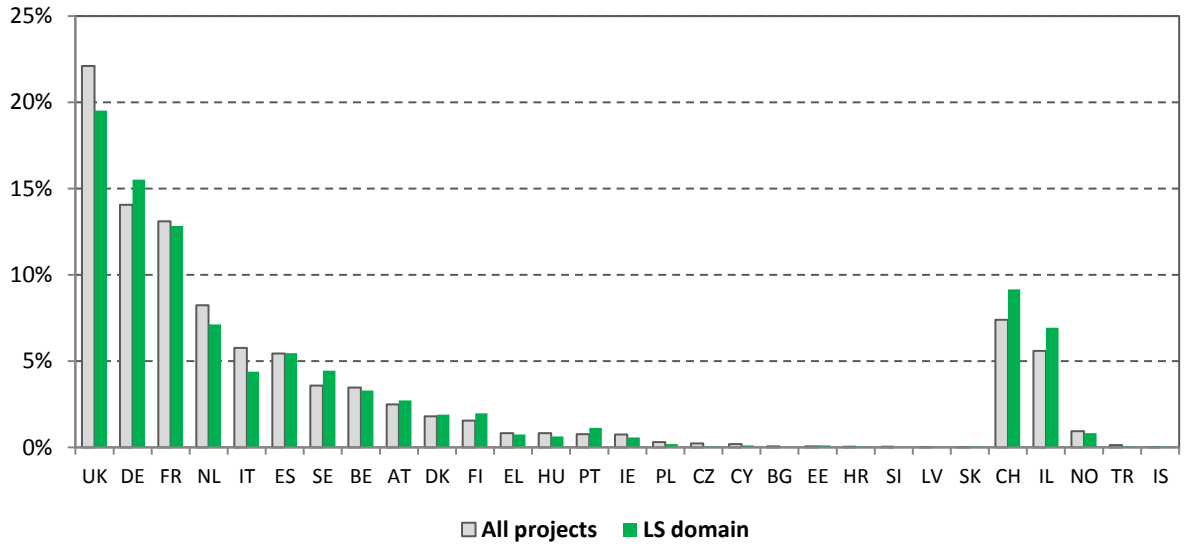
A total of 1573 projects were selected for funding: 948 in the StG/CoG[8] schemes and 625 in the AdG scheme, representing 60% and 40% of the funded projects, respectively. The total budget used by the domain in this period was €2.9 billion, with an almost equal budget distribution between the AdG and StG/CoG calls (see Table 1).

In terms of gender, 330 of the 1573 projects funded have a female PI. The share is higher in the StG/CoG schemes, with 24% female grantees, compared to 16% in the AdG scheme. It should be noted that the share of female grantees in the AdG calls reflects the share of female applicants, while in the StG/CoG calls it is 10 percentage points lower than that of female applicants. The discrepancy between submitted and funded proposals with a female PI is larger in the LS domain than in the other two domains.

Figure 1 shows the geographical distribution of LS-funded projects in EU Member States and FP7 associated countries. A total of 26 countries have at least one ERC grantee funded in this domain, with 18 countries hosting 9 or more grantees. The distribution of projects in the LS domain is similar to that obtained when considering all ERC-funded projects, though there are some differences: some countries have a higher than average percentage of LS projects (e.g. Germany, Israel, Switzerland), while others have a lower than average percentage (e.g. Italy, Netherlands, United Kingdom).

[8] In the 2013 Work Programme, the StG scheme was split into two independent calls: Starting and Consolidator Grants.

Figure 1. Distribution of ERC projects by country funded by the LS domain



More than 300 prestigious research institutions host at least one of the 1573 projects funded by the LS domain in FP7. Of these, one third have at least four ERC grantees. The list of the top 21 host institutions in terms of the number of projects they host is presented in Table 2. The Max Planck Society, and the National Center for Scientific Research (CNRS) and the French National Institute of Health and Medical Research (INSERM) are the research bodies with the highest number of grants in the LS domain, though these grants are distributed throughout various institutes and research facilities in Germany and France, respectively.

Table 2. Top 21 research organisations in the LS domain[9]

Host Institution	Country	LS projects
Max Planck Society (MPG)	DE	58
National Center for Scientific Research (CNRS)	FR	58
French Institute of Health and Medical Research (INSERM)	FR	54
Weizmann Institute	IL	45
University of Cambridge	UK	43
University College London	UK	39
University of Oxford	UK	38
Hebrew University of Jerusalem	IL	33
Karolinska Institutet	SE	28
Swiss Federal Institute of Technology Zurich (ETH Zurich)	CH	26
Institut Pasteur	FR	25
Swiss Federal Institute of Technology in Lausanne (EPFL)	CH	25
Imperial College	UK	24
University of Helsinki	FI	21
Flanders Institute for Biotechnology (VIB)	BE	21
Institut Curie	FR	20
University of Zurich	CH	20
University of Geneva	CH	19
European Molecular Biology Laboratory (EMBL)	DE	18
Medical Research Council	UK	17
Uppsala University	SE	17

[9] Data on HIs as of June 2014 (extracted from Grant Agreement database)

II - Science behind the projects funded by the LS domain

The LS1 panel "**Molecular and Structural Biology and Biochemistry**" encompasses a broad range of fields of research: molecular synthesis, modification and interaction, biochemistry, biophysics, structural biology, metabolism and signal transduction. The core area of the projects funded by the panel is *Biochemistry of macromolecules*, which aims at understanding/explaining major biochemical processes. This research area alone represents almost half of the project portfolio of the panel, while the other half is distributed among projects that fall into the general fields of *Structural biology*, *Biophysic*s and *Biochemical mechanisms/cellular mechanisms*.

Molecular and population genetics, genomics, transcriptomics, proteomics, metabolomics, bioinformatics, computational biology, biostatistics, biological modelling and simulation, systems biology and genetic epidemiology is the spectrum of fields covered by the LS2 panel "**Genetics, Genomics, Bioinformatics and Systems Biology**". Projects funded by the panel can be mostly grouped under *Genetic phenomena*, a core area that represents almost 60% of all LS2 projects. These projects focus on genetic processes and structures, genetic variation and genotype/phenotype studies addressing the links between an organism's genetic code and their observable characteristics or traits. The remaining 40% of the projects are distributed amongst 21 thematic areas, of which *Cell physiological phenomena* with 8%, and *Microbial phenomena* and *Neoplasms* with 4% each, are the most representative areas.

The LS3 panel "**Cellular and Developmental Biology**" covers a broad range of fields of research including cell cycle and division, cell signalling, stem cell biology and morphogenesis. The project portfolio of this panel comprises two main pillars, namely *Cellular biology* and *Developmental biology*, with the former representing over 60% of the funded projects and the latter representing around 30%. The remaining projects fall in the interface between these two pillars.

The LS4 panel "**Physiology, Pathophysiology and Endocrinology**" covers the fields of organ physiology, endocrinology, metabolism, ageing, cancer, cardiovascular diseases and non-communicable diseases. *Cancer* research, with almost 40% of the projects, is the dominant theme, with projects studying cancer genetics, metastasis, cancer development, metabolism, angiogenesis, inflammation and drug development. The remaining 60% of the projects are distributed amongst the global themes of *Cardiovascular diseases*, *Metabolism*, *Physiology*, *Ageing* and *Endocrinology*.

The project portfolio of the LS5 panel "**Neurosciences and Neural Disorders**" includes all fields of neuroscience, from diseases to molecular and cellular bases of neural processes and structures. Globally, this project portfolio is distributed into five fairly balanced areas in terms of the distribution of research projects: *Diseases of the nervous system*, *Cognition and behaviour*, *Cellular neuroscience*, *Neural development and networks*, and *Sensory perception*.

Research into the immune system and its related disorders, infectious agents and resulting diseases, and the prevention and treatment of infection is dealt with by the LS6 panel "**Immunity and Infection**". Two thirds of the projects funded by the panel can be grouped under the general theme of *Immunity*, and these projects can be further subdivided, more or less equally, into the themes of innate and adaptive immunity. The remaining third of LS6-funded projects are in the field of *Microbiology* that can be further subdivided, in decreasing order of frequency, into *Bacteriology, Virology, Parasitology and Microbiology* (other), i.e. projects on microorganisms that are not viruses, bacteria or parasites (e.g. fungi).

The LS7 panel "**Diagnostic Tools, Therapies and Public Health**" covers various fields including research into medical engineering and technology, diagnostic tools, therapeutic research, public health research and medical ethics. The core of the project portfolio of this panel is the development

of diagnostics and therapies for disease. This area represents about two thirds of the overall LS7 portfolio, whereas *Public health* represents about 14% and the remaining projects fall under global themes of a more cross-panel nature (*Stem cell* and *Cancer* research).

The LS8 panel "**Evolutionary, Population and Environmental Biology**" moves the focus to a different set of fields, which include evolution, ecology, animal behaviour, population biology, biodiversity, biogeography, marine biology, ecotoxicology and microbial ecology. The core area of the projects funded by the panel (over half of the projects) is the study of evolution, which is the unifying concept in *Evolutionary biology*. This research aims at explaining the origins of life, the evolutionary tree of life and the evolutionary processes that produced the diversity of life on Earth. Many of these projects have a strong ecological context, which is essential to understand the patterns and processes of evolution. The remaining projects are distributed amongst the global themes of *Behavioural ecology and evolution*, *Ecosystem structure and function*, *Biodiversity scenarios and Global change*.

The LS9 panel "**Applied Life Sciences and Non-Medical Biotechnology**" encompasses a very broad range of fields of life science, with a dedicated focus on applied life sciences. The panel portfolio is distributed between two main areas, *Biotechnologies* in the environmental, industrial, nanotechnology and synthetic biology fields, with almost 50% of the projects, and the *Agricultural and food sciences* research area, with almost 40% of the projects. The remaining projects are grouped in the *Medical and health sciences* category.

PHYSICAL SCIENCES AND ENGINEERING

PE1 Mathematics

PE2 Fundamental Constituents of Matter

PE3 Condensed Matter Physics

PE4 Physical and Analytical Chemical Sciences

PE5 Synthetic Chemistry and Materials

PE6 Computer Science and Informatics

PE7 Systems and Communication Engineering

PE8 Products and Processes Engineering

PE9 Universe Sciences

PE10 Earth System Science

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Physical Sciences and Engineering (PE) domain

I - General Background

The Physical Sciences and Engineering domain is organised in ten evaluation panels[10] (PE1–PE10). These panels range from abstract and fundamental science (mathematics and fundamental constituents of matter) to materials sciences (condensed matter physics, physical and analytical chemistry and synthetic chemistry and materials) and all fields of engineering research (computer science and informatics, systems and communication engineering, and products and processes engineering). The domain also contains two panels defined by the object of the research rather than the methodology (universe sciences and earth system science) (Box 2, ref. ERC Work Programme 2013).

Box 2. PE domain panel structure

PE1 Mathematics
All areas of mathematics, pure and applied, plus mathematical foundations of computer science, mathematical physics and statistics.

PE2 Fundamental Constituents of Matter
Particle, nuclear, plasma, atomic, molecular, gas, and optical physics.

PE3 Condensed Matter Physics
Structure, electronic properties, fluids, nanosciences, biophysics.

PE4 Physical and Analytical Chemical Sciences
Analytical chemistry, chemical theory, physical chemistry/chemical physics.

PE5 Synthetic Chemistry and Materials
Materials synthesis, structure-properties relations, functional and advanced materials, molecular architecture, organic chemistry.

PE6 Computer Science and Informatics
Informatics and information systems, computer science, scientific computing, intelligent systems.

PE7 Systems and Communication Engineering
Electronic, communication, optical and systems engineering.

PE8 Products and Processes Engineering
Product design, process design and control, construction methods, civil engineering, energy systems, material engineering.

PE9 Universe Sciences
Astro-physics/chemistry/biology; solar system; stellar, galactic and extragalactic astronomy, planetary systems, cosmology, space science, instrumentation.

PE10 Earth System Science
Physical geography, geology, geophysics, atmospheric sciences, oceanography, climatology, ecology, global environmental change, biogeochemical cycles, natural resources management.

Almost 19000 proposals were submitted to and evaluated in the PE domain during FP7, of which 71% were submitted to the StG calls (including the 2013 CoG call). This higher share reflects the strong demand for the StG scheme, with an ever increasing number of applications since the 2009 call (Table 3), though these applications are not distributed evenly across the 10 panels. The two largest

[10] In 2007, the PE panel structure consisted of 8 panels; in 2008, the number of panels was increased to 10 and this structure has remained stable since then.

panels, PE3 and PE6, have roughly twice the number of proposals (12% each) compared to the smallest panel PE7, which accounts for 6% of all PE proposals.

Table 3. ERC calls for proposals 2007–2013: PE domain data

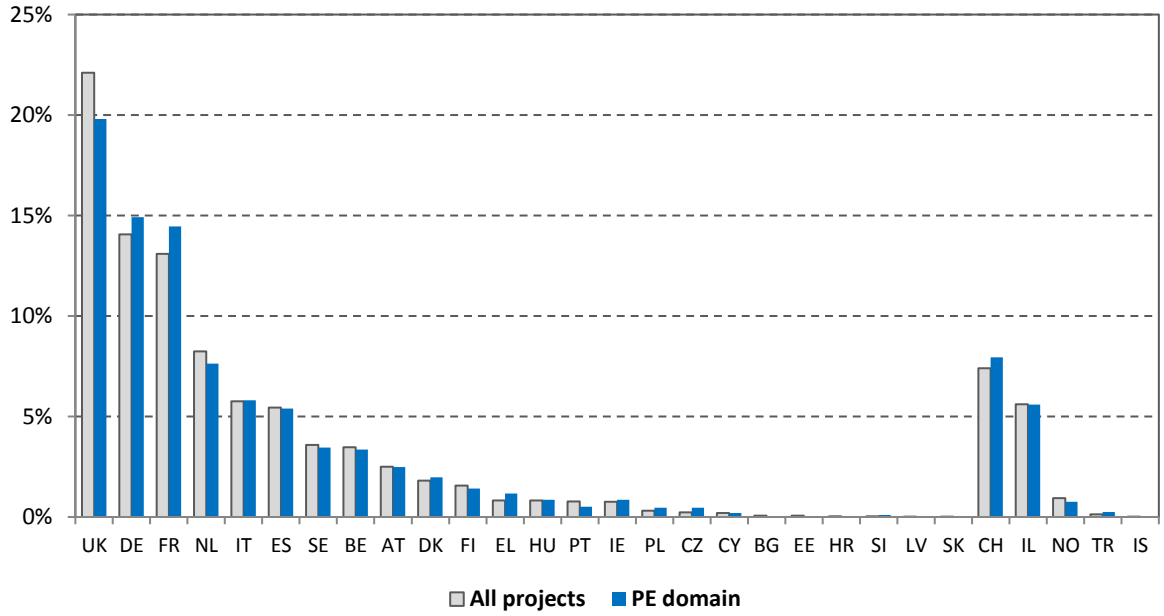
Calls	Evaluated proposals (eligible)			Funded PE		
	Total number	PE domain	% Women	Domain Grants	Domain budget (M€)	% Women
StG 2007	8787	4236	22%	137	154	21%
StG 2009	2392	1069	20%	110	143	22%
StG 2010	2767	1175	19%	201	258	23%
StG 2011	4005	1662	17%	223	308	15%
StG 2012	4652	2028	19%	252	353	17%
StG 2013	3255	1467	24%	131	189	27%
CoG 2013	3604	1646	19%	139	253	17%
Total StG + CoG	**29462**	**13283**	**20%**	**1193**	**1658**	**20%**
AdG 2008	2034	939	9%	128	242	5%
AdG 2009	1526	707	9%	108	231	7%
AdG 2010	1967	885	7%	125	268	6%
AdG 2011	2245	904	8%	138	299	7%
AdG 2012	2269	970	10%	142	310	8%
AdG 2013	2408	1038	9%	131	298	10%
Total AdG	**12449**	**5443**	**8%**	**772**	**1647**	**7%**
Total all Calls	**41911**	**18726**	**17%**	**1965**	**3305**	**15%**

The PE domain has funded 1965 projects in this period, with a total budget of €3.3 billion. The StG/CoG schemes have awarded 1193 grants, while 772 grants were awarded by the AdG scheme, representing 60% and 40% of the funded projects of the domain, respectively. The budget distribution between the AdG and StG/CoG schemes is almost equal (see Table 3).

The share of female grantees, 292 in total, is well aligned with the share of female applicants in all the schemes. This share is higher in the StG/CoG schemes, with 20% female grantees, compared to 7% in the AdG scheme.

Figure 2 shows the geographical distribution of PE-funded projects in EU Member States and FP7 associated countries. A total of 25 countries have at least one ERC grantee funded by this domain, with 20 countries hosting 9 or more grantees. The distribution of projects in the PE domain is similar to that obtained when considering all ERC-funded projects, though there are some countries that have a higher percentage of PE projects than all ERC projects (e.g. France, Germany and Switzerland), while others (most importantly the United Kingdom and, to a lesser extent, the Netherlands) have a lower percentage of PE projects.

Figure 2. Distribution of ERC projects by country funded by the PE domain



More than 350 prestigious research institutions host at least one of the 1965 projects funded by the PE domain in FP7. Of these, slightly more than one third have at least four ERC grantees. The National Center for Scientific Research (CNRS) is the research organisation with the largest number of grants in the PE domain, though these grants are distributed throughout various institutes and research facilities in France (see Table 4).

Table 4. Top 21 research organisations in the PE domain[11]

Host Institution	Country	PE projects
National Center for Scientific Research (CNRS)	FR	122
Swiss Federal Institute of Technology in Lausanne (EPFL)	CH	56
University of Cambridge	UK	55
Swiss Federal Institute of Technology Zurich (ETH Zurich)	CH	53
University of Oxford	UK	53
Max Planck Society (MPG)	DE	44
Imperial College	UK	39
French Alternative Energies and Atomic Energy Commission (CEA)	FR	36
Weizmann Institute	IL	33
French Institute for Research in Computer Science and Automation (INRIA)	FR	31
Hebrew University of Jerusalem	IL	25
University of Bristol	UK	24
Delft University of Technology	NL	23
Technion Israel Institute of Technology	IL	23
University of Leuven (KU Leuven)	BE	22
Spanish National Research Council (CSIC)	ES	21
University College London	UK	21
Eindhoven University of Technology	NL	20
Technische Universität München (TUM)	DE	20
Royal Institute of Technology (KTH)	SE	19
University of Edinburgh	UK	19

[11] Data on HIs as of June 2014 (extracted from Grant Agreement database)

II - Science behind the projects funded by the PE domain

A majority of the projects funded by the PE1 panel "**Mathematics**", roughly two thirds, fall into pure mathematics, which covers relatively evenly all major fields (analysis, geometry, algebraic geometry, number theory, etc.). The rest of the projects are mostly related to applied mathematics in the fields of sciences, engineering, industry, health and finance applications, as well as statistics.

Projects in the PE2 panel "**Fundamental Constituents of Matter**" are largely divided into two core areas, fundamental particle physics, and atomic and optical physics. The former covers high-energy quantum physics (nuclear and particle physics as well as string theory — roughly 40% of all projects) as well as a small number of projects in general relativity and gravitation, whereas the latter deals with low-energy quantum physics (fundamental quantum mechanics and optics, as well as quantum information — roughly 35%) as well as laser physics, optics and atomic and molecular physics.

The PE3 panel "**Condensed Matter Physics**" has a strong emphasis on projects dealing with structural and electronic properties of condensed matter — roughly 40% of all projects. Thematically, they also often overlap with projects in 'device physics' (about 25%) and a smaller number of macroscopic quantum phenomena projects. The remaining 28% of the projects relate to complex non-quantum forms of condensed matter, such as soft matter and fluids, as well as biological materials.

Projects in the PE4 "**Physical and Analytical Chemical Sciences**" and PE5 "**Synthetic Chemistry and Materials**" panels span all fields of chemistry. The PE4 panel covers, with near-equal numbers, projects in surface chemistry, analytical chemistry and physical chemistry, with a strong emphasis, on the one hand, on spectroscopic techniques and, on the other hand, on theoretical and computational methods. The PE5 panel covers synthetic chemistry and materials, including nanosciences, organic synthesis and catalysis. Many projects in PE5 are also directed towards material synthesis for specific applications such as therapeutic methods, electronics or energy.

Projects funded by the PE6 panel "**Computer Science and Informatics**" form roughly three groups, one third being in the area of theoretical computer science, cryptology and security, a second third in computer graphics and vision and human–computer interaction and interface, and the last third consisting of three smaller groups: systems and software, algorithms and artificial intelligence, big data and machine learning.

The PE7 "**Systems and Communication Engineering**" and PE8 "**Products and Processes Engineering**" panels fund projects in a large number of engineering disciplines. The largest group of projects by far in the PE7 panel is new (opto)electronic systems, accounting for almost 50%, followed by signal processing applications, communication and networking technologies, and robotics. The PE8 panel covers a large variety of projects, most commonly dealing with process and manufacturing engineering and often using new materials such as nanomaterials, metamaterials and biomaterials. The applications of PE8 projects vary from aeroplanes to solar energy to wearable electronics.

Projects in the PE9 panel "**Universe Sciences**" fall into four larger groups, starting from cosmology (almost a quarter of all projects), stars, planetary systems and galaxies, with a smaller number of projects in data processing and instrumentation, and specific studies on our sun and galaxy as well as interstellar medium. The largest share of projects in the PE10 panel "**Earth System Science**" is on climate change (close to 20%) and related areas, such as atmospheric sciences and biogeosciences, all of which are related to global change studies. The second largest group of projects covers the structure of the Earth, from deep Earth and tectonics to volcanology, followed by geochemistry and the Earth's evolution.

SOCIAL SCIENCES AND HUMANITIES

SH1 Individuals, Institutions and Markets

SH2 Institutions, Values, Beliefs and Behaviour

SH3 Environment, Space and Population

SH4 The Human Mind and Its Complexity

SH5 Cultures and Cultural Production

SH6 The Study of the Human Past

European Research Council
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Social Sciences and Humanities (SH) domain

I - General Background

The Social Sciences and Humanities domain encompasses 6 evaluation panels[12] that comprise all fields of social sciences and the humanities from economics to politics, law, geography, urban studies, sociology, psychology, linguistics, cultural production, archaeology and history (Box 3, ref. ERC Work Programme 2013).

Box 3. SH domain panel structure

SH1 Individuals, Institutions and Markets:
Economics, finance and management.

SH2 Institutions, Values, Beliefs and Behaviour
Sociology, social anthropology, political science, law, communication, social studies of science and technology.

SH3 Environment, Space and Population
Environment studies, geography, migration, regional and urban studies.

SH4 The Human Mind and Its Complexity
Cognitive science, psychology linguistics, education.

SH5 Cultures and Cultural Production
Literature and philosophy, visual and performing arts, music, cultural and comparative studies.

SH6 The Study of the Human Past
Archaeology, history and memory.

In the SH domain, almost 70% of the applications evaluated were submitted to the StG calls (including the 2013 CoG call). As for the LS and PE domains, the number of applications submitted to the StG scheme has increased over time and at a higher pace than for the AdG scheme (Table 5). SH2 and SH4 are the largest panels, each receiving around 22% of the applications submitted to the SH domain; the SH3 and SH5 panels have the lowest application share amongst all SH panels, with around 10% each; and the SH1 and SH6 panels are in the middle range, with 17% each of the application share.

[12] In 2007, the SH panel structure consisted of 5 panels; in 2008, the number of panels was increased to 6 and this structure has remained stable since then.

Table 5. ERC calls for proposals 2007–2013: SH domain data

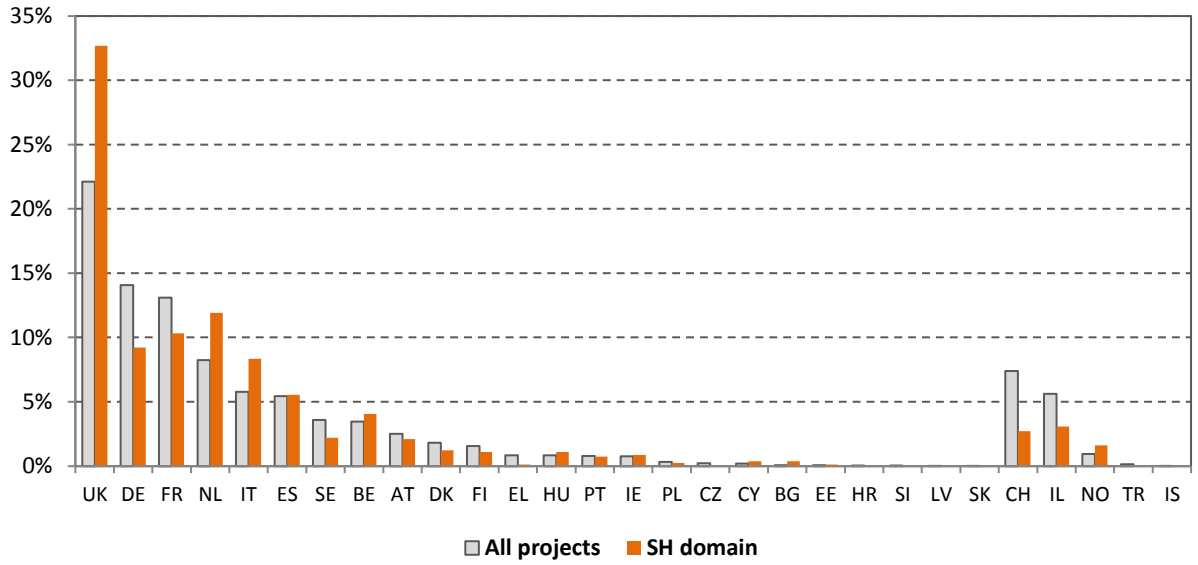
Calls	Evaluated proposals (eligible)			Funded SH		
	Total number	SH domain	% Women	Domain Grants	Domain budget (M€)	% Women
StG 2007	8787	1283	43%	57	49	51%
StG 2009	2392	440	40%	53	56	30%
StG 2010	2767	610	43%	81	93	38%
StG 2011	4005	930	40%	92	115	34%
StG 2012	4652	1004	41%	105	133	35%
StG 2013	3255	750	45%	56	74	34%
CoG 2013	3604	793	42%	59	97	44%
Total StG + CoG	**29462**	**5810**	**42%**	**503**	**617**	**38%**
AdG 2008	2034	382	19%	56	95	18%
AdG 2009	1526	325	21%	44	79	32%
AdG 2010	1967	471	25%	45	94	22%
AdG 2011	2245	560	24%	54	114	15%
AdG 2012	2269	539	24%	59	123	25%
AdG 2013	2408	552	26%	53	114	17%
Total AdG	**12449**	**2829**	**24%**	**311**	**620**	**21%**
Total all Calls	**41911**	**8639**	**36%**	**814**	**1237**	**31%**

Of the 814 projects selected for funding in this domain, 503 were awarded in the StG/CoG schemes and 311 in the AdG scheme — 62% and 38% of the funded projects, respectively. The total budget funded by the domain in this period was €1.2 billion, with an almost equal budget distribution between the AdG and StG/CoG schemes (see Table 5).

255 of the 814 projects funded have a female PI. The share of female grantees is higher in the StG/CoG schemes, with 38% female grantees, than in the AdG scheme, with 21%. They are both around 5 percentage points lower than the share of female applicants. However, these figures differ significantly from panel to panel, probably due to a long tradition in each of the fields involved. In SH1, the percentage of female grantees is about 15 percentage points lower than the share of female applicants, while in panels SH2 and SH5 there is no difference between these two percentages. However, the proportion of female grantees is significantly higher in the SH domain than in the LS and PE domains.

Figure 3 presents the geographical distribution of SH-funded projects in EU Member States and FP7 associated countries. A total of 29 countries have at least one ERC grantee funded by this domain, with 20 countries hosting three or more grantees. The distribution of projects in the SH domain differs, to some extent, from that obtained when considering all ERC-funded projects. The share of the SH projects in the United Kingdom is more than 10 percentage points higher, and the Netherlands and Italy also have a larger share of the SH projects, while France, Germany, Israel and Switzerland have a much smaller share of SH projects compared to that of all ERC-funded projects.

Figure 3. Distribution of ERC projects by country funded by the SH domain



The 814 projects funded by the SH domain in FP7 are hosted in more than 200 prestigious research institutions. Of these, around 30% have at least four ERC grantees. Table 6 includes a list of the top 21 host institutions in terms of the number of projects funded by the domain that they host. The University of Oxford, the National Center for Scientific Research (CNRS) and University College London are the three biggest beneficiaries of the SH projects, though the grants of the CNRS are distributed throughout various institutes and research facilities in France.

Table 6. Top 21 research organisations in the SH domain[13]

Host Institution	Country	SH projects
University of Oxford	UK	35
National Center for Scientific Research (CNRS)	FR	31
University College London	UK	28
University of Cambridge	UK	22
University of Amsterdam	NL	20
Leiden University	NL	18
London School of Economics and Political Science (LSE)	UK	17
Hebrew University of Jerusalem	IL	14
King's College London	UK	14
University of Edinburgh	UK	14
Bocconi University	IT	13
VU University Amsterdam	NL	13
European University Institute	IT	12
Pompeu Fabra University	ES	12
University of Exeter	UK	12
Radboud University	NL	11
Goldsmiths' College	UK	10
Toulouse School of Economics (TSE)	FR	10
University of Leuven (KU Leuven)	BE	10
University of Oslo	NO	10
University of Sussex	UK	10

[13] Data on HIs as of June 2014 (extracted from Grant Agreement database)

II - Science behind the projects funded by the SH domain

The SH1 panel "**Markets, Individuals and Institutions**" encompasses the fields of economics, econometrics, finance, marketing, organisational behaviour, innovation studies, etc. The projects concerned with the *Economic and financial crises* and related issues, such as financial markets and risk management, represent the largest share (22%). Two other areas include research into the *Behaviour of economic agents* (representing 14% of the total), i.e. seeking answers to questions of what determines the choices of economic agents and, ultimately, the decisions that they make, as well as advances in the methods and modelling in the field of econometrics (11% of the total). *Labour markets, Income distribution, Information flows* and the *Study of institutions* each represent around 10% of all the funded projects. The remaining 15% of funded projects touch upon several areas closely linking markets and other dimensions, such as organisational behaviour and cooperation, conflicts, globalisation and market failure.

The SH2 panel "**The Social World, Diversity and Common Ground**" encompasses a broad range of research fields: sociology, social anthropology, political science, law, communication, and science and technology studies. These fields can be grouped into 6 broad research areas: *Sociology*, *Anthropology*, *Political sciences*, *Law*, *Science and technology studies*, and *Communication studies*. The highest number of projects (35%) was funded in *Political sciences*, followed by *Sociology* (22%), *Law* (13%), *Anthropology* (13%), *Science and technology studies* (8%) and *Communication studies* (5%)

The SH3 panel "**Environment, space and population**" covers a wide range of fields of research: from environmental and sustainability studies, human geography, demography, migration, regional and urban studies to geographic information systems and spatial data analysis (GIS). The greatest number of SH3-funded projects falls under the *Population and health* global theme; 31 of the panel's projects (43%) belong here. The remaining projects are between the *Environment*, and *Human geography*, *urban and regional studies* global themes, with an almost equal share of projects in each.

The SH4 panel "**The Human Mind and Its Complexity**" deals with a broad field of research: cognitive sciences, psychology, linguistics, philosophy and education. These fields can be grouped into four main areas: *Psychology*, *Linguistics*, *Philosophy* (Philosophy of mind, epistemology and logic) and *Education*. The most important area is *Psychology*, with a total of 141 projects, representing around 74% of the total; 27 projects were funded in *Linguistics*, which represents around 14% of the total; and 23 projects were funded in *Philosophy*, which represents around 12% of projects funded. There were no proposals funded in *Education*. The core area of the projects funded by the SH4 panel is the study of human cognition through the understanding of human *Cognitive processes*, its development throughout the lifespan (*Cognitive development*) and its evolution over generations (*Evolution of mind and cognitive processes*).

The SH5 panel "**Cultures and Cultural Production**" covers classics, literature and philosophy, visual and performing arts, music, and cultural and comparative studies, and can be grouped into five broad categories: *Arts*, *Cultural studies*, *Literature*, *Philology and Philosophy* (history of philosophy). The analysis of data reflects the importance of both the *Arts* and *Literature* axes of the SH5 panel, with an average share of 54% of all funded projects (31% and 23%, respectively). *Philology* and *Cultural studies* are the third and fourth relevant axes, with an average share of 37% of the total (19% and 18%, respectively). Philosophy is the last axis of the SH5 panel, encompassing 7% of the funded projects.

The SH6 panel "**The Study of the Human Past**" mainly covers the fields of research pertaining to *History* and *Archaeology*. These two broad thematic fields should be understood as referring to different scientific approaches and cover similar time periods but using different methodologies. A

study of the evolution of the overall number of proposals over the 2007–2013 calls shows a steady and largely proportionate increase between the number of proposals in *History* and that in *Archaeology*. The overall proportion of *Archaeology* versus *History* proposals remains quasi linear over time, with a rough proportion of 30–40% of proposals in *Archaeology* versus 60–70% in *History* across all calls and years.

CROSS PANEL/ CROSS-DOMAIN INTERACTIONS

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Cross-Panel/Cross-Domain Interactions

A significant proportion of the more than 4300 projects funded in the 13 calls launched since 2007 cover areas of research beyond those that are within the remit of each individual panel. This is due to the highly interdisciplinary nature of many of these projects (e.g. engineering projects funded by the PE domain developing medical applications), but also to the broad scope of some of the research questions addressed by the projects (e.g. climate change).

In this analysis, each proposal was given a 'best match' panel, which is the panel to which the proposal belongs thematically. This is, in most cases, the same panel that funded the proposal, but not always. If the project or a part of it overlaps scientifically with the fields covered by another panel, it is counted here as a cross-panel connection or interaction.

On average, 42% of the projects funded by any of the panels have a connection to another panel within the same or a different domain. This figure varies across the three domains: the LS domain has the highest share of funded projects with a cross-panel component (54%) and the PE domain the lowest share (31%), while the SH domain is in the middle (45%). Most of the cross-panel connections are between panels within the same domain (see Table 7).

Table 7. Distribution of cross-panel connections

		Cross-panel Connections		
		LS	PE	SH
Best Match Panel	LS	88%	9%	3%
	PE	27%	71%	2%
	SH	21%	8%	71%

Cross-domain connections

The cross-domain connections are most commonly towards the LS domain, sometimes towards the PE domain and more rarely towards the SH domain. In the LS domain, only 12% of the connections observed are cross-domain, namely with panels in PE (9%) and, to a lesser extent, with panels in the SH domain (3%). The PE and SH domains display a different behaviour, with almost 30% of the cross-panel connections with panels of other domains, and in particular with the LS domain (see Table 7).

Figure 4 maps the distribution of the cross-panel connections of the projects funded by the 25 panels. Each row corresponds to the projects that belong to that panel (best match panel), while each column indicates a cross-panel connection to a second panel. Colours are associated with the strength of the connection between two given panels, with red–orange colours representing stronger connections (e.g. >29% of the projects funded by the LS4 panel have a connection with LS3), green colours representing looser connections (e.g. <5% of the projects funded by PE1 panel have a connection with LS1), and white colour indicating the absence of connections between panels.

The most significant cross-domain connections are described below:

In the LS domain, the projects funded by the panels LS5, LS8 and LS9 are the ones with the strongest cross-domain nature. In the LS5 panel "**Neurosciences and Neural Disorders**", these connections are restricted to the SH4 panel "**The Human Mind and Its Complexity**". Both panels overlap in the areas of cognition, behavioural neuroscience and, to a lesser extent, psychiatric disorders. Thus, many of the LS5 projects funded in these areas have components of social and clinical psychology, and cognitive and experimental psychology that are covered by the SH4 panel.

Many of the projects funded by the LS8 panel "**Evolutionary, Population and Environmental Biology**" in the *Ecosystem structure and function* and *Biodiversity scenarios and global change*

thematic areas show a clear connection to the PE10 panel "**Earth System Science**". These projects have relevant components in the fields of *Terrestrial ecology, land cover change*, and *Biogeochemistry, biogeochemical cycles, environmental chemistry*, which are covered by the PE10 panel. Indeed many of the projects that fall at the intersection of panels LS8 and PE10 could have been funded by either panel.

The cross-domain connections of the LS9 panel "**Applied Life Sciences and Non-Medical Biotechnology**" are mostly limited to projects that have a life science character and also involve a PE field of research. This is the case for the cross-panel connection with the PE8 panel "**Products and Processes Engineering**", which covers engineering, in particular micro-engineering, process engineering and bioengineering.

The PE5 panel "**Synthetic Chemistry and Materials**" intersection with the LS1 panel "**Molecular and Structural Biology and Biochemistry**" mainly concerns biophysical analysis of protein–protein interactions as well as research on biomimetic approaches that emulate nature in order to understand the mechanisms of biological systems and to develop more efficient catalysis, green methodologies and efficient molecular machines. Of lesser importance are the connections to the LS7 panel "**Diagnostic Tools, Therapies and Public Health**" in the general area of diagnostic tools and pharmacology.

The link between the PE7 panel "**Systems and Communication Engineering**" and LS panels, such as LS7 "**Diagnostic Tools, Therapies and Public Health**", is with those projects aiming at developing components and systems for medical purposes. When the main focus of the project is biological applications (e.g. neuronal interfaces, biomedical imaging, cell processes, spectroscopy), the LS5 panel "**Neurosciences and Neural Disorders**" prevails. Additionally, one particular interaction worth mentioning is the interaction with the SH4 panel "**The Human Mind and Its Complexity**"; in this case, the knowledge of human mind processes are used to inspire the design of electronic and/or optics components and systems with different purposes (i.e. the development of neuromorphic computer processors).

The PE8 panel "**Products and Processes Engineering**" intersection with the LS domain is mostly focused on the LS7 panel "**Diagnostic Tools, Therapies and Public Health**" and concerns projects in the area of medical engineering and regenerative medicine (i.e. biomechanics, tissue engineering).

The PE10 panel "**Earth System Science**" has the strongest link in the PE domain to the LS domain, even though this link is mostly restricted to the LS8 panel "**Evolutionary, Population and Environmental Biology**". These panels have a certain degree of overlap in projects that deal with terrestrial ecology and oceanography topics, as they are covered by both panels. The other important area of intersection is that of biosphere–atmosphere interactions and the role of microbes in key biochemical cycles.

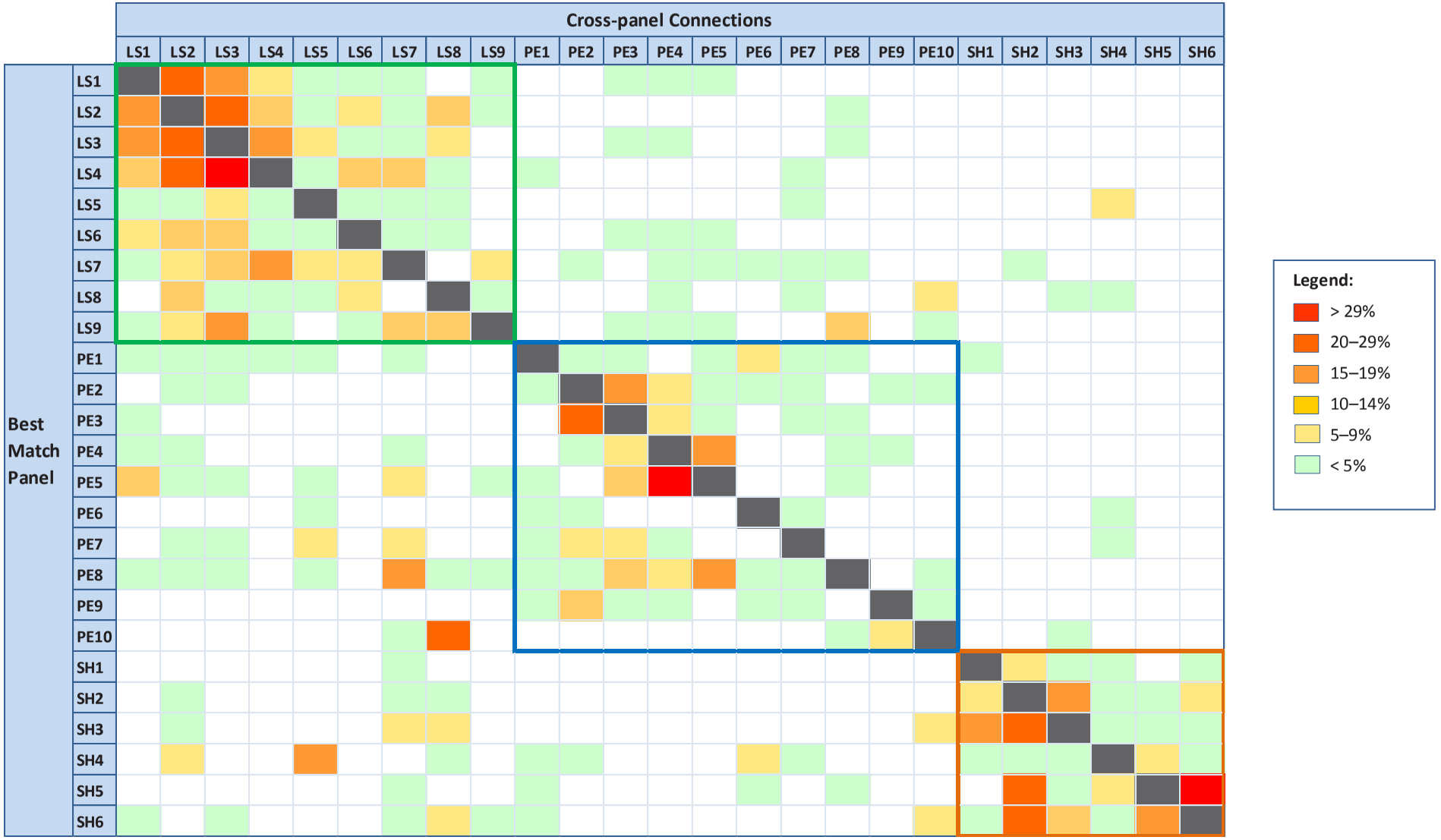
In the SH domain, over 20% of the cross-domain connections are mostly concentrated around panels in the LS domain. The SH3 panel "**Environment, Space and Population**" link with the LS7 panel "**Diagnostic Tools, Therapies and Public Health**" falls in the area of health geography, a field within human geography that uses geographic information, methods, and perspectives — especially in terms of spatial distribution — to study disease, population health, and wellbeing and healthcare. There is also a thematic overlap with the LS8 panel "**Evolutionary, Population and Environmental Biology**" in the field of population biology, which overlaps with demography where human populations are concerned. SH3 projects on social-ecological systems policy, climate change and environmental economics have research components covered by the LS8 panel, such as conservation strategies, biodiversity scenarios/models and global change impacts and resilience, and by the PE10 panel "**Earth System Science**", with topics such as terrestrial ecology and land cover change. The

distinctive factor that determines whether a project is better placed in SH3 or one of the other two panels is the importance that human activity or social consequences have in the proposal.

The SH4 panel "**The Human Mind and Its Complexity**" connection to the LS domain is concentrated mostly around the LS5 panel "**Neurosciences and Neural Disorders**". The use of neuroimaging and neurotechnologies, as well as the study of neuroanatomical regions and neural mechanisms are fundamental questions in the current research of *Cognitive processes* and *Cognitive development* which are the core areas of the projects funded by the panel. Several of the research questions explored by the projects funded by the SH4 panel (i.e. psychological/psychiatric diseases, such as autism and schizophrenia, impairments in neurocognitive functions following brain injury, questions on sensation and perception or the study of neuroanatomical regions or mechanisms behind cognitive processes) are also partially covered by the LS5 panel, albeit from a different perspective. The interaction with the LS2 panel "**Genetics, Genomics, Bioinformatics and Systems Biology**" is mostly restricted to those projects studying the influence of genetic factors in psychological diseases (the altered mind) or in the development of cognitive capacities under the global theme *Cognitive development*. The question about the influence of nature versus nurture in human behaviour has always been present in psychology. The latest developments in innovation in high throughput technology in genetics have positively influenced the interactive research between these areas.

Finally, the SH6 panel "**The Study of the Human Past**" interaction with the LS domain, in particular the LS8 panel "**Evolutionary, Population and Environmental Biology**", is mostly restricted to archaeology projects, including projects looking at landscape archaeology, bioarchaeology and archaeoecology (LS8 panel, in particular linked to evolutionary population genetics), and the origins of agriculture (LS9 panel, in particular agriculture and animal husbandry). The cross-panel connections with the PE domain are restricted to the PE10 panel "**Earth System Science**" in those archaeology projects that have a palaeoclimatology and isotope component.

Figure 4. Map of cross-panel connections. Colours are associated with the strength of the connection between two given panels



Cross-panel connections within the LS domain

As previously indicated, almost 90% of the LS cross-panel connections are restricted to panels within the LS domain (see Table 7, Figure 4). Panels LS1 to LS4 form a well-defined core within the LS domain, with almost 50% of all connections in the domain concentrated within these four panels. They deal with core principles relevant to major fields in life sciences (i.e. structural, molecular, developmental biology), but also with methodological developments and approaches used by several fields across the panels in this domain (i.e. systems biology, bioinformatics, cellular biology). The projects at the intersection of these four panels, for example, study the mechanisms behind genome stability, gene regulation and expression, and cell signalling, which are essential for life, and investigate the impact that errors in these processes may have on tumour formation, developmental syndromes and other genetic disorders.

Table 8 provides further details about the main research fields or topics concerned by the cross-panel connections. Connections that affect less than 5% of the projects are not considered. The columns list the main topics/fields within a given panel that are relevant for those projects funded by other panels (see rows, best match panel). For example, panels LS2 and LS3 cover topics/fields that are highly relevant for many of the projects funded by the other LS panels that have a cross-panel connection. The topics listed in each cell are in decreasing order of importance, e.g. Cancer and its biological basis is a topic covered by the LS4 panel, but it is also the most relevant topic for those projects funded by several other LS panels that have a connection with LS4.

The strongest intersection in the LS domain is that between panels LS4 and LS3 with over 29% of the projects funded by LS4 having a connection with the LS3 panel. Cell signalling and cellular interactions, stem cell biology and signal transduction processes, which are covered by LS3, play a key role in physiology and endocrinology, ageing and metabolism, which are fields covered by LS4 and by many of the projects funded by this panel. Similarly, Epigenetics and gene regulation, and Genomics, which are covered by LS2, are the most relevant fields for those projects funded by other LS panels that have a connection with LS2. The study of changes in the regulation of gene activity and expression that are not dependent on gene sequence has opened up new research frontiers. Thus, several projects investigate the influence of these mechanisms in developmental or metabolic pathways, host–pathogen interactions or responses to environmental stimuli. Moreover, the development/use of genome-scale technologies and their application in all areas of biological investigations to better understand the functioning of complex biological systems is clearly reflected in the table when listing the LS2 fields that are most relevant to other LS panels.

Table 8. Main research areas behind the cross-panel connections within the LS domain

Best Match Panel	Cross-panel Connections: LS1	LS2	LS3	LS4	LS5	LS6	LS7	LS8	LS9
LS1		- Genomics - Epigenetics and gene regulation - Proteomics - Molecular and reverse genetics, RNAi	- Cell cycle and division - Cell biology, molecular transport mechanisms - Organelle biology	- Cancer and its biological basis					
LS2	- RNA - Protein synthesis, modification and turnover - Molecular interactions - DNA		- Cell cycle and division - Cell differentiation - Developmental genetics (animals) - Stem cell biology	- Cancer and its biological basis		- Bacteriology		- Evolutionary biology - Systems evolution	
LS3	- Biophysics - Protein synthesis, modification and turnover - DNA	- Epigenetics and gene regulation - Biological systems analysis - Molecular and reverse genetics, RNAi - Genomics		- Cancer and its biological basis	- Developmental neurobiology - Molecular and cellular neuroscience			- Evolutionary biology - Comparative biology (evo-devo)	
LS4	- RNA - DNA	- Genomics - Epigenetics and gene regulation - Molecular and reverse genetics, RNAi - Transcriptomics	- Cell signalling, cellular interactions - Stem cell biology - Signal transduction - Cell differentiation			- Innate immunity and inflammation - Biological basis of immunity related disorders	- Pharmacology - Diagnostic tools - Gene/cell therapy, regenerative medicine		
LS5			- Developmental biology (animals) - Cell signalling, cellular interactions - Cell biology, molecular transport mechanisms - Organelle biology						
LS6	- RNA - Molecular interactions - Protein synthesis, modification and turnover	- Epigenetics and gene regulation - Genomics - Biological systems analysis - Transcriptomics	- Cell signalling, cellular interactions - Cell biology, molecular transport mechanisms - Apoptosis						
LS7		- Epigenetics and gene regulation - Molecular and reverse genetics, RNAi - Genetic epidemiology - Bioinformatics	- Stem cell biology - Cell signalling, cellular interaction - Morphology & functional imaging of cells	- Cancer and its biological basis - Ageing	- Psychiatric disorders - Neurological disorders	- Immunogenetics			- Synthetic biology
LS8		- Biological systems analysis - Genomics				- Bacteriology			
LS9		- Genomics	- Developmental biology (plants) - Cell biology and molecular transport mechanisms				- Public health and epidemiology	- Evolutionary biology - Biodiversity, conservation biology	

>29% 20–29% 15–19% 10–14% 5–9%

Cross-panel connections within the PE domain

The dominant cross-panel connections in the PE domain follow traditional scientific disciplines and their links to related engineering disciplines. The two physics panels (PE2 and PE3) as well as the two chemistry panels (PE4 and PE5) form the closest two pairs, and put together, these four panels form the hard core of natural sciences (see Table 9). The engineering panels link to 'natural' scientific panels: PE6 "**Computer Science and Informatics**" links to PE1 "**Mathematics**"; PE7 "**Systems and Communication Engineering**" links to the two physics panels (PE2 and PE3); and PE8 "**Products and Processes Engineering**" links to three materials science panels (PE3–PE5). However, the opposite is not true, and the traditional natural science panels (PE2–PE5) do not refer much to the engineering panels.

Table 9 provides further details about the main research fields or topics concerned by the cross-panel connections. Connections that affect less than 5% of the projects are not considered. The columns list the main topics/fields within a given panel that are relevant for those projects funded by other panels (see rows, best match panel). The topics listed in each cell are in decreasing order of importance.

The strongest connection is between PE5 and PE4 topics: The synthetic chemistry and (new) materials projects depend heavily on topics such as surface science and nanostructures, theoretical and computational chemistry, electrochemistry, photochemistry and molecular architecture. To a slightly lesser extent, PE4 projects link to products and methodologies of synthetic chemistry. Similarly, PE2 and PE3 projects overlap on topics where fundamental quantum physics is used for understanding condensed matter properties or where light interacts with nanoscopic devices. Projects in PE9 "**Universe Sciences**" are also closely connected to PE2 when studying fundamental physical processes in space, including astroparticle physics and space plasmas. PE10 "**Earth System Science**" also connects to PE9 on planetary studies of the Earth itself.

PE6 "**Computer Science and Informatics**" is the panel with the least interactions of all 25 panels of all three scientific domains.

Table 9. Main research areas behind the cross-panel connections within the PE domain

Best Match Panel	Cross-panel Connections: PE1	PE2	PE3	PE4	PE5	PE6	PE7	PE8	PE9	PE10
PE1						- Machine learning, data/signal processing - Scientific computing				
PE2			- Nanophysics - Electronic properties of materials - Semiconductors and insulators - Condensed matter-beam interaction - Magnetism and strongly correlated systems	- Spectroscopic and spectrometric techniques - Chemical physics - Surface science and nanostructures						
PE3		- Quantum optics and quantum information - Optics, non-linear optics and nano-optics		- Surface science and nanostructures - Spectroscopic and spectrometric techniques - Physical chemistry of biological systems						
PE4			- Physics of biological systems - Nanophysics - Molecular electronics		- New materials - Homogeneous catalysis - Structural properties of materials - Coordination chemistry - Ionic liquids					
PE5			- Electronic properties of materials - Nanophysics	- Surface science and nanostructures - Theoretical and computational chemistry - Electrochemistry - Photochemistry - Molecular architecture						
PE6										
PE7		- Lasers, ultra-short lasers and laser physics - Optics, non-linear optics and nano-optics	- Nanophysics - Semiconductors and insulators			- Artificial intelligence - Computer systems		- Materials engineering - Computational engineering		
PE8			- Nanophysics - Fluid dynamics - Mechanical properties of matter	- Spectroscopic and spectrometric techniques - Electrochemistry, electrodialysis, microfluidics, sensors - Surface science and nanostructures	- Surface modification - New materials - Biomaterials synthesis - Structural properties of materials					
PE9		- Fundamental interactions and fields - Particle physics - Gas and plasma physics - Nuclear astrophysics								
PE10									- Planetary systems sciences - Formation of stars & planets	

>29% 20–29% 15–19% 10–14% 5–9%

Cross-panel connections within the SH domain

Overall, 45% of the projects funded by all panels in the SH domain have a connection with another ERC panel, of which 71% are with SH panels, 21% with LS panels and 8% with PE panels (see Table 7).

Table 10 provides further details about the main research fields or topics concerned by the cross-panel connections in the SH domain. Connections that affect less than 5% of the projects are not considered. The columns list the main topics/fields within a given panel that are relevant for those projects funded by other panels (see rows, best match panel). Colours are associated with the strength of the connection between two given panels, with red–orange colours representing larger values (i.e. >29% of the projects funded by the SH5 panel have a connection with SH6) and yellow colours smaller values (i.e. only 5–9% of the projects funded by the SH4 panel have a connection with SH5).

The projects funded by the SH1 panel have components relevant to the SH2 panel. The corresponding global theme is: violence and conflict, social structure and social mobility. More specifically, the predominantly economic approaches taken in the study of conflict intersect with studies of social structures, institutions and interethnic relations. Moreover, income distribution and wealth are directly related to the concepts of inequality, poverty and social mobility.

The SH2 panel has the highest collaboration rate with the rest of the SH panels because its broad categories are at the intersection between social and political sciences. This panel is frequently flagged as a second alternative in SH3 and SH6 projects. Several of the research questions explored by the projects funded by SH3 (such as migration, social structure, environment and sustainability) are also covered by the SH2 panel. Moreover, the main topics in SH6 such as history of ideas, social and economic history, are topics that are covered by SH2 as well.

The SH3 panel has links in terms of topics and methodological approaches with the SH1 panel (regional/environmental economics, behaviour economics and consumer choice, econometrics) and a strong relation with the SH2 panel (social inequalities and mobility, ethnic groups, political systems and ageing, health and society). Whereas the links with SH1 are limited to specific fields of science and methods, for example, environmental and population economics, economic geography or econometric modelling and consumer choice (population and transport models), the links to SH2 are more widely spread over the fields covered by the panel, reflecting the interdisciplinary approach of projects that also integrate aspects of sociology, political science (in particular, global governance and institutions), science and technology studies, and anthropology.

The SH4 panel is the least connected with the rest of the panels of the SH domain. The interaction with SH5 is mainly due to projects in philosophy, as this area is covered by both panels.

The SH5 panel encompasses a broad range of research fields. Offering accurate solutions to many of the research objectives contemplated by SH5-funded projects will require a type of research that is at the intersection between various disciplines in the social sciences and humanities. In this sense, the strongest overlap is with the SH6 panel, with over 29% of the projects funded by the SH5 panel having a connection with SH6 in the topics listed in the table.

Finally, the SH6 panel has important links, mainly with three panels, SH2, SH3 and SH5. The connection with SH2 is self-evident, as social, political and religious studies play an important role in the study of history, which is the core area of the projects funded by the panel. Additionally, several of the research questions explored by the projects funded by SH6, such as social mobility, interethnic relations, history of religion, contemporary history/global and transnational history, history of science and techniques, are also covered by the SH2 panel.

Table 10. Main research areas behind the cross-panel connections within the SH domain

Best Match Panel	Cross-panel Connections: SH1	SH2	SH3	SH4	SH5	SH6
SH1		- Violence and conflict resolution - Social structure, social mobility, interethnic relations				
SH2	- Income distribution and poverty		- Enviroment, resources and sustainability - Migration - Ageing, health and society			- History of ideas,history of sciences and techniques - Cultural history, history of collective identities and memories
SH3	- Microeconomics, behavioural economics - Statistical methods	- Social structure, social mobility, interethnic relations - Work and welfare - Global and transnational governance, international studies				
SH4					- History of philosophy	
SH5		- Myth, ritual, religious studies - Communication networks, media, information society		- Linguistics		- Medieval history - History of ideas - Cultural history -Ancient history
SH6		- Legal studies, constitutions, human rights - Social structure, social mobility, interethnic relations - Myth, ritual, religious studies	- Environmental change and society - Geo-information and spatial data analysis		- Textual philology, palaeography and epigraphy - Cultural studies, cultural diversity	

>29% 20–29% 15–19% 10–14% 5–9%

HIGHLIGHTS OF THE ERC RESEARCH LANDSCAPE

European Research Council
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Established by the European Commission

Highlights of the ERC research landscape

The ERC was created in 2007 to stimulate scientific excellence in any field of research in a totally bottom-up approach, with no thematic priorities or geographical quotas, and with "excellence" as the sole selection criterion. The pursuit of excellence in research is an indispensable and critical element for any future knowledge society, striving to innovate through its technologically highly developed potential and through the aspirations and reinforced capabilities of its citizens[14]. The aim of this section is to illustrate, with a few selected examples, how the ERC project portfolio not only serves to build up frontier research capacity in Europe, but also contributes to economic growth and helps to generate societal benefits. The four selected highlights are: Nanotechnology, Energy, Health and Migration. These examples have been chosen because they are well established priorities within the broader EU policy framework and are also specifically addressed in the Horizon 2020 EU Research and Innovation programme (2014-2020). While the ERC forms part of the "Excellent Science" pillar in the Horizon 2020 programme, the four selected examples are high priorities in the "Industrial Leadership" or the "Societal Challenges" pillar. These examples also reflect how a wide range of ERC panels are contributing to address the broad challenges, sometimes even across the whole spectrum of research domains.

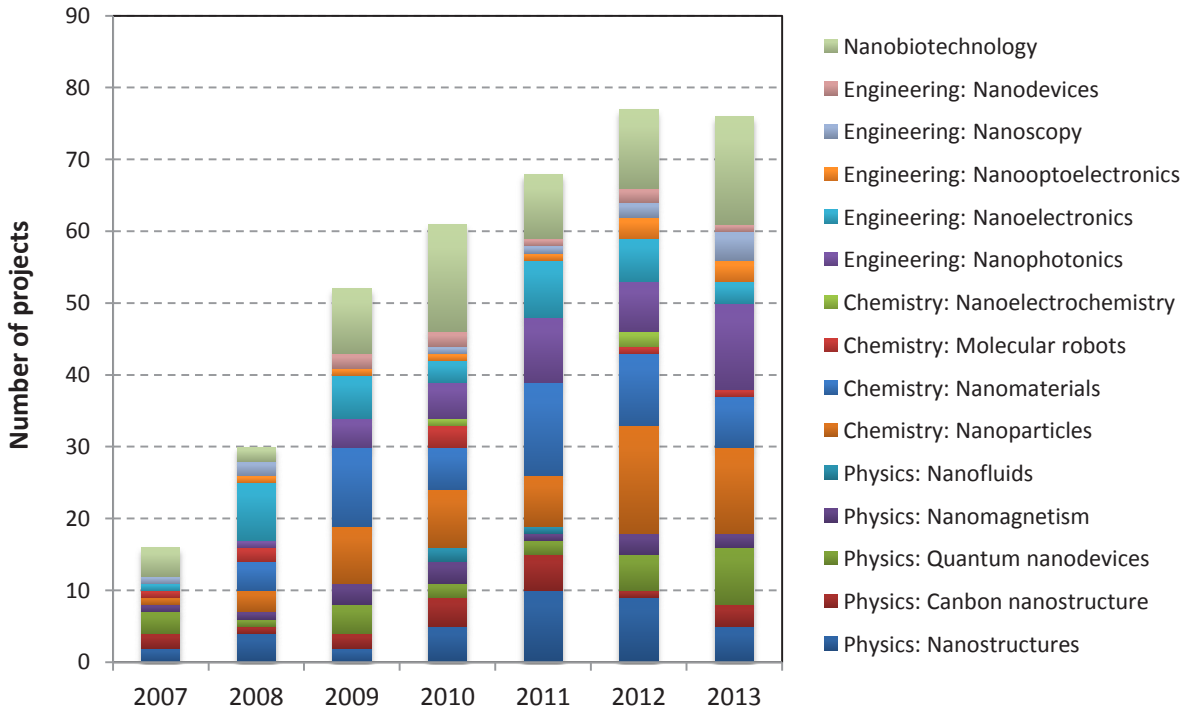
[14] http://erc.europa.eu/sites/default/files/document/file/erc_scc_contribution_common_strategic_framework.pdf

Nanotechnology

Many ERC-funded projects contribute to current and future technologies and, thus, in the long term, will foster industrial leadership. One such broad area is nanotechnology, which has become a field of its own due to the miniaturisation of many technologies from microchips to materials engineering to bioengineering.

Nanotechnology largely covers physics, chemistry, engineering and biological sciences, in which physical structures are smaller than a micrometre. However, crossing this border not only makes devices smaller, but also brings new phenomenology to the physics and chemistry of the devices, such as the interaction with visible light and the emergence of quantum effects on mechanical structures.

Nanotechnology has, thus, become the new frontier of materials and technology research, which plays an ever increasing role in our society [1]. Nanotechnology is already applied across various industries, but also plays an important role in fundamental sciences. The ERC has funded both scientific and applied research, ranging from quantum physics of nanostructures and the synthesis of nanomaterials to a large range of biotechnology research and applications based on nanotechnology (see figure below).



Nanophysics projects cover fundamental research on the physics of nanostructures, including carbon nanostructures, such as graphene, fullerenes and carbon nanotubes; nanodevices with an explicit quantum nature; magnetic properties of nanostructures and molecules; and properties of fluids in various nanostructures. Nanostructures, in this context, mostly refer to the design and production of ideally-nanostructured samples, as well as modelling and measuring their physical and, sometimes, chemical properties.

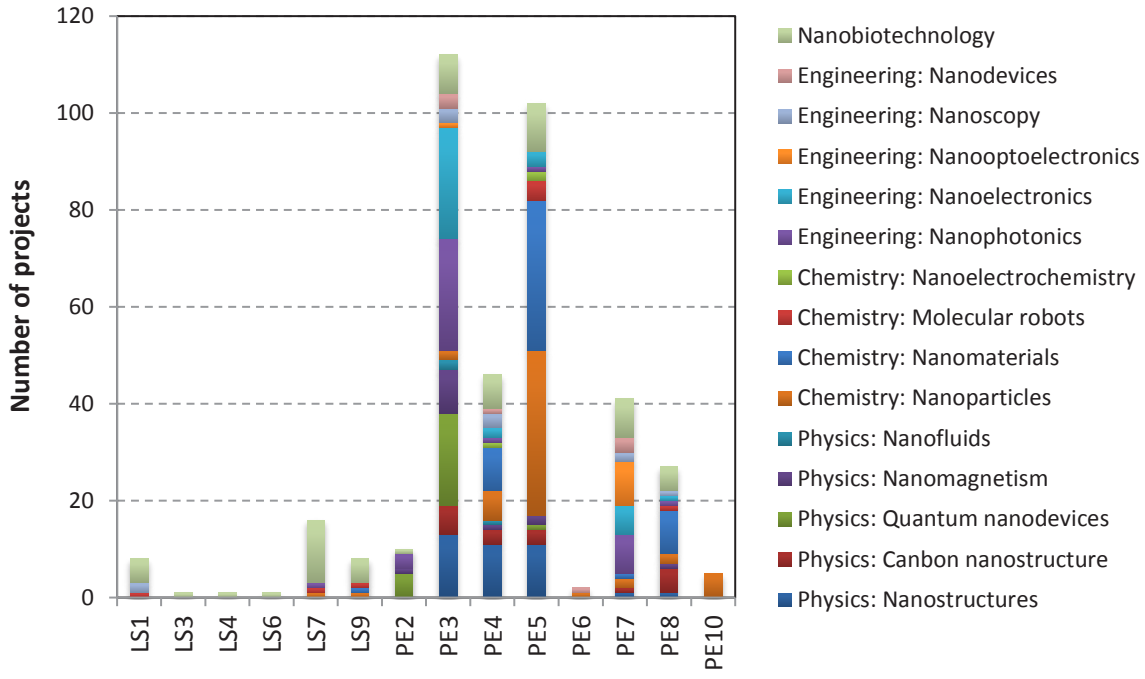
→

Nanochemistry projects include the synthesis and use of a larger number of nanoparticles and nanomaterials (as opposed to individual samples) as well as the study of their (electro)chemical properties, including their environmental effects (mostly projects funded by panel PE10 "Earth System Science"). This category also covers projects on molecular robots that can be controlled to perform simple tasks, such as molecular swimmers or targeted drug delivery.

Engineering projects are generally of a more applied nature, covering nanostructures used in nanoscale mechanics, optics or electronics that have new qualitative properties compared to micro-scale components that have merely been miniaturised. This group also covers nanoscopy, projects that largely involve imaging and measuring techniques for studying existing samples of nanomaterials and devices.

Nanobiotechnology includes a broad category of projects that are characterised by the field of application rather than by the technology used. There are many applications ranging from nanotechnology-based biosensors to drug delivery technologies to cell biology to supramolecular chemistry with biotech applications.

Nanotechnology projects often break the boundaries of classical disciplines and are funded by several ERC panels. The predominant panels in nanotechnology are PE3 "Condensed Matter Physics" and PE5 "Synthetic Chemistry and Materials", followed by PE4 "Physical and Analytical Chemical Sciences", PE7 "Systems and Communication Engineering" and PE8 "Products and Processes Engineering" (see figure below). Most nanotechnology projects funded by LS panels naturally fall into the field of nanobiotechnology; furthermore, all PE panels (except PE10) also fund projects in this field.

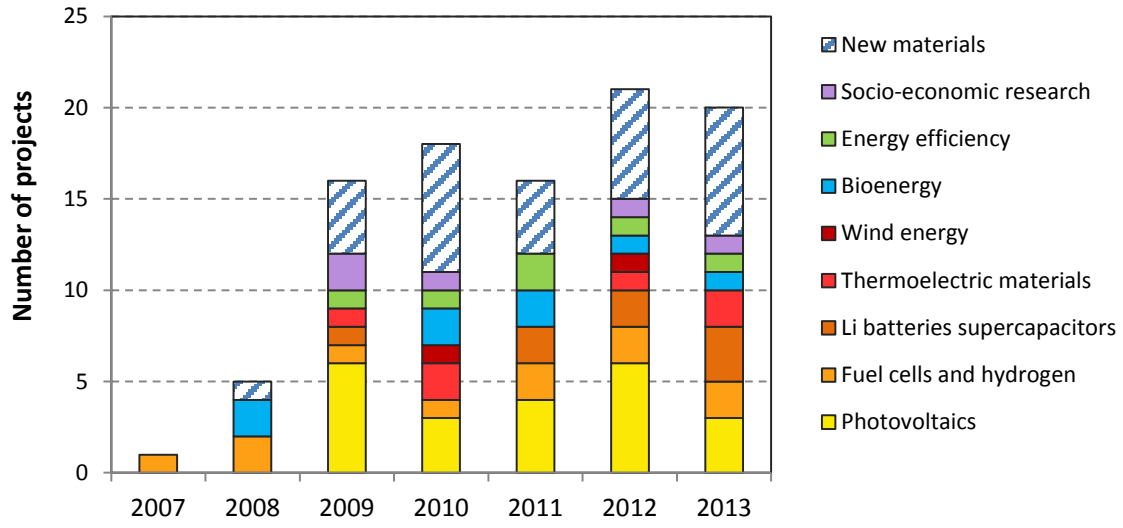


[1] http://ec.europa.eu/programmes/horizon2020/en/h2020-section/nanotechnologies-advanced-materials-advanced-manufacturing-and-processing-and

Energy

The challenge to "transform Europe into a low-carbon economy and increase its energy security" [1] is one of the Grand Challenges that European policymakers are facing. The EU has set itself a legally binding goal to cut greenhouse gas emissions from all primary energy sources by at least 20% by 2020 (compared to 1990 levels) [2], while pushing for an international agreement to succeed the Kyoto Protocol aimed at achieving a 30% cut by all developed nations by 2020. In October 2009, EU leaders endorsed a long-term target of cutting up to 50% of carbon emissions from primary energy sources by 2050, compared to 1990 levels [3].

In parallel, the European Commission has put forward a Strategic Energy Technology Plan (SET-Plan) "to accelerate the development and deployment of cost-effective low carbon technologies" [3]. Both actions, which originated from the Climate action and Energy Commissioners, respectively, coincide in the need for appropriate research.



Secure, clean and efficient energy is one of the societal challenges targeted in the Horizon 2020 Programme. The ERC, though not motivated by policy, also funds research projects in several fields related to energy (see figure above). The research topics can be classified in the 9 groups shown in the graph, in rough agreement with the SET-Plan: 6 correspond to technologies for energy supply and storage (photovoltaics, fuel cells and hydrogen, Li batteries and supercapacitors, thermoelectric materials, wind energy and bioenergy), the others to energy efficiency, socio-economic research and new materials.

Photovoltaics is the largest group of projects funded in energy supply technologies. This covers mostly materials research, and modelling and research on fundamental processes, as well as a smaller number of engineering projects. Fuel cells and hydrogen research and bioenergy (biofuels) is the second largest topic in terms of number of projects, followed by Li batteries and supercapacitors projects and projects on thermoelectric materials and wind energy.

Energy efficiency covers mostly communication technologies and energy uses of nano-electronics, but also power grid networks and gas turbine combustion technology, whereas socio-economic research focuses on climate change mitigation, urban energy infrastructure and the consumer role on them.

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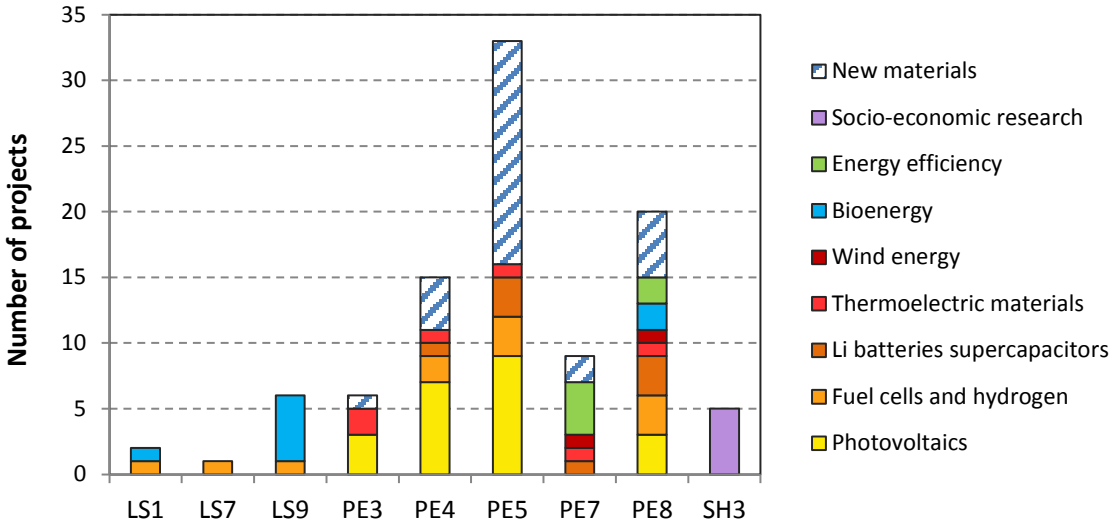
The projects grouped in new materials are not directly related to energy research, but are aimed at design and synthesis of new materials that can be technology enablers and have potential for energy-related applications.

The energy-related portfolio is mainly relevant in the PE domain; nonetheless, energy research is a truly global theme that ranges from engineering and materials (in the PE domain) to bioenergy (in the LS domain) and energy-related innovations and urban design (in the SH domain). The panels that have funded these projects and the number of projects funded along the 9 groups are presented in the figure below.



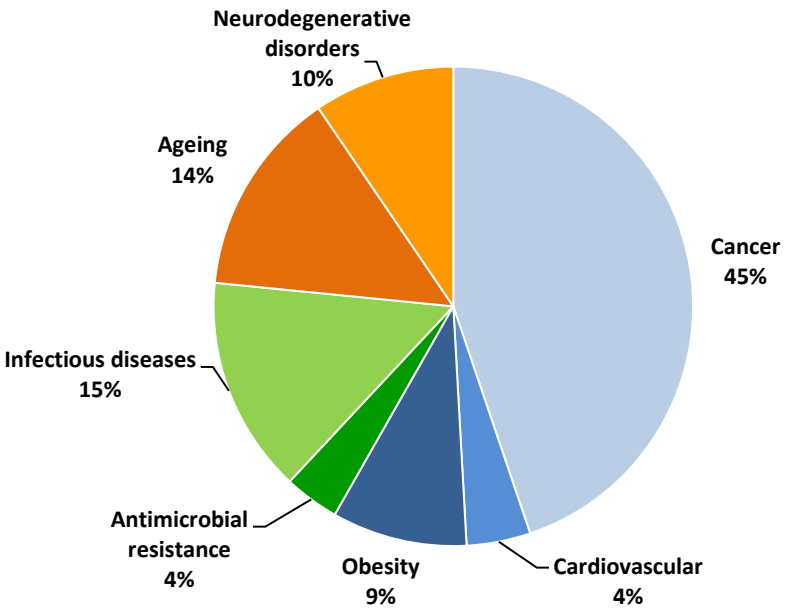
[1] http://ec.europa.eu/clima/policies/package/index_en.htm
[2] Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020; OJ L 140, 5.6.2009; http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009D0406
[3] http://ec.europa.eu/energy/technology/set_plan/set_plan_en.htm

Health

An ageing population has been widely recognised as one of the grand societal challenges that Europe will be facing in the coming years. In Europe, 85 million (17%) people are 65 years or older and projections show that this share will increase to 23% or 125 million people in 2020, and to 30% or 155 million people in 2060 [1]. This will contribute greatly to rising costs related to care and prevention measures. Thus, improving lifelong health and wellbeing has become a key objective for European policymakers. The need to tackle this issue by investing considerably in research and innovation has been acknowledged by the EU, which has dedicated almost €8 billion in research under the Horizon 2020 theme "Health, Demographic Change and Wellbeing" [2].

The programme leverages major efforts currently being made in important areas, such as neurodegenerative disorders, chronic diseases (e.g. cardiovascular disease, diabetes) and cancer. It also encompasses work carried out on infectious diseases and, in particular, tackling the growing threat of antimicrobial resistance [3].

The ERC, though not motivated by policy, also funds research projects in several fields related to major health challenges. These projects have been grouped into 7 main categories, with cancer representing almost half of this research portfolio (see figure below).



The research topics covered under these categories are broad and may range from the study of specific cellular processes involved in these disease areas or conditions, to the development of improved or novel diagnostics and the delivery of new treatments. The breadth of the research covered in these areas is reflected in the distribution of the projects funded across the dedicated ERC panels (see figure below).

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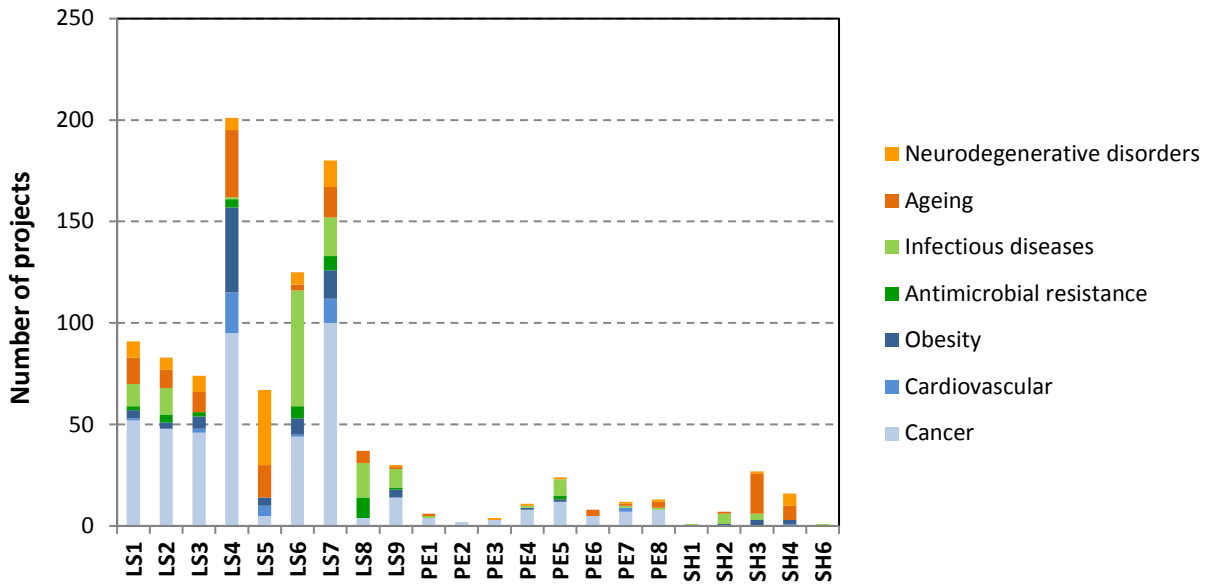
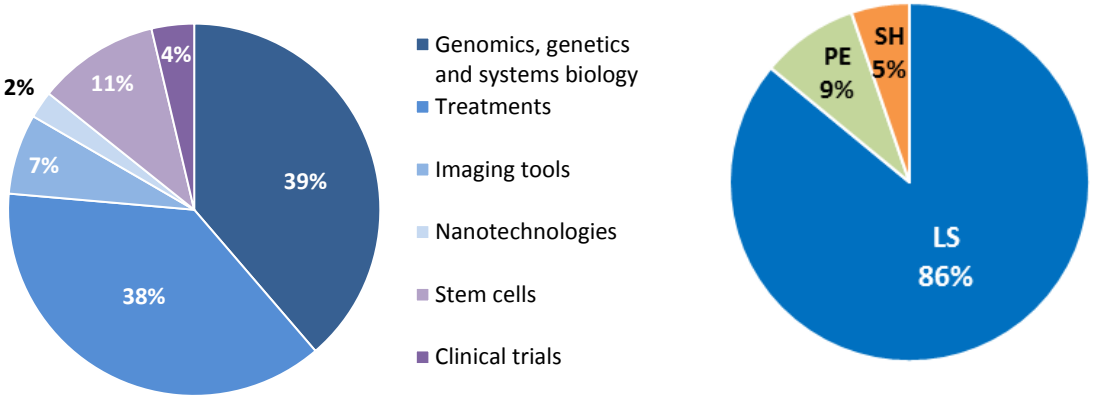


Moreover, a wide range of tools and methodologies are applied within the research projects of the ERC health portfolio with genomics and systems biology approaches being utilised in the majority of projects. Another prominent category is novel treatment and prevention strategies, including for example, gene therapy, cell-based therapies and vaccines. Finally, stem cell-oriented studies represent an important category within the health portfolio (see figure below).



While health-related research in the ERC falls mainly under the LS domain, the theme of health is nonetheless truly global and cross-domain in character. As shown in the figure above, some of the projects that tackle issues related to one or more of these major health challenges have actually been funded through the PE (9%) or the SH (5%) domain and include, for example, the development of diagnostic tools or imaging systems (in the PE domain) or the impact of ageing on demographics and society as a whole (in the SH domain).

[1] https://ec.europa.eu/digital-agenda/en/news/turning-demographic-ageing-europe-opportunities
[2] http://ec.europa.eu/programmes/horizon2020/en/h2020-section/health-demographic-change-and-wellbeing
[3] http://www.jpiamr.eu/

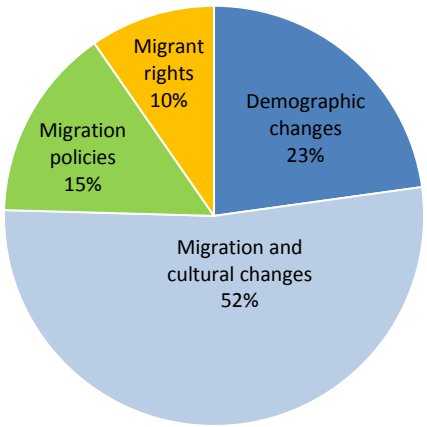
Migration

There are around 232 million international migrants worldwide, which represents 3% of the world's population. The global migrant stock increased twice as fast in the decade from 2000 to 2010 than during the previous decade [1]. Migration embraces all dimensions of social existence and its study, therefore, demands an interdisciplinary approach. Millions of workers and their families move across borders and continents each year, seeking to reduce what they see as the gap between their own position and that of people in other, wealthier places. The theoretical concepts now employed by social scientists to analyse and explain migration reflect its particular economic arrangements, social institutions, technology, demography and politics.

Europe faces a huge effort to reduce inequality and social exclusion. Reducing these inequalities, overcoming the economic crisis and tackling unemployment are crucial challenges for the future. This societal challenge of the Horizon 2020 Programme aims at fostering a greater understanding of Europe [2].

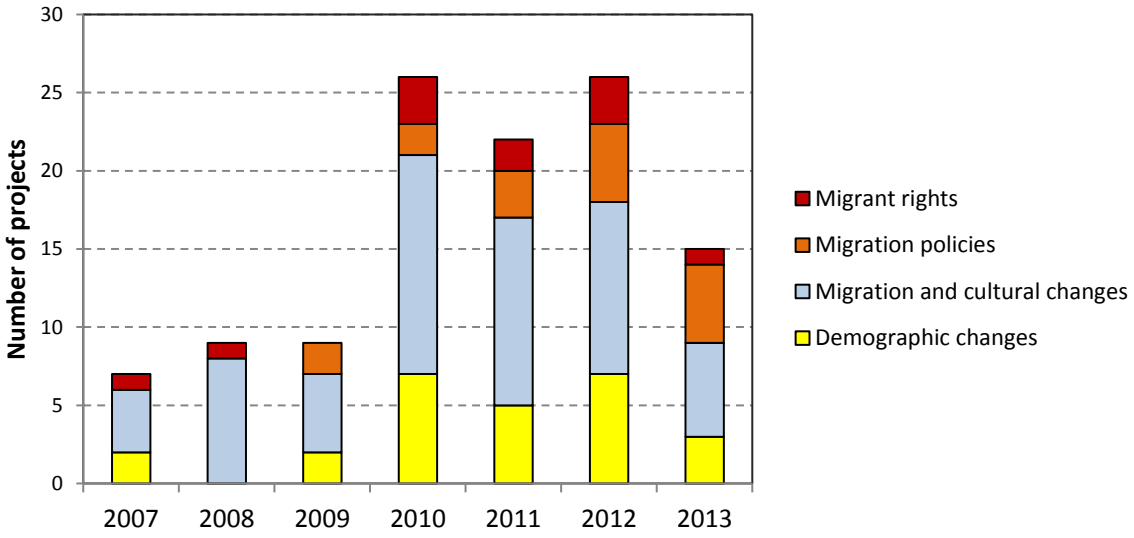
In late June 2014, the European Council announced that it wanted to "reverse inequalities" [3]. Since the 1980s, inequalities have been increasing in Europe, although with differences across countries. These inequalities have consequences for citizens' wellbeing, the economy, social cohesion, poverty and democracy. The Social Sciences and Humanities research programme of the EU has funded several projects to analyse these inequalities, among which GINI (Growing Inequalities Impact) and GUSTO (Meeting the Challenges of Economic Uncertainty and Sustainability through Employment, Industrial Relations, Social and Environmental Policies in European Countries) were the most important [4].

The SH domain of the ERC also funds this type of project. The projects have been grouped into four main categories, with migration and cultural changes representing more than half of the research portfolio. The topics addressed in this category are broad, covering the study of the onset of modern humans in Europe, cultural adaptation, cultural innovation, social changes, social structures, inter-ethnic relations, globalisation and war.

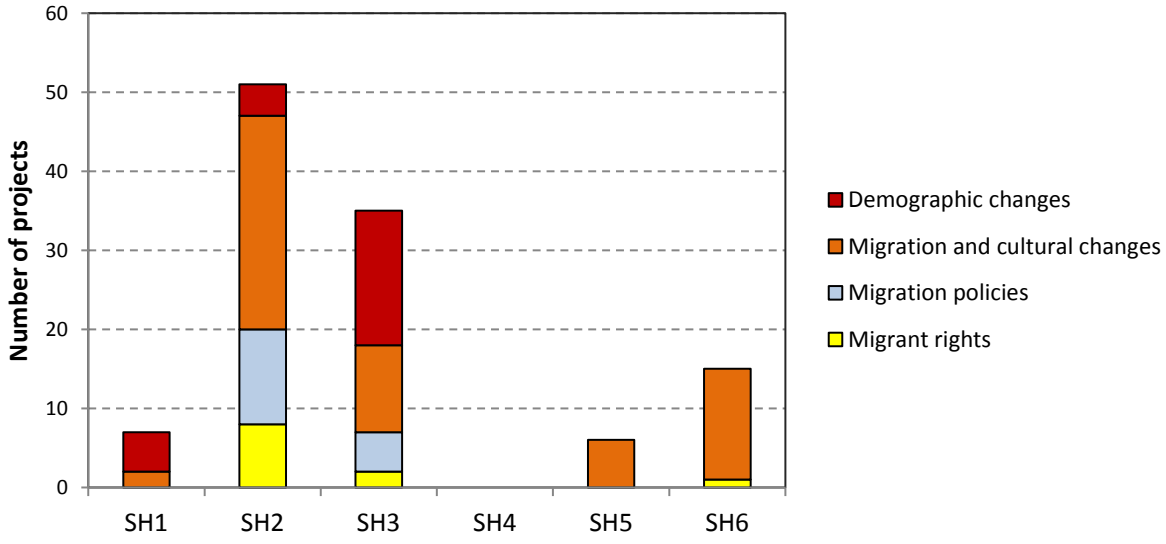


The category of demographic changes includes projects dealing with population ageing, urbanisation structures, family formation, family and fertility, and household. The category of migration policies encompasses projects about international migration, migrant networks, migration flow and social →

policies. The last category is migrant rights and includes projects on migrant work, migrant identity, labour rights, and social and human rights, and is linked to one of the targets for the EU in Horizon 2020, namely the fight against poverty and social exclusion.



The general trend is that these four topics have been present since 2010. In 2007–2009, there is a low number of projects under these categories.



While migration is at the core of the SH2 and SH3 panels, the breadth of migration research is evidenced by the distribution of projects including aspects of migration funded across 5 of the 6 SH panels.

[1] http://www.oecd.org/els/mig/World-Migration-in-Figures.pdf
[2] http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-societies_en.pdf
[3] http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/ec/143478.pdf
[4] http://ec.europa.eu/research/social-sciences/index.cfm?pg=home

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