



PROGRAMME PLANNING
of the French National Research Agency

2011-2013

2013 Edition

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2011-2013 PROGRAMME PLANNING CYCLE

The orientations for 2013 voted by the Governing Board

1 The programme planning process

In order to enrich its portfolio of strategic targeted thematic programmes, the ANR implements a continuous programme planning process in which it consults the widest possible range of national and international stakeholders. Programming is thus a highly iterative process that is based on a broad consultation of the national scientific community on future research needs, in both fundamental and objective-based research. The ANR's goal is to design programmes in priority areas corresponding to national strategic orientations. The programmes respond not only to societal, environmental and economic needs, but also to technological and scientific challenges.



The transformation of strategic government orientations into thematic programmes is a broadly open exercise based on constant exchanges with all of the research community in both the public and private sector.

The consistency of the proposals with the strategic orientations mobilises ANR's Strategy and Planning Boards, whose support in the implementation of programme planning is organised in accordance with the provisions of Article 2 of the decree that created the ANR.

The thematic programming strives to act as a catalyst and amplifier for research themes that emerge within different components of society. It is highly iterative. It is governed by a rigorous methodology that received ISO9001 certification in 2010.

ANR determines the general framework of its programme planning on the basis of the work of its Foresight Council¹ chaired by Christian de Boissieu, and the remarks below are taken from the council's considerations to a large extent.

¹ The ANR Foresight Council was created in February 2008 and is composed of a small number of members from a range of sectors with experience in foresight and planning. The council's objective is to provide a continuous set of guidelines for strategic positioning on the international research and development scene. The council listens to expert testimonies and examines future prospective reports submitted by ANR Strategy and Planning Boards as well as by Foresight Workshops. The opinions produced by the Foresight Council help determine the content of ANR programmes over the long term. The Foresight Council meets tri-annually. The composition of the ANR Foresight Council can be consulted through the following link: http://www.agence-nationale-recherche.fr/documents/uploaded/2008/conseil_prospective.pdf

The proposed programme planning was thus developed from the work of the following eight ANR Strategy and Planning Boards²:

- Social Sciences and Humanities
- Biology – Health
- Earth System Sciences
- Ecosystems and Sustainable Development
- Information and Communication Sciences and Technologies
- Nanotechnologies
- Chemistry, Materials, Processes
- Sustainable Energy

These boards play a key role in defining ANR programme planning through reflection on new programmes, permanent guidance on calls for proposals, or decisions to terminate programmes. Their reflection is enriched by considering all proposals on new programmes stemming from research stakeholders through a consultation by letter, as well as advice from the ANR Foresight Council, existing foresight studies, assessments of previous calls, information on the international research scene and the results of Foresight Workshops. The Strategy and Planning Boards are invaluable as crossroads for discussion on strategies, in particular between public and private sector research.

The recommendations of the Strategy and Planning Boards are based on a broad consultation system:

- The consultation with the public authorities takes up, among others, the suggestions resulting from the Interministerial Groups for research and innovation coordinated by the MESR (Ministry of Higher Education and Research).
- The exchanges with the national Alliances of research performing organisations (ALLENVI (environment), ALLISTENE (ICT), ANCRE (energy), ATHENA (social sciences and humanities), AVIESAN (health)) largely helped to define the orientations of the proposed 2013 programme through their written proposals and contributions at the Strategy and Planning Boards meetings.
- The companies and competitiveness clusters contribute through regular exchanges of views, thematic seminars and written proposals.
- A highly diversified consultation by letter (research institutions, universities, academies, learned societies, administrations, industrial federations, etc.) produces several hundred research theme proposals each year.
- Emerging and cross-cutting themes are also covered by the contributions of the Foresight Workshops³ set up by the ANR following the orientations voted by the ANR Governing Board.

² The composition of the ANR Strategy and Programme Planning Boards can be consulted through the following link: [http://www.agence-nationale-recherche.fr/programmes-de-recherche/comites/nc/?tx_saap_pi2\[type\]=10](http://www.agence-nationale-recherche.fr/programmes-de-recherche/comites/nc/?tx_saap_pi2[type]=10)

³ The ANR Foresight Workshops (ARP) are intended to encourage collective and prospective analyses on emerging themes with strong societal and scientific implications. These workshops unite researchers and decision makers from the public, private and associative sectors and serve to identify new research questions, thereby contributing to ANR programme planning in areas as yet relatively unstructured.

The results of the ANR Foresight Workshops can be consulted on the website page: <http://www.agence-nationale-recherche.fr/programmes-de-recherche/ateliers-de-reflexion-prospective/>

2 The ANR 2013 programme planning context

As a protagonist of interdisciplinarity, cooperation and dialogue, in close contact with the scientific community, each year the ANR implements the programme voted by its Governing Board for the various calls for proposals that will be open to the scientific community. To this end, wide-ranging discussions are organised beforehand with all the parties involved in research and innovation – research performing organisations, academies, scientific societies, companies and ministries – in order to identify and prioritise the high-potential themes. The definition of thematic priorities follows the national strategic orientations for research and innovation defined by the government.

The ANR 2013 programme planning completes the three-year cycle spanning 2011-2013. The programme planning framework has been restructured to integrate the recent government orientations set in 2012.

Many industrial countries have decided to invest in R&D and innovation with a view to improving their competitiveness in order to save jobs and create a "new economy" (markedly oriented towards green growth and the digital economy) and to open up new markets that could rebalance foreign trade. Science and technology have thus become key activities to "emerge changed" from the crisis. All the large industrial countries have decided simultaneously to invest in research and innovation, which raises the intensity of competition on the global scale⁴. This has led certain countries to increase research budgets (Germany, Switzerland, Finland) or to massively redeploy them (USA, UK, Japan) towards areas with high innovation potential (ecotechnologies, information and communication technologies (ICT), nanotechnologies, biotechnologies, advanced manufacturing systems, etc.). Alongside this, R&D spending in the 10 largest countries of Asia has exceeded that of the United States since 2011⁵, with massive investments in cutting-edge infrastructures and, something that sets them apart from the advanced countries, a fundamental research catch-up strategy (chiefly in China).

The growth of the emerging countries induces new situations of scarcity (fossil fuel and raw materials) leading to price rises and increased volatility; consequently there is an urgent need for research in this area to improve efficiency in the consumption of resources or to identify alternatives. The explosion of environmental questions or increased life expectancy also calls upon research to find solutions. The spreading of digital technologies is drastically changing modes of communication, production and exchange. These technologies ensure a large part of world growth while at the same time creating new economic models. Population aging in industrialised countries also leads to major health policy issues.

Fundamental research remains a vital strategic constant to keep France in the running among the major scientific countries. This is all the more important in today's world where innovation trajectories are getting shorter.

The ways industrialists organise research are also being greatly transformed by the need to maximise the streamlining of investments and to harness innovations at the earliest possible stages. The concepts of collaborative public-private research are at the core of these organisational changes in most of the major industrial sectors.

This is the only possible strategy, but it is difficult because it is part of a competition between economic and social spaces, as the industrial countries are all investing strongly in R&D and

⁴ Battelle and R&D Magazine, 2012 Global R&D Funding Forecast (December 2011).

⁵ National Science Board, 2012

innovation⁶, while the emerging countries are engaging in a scientific and technological race to catch up. There are strong thematic convergences in all these government plans to promote innovation.

How, in this context, can ANR's funding incentives contribute to achieving better performance in research and innovation? This question can be broken down into a multitude of issues that existed before the crisis but which are even more acute today:

- What can be done to make public research produce more research that breaks away from the current trends of sciences and techniques?
- How can we respond to the major issues facing our societies in terms of energy, environment and health?
- How can we effectively assist the scientific and technological build-up and creativity?
- How can we make the French research system more competitive with respect to the international competition?
- What can be done to ensure that the best of French science makes companies more productive?
- How can we consolidate employment and stimulate the fabric of companies with regional roots?

This is the spirit in which the 2013 programme planning has been constructed and voted by the ANR Governing Board, based on the reflections from all the contributions.

⁶ The US Government is re-launching its innovation policy (Innovation American Act) notably by encouraging the "decompartmentalization" of research activities (for example: research – patient interplay in medicine), whereas risk capital activities are decreasing further to the crisis of 2008 (Source: ADIT). Alongside this, the scope of scientific cooperation with China is widening (Source: French embassy in Washington)

3 The rationality of the 2013 programme planning

Supporting fundamental research

Fundamental research remains a major item on the ANR's agenda. The activities supporting research at the frontiers of knowledge are dealt with more particularly in the non-thematic programmes, which, since 2010, represent 47% of the ANR's call for proposals budget, and about 70% of the projects backed by the ANR concern a fundamental research activity.

Each year the Blanc Programme finances nearly 500 projects. To complement this, the ANR has set up a series of instruments accompanying fundamental research as well as encouraging the creation or orienting of teams towards emerging subjects, by financing chairs of excellence and young researchers' projects, for example.

Thematic programme planning targeting the major socio-economic issues

The economic actors are asking the ANR to increase its activities in orienting thematic research and enhancing partnership research work. This is also the case for certain Alliances of research performing organisations (ALLISTENE, ANCRE and ALLENVI). The reports of the Economic Analysis Council, or the recent report of Louis Gallois⁷ on French competitiveness, insist moreover on the need to come back to sector-based industrial policies, as is happening in most industrial countries, and to invest in R&D and innovation by targeting sectors in which France has true industrial and economic drivers, particularly with respect to its competitors. By listing the various priorities, the 2015 Key Technologies report⁸ constitutes a sound programme planning basis.

Maintaining a significant portion of project research

The specific efficiency of research as an activity has already seen very marked improvements: the presentation of research work in project mode has contributed to this improvement since it requires particular care in the defining of the objectives, the methodological construction of the research actions, and the budgets. Since its creation, the ANR has widely contributed to the spreading of this way of doing research. Some 5500 collaborative projects supported by the ANR are currently in progress in almost all branches of science.

Helping French research to better communicate

The public opinion on science and researchers varies from appreciation and praise to suspicion and even outright attack. Researchers must win back the confidence of the French public, confidence which has been eroded over the last few decades by numerous recurrent technological accidents that have not been handled in a sufficiently elucidatory manner. Many researchers are unaware of this disconcerting social fact, at a time when research as a discipline must endeavour to better account for its results, be more transparent, and give guarantees of its usefulness. Since 2012 the ANR has taken an initiative in this direction by favouring the emergence of scientific culture and communication actions by making up to 10% of the project grant eligible for these expenses.

The programme planning orientations for 2013 hinge around three components:

1. The non-thematic instruments
2. The construction of the European research area and multilateral collaborations
3. The thematic programme planning

⁷ "A Pact for the Competitiveness of the French Industry", Louis Gallois, November 2012

⁸ Key technologies 2015, Ministry of Economy, Finance and Industry, DGCIS, Paris, 2011

4 Non-thematic instruments

The non-thematic instruments help support the bulk of fundamental research in France. In 2013, the ANR will renew the main programmes that fashion its action in this field and which arouse keen interest from the scientific community, namely the "**Programme Blanc**", "**Young researchers**", and "**Post-doctoral return**" programmes. In addition, the "**Industrial chairs**" programme is a specific non-thematic instrument dedicated to the development of partnership research and promoting the industrial funding of long-term actions, particularly within universities.

Blue sky research

The "**Blanc**" programme aims at acknowledging excellence and enhancing our potential for innovative research. Since its creation in 2005, the "**Blanc**" programme has given researchers a real opportunity to submit single or multi-partner projects evaluated on the sole criteria of originality and excellence. It is open to all types of research projects, from the most fundamental to applied or partnership research; it stimulates cooperation between teams from different laboratories, particularly at international level, and possibly with partners from the socio-economic sphere.

The aim of the "**Young researchers**" programme is to support the projects of researchers or lecturer/researchers at the start of their career, to encourage them to take responsibility, to enable them to independently develop a specific theme, to set up or consolidate an existing research team, and give them the possibility of rapidly demonstrating their ability to innovate.

The "**Post-doctoral return**" programme completes the arrangement by encouraging the return to France and integration of top-level French or foreign young scientists who have spent a post-doctoral period abroad after obtaining their doctorate degree in France.

Partnership research

The "**Industrial chairs**" programme is open to all the research themes on subjects determined jointly by the academic partners and the company or companies co-funding the chair. The project principal investigator is a scientist who will be the future holder of the chair. The programme has three objectives:

- conduct research in priority and strategic areas for the public and private players involved in the chair through a strong and lasting partnership,
- ensure training through high-quality research by opening the door to doctoral or post-doctoral students in high-level public research laboratories and adding the vision, the methodologies and experience of players from the business world,
- favouring the taking on and maintaining of eminent French (expatriates or not) or foreign lecturer/researchers within higher education and research institutions and public research organisations.

5 Contribution to the construction of the European research area and multilateral actions

The ANR's European and international actions now represent an important part of programme planning given that about 15% of the funded projects are collaborative projects integrating European or international teams. This share has been growing constantly since the ANR was created.

The ANR's transnational collaborations are, insofar as possible, integrated in the national programme planning, in both the thematic priorities and the budget.

ANR programme planning takes into account the international dimension of the subjects, and a large number of its thematic programmes have an international component through participation in an ERA-NET or the mutual opening of programmes in relation with one or more foreign agencies. Although the transnational projects are similar to the national projects in quality and budget, the costs are shared, with each country funding its own teams.

European collaborations

ANR's European collaboration is developed in relation with the main funding agencies and research ministries, primarily in the framework of actions such as ERA-NETs or the Joint Programming Initiatives (JPIs). The ANR is a member of the governing board of six Joint Programming Initiatives which are consistent with its programme planning.

- "Neurodegenerative diseases" JPI (JPND): 2013 Call for proposals
- "Agriculture, Food Security and Climate Change" JPI (JPI FACCE): 2013 call for proposals: Europe + USA, Canada, and New Zealand
- "Connecting Climate Knowledge for Europe" JPI (JPI Climate): 2013 Call for proposals
- "A healthy diet for a healthy life" JPI (JPI HDHL)
- "Anti-Microbial Resistance" JPI (JPI AMR)
- "Healthy and Productive Seas and Oceans" JPI (JPI-OCEANS)

The ANR's thematic programme planning has been interlinked with the content of the 7th Framework Programme for Research and Technological Development (FP7) for 2013 in order, whenever possible, to maintain optimal complementarity.

The ANR plans to contribute to 11 ERA-NET calls for proposals in 2013.

<i>Environment</i>
ERA-NET Biodiversa 2 PLANT/KBBE Multilateral programme on plant genomics JPI FACCE
<i>Digital technology</i>
ERA-NET CHIST-ERA: long term CHallenges in IcST
<i>Materials</i>
M-ERA.NET: From materials science and engineering to innovation for Europe
<i>Biology-Health</i>
ERA-NET E-Rare 2: rare diseases ANIHWA: Animal health ERA-NET SynBio: Synthetic biology JPND: neurodegenerative diseases Franco-German bilateral call on Epigenomics with BMBF

INFECT-ERA: infectious diseases
EuroNanoMed 2: nanomedicine
AAL185 - Ambient Assisted Living

Reinforcement of the Franco-German collaboration

The bilateral collaboration with Germany is getting stronger. The Deutsche Forschungsgemeinschaft (DFG) is widening its partnership with the ANR, firstly through the renewal of the common call dedicated to Social Sciences and the Humanities (SSH), and secondly the opening of the Programme Blanc to Franco-German projects in all disciplines (except SSH).

The ANR also plans organising a joint call on epigenomics with the BMBF in 2013. Likewise, the Programme Mat&Pro call will be open to Franco-German projects in partnership with the analogous BMBF programme on materials.

Enhance French presence in the ERC

In order to stimulate the French scientific offering in the European Research Council (ERC), a condition has been included in the "Young Researchers" (JCJC) programme asking the successful programme applicants to submit a proposal to the ERC calls during their project.

Multilateral collaborations

As part of the build-up of international collaborations, we can mention the setting up of programmes to address global environmental questions. Thus, the ANR will contribute to the Belmont Forum Network⁹ for the European part, alongside the agencies of other countries such as the USA, Canada, China, Japan, Brazil, South Africa, etc.

In the frame of the renewal of demands for scientific cooperation with the countries of the Mediterranean basin and Sub-Saharan Africa, a framework collaboration agreement with the AIRD (inter-agency research institutions for development) has been signed in order to allow a better integration of the teams from the South and their funding in the research projects supported by the ANR, and will focus in 2013 on the CESA and Agrobiosphere calls for proposals.

With regard to transdisciplinary programmes, the ANR will collaborate with the NSF in the framework of the Neurocompute Programme on computational neurosciences at the interface of the life sciences and information and communication technologies.

Lastly, in the area of the social sciences, the "ORA - Open Research Area for social sciences" call, common to the ANR, the DFG (Germany), the NWO (the Netherlands) and the ESRC (United Kingdom) will also be opened with a new partner, the United States (NSF). The call will be non-thematic.

Multilateral collaborations
Belmont Forum in collaboration with the JPI Climate
Neurocompute (in collaboration with the NSF): computational neurosciences
ORA Open Research Area for social sciences (DFG, NWO, ESRC, NSF)

⁹ <http://igfagcr.org/index.php/belmont-forum>

Funding of international collaborations in the “Programme Blanc”

International partnerships aim at facilitating the financing of collaborations associating the best French and foreign teams. The ANR has set up cooperation agreements with the main funding agencies in Europe and the world, particularly in the area of fundamental research.

The 2013 programme planning now integrates all the bilateral collaborations (apart from the thematic calls for proposals) in the framework of the Programme Blanc evaluation process. This ensures uniformity in proposal evaluation and selection and a single processing procedure.

6 Thematic programme planning

The thematic programme planning for 2013 is organised around major societal issues that are consistent with Horizon 2020:

1. **Innovative, secure and cohesive societies**
2. **Health and increased life expectancy**
3. **Biological resources, environmental monitoring and protection**
4. **Energy transition and the post-carbon economy**
5. **Digital technology**
6. **Global security and dual research**

6.1 Innovative, secure and cohesive societies

The thematic programme planning on the international scale increasingly integrates the capacity of the SSH to play a role in the major societal issues. Over and beyond the diversity of their study methods and purposes, the social sciences and humanities share the development of new approaches to understand the world and the major problems or changes facing our societies. They enable them to be resituated in a long-term perspective and in their diversity, and to distinguish the changes, transformations and disruptions, as well as the things that remain constant. They thus contribute to the reflexivity of societies, and to the invention of new potentials and options for their development. The 2013 programme planning in Social Sciences and the Humanities continues in line with the 2011-2013 programming framework, with renewal of the themes on an annual basis for some programmes.

ANR's support to projects in the social sciences and humanities revolves around three axes: the non-thematic programmes (Blanc and Young Researchers) representing 50% of the funded projects, while international and thematic programme planning each correspond to 20% and 30% respectively of the grants assigned to this sector. On the international front, the Franco-German call in collaboration with the DFG, which represents the backbone of the European cooperation actions – will be renewed in 2013, as will the Open Research Area (ORA) call in partnership with Germany, the United Kingdom, the Netherlands and the USA.

The thematic programme planning comprises the "**Changing societies**" programme, whose aim is to identify the various forms of societal change through an approach that favours multidisciplinary, mainly within the scientific domain. Due to the large number of scientific questions to address, more specific calls for proposals are proposed in the programme and renewed on an annual basis. It is proposed to open the "*Emergence and evolution of cultures and cultural phenomena*" call in 2013 for the second year round.

The SSH programme planning is firmly committed to the construction of research work that is highly multidisciplinary and combines several scientific domains. This is why two cross-disciplinary programmes with strong SSH components are presented in the 2013 programme planning. The "**Innovative Societies**" programme, proposed for the third year running, is coordinating this action. The dynamics and the scientific interest of this programme justify having a third edition.

In the same spirit, the new "**Learning**" programme, devised further to a Foresight Workshop on this subject, meets the needs for research stemming from other scientific domains, particularly the ICTs and neurosciences.

Changing Societies Programme

The aim of the multi-annual "**Changing Societies**" programme, intended for all the social sciences and humanities, is to analyse the changes in societies in an environment marked by new forms of exchanges, interdependence and differentiation between cultures, and by certain forms of globalisation of ways of life and thinking. The 2013 call will focus on the following theme:

2013 call: Emergence and evolution of cultures and cultural phenomena

This call for proposals must lead to a deeper analysis and understanding of the cultural phenomena as a whole through their history, and a better grasp of the conditions of their emergence, their spreading, their obsolescence and their disappearance. It will allow the work on hominization and the evolution of symbolic systems to be taken to greater depth, and the cultural and social dimensions of the human mind to be assessed. It should also give greater insight into the interactions between biology, culture and the environment during the evolution of humanity.

Innovative Societies Programme

This is a transdisciplinary programme. It intends to promote the cooperation and comparison of the approaches of the SSH disciplines and the issues raised by the other scientific disciplines and technological development. It aims to strengthen the partnerships between companies, SSH teams and laboratories in various thematic areas (ICSTs, nanotechnologies, materials, energy, transport, housing, environment, agricultural and food production, industrial processes, health, etc.) that focus on individual and social behaviours and economic models in situations of technical or social innovation. It is a question of better understanding the methods of spreading, adopting or rejecting innovations and contributing to the study of the processes whereby individuals, groups and societies integrate innovation; of anticipating the structural changes in societies and economies and in individual and collective behaviour, and developing the capacities for forward-looking reflection on the conditions of the transition towards new forms of organisation of life in society; of promoting comparative approaches between sectors, regions, countries and societies, and temporal and international comparisons.

Learning Programme (new programme)

Scientific and technological progress leads to profound changes in the educational and training system, which must reconcile the acquiring of basic skills with objectives of specialisation and vocational training. The increase in human life expectancy brings also new questions concerning the capacity to learn throughout life. Moreover, learning processes have become one of the challenges of innovation. The speeding up of advances in knowledge has consequences regarding its acquisition. Since the beginning of automation, machines and technical devices have been evolving towards a capacity to fulfil tasks previously carried out by humans.

This new transdisciplinary programme targets the development of knowledge on the representations and mechanisms involved in different forms of learning processes. Acquiring a better understanding of learning also implies the involvement of the information and communication technologies, but also neurosciences among others.

6.2 Health and increased life expectancy

The ANR is the primary source in France of funding for research projects in biology and biomedical disciplines. Various instruments are available to support projects relating to fundamental biology, biomedical research, the development of investigation tools, value-creating and technological transfer processes. These aspects are taken into consideration in all the programmes, but are concerned to varying degrees depending on their nature and their goals, in

order to ensure balanced funding of the various disciplines in the sector and promote the areas perceived as being emerging, cross-cutting or promising.

The definition of the programmes and their respective scope meets the public policy priorities, the recommendations made by the ANR Biology-Health Strategy and Planning Board and the AVIESAN Alliance, the analysis of the programme planning of the major international funding agencies, and the responses to the ANR's questionnaire sent to the French institutions concerned by research in biology and biomedical disciplines (universities, academies, learned societies, companies).

The non-thematic programmes (mainly Blanc and Young Researchers) provide regular and relatively constant support for fundamental biology (molecular, structural, cellular and developmental biology), the development of new investigation methods ("-omics", imaging, systems biology), and the major areas of biomedical research such as they are defined around organs and diseases. The non-thematic part currently represents about 65% of ANR funding devoted to biology-health. The aim of the thematic programmes relating to biology-health is to supplement the ANR's non-thematic funding by favouring the emerging areas, cross-cutting and multi-disciplinary approaches, the creation of value from the research, and the technological transfer notably by involving companies in the projects.

The national thematic programmes more particularly concern the major societal issues and the public-private partnership research in this sector.

The partnership research programmes obligatorily associate academic and industrial teams proposing projects in the area of Technologies for Health (**TecSan**) or biomedical innovation (**RPiB**). They support the projects to put research into application upstream of industrial developments, with no exclusions regarding the proposed themes. These programmes are exclusively public-private partnership programmes. In addition to support for industrial value creation, and at the request of the Ministries of Health and Research, the ANR is putting in place as of 2013 a new research valorisation programme intended to facilitate the transfer of innovative approaches to clinical studies in the hospital environment. This "**Translational Clinical Research**" programme will be co-funded by the DGOS (Directorate General for Care Provision) in relation with the Clinical Research Hospital Programme (PHRC).

To enhance European collaborations and the linking between national and European calls for proposals, the ANR proposes opening several new transnational thematic calls in 2013 concerning the constitution of epigenomic maps, synthetic biology, computational neurosciences, emerging infectious diseases, neurodegenerative diseases and medical applications of nanotechnologies. These new calls will supplement the funding that exists for environmental contaminants and health, mental illnesses and addictions, rare diseases, animal health, ambient assisted living and regenerative medicine.

As a reminder, the European and international component of this thematic area represents about 20% of the activity of this sector and comprises the following programmes:

- Immunology, microbiology, inflammation, infectious diseases ERA-NET INFECT-ERA (new programme)
- Rare diseases, physiopathology, metabolism ERA-NET E-Rare 2
- Joint Programming Initiative on Neurodegenerative Diseases (JPND)
- AAL185, Ambient assisted living
- Computational neurosciences (at the interface of ICST and health)
- Synthetic and epigenome biology (ERA-NET ERASynBio)
- Franco-German Epigenomics programme (in partnership with the BMBF)
- Nanomedicine ERA-NET EuroNanoMed 2 (new programme)
- Animal health ERA-NET ANIHWA

Technologies for Health programme (TECSAN)

The TECSAN programme requires a partnership with a company. Its aim is to promote innovative technologies and methodologies applied to the fields of health and autonomy. It particularly concerns the development of technologies contributing to technological leaps or breakthroughs in the broad areas of medical assistance, the development of innovative services and rehabilitation devices, the correction or functional replacement of deficiencies, the development of acquisition methodologies, data processing and modelling, and methods of decision making.

The role of medical technologies and imaging in improving diagnoses and the implementation of innovative therapeutic strategies remain important. The industrial sector of health technologies represents major economic stakes. The French industry, made up above all by SMEs, is a vital link in the transition from the laboratory to the patient's bed. It must benefit from the technology transfers or co-developments achieved in the projects funded by the ANR.

Partnership Research and Biomedical Innovation Programme (RPIB)

The RPIB programme requires a partnership with a company. It is intended to fund projects that use the results of academic research in the health sector and promote the transfer of these results to industrial applications. It supports translational research into common and rare diseases in order to help develop new therapeutic approaches (medicines, biological products, cells, etc.), galenic innovations, new vaccines, new approaches and tools for diagnostics, prognostics and therapeutic monitoring. The programme also supports projects aiming at facilitating, speeding up, improving and increasing the efficiency and productivity of biomedical research (in silico, cellular and animal models, new tools for research etc.) and the production of biomolecules.

Translational Research into Health Programme (PRTS) - (new programme)

The new PRTS programme, to be launched in 2013, requires a partnership with a hospital-based medical team. Its aim is to facilitate the preparation and performance of the initial phases of clinical tests conducted by the investigators (and not by an industrial promoter). This is a joint programme with the national Clinical Research Hospital Programme (PHRC) supported by the Ministry of Health. It meets the need - not catered for previously - to support projects based on a demonstrated proof of concept, and therefore not really eligible for the ANR programmes intended for exploratory research, but requiring additional studies to determine the relevance and justification of a large scale investigation on humans, making them also difficult to integrate in the PHRC. The programme intends to provide the support necessary for carrying out these complementary studies. They can consist in investigations in animal models, particularly large animals, or clinical studies prior to the launching of the ultimately envisaged clinical test.

Neurosciences, Mental Health, Neurodegenerative Diseases. National programme on mental health and addictions (SAMENTA)

Mental illnesses are frequent, chronic, and often debilitating. Their complications can be extremely serious, leading to social exclusion and/or suicide. The identification of a growing number of biomarkers, cognitive markers, and imaging markers associated with mental disorders underlines the importance of the biological disorders that accompany behavioural disorders, whether of an addictive, depressive, psychotic or autistic nature.

Programme Contaminants - Environment - Health - Adaptability - Behaviours and Uses (CESA)

This multidisciplinary programme is situated at the interface between the health sciences and the environment. The CESA programme intends helping acquire a deeper fundamental knowledge of the contaminants, their cycles and transfers between the various compartments of the ecosystems, their effects on the ecosystems and on human and animal health. It concerns the detection of contaminants and their transformation products, ecotoxicology and toxicology,

studies of physiopathology, functional and molecular biology, epigenomics and epidemiology. Opened back in April 2012, the 2013 call for proposals supports research into the adaptation capacities and resilience of organisms exposed to contaminants, whether mixed or individual, the questions of exposure and behaviour in the face of contamination, and research into innovative methods of bioremediation, biotransformation and biodegradation. The knowledge acquired through the funded projects will allow the constitution of predictive ecotoxicology and predictive toxicology, and will contribute to the evaluation of the environmental and health impact of technological innovations, of methods of contaminant detection, methods of bio-decontamination or bioremediation of contaminated environments, in order to protect individuals more effectively.

6.3 Biological resources, environmental monitoring and protection

6.3.1 Understanding, monitoring and protecting against the impacts of global changes

The intensive use of natural resources resulting from the development of human societies means that a dual planet-wide challenge has to be met in the 21st century:

- maintaining resources, biological in particular, to meet needs for food, energy, biochemicals, etc.
- maintaining environmental services (climate, air, water, soil, etc.), ecosystem services and the biodiversity necessary for the development and security of human, animal and plant populations.

The scientific questionings on these crucial issues now require a comprehensive vision of the interactions of scales, from the cell to the population, from the parcel to the landscape, from the region to the globe, from the day to the decade. Science-society interdisciplinarity and transdisciplinarity are reinforced by this. It is in this context that innovative, cross-cutting, integrated and international research approaches are developed. The backbone of the programme planning developed by integrating the priorities is the sustainable management of the territories, their resources and their services, under the constraints of global changes (climatic and demographic, and more generally the anthropogenic impacts associated with changes in practices and ways of life).

The steady growth of the international dimension of the programmes is another notable change allowing an increase in the critical mass of researchers necessary to address transfrontier environmental problems. This is ensured by ERA-NETs for the European part, and the broader programmes on global environmental change coordinated by the International Council for Science¹⁰ or the Global Research Alliance¹¹.

Global change and societies issues

The challenges of large-scale adaptation to the changes in climate, air, water and soils necessitate joint advances in the areas of natural science and human, social and economic sciences. The emergence of an interdisciplinary community with high visibility is fostered by the cross-cutting programme "Facing **societal, climate and environmental changes**" (**SOC&ENV**). This cross-cutting programme is dedicated to integrated approaches in Earth System Science working towards sustainable development, interconnecting research into climate and environmental changes and research into the development of human societies, with particular attention devoted to the regional and global scales. It is intended to drive and enhance the

¹⁰ www.icsu.org

¹¹ www.globalresearchalliance.org

synergies between the disciplines within the SSH or within the natural sciences (climate included), and between the natural sciences (climate included) and the SSH. The questions associated with the dynamics of human societies confronted with the climatic and environmental constraints are at the core of the programme, of which one of the objectives is the capacity to avoid or manage risk, and more broadly the issues of governance and social, political and technological innovation. It is supplemented by a call for proposals managed by an international multi-agency call with the G8 and BRICS countries under the "**Belmont Forum**" on the issues relating to water and the vulnerability of coastal zones. The ANR will also contribute to a joint call in 2013 within the umbrella of the JPI FACCE on the evaluation of CO₂ fluxes produced by agricultural activities at global scale.

The challenges associated with the evolution and erosion of biodiversity are developed through the **Biodiversa** ERA-NET. After a call in 2012 on the modelling of the change in biodiversity under the constraint of the global change scenarios, this programme will focus on invasive species, the disturbances they induce in the ecosystems and how to monitor and control them.

Genetic mechanisms of adaptation

The implications of adaptation of species and populations to the global changes raise the question of the capacity for genetic adaptation and its improvement. This theme is developed through the national **BIOADAPT** programme with the aim of developing knowledge allowing progress towards greater sustainability in the management of natural and exploited ecosystems, biodiversity and natural resources. The programme supports research in biology and genetics into the understanding of the mechanisms of adaptation of living organisms in the genes, individuals, populations and species and how they evolve in the face of global changes, stresses and disturbances. To apply this knowledge, the programme also relies on research into the methods and tools that promote the adaptability and ecological resilience of species and communities, and to improve the varieties and breeds in response to global changes. The **BIOADAPT** programme is supplemented by an international part, the "Knowledge Based BioEconomy" (**KBBE**) programme, the aim of which is to select cultivated plants and seaweeds for better adaptation to global changes and the reduction of inputs, with the aim of increasing the competitiveness of the sector involved and cooperation between public and industrial research.

Ecotechnologies and EcoServices (ECO-TS) (new programme)

The ECO-TS programme targets the notions of technological research but also related services, with the aim of enhancing the competitiveness of the French eco-industries. The programme covers most of the environmental impacts related to anthropogenic pressure such as pollution, but also the emerging pressures generated by global change processes such as climatic change, biodiversity erosion, natural hazards, etc. The programme also considers the issues of ecotechnologies and ecoservices that will favour the implementation of circular economy concepts such as flow material analysis, waste recycling technologies, etc. This programme strongly encourages public-private partnerships.

6.3.2 Developing sustainable agriculture and food

Sustainable agricultural and fishery resources

Transitions must be organised towards production systems that inevitably make intensive use of certain resources - in particular the natural functions of ecosystems – due to the increased needs for high, but also sustainable, efficiency. This theme is developed through the national **AGROBIOSPHERE** programme. The technologies relative to all forms of utilisation of ecosystems must therefore evolve, and this must take place by continuing along the path of ecological intensification, which among other things implies integrated plant and animal health management strategies, and better control of biotic interactions. The program therefore aims at

offering technological, economic and social solutions to the problems of viability and adaptation of productive ecosystems and resources in the face of global changes. An international collaboration links the **JPI FACCE** and the Global Research Alliance on the remediation of greenhouse gases produced by livestock rearing.

The transformation of foodstuffs with the aim of producing healthy low-cost food products that meet consumers' expectations in a context of increasing energy costs and pauperisation of a portion of the population, is developed under a programme (**ALID - Sustainable food systems**). The aim is to encourage the creation of sustainable food production, distribution and consumption systems, with particular consideration for business competitiveness, the satisfying of consumers' demands, and the protection of ecosystems in a context of global changes (climatic change, depletion and rising price of energy, price volatility and raw material variability, urbanisation and world population increase). The ALID programme hinges around two themes: the first is that everyone should have access to sustainable, good-quality food. It endeavours to improve product accessibility in terms of availability, buying price, practicality and service, while maintaining product quality, by placing the consumer, and in a broader sense the citizen, at the centre of the investigations. The second aims at developing a global and integrated approach to sustainability. It endeavours to evaluate the risk-benefit trade-off of the production processes or cross-cutting multi-process systems (distribution, logistics, foodservice industry, etc.), taking into consideration all the constraints and requirements of the different players.

The European and international component in this theme is represented by the Belmont Forum, ERA-NET Biodiversa 2 programmes and the multilateral Plant/KBBE programme.

6.4 Energy transition and the post-carbon economy

Energy transition is a major subject for society as a whole. Firstly because it places the individual, as an energy consumer for his/her activities and comfort, at the very core of the problem. But also because it interacts closely with the economic and environmental protection challenges, in a development perspective that lies within a virtuous circle where any change in societies complies with the vital need - now adopted by the majority of countries - to reduce emissions of pollutants and greenhouse gases. This necessary reduction will result chiefly from the implementation of complementary approaches:

- it is firstly a question of managing energy resources by controlling the finite sources, making optimum use of renewable energies and developing substitutes for fossil fuels,
- the energy efficiency of the entire chain that harnesses, stores, converts and delivers the energy must also be developed,
- it is also vital to reduce the cost and environmental impact of the main energy consuming sectors, that is to say industry, transport and housing,
- as human activity remains the focal point of any analysis, it is important to be vigilant regarding the customs that contribute to the conditions of acceptability of the energy transition, by integrating all associated socio-economic aspects, but also by exploring new ways of reducing consumption, and of capturing, storing and recycling CO₂.

Furthermore, the tense situations of the last few years regarding non-renewable raw materials have led to a review of the R&D strategies that aim to optimise raw material consumption or develop innovations that can substitute for certain rare materials. Industry has widely integrated the reality of certain constraints (increasing cost of energy, CO₂ credits, control of discharges, recycling, REACH regulations, etc.) into its innovation and investment strategies, but considerable R&D investments will be required to find sustainable solutions. The competitiveness of companies established in France (and therefore of the associated jobs) will ultimately depend on the aptness of these solutions.

This theme is essentially covered by two programmes: "**Materials and Processes**" (MatetPro) and "**Sustainable Chemistry-Industries-Innovation**" (CD2I), which fit into a broad theme associated with sustainable development and company competitiveness. The partnership programmes MatetPro for high-performance products and CD2I are situated at the crossroads of research ranging from discovery research to R&D, and of several major societal concerns, all linked to the changes in European society and global constraints (energy, reducing CO₂ emissions and other environmental footprints, competitiveness).

6.4.1 Developing new energy technologies

Currently hinging around new energy technologies, associating both academic research and a large proportion of public-private partnerships (about 70% of the projects), the 2013 programme planning today considers a more global analysis and integrated management of the energy cycle as a whole, which nevertheless maintains a balanced contribution from engineering sciences and social sciences and the humanities, while calling upon other scientific fields (life sciences, physics, etc.) when necessary.

This is why the three major energy vectors, namely electricity, heat and biofuels, constitute the mainstay of the programming cycle. More precisely, it is the whole – efficient & decarbonised energy systems, renewable production & electricity management, and lastly biomaterials & bioenergies – that underpins this vision of sustainable energy. Supplementing these three broad lines, the two major application sectors, i.e. building and transport, also find themselves highlighted in a context that is respectful of societal choices and their direct link in terms of environmental costs and energy consumption.

Efficient & Decarbonised Energy Systems (SEED)

The aim of the **SEED** programme is to stimulate research into energy efficiency in industrial equipment and systems, and the climatic equipment of buildings, particularly for the future low-consumption buildings, with a view to reducing primary energy consumption and greenhouse gas emissions. It also addresses the development of technologies for capturing and storing CO₂, including its utilisation for energy purposes, as an additional means of drastically reducing emissions from industrial stationary sources. It aims at helping achieve the objectives of the European Energy-Climate package to improve energy efficiency by 20% and reduce greenhouse gas emissions by 20% between now and 2020, and divide GHG emissions by four (the "factor four" objective) in France by 2050.

Renewable Electricity Production and Management programme (PROGELEC)

The **PROGELEC** programme includes a broad thematic field the aim of which is to develop components and innovative electricity production systems from renewable energies, especially solar photovoltaics. It also intends to bring together research work relative to embedded and static storage and production systems (vector hydrogen, electrochemical storage). More generally, it aims at optimising the production and storage systems and the associated smart grids, taking intermittence into account.

A technological challenge on the electrochemical storage of energy will be initiated under the **PROGELEC** programme in partnership with the DGA.

Biomaterials and Bioenergy (Bio-ME)

The Bio-ME (biomaterials & bioenergy) programme accompanies the development of low-environmental-impact energy vectors derived from biomass. Biomass represents one of the highest potentials among the renewable energies. Nevertheless, the widespread use of biomass for energy purposes (apart from wood-energy) requires the development of economically viable

processes. This viability could be ensured by joint material and energy recycling, particularly through the development of applications in plant chemistry (from biomass-derived platform molecules), in the context of biorefineries. The transformation of biomass by thermochemical or biological processes makes it possible to envisage not only the providing of biogas and fuel syngases that can be used as a substitute for natural gas in combined heat and power facilities (cogeneration), but also the development of biofuels (of 2nd and 3rd generation), usable in the transport sector. To achieve this ambitious objective it is necessary to reduce costs, improve the productivity and economics of the processes, notably by making better use of their coproducts. The Bio-ME programme also aims to support scientific and technical actions supporting demonstrators, put in place for the industrial development of 2nd generation processes, in particular by increasing SMI-SME initiatives in this area.

6.4.2 Promoting sustainable cities and mobility

Linked to the programme planning in the area of energy, the city and its buildings - like sustainable mobility - are strongly dependent on the conditions of use of the energy. Two programmes address these essential questions: "Sustainable Cities and Buildings" and "Sustainable Transport and Mobility".

Sustainable Cities and Buildings (VBD) programme

The **VBD** programme is centred on the sustainability of the environment and places of daily urban life, from the scale of the building to that of the urban area. It fits into a context of significant and uncertain structural changes: metropolisation, depletion of natural resources, limiting of the impact of urban activities and construction, adaptation to climate and demographic changes. The question is to address, through research, the questions of development, design, maintenance, renovation and management of constructed and urban heritages from the sustainable development aspect, and notably with a view to the factor 4 reduction by 2050. The scientific questioning hinges around the understanding of phenomena, of the measurement, modelling and design, as well as the implementation of the techniques and modes of intervention. The programme focuses on 4 themes: (a) urban dynamics and organisations, practices and mobility; (b) building, construction, positive- energy city blocks with low environmental impact; (c) urban environment, ecosystems, metabolism, resources and deposits, and (d) multi-scale and cross-cutting approaches, governance.

Sustainable Transport and Mobility (TDM)

The aim of the **TDM** programme is to develop knowledge and build the technological bricks required to make progress in the transport sector. It aims at increasing the energy efficiency, the quality, reliability, fluidity and safety of vehicles and transport systems. The question is more precisely to support work ranging from the vehicle engine systems (thermal, electric, hybrid) through to the management of transport systems and the logistic flows optimisation. Likewise, the questions of overall optimisation, safety, security, reliability, mobility assistance, communication between users are also explored. Although the programme chiefly concerns land transport, it is also open to air and maritime transport for the common research themes, in order to benefit from a cross-fertilisation effect.

6.4.3 Key technologies for the post-carbon economy

Materials and Processes for High-Performance Products (MatetPro) programme

One of the challenges of the **MatetPro** programme consists in federating the scientific players from extremely varied areas, such as materials science, process engineering, chemistry, mechanics, physics, applied mathematics, around common objectives, that is to say the

development of materials and processes that lead to higher-performance products. Improved performance targets:

- energy savings (energy efficiency and reduction in CO₂ emissions),
- raw material savings (fossil and mineral resources),
- limit state design,
- innovative processes (production, shaping and assembly) leading to greater competitiveness.

The strongly cross-cutting aspects of the materials and associated processes mean that this programme concerns important and highly varied industrial domains ranging from transport (land and air), energy production, the manufacturing industry, the building industry, etc. The programme places emphasis on greater materials/process/product integration to bring improved performance. The life cycle assessment methods must also be taken into consideration more systematically. More particularly, the problems relating to the availability and possibilities of substituting certain natural resources, especially the strategic metals, are specifically targeted.

The **MatetPro** programme has given itself a European component by participating in **M-ERA.NET** (*From materials science and engineering to innovation for Europe*).

Sustainable Chemistry, Industry-Innovation (CD2I) programme

The chemical industry is exploring several avenues for the chemicals of tomorrow, whether considering the reduction of greenhouse gas emissions or transition from 7 to 15% of renewable materials in its procurements by 2017. The period of "eco-efficiency" that we have known must give way to an era of "eco-design", in which the environmental parameters are taken into consideration from the very beginning of product design. To overcome, at least partially, the need for fossil resources, research into the synthesis of new molecules derived from renewable resources is necessary. Here the emphasis must be placed on both the substitution aspect and the new properties that certain molecules resulting from natural diversity can introduce. Furthermore, the REACH regulations require the setting up of new tools for risk evaluation and quantitative structure-activity relationship (QSAR) modelling in order to predict any toxicity (and reduce animal testing). For products subject to authorisation (CMR –carcinogenic, mutagenic, reprotoxic products), the search for substitute products has become a major issue in many domains, and it is important not to underestimate the difficulties.

Research into processes that are clean and efficient in terms of atoms, solvent and energy, is also targeted by this programme. Appropriate processes are one of the keys for maintaining the chemical industry in Europe. A convergence between chemistry and biochemistry will also be encouraged.

The **CD2I** programme is structured around 3 research and innovation themes: (a) Innovative alternative resources, routes and products; (b) Efficient reactions and processes and (c) Chemistry and processes serving the major environmental challenges.

The majority of the international research strategies set forth initiatives targeting the development of nanotechnologies, which are fast diffusing into many technological applications.

6.5 Digital technologies

We are living through a period of transition marked by considerable breakthrough in the ICSTs, the emergence of the digital society with the explosion of embedded systems and communicating objects, the domination of the Internet, the dematerialisation of systems / computing and communication infrastructures offered in particular by the cloud and the multiplication of smart objects, the growing place of digital simulation and supercomputing in the design, production and optimisation of processes, manufactured goods and services.

According to the "Key Technologies 2015 report"¹², the information and communication technologies (ICT) sector has become a major segment of the economy of the main industrialised countries with a direct contribution of 5.9% of the GDP in Europe (and 7.5% in the USA). Over and beyond the sector itself, the ICTs diffuse through and contribute to the development of all the other economic sectors, effectively representing more than 50% of the growth of productivity in Europe¹³. Furthermore, the growth prospects of the ICST sector are considerable, with +8% growth per year for the Internet economy between now and 2016¹⁴. The Information and Communication Sciences and Technologies (ICST) therefore constitute the basis of this momentum.

The issues at stake include not only the competitiveness of national and European industry, but also progress in training, health, sustainable development, and access to culture. They also concern the development of a secure digital world that wins users' confidence. In terms of research and development organisation, the 2011-2013 programming cycle has been inspired by the emergence of the "digital society". The challenges underlying this term are as varied as the design and production of manufactured goods and complex systems, the services industry, culture, health, energy, the management of cities and transport, education, and even leisure.

6.5.1 Digital technologies

The ICST issues addressed in 2013 are structured around 4 main lines:

- the development of communication infrastructures, data and supercomputing, encompassing cloud computing, the components/subsystems (e.g. optical or even photonic components) equipping and ensuring the operation of these infrastructures (**INFRA: Hardware and Software Infrastructures for the Digital Society programme**),
- the methods and software aids for services engineering and digital systems, embedded systems and the security of information systems and the confidence in these systems (**INS: Digital Engineering & Security programme**),
- the production and exchange of content and knowledge (creation, publishing, mining, interface, use, economy, confidence, enhanced reality, social networks, Internet of the future), the associated services and robotics (**CONTINT: Digital Content and Interactions programme**),
- the development of a "digital double" through the modelling and simulation of the physical world, of objects, services and human interactions and behaviour (modelling, simulation, supercomputing, production and processing of massive or complex data, virtual reality and visualisation) (**MN: Digital Models programme**).

At European level, the ANR has been coordinating the CHIST-ERA ERA-NET since 2009. Its objectives are to develop the coordination and cooperation of research funding agencies in Europe, with an annual call for emerging high-potential and pre-competitive subjects in the ICST sector.

Hardware and Software Infrastructures for the Digital Society programme (INFRA)

The aim of the INFRA programme is to position France in the leading group of countries researching into the development of communication networks and associated services, high-performance computing infrastructures and data services, and stimulating innovations and technology transfers to French industry in these key areas for the future . The programme covers all the research work aiming to produce hardware and software infrastructures that

¹² www.industrie.gouv.fr/tc2015/technologies-cles-2015.pdf

¹³ source: Europe's Digital Competitiveness Report (Annual Report 2011)

¹⁴ source : Boston Consulting Group (2012) - The Internet Economy in the G-20

make available ubiquitous communication, storage and computing resources. These infrastructures are very widely distributed on highly diverse scales (multi-scale), ranging from deeply embedded equipment items (sensors, micro and nano-controllers, etc.) heterogeneous and massively parallel architectures (multi-core) and machine grids on the scale of the Internet. The programme is at the core of the rise of the digital society, especially on the following themes:

- The consideration of global mobility
- Management and optimisation of resources, including energy
- Ubiquitous communications and very high bandwidth technologies
- The Internet of objects and control of the physical world
- Omnipresent, convergent and interoperable services
- Infrastructures for high-performance computing and mass storage
- Effective utilisation of new hardware components
- The problems of security, reliability, resilience, performance and quality of service associated with these infrastructures
- The applications and uses of the digital services associated with these infrastructures;

Digital Engineering & Security (INS) programme

The penetration and exponential growth of the digital sciences and techniques for the benefit of society and the economy (industry and services) combined with the increased presence of objects, machines and large digital systems in our daily life, necessitate cutting-edge research in the engineering of digital systems and their security. This phenomenon lies within the context of the Internet of the future, the backbone of digital sciences and techniques as the indispensable communication and computing medium.

Digital systems engineering research covers the invention, design and adjustment of paradigms, technological elements/bricks, original methods and tools for software and hardware systems, and their integration and upgrading.

The programme targets innovation in the areas of hardware and software architecture, embedded systems, quality of the digital systems, security – as much for the hardware parts as for the processed and stored information (integrity, confidentiality, etc.), operating dependability, system approach and scalability (information systems), ease of use by taking human factors into account both upstream (requirements) and downstream (usability), and adaptation and performance through any type of optimisation, such as energy saving.

Digital Content and Interactions (CONTINT) programme

The generalisation of digitization induces major changes in both the development and manipulation of content, in the ubiquity and pervasiveness of their access, in the enrichment of the modes of interaction and in the cross-cooperation between creators and users. New uses, new models and new economic players today are significantly modifying and widening the historic foundations of the content industry. For example, education and in-company training are undergoing profound changes due to the increasingly massive introduction of ICSTs. Culture is also very much concerned, with the digitizing of the cultural heritage. The objectives of the CONTINT programme are to develop knowledge and promote its dissemination in the industrial environment, to create synergies between sectors that are currently far apart, such as robotics and content or animation and games, to encourage research into non-technical subjects, whether it concerns studies on uses, human factors, legal implications or economic models and value chains.

The programme brings together two domains that converge in many ways:

- the digital content sector as a whole: capture, storage, creation, production, publishing, processing, interpretation, interaction, economy and usages; it covers not only all types of multimedia content, but also scientific content, data on the Internet, personal content, etc.

- the part of robotics that relates to questions of cognition by robots (terrestrial, humanoid, flying, etc.), placed in the general framework of interactions between artificial systems and the physical world.

At their point of intersection, the notions of semantic representation and data abstraction to knowledge become essential.

Digital Models (MN) programme

The development and use of modelling and digital simulation associated with the processing of large masses of data supported by supercomputing, play a vital role in understanding and predicting, designing and steering, deciding and acting.

The MN programme aims to fill the gap between research and industry by proposing full-scale research and test partnerships on the new digital methods, favouring the transfer to SMEs and research-industry relations for researchers. The scientific objectives of the programme are to further scientific knowledge in applied mathematics and computing in the areas of supercomputing, processing big data, the design and optimisation of processing uncertainties in order to solve the major application challenges, whether scientific (combustion, materials, Earth sciences, climate, health, etc.) or industrial (engineering, etc.). The programme more particularly seeks to take up the new technological challenges of computing, such as exascale computing.

The MN programme also aims at sustaining and deepening the knowledge acquired in simulation software programmes and favouring their use and valorisation. It also seeks to help develop the modelling and simulation ecosystem in France and Europe by integrating the developers, the users and the computing industry, that is to say applying the principle of integrative research or co-design.

Reminder: the European component in this sector is part of the ERA-NET CHIST-ERA programme coordinated by the ANR. The two calls for proposals topics selected for 2013 are:

- *User-driven, context- and content-aware communication networks*
- *Intelligent User Interfaces*

6.5.2 Nanotechnologies

Programme planning in the field of nanotechnologies takes into account the disseminating and cross-cutting nature of this scientific field which figures in several programmes. Firstly, the **Nanotechnologies and Nanosystems programme (P2N)** is oriented towards the development of generic technologies and the demonstration of component and nanosystem concepts, and aims at promoting the diffusion of nanoscience and nanotechnologies into the application domains (health, energy, environment, etc.). It is linked to the ANR's other thematic programmes, and in particular "**Materials and Processes for High-Performance Products (MatetPro)**", "**Digital Models (MN)**", "**Hardware and Software Infrastructures for the Digital Society (INFRA)**", "**Electricity Production and Management (PROGELEC)**", "**Technologies for Health (TECSAN)**", and "**Ecotechnologies and Ecoservices (ECO-TS)**". Lastly, at European level the ANR coordinates the **ERA-NET EuroNanoMed 2** addressing applications in nanomedicine (see above).

Nanotechnologies and Nanosystems programme (P2N)

The programme more particularly targets multidisciplinary projects, partnership projects and projects with high value-creation and transfer of technology potential. In this context, the P2N programme will focus more specifically on (i) the upstream aspects of nanotechnologies (technological breakthrough for new applications), (ii) the use of nanotechnologies for generic components, integrated nano- and microsystems, (iii) multi-physical and multi-scale simulation

associated with characterisation, and accompanying the development of the technological processes, (iv) the use of nanotechnologies in the areas of health, energy and the environment in a manner complementary to the ANR's other thematic programmes, and (v) the material integration in the framework of projects intended to promote a rapid transfer to industry and create intellectual property.

The programme will also support research that may contribute to solve problems currently arising in societies marked by:

- the need to save natural resources and produce low-carbon energy,
- the responsible, safe, controlled and shared development of technologies going from research to the industrial players,
- the need for technological innovation and integration with a view to converting science into economic growth,
- the growing needs in health and the aging of the population,
- the emphasis on growth based on the SMEs, without forgetting the important role played by the large groups as engines of progress and ecosystem leaders.

6.6 Global security and dual research

The ASTRID ("Specific Assistance for Defence Research and Innovation Work") and CSOSG ("Concepts, Systems and Tools for Global Security") programmes are based on a long term cooperation between the ANR and the Direction Générale pour l'Armement (DGA), the French defence procurement agency, but which differ in their scope and objectives. These two programmes do however, due to their cross-cutting nature, foster creativity at the interfaces of the disciplines and the acculturation of the research players to complex societal issues like defence and security.

Programme Specific Assistance for Defence Research and Innovation Work (ASTRID)

The ASTRID programme supports dual research projects, that is to say concerning the needs of both defence and civil applications. Funded by the DGA, the aim of this programme is to stimulate the emergence of new avenues of research and development, to identify technological breakthroughs and study the feasibility of their concept around 9 scientific domains that are priorities for the DGA:

- Information engineering and robotics,
- Fluids and structures,
- Acoustic and radioelectric waves,
- Nanotechnologies,
- Photonics,
- Materials, chemistry and energy,
- Biology and biotechnologies,
- Men and systems,
- Environment and geosciences.

The scientific and technical results of the projects in the targeted Technological Readiness Level (TRL) range (1 to 3) retain their dual nature until they become too highly specific. The scope and priorities of the call are based on the orientations of the DGA's policy and scientific objectives document (POS), whose availability and accessibility is unrestricted. The first two editions of this approach, which is highly innovative in Europe, met with great success and have already confirmed the cross-fertilisation potential, whether considering the proposed subjects or the heightened awareness of the public or private research teams. Effectively, one observes firstly a heightened awareness of certain research teams to the implications of the duality and of national defence and, secondly, for other teams, a familiarisation with the peer review methods used by civil research in France and Europe.

Programme Concepts, Systems and Tools for Global Security (CSOSG)

The CSOSG programme is designed exclusively for civil applications, following thematic orientations stemming from interministerial priorities (public and civil protection, prevention and handling of disasters and emergencies, etc.), targeting global issues, from local to national and public to private. The funded projects aim at finding concrete solutions to the issues of global security by using systemic, cross-cutting and multidisciplinary approaches, associating industrial and academic partners and the players from the security sector (programme owners and/or managers).

The partnership created since 2009 with the equivalent programme of the German Ministry of Research (BMBF) will be reinforced, and over and beyond the 11 on-going projects gathering some 150 Franco-German teams, new initiatives will be launched with the aim of structuring the European landscape ahead of the Horizon 2020 phase. The problems relating to emergency management and resilience (large scale emergencies, humanitarian crises), the protection of critical transport and energy infrastructures, the convergence between physical and digital security (fighting cybercriminality) will be addressed.

7 Key technologies for industry

Industry has widely integrated the reality of certain constraints (increase in the cost of energy, CO₂ credits, control of discharges, recycling, REACH regulations, etc.) into its innovation and investment strategies. Considerable R&D efforts are necessary to find sustainable solutions. The competitiveness of companies established in France (and therefore of the associated jobs) will ultimately depend on the aptness of these solutions.

On the global scale, the advanced countries (USA, Japan, EU) are the theatre of a large-scale movement to promote a reindustrialisation process through research programmes, notably with the launching of high-profile initiatives such as the "*Advanced manufacturing initiative*" programmes in the USA and the United Kingdom. Germany and Japan have always maintained a proactive strategy in this area, but they are also reinforcing their reindustrialisation capacities. This theme will also be presented in the Horizon 2020 programme planning on the European scale as of 2014 (*Key Enabling Technologies*).

In this field, the ANR initiated a Foresight Workshop entitled "Production systems of the future"¹⁵ (**ARP FuturProd**) aiming to enlarge the national network of researchers and open up the possibility of having a backed-up programme theme as of 2014.

The programmes implemented by the ANR currently cover this theme, essentially through a corpus of three programmes: "Materials and Processes", "Sustainable Chemistry Industries-Innovation" and "Nanotechnologies and Nanosystems (P2N)". Other programmes relating to ICSTs (INFRA, CONTINT, MN), energy and the environment (SEED, PROGELEC, TDM, ECO-TS), dual research (ASTRID) and social sciences and the humanities (SOC_INNOV) also address topics that support this cross-cutting theme.

The following must also be mentioned:

- The Industrial Chairs programme, the support for the micro/nano-manufacturing platforms (BTR – basic technological research) and the Carnot Institutes.
- The new instrument (LabCom) to support the creation of joint laboratories between public research and SMEs or intermediate-size enterprises aims to create about a hundred laboratories under a system of calls opened as and when required.
- The reinforcement of the technological challenges policy.

Altogether these initiatives represent nearly 40% of the ANR's thematic budget for 2013, which seems to be a very substantial proportion.

¹⁵ <http://www.cluster-gospi.fr/-ARP-FUTURPROD->

8 Summary table of the calls for proposals in the 2011-2013 cycle

(*) European and international calls for proposals

Programme title	2011	2012	2013
<i>Non-thematic programmes</i>			
Blanc	1	1	1
Blanc International	1	1	
Young Researchers	1	1	1
Chairs of Excellence	1	1	
Post-Doctoral Return	1	1	1
<i>Public-Private Partnership Research, Value Creation and Transfer of Technology</i>			
Industrial chairs		1	1
Emergence of projects with high value creation potential	1	1	
Inter Carnot-Fraunhofer Programme	1		
<i>Social Sciences and Humanities</i>			
Changing Societies:			
"Inequality - Inequalities"	1	1	
"Work, company, organisation"			
"Cultures and cultural phenomena"		1	1
"Globalisation and governance"		1	
Innovative Societies. Innovation, New Economy, New Lifestyles	1	1	1
Corpus, SSH data and research tools		1	
Emotion(s) - cognition – behaviour	1		
Learning			1
*ORA: Open Research Area in Europe for the Social Sciences and Humanities		1	1
Franco-German SSH programme	1	1	1
Franco-Japanese SSH programme	1	1	
Franco-Quebecer call for proposals in SSH	1		
<i>Biology – Health</i>			
Social Determinants of Health (DDS)		1	
SAMENTA: Mental health and addictions		1	1
*Ambient Assisted Living (AAL169/185)	1	1	1
MALZ: Alzheimer's disease	1	1	
Neurogenerative diseases JPI (JPND)		1	1
* E-Rare 2 ERA-NET	1		1
* Infect-ERA: Infectious diseases			1
* Metabolic diseases (Germany, Canada, Spain)	1		

* NEURON ERA-NET: Healthy and diseased central nervous system	1	1	
PRTS: Translational Research into Health			1
*Neuro-Compute: Computational Neurosciences (NSF)			1
* CIRM: Stem Cells (California)		1	
*Human epigenomics (Germany)			1
* ERA-SynBio ERA-NET – Synthetic Biology			1
*ANIHWA ERA-NET (EMIDA 2) Well-being, infectious and emerging diseases in animals	1	1	1
*EuroNanoMed 2 ERA-NET: Nanomedicine	1		1
CESA: Contaminants and Environments: Metrology, Health, Adaptability, Uses	1		1
*SIINN ERA-NET: Security and toxicology of nanosciences and nanotechnologies		1	
TecSan: Technologies for health and autonomy	1	1	1
RPIB: Partnership Research and Biomedical Innovation	1	1	1
<i>Biological resources, environmental monitoring and protection</i>			
SOC&ENV, CEP&S: Societies & Environmental changes	1	1	1
*IGFA/Belmont Forum - Environmental changes + Climate JPI			1
*BIODIVERSA: ERA-NET Biodiversity	1	1	1
*NET-BIOME: Management of tropical and subtropical biodiversity in the European overseas territories to support sustainable development	1		1
ECO-TS: EcoTechnologies & EcoServices (formerly ECOTECH)	1		1
*ECO-INNOVERA ERA-NET		1	
<i>Developing sustainable agriculture and food</i>			
ALID: Sustainable food supply systems	1	1	1
*ICTAGRI: ICT and Automation for a Greener Agriculture		1	
*ARIMNET: Agricultural Research in the Mediterranean Area		1	
*SEAS-ERA ERA-NET : marine research		1	
TRANSMED: Cross-disciplinary research into the future of the Mediterranean		1	
Agrobiosphere: Viability and adaptation of productive ecosystems, regions and resources to global changes	1	1	1
BIOADAPT: Genetics and biology of adaptation to stress and disturbances		1	1
*PLANT/KBBE/ Plant genomics	1		1

MATetPRO: Materials and Processes for High-Performance Products	1	1	1
M-ERA.NET: Materials sciences and engineering			1
CD2I: Sustainable Chemistry – Industries - Innovation		1	1
<i>Digital technologies</i>			
INFRA: Infrastructures for the digital society	1		1
INS: Digital engineering and security	1	1	1
CONTINT: Digital content and interactions		1	1
MN: Digital models	1	1	1
*CHIST-ERA: Information and Communication Sciences and Technologies: long-term challenges	1	1	1
P2N: Nanotechnologies and Nanosystems	1	1	1
<i>Security and dual research</i>			
CSOSG: Concepts, Systems and Tools for Global Security	1	1	1
ASTRID - Specific assistance for defence research and innovation work	1	1	1



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www.agence-nationale-recherche.fr

Tél. : +33 (0)1 78 09 80 00

212 rue de Bercy - 75012 Paris France

