

FUNDING PROJECT-BASED RESEARCH IN ALL ITS DIVERSITY



PHYSICS,
ENGINEERING,
CHEMISTRY &
ENERGY



SOCIAL
SCIENCES &
HUMANITIES



ENVIRONMENT,
ECOSYSTEMS &
BIOLOGICAL RESOURCES



HEALTH &
BIOLOGY



DIGITAL &
MATHEMATICS

ANNUAL
REPORT
2017

AGENCE NATIONALE DE LA RECHERCHE

ANR

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EDITORIAL



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By Thierry DAMERVAL
ANR President and CEO

— *We share the same goals as everyone involved in research – advancing knowledge, serving research and promoting innovation.* —

My presidency of the French National Research Agency is a source of great pride, and I am keenly aware of the responsibility this role represents.

With its missions of financing and promoting the development of research and managing the French government's Investments for the Future programmes in the fields of higher education and research, the ANR occupies an important space in the landscape of public policy on research and innovation.

Frédérique Vidal, the French Minister of Higher Education, Research and Innovation, has restated this principle and acknowledged the role of the agency by allocating more resources for its work. The 2018 budget builds on this trend of positive growth, benefiting project-based research funding in general and the Generic Call for Proposals (AAPG) in particular.

2017 was a year of transition for the agency. Progress was made on a number of projects throughout the year. Efforts were made to simplify the whole project selection process, including grant agreement.

These measures, announced by the minister, are part of a wider evolution of the agency, and we must take them further in order to fulfil our role and meet the many challenges that lie ahead.

We share the same goals as everyone involved in research – advancing knowledge, serving research and promoting innovation.

We are governed by a dual commitment: to reinforce dialogue and to achieve better legibility for our actions by ensuring a clear separation between programming and evaluation.

We have already begun working with the French Ministry for Research on programme coordination. We have set up steering committees bringing together government ministries, representatives of the five thematic research alliances, CNRS, CPU and private-sector R&D. These committees cover the alliances' research fields and the ANR's scientific departments.

The agency's Work Programme now provides a structure based on scientific fields, enabling researchers to identify more easily the Scientific Evaluation Panel that will review their project. The Generic Call for Proposals thus favours a freer approach, allowing considerable scope for basic research.

The ANR's programming also offers targeted provision in line with public research policy and the government's priorities in areas such as artificial intelligence, health, environment, energy and security. Our actions also aim to promote participation by French teams in European projects (MRSEI, Springboard-ERC, ERA-NET, JPI) and to support public-private research partnerships (Carnot, Labcom, Industrial Chairs, Challenges).

Pursuing its goal of supporting different forms of research projects, the ANR has developed a network of institutional partners, both nationally and internationally. It interacts with many research actors in both the public and the private sectors.

High-quality peer review and rigorous processes are our top priorities. The agency is committed to a continuous improvement approach, including a modernisation programme for its systems and tools. The quality management programme has been

— *High-quality peer review and rigorous processes are our top priorities.*

The agency is committed to a continuous improvement approach... —

restarted within the agency, which has made it possible to achieve the ISO 9001 Certification for its central task, the "Project Selection" process. The agency also works to promote its service to researchers and beneficiary organisations and to evaluate projects retrospectively. This ranges from reviewing their results to carrying out an impact assessment, with an approach based on openness and partnership.

Respect for best ethical practice and scientific integrity is also central to our concerns. Here the ANR has reinforced its position by revising its code of ethics and signing the national ethical charter for research.

The ANR's role with regard to the Investments for the Future programmes (PIA) has been confirmed with the creation of the French General Secretariat for Investment (SGPI). The selection of the last 8 PIA 2 Idex/Isite projects and the first PIA 3 awards, along with the University Research Schools, the New University Curricula and of course the MOPGA programme ("Make Our Planet Great Again"), initiated by the French President, demonstrate once again the agency's responsiveness.

These projects, some of them launched in 2017, will bear fruit in the coming years thanks to the commitment and motivation of the agency's staff to serve the values of public service for the benefit of research.

KEY FIGURES FOR 2017

ACTIVITY

302

EMPLOYEES
AT 31/12/2017
265 FTEW
(FULL-TIME EQUIVALENT
WORKED)



62%



38%

€624.5M

FUNDING BUDGET
IN 2017

INCLUDING:

€496.5M

ALLOCATED THROUGH CALLS
FOR PROPOSALS

€34.6M

OPERATING BUDGET
IN 2017

PROJECTS FUNDED

1,380

PROJECTS FUNDED
IN 2017



€360K

AVERAGE AMOUNT
PER PROJECT FUNDED

14.9%

SELECTION RATE
ACROSS ALL CALLS

NEARLY 17,000
PROJECTS FUNDED
SINCE THE ANR WAS FOUNDED

FOCUS

AAPG* 2017

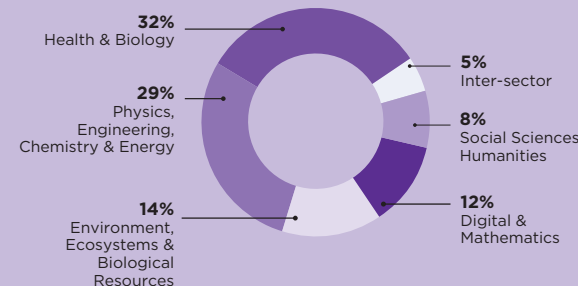
1,063
PROJECTS FUNDED
IN 2017

13.3%
GLOBAL SELECTION RATE,
COMPARED WITH 12.9% IN 2016

72% OF FUNDED PROJECTS
INVOLVE COLLABORATION BETWEEN
RESEARCH TEAMS

9.2% OF FUNDED PROJECTS
ARE INTERNATIONAL PROJECTS
JOINTLY FUNDED WITH FOREIGN
AGENCIES

80.1% OF FUNDED PROJECTS
ARE BASIC RESEARCH PROJECTS



* Generic Call for Proposals

FUNDING INSTRUMENTS

4 AAPG INSTRUMENTS:
PRC, PRCI, PRCE, JCJC¹

85% of the ANR budget allocated
to calls for proposals

87% of applications

77% of selected projects

€420.6 M of funding budget in 2017

7 INSTRUMENTS DEDICATED
TO "SPECIFIC" CALLS FOR
PROPOSALS

Labcom shared laboratories, Industrial
Chairs, MRSEI, Springboard-ERC, Interna-
tional calls, Flash, Challenges

€75.9M of funding budget in 2017

1 CARNOT PROGRAMME
to finance certified Carnot Institutes
€57M of funding budget in 2017

¹ PRC : Collaborative Research Projects ; PRCI : International Collaborative Research Projects ;
PRCE : Collaborative Research Projects involving Enterprises ; JCJC : Young Researchers

INVESTMENTS FOR THE FUTURE

PIA BUDGETS ENTRUSTED TO THE ANR

PIA 1:
€22.5BN
OF THE PROGRAMME'S
35 BILLION EUROS

PIA 2:
€4.5BN
OF THE PROGRAMME'S
12 BILLION EUROS

PIA 3 (GPI):
€2.85BN
OF THE PROGRAMME'S
10 BILLION EUROS

2017 HIGHLIGHTS

Launch of the first ERA-NET QuantERA call for proposals dedicated to quantum technology
The ANR is working with about thirty European funding agencies, acting as the lead partner responsible for preparing and managing the call.

J ANUARY

10 > 11 **Review of the PIA 1 EQUIPEX «Equipment of Excellence» action**
An international jury of independent scientists reviewed the 90 EQUIPEX projects. Their work provided an external view and emphasised the exceptional, transformative nature of many of the projects.



J UNE

13 > **First results of the 2017 AAPG - Results consolidated with the International Collaborative Research Projects (PRCI Instrument) in December 2017**
In all, the ANR supported 1,063 projects out of about 7,000 submitted in stage 1 and nearly 3,000 in stage 2.



10 > 11 **4th edition "At the Crossroads of Research and Artistic Creativity" organised in collaboration with the Avignon Festival**
This event brought together archaeologists, anthropologists, historians, sociologists, economists, philosophers, theatre and literature specialists, psychologists and cognitive neuroscientists to talk to authors, directors and actors at the Festival.

J ULY

Launch of the "Hurricanes 2017" flash call on Disasters, Risks and Resilience < 18
Following the extreme weather events in August and September 2017, the French Ministry of Higher Education, Research and Innovation and the ANR launched a call for proposals to acquire new knowledge about these phenomena and their environmental and social consequences.

Make Our Planet Great Again, 18 researchers selected following a call issued by the French President to combat global warming < 12
The nominees come from six different countries, but mostly the USA (13 projects). The chosen projects are of a very high level and cover particularly important subjects, such as understanding the impact of climate change.



Signature of an agreement between the ANR and the Japanese science and technology agency, JST, < 6
as part of the CREST programme. The 2018 collaboration focusing on the two CREST programmes quantum technologies and symbiotic interactions, with a view to launching joint calls in early 2018.

D ECEMBER

Launch of the www.app-recherches.fr portal, offering a single access point to national calls in the Social Sciences and Humanities < 20
during the "SSH Spring Day" organised by the Athena alliance.

M ARCH

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20 > 21 **SPICE Seminar at the Maison de la Chimie in Paris - Presentation of projects in the fields of Physics, Engineering, Chemistry and Energy:** from basic to applied research, a set of scientific fields favourable to the development of technology transfer at low levels of maturity, offering scope for the preparation of tomorrow's industrial applications.

24 > **Personalised medicine: publication of an international action plan designed to stimulate research**
An international consortium (ICPerMed) of about thirty European and international organisations, including the ANR, has just published a shared strategic research agenda for the growth of personalised medicine, a road map for a future ERA-NET (ERA PerMed).

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11th WISG Conference, the meeting place for research and security actors < 14 15
organised by the French Defence Procurement Agency (DGA), the French General Business Department (DGE) and the French General Secretariat for Defence and National Security (SGDSN) and attended by a representative of the German Federal Education and Research Ministry.

S EPTEMBER

SEPTEMBER / OCTOBER ANR TOUR

For the second year, the ANR set off to meet scientific stakeholders and present the 2018 Work Programme and the calls for proposals. About twenty meetings were held in Paris and across France thanks to support and hospitality from regional CNRS offices and universities, and over 2,500 people attended.



O CTOBER

13 > **Results of the first phase of the PIA 3 New University Curriculum call for proposals**
Frédérique Vidal, the French Minister of Higher Education, Research and Innovation, and Louis Schweitzer, the French General Investment Commissioner, announced the list of 17 winners, awarded a total of €150M. This initiative supports institutions in the evolution of their training provision. The selected projects incorporate far-reaching ideas suitable for large-scale deployment and illustrate the institutions' ability to deliver ambitious training policies.





1. PROJECT-BASED RESEARCH FUNDING

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THE PROJECT-BASED FUNDING AGENCY FOR RESEARCH IN FRANCE

– Founded as a public interest grouping in 2005, the French National Research Agency (ANR) became a public administrative institution under the authority of the French Ministry of Higher Education, Research and Innovation in 2006. Serving the scientific community, the ANR's core mission is to implement project-based research funding in France. Its role was defined by decree on 1 August 2006 before being consolidated and expanded on 24 March 2014.

FIVE MISSIONS

To fund and promote the development of basic and targeted research, technological innovation, technology transfer and public-private partnerships;

To implement the programme approved by the French Minister of Research, following consultation with the ministers responsible for France's research organisations and public higher education institutions;

To manage major government investment programmes in the fields of higher education and research and to oversee their implementation;

To strengthen scientific cooperation across Europe and worldwide by aligning its Work Programme with European and international initiatives;

To analyse trends in research provision and assess the impact of the funding it allocates on scientific output in France.

THE PROJECT-BASED RESEARCH FUNDING

A driving force in multi-partner thinking on behalf of scientific communities and research actors, the ANR fosters partnerships between academic researchers and between the public and private sectors and stimulates collaboration between scientists across Europe and worldwide.

The agency supports excellence in French scientific research at different technology readiness levels (TRLs) and promotes innovation and technology transfer.

The ANR fulfils its project-based research funding mission through a model based on calls for proposals and a selection process involving fundamental internationally agreed principles such as peer review by independent experts.

Project-based funding allows researchers to manage credits on a multi-year basis and enables research activity in different fields to be measured. The response to scientific and societal challenges favours collaboration between scientific teams from different disciplines and organisations, coming together to focus on shared objectives. In addition, the competitive, independent nature of the project selection process encourages scientific excellence by promoting the emergence of projects and teams of a very high level, including young researchers.



€496.5M

ALLOCATED IN 2017*

1380 projects were funded, representing **4401** partners, including those from abroad.

* excluding Carnot funding

A PARTNERSHIP STRATEGY FOCUSED ON EXCELLENCE

The ANR works in collaboration with major research actors in the public and private sectors and maintains a network of institutional partners who can support research projects in their areas of interest in a variety of forms. For example, the agency has developed co-funding arrangements representing valuable partnerships for French research.

In 2017, the agency's principal partners included: the French Defence Procurement Agency (DGA), the French National Solidarity Fund for Autonomy (CNSA), the French Biodiversity Agency (AFB) and the French General Secretariat for Defence and National Security (SGDSN).

These partnerships represent nearly 20 million euros a year, or 5% of the ANR's funding budget.

The 2017 Generic Call for Proposals (AAPG) includes many co-funded projects, demonstrating the importance of partnerships in overcoming scientific obstacles and promoting interdisciplinary research:

- ▶ As well as the Astrid and Astrid Maturation programmes, the DGA supports about a dozen high-level research projects with both civil and military aspects in the sectors of energy, industrial renewal, security, information and communication;
- ▶ The SGDSN sponsors studies aiming to understand and simulate human behaviour in disaster-struck regions;
- ▶ Work backed by the AFB includes using an insect as the primary organic means of eradicating a different insect that attacks corn crops;
- ▶ The CNSA has financed work on risk and resilience mechanisms between parents and child development in the early years of life; how to care for patients suffering from neurodegenerative diseases and the interaction between memory and time through a transdisciplinary study in young and elderly subjects.



17,000
PROJECTS
FUNDED

Since 2005, the agency has funded nearly 17,000 projects, involving 55,000 partners, including those from abroad, with total funding amounting to €7.2bn for French research.

The agency also makes its expertise in managing calls for proposals available to outside bodies. For example, the whole operational structure of the ANR can be used on behalf of public bodies wishing to benefit from its skills.

They can commission the agency to conduct calls for proposals, manage review processes, agree contracts and monitor funded projects, or they can choose to organise the agreement of contracts with the selected teams themselves.

In the **Astrid** (French acronym for specific support for defence research and innovation) and **Astrid Maturation** programmes, for example, the ANR manages specific calls for proposals but the projects are funded solely by the DGA. These programmes are characterised by their broad scientific scope, covering all the key areas of civil and military research, enabling innovations to be generated from basic research.

In the case of the **ERDF-ESF Operational Programme (OP) for the Guadeloupe region**, the ANR carried out the scientific review of collaborative research submissions associated with Guadeloupe's strategy for intelligent specialisation and is also responsible for monitoring the selected projects. In this role, it organised a mid-term review meeting attended by members of the evaluation panel in 2017.



A SPECIFIC MISSION: THE INVESTMENTS FOR THE FUTURE PROGRAMMES

– As the lead operator of the Investments for the Future programmes (PIA 1, 2 and 3) in the fields of higher education and research, the ANR draws on its expertise to implement and monitor these programmes on behalf of the government. The objectives and the selection, monitoring and review criteria for these initiatives are defined in agreements between the government and the ANR.

SEVEN YEARS OF MANAGEMENT

Within the Investments for the Future programmes, the ANR is responsible for:

- ▶ managing the calls for proposals;
- ▶ selecting and funding projects and agreeing contracts;
- ▶ monitoring, auditing, assessing, reviewing and studying the impact of the projects.

Managing Investments for the Future differs in specific ways from the ANR's other missions:

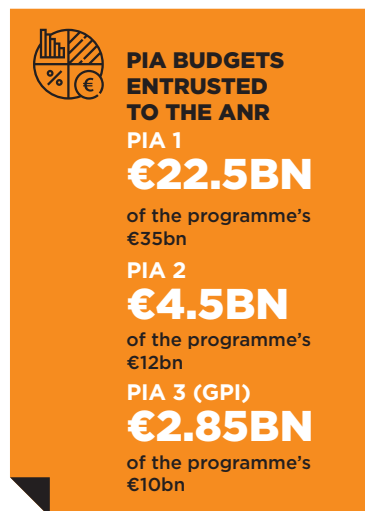
- ▶ reviews are mostly carried out by international juries;
- ▶ the selection criteria are defined based on the priorities of the Investments for the Future;
- ▶ the final selection is up to the French Prime Minister;
- ▶ the programme includes large-scale research and infrastructure projects requiring significant credit allocations over more than 10 years, opening up new possibilities and leading to collaborations that could not have taken shape otherwise.

Every year, the agency drafts an *Impact Assessment* report on each action for the French General Secretariat for Investment (SGPI). The ANR also publishes summaries for each action, region and theme⁽¹⁾.

Since the launch of the first programme, in terms of monitoring:

- ▶ there are 618 projects (PIA 1, 2 and 3) in the portfolio;
- ▶ 1,940 site visits have been carried out;
- ▶ 65 EQUIPEX projects have completed phase one;
- ▶ 20 projects have been closed down;
- ▶ 660 amendments to funding agreements have been signed;
- ▶ 29 financial and accounting audits have been conducted.

In addition, intermediate assessments have been carried out on all the actions in the first programme, most of them by the international selection jury.



(1) <http://www.agence-nationale-recherche.fr/investissements-d-avenir/suivi/>

FRANCE'S INVESTMENT PLAN (GPI) 2018-2022

On 25 September 2017, the French government launched a **57-billion-euro Investment Plan**, announced by the French Prime Minister on 4 July 2017, that will span its five-year term. The plan is designed to support structural reform in France and respond to four major challenges: carbon neutrality, access to jobs, competitiveness through innovation and digital government. The plan includes funding for the Investments for the Future programme (PIA 3), which continues to serve competitiveness, growth and employment in France. The French General Secretariat for Investment (SGPI) is coordinating both programmes.

THIRD INVESTMENTS FOR THE FUTURE PROGRAMME (GPI)

Scheduled by the 29th December 2016 finance act, the PIA 3 has the same key objectives as its two predecessors: excellence, innovation and cooperation. The ANR has been appointed as the operator for eight initiatives under the "Supporting progress in teaching and research" and "Exploiting research" components, and has received 2.85 billion euros.

Four initial calls launched in 2017

- ▶ **"New University Curriculum (NCU)"**: to support universities, schools and groups of institutions that want to diversify their teaching provision.
- ▶ **"University Research School (EUR)"**: to offer all university sites a chance to reinforce the impact and international attractiveness of their research and teaching in one or more scientific fields.

- ▶ **"University Hospital Institutes (IHU2)"**: building on the first IHU call for proposals, this action will create up to two centres of excellence in research, treatment, training and technology transfer in the health field thanks to a grant of 100 million euros. The first IHU call for proposals in 2010 led to the creation of six IHUs.
- ▶ **"Make Our Planet Great Again" (MOPGA) Priority Research Programmes (PPR)**: launched by the French President on 1 June 2017, this call invites researchers to come to France to carry out work aiming to combat global warming. The first 18 researchers selected for MOPGA were announced at the *One Planet Summit*. This priority research programme is coordinated by the French Ministry for Research with scientific leadership provided by the CNRS and the ANR.

PROGRAMMING BASED ON CONSULTATION

– The ANR is committed to aligning its programme with trends in the research world and the priorities of its stakeholders. It works with research actors to develop a Work Programme that defines the year's actions and funding instruments in the context of national priorities and European research funding initiatives.

Acting as a road map for the agency, the 2017 Work Programme builds on the orientations defined in the French National Research Strategy (SNR) and the "France Europe 2020" strategic agenda for research and innovation.

To ensure that stakeholders' priorities and needs are taken into account, the ANR consulted the five research alliances (Allenvi, Allistene, Ancre, Athena and Aviesan) and the CNRS between September 2015 and June 2016 to develop the 2017 Work Programme under the authority of the French Ministry for Research. It also called on the nine Scientific Challenge Steering Committees (CPSD) to provide feedback on previous submissions and selections and adapt the content of the 2017 Work Programme.

Organised into four components, each with its own funding instruments, calls for proposals and specific programmes, the 2017 Work Programme aims to offer the scientific community in the public and private sectors a global view of the agency's funding provision. The ANR Board of Directors adopted this document on 29 June 2016.

TWO MAJOR EVOLUTIONS IN 2017

The 2017 edition was improved in two major ways:

- ▶ **The creation of a new funding instrument called Springboard-ERC (T-ERC)**, aiming to reinforce French participation and improve the success rate of French research in European Research Council (ERC) calls for proposals.
- ▶ **The strengthening of basic research** within each challenge of the 2017 Work Programme with a dedicated theme or sub-theme. The objectives and disciplines covered by the Other Knowledge Challenge, which could be seen as dedicated to basic research, were also clarified to make it easier to understand as a supplement to the societal challenges defined in the National Research Strategy.

PREPARING THE 2018 WORK PROGRAMME

The ANR has drawn on exchanges with its supervisory ministry, the research alliances and the CNRS and on feedback from the Scientific Evaluation Panels (CES), Project Coordinators and the agency's scientific teams to make its policy framework more legible.

The 2018 AAPG now structured by themed research disciplines

The 2018 Generic Call for Proposals has been structured into research themes to enable applicants to submit their project directly to the relevant committee without reference to the societal challenges. This new structure offers greater visibility for individual disciplinary fields in alignment with the societal challenges, which now constitute the background to the call.

DEVELOPING THE PARTICIPATION OF FRENCH TEAMS IN EUROPEAN AND INTERNATIONAL RESEARCH



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– European and international initiatives are an integral part of the agency's programming. Its national activities and funding instruments are coordinated with the programmes of other national and international bodies. These activities aim to help establish the European Research Area and to develop partnerships that will promote cooperation between French and international teams.


ENCOURAGING FRENCH PARTICIPATION IN H2020, THE EUROPEAN UNION'S FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

The ANR is committed to coordinating its national programme with Horizon 2020 and has introduced several support mechanisms to encourage French researchers to take part in the European Framework Programme for research and innovation.

Setting up European and International Scientific Networks (**MRSEI**) is a funding instrument that helps researchers to set up and coordinate European or international projects. The **Springboard-ERC** mechanism was created to help researchers access selective funding from the European Research Council. It is of particular benefit to young researchers long-listed but not selected by the ERC, helping them to develop their project and reapply (see p. 21).

The ANR has also set up non-thematic Lead agency⁽¹⁾ collaboration agreements with European partners (Germany, Switzerland, Austria, Luxembourg) and non-thematic Open Research Area multilateral calls (Germany, UK, Netherlands) to create borderless scientific communities.

The ANR takes part in the **ERA-NET, ERA-NET Cofund and Joint Programming Initiative (JPI)** networks to coordinate actions across Europe in response to major scientific and societal challenges. It co-funds participation by French teams in transnational projects (European and international) through these multilateral calls for proposals.

 EUROPE

81% OF TRANSNATIONAL PROJECTS ARE CO-FUNDED WITH EUROPEAN AGENCIES

16 ERA-NET COFUND CALLS

3 ERA-NET CALLS

GERMANY, THE ANR'S PRIMARY EUROPEAN PARTNER

The ANR maintains close links with Germany. It collaborates with the German Research Ministry (BMBF) on specific bilateral calls for proposals in strategic areas such as civil security, strategic materials and energy. With its counterpart the DFG (German Foundation for Research – *Deutsche Forschungsgemeinschaft*), the agency launches a call every year open to all areas of the Social Sciences and Humanities (SSH) and offers non-thematic collaboration through the Lead agency mechanism covering all other scientific fields. Of 268 projects funded in 2017 with other foreign agencies, 125 involved German partners either multilaterally or bilaterally.

⁽¹⁾ Within this framework, the teams from the two countries prepare a joint project and one single agency, the Lead agency, evaluates it and takes charge of project submission and review.

ENCOURAGING INTERNATIONAL COOPERATION TO SUPPORT FRENCH TEAMS

The ANR also develops joint programmes with funding agencies outside the European Union (EU) through bilateral agreements. These bilateral collaborations are managed through two funding mechanisms. The International Collaborative Research Projects (**PRCI**) instrument (see p. 21) enables bilateral projects to be co-funded with foreign agencies within the Generic Call for Proposals. There are also **specific bilateral calls for proposals** on targeted themes.

Some non-EU collaborations are implemented using a multilateral regional approach, as for the Mediterranean and Africa, for example. In few specific cases European multilateral calls such as ERA-NET or JPI include partners in non-EU third countries.

PARTNERSHIPS AND CO-FUNDING WITH THE FRENCH DEVELOPMENT AGENCY (AFD)

The agency also coordinates the **Leap Agri ERA-NET** with European and sub-Saharan African countries on the themes of sustainable agriculture and aquaculture and on food security. The first call was launched in 2017. The ANR and the AFD co-fund the participation of French teams and the ANR represents both agencies.

NORTH-SOUTH: RESEARCH AND INNOVATION IN WATER, AGRICULTURE AND FOOD

The Mediterranean and Africa are the two world regions covered by specific regional multilateral programming within the ANR. This programming is developed in line with the national research and innovation policy of the French Ministry of Higher Education, Research and Innovation (MESRI) and the French Ministry of Foreign Affairs and International Development (MAEDI). The programmes are constructed and financed jointly by funding bodies in the North

and the South. They reflect a strong willingness to encourage interdisciplinary research and systemic approaches to common challenges, including sustainable food production and food and water resource security. The ANR contributes to developing the Euro-Mediterranean research area through the **PRIMA programme** (*Partnership on Research and Innovation in the Mediterranean Area*), which will allocate more than €400M of funding through annual calls for proposals over a

10-year period (2018-2028). It follows a series of programmes and six transnational calls dedicated to the problems of the Mediterranean, including the latest **ARIMNET 2** ERA-NET call (*Agricultural Research in the Mediterranean Area network*) dedicated to projects from young researchers.

FUNDING OPPORTUNITIES ADAPTED TO THE EVOLUTION OF RESEARCH

– The ANR's funding opportunities concerns all scientific communities, including young researchers, and all public and private actors involved in research in France, including microbusinesses and small and medium-sized enterprises. Every funding instrument has its own expected effects and distinct characteristics. When submitting a project, researchers choose the funding instrument that will best serve the scientific objectives and requirements of their project.

REINFORCING COLLABORATIVE AND TRANSDISCIPLINARY RESEARCH (PRC)

The ANR's main funding instrument, with 51% of the budget allocated to calls for proposals in 2017, Collaborative Research Projects (PRC) promote the pooling of skills to achieve the objectives of a research project.

Aiming to encourage approaches that cut across academic disciplines, it enables all forms of collaboration other than those targeted by Collaborative Research Projects involving Enterprises (PRCE) or International Collaborative Research Projects (PRCI). Teams or multidisciplinary groups within the same organisation or public research laboratory can propose projects that will be considered collaborative.

89% of the PRC projects funded in 2017 are basic research projects

PROMOTING THE EMERGENCE OF YOUNG SCIENTISTS AND NEW TEAMS (JCJC)

Support, preparation and assistance for the next generation of researchers are key concerns for the ANR, which has created a dedicated Young Researchers (JCJC) funding instrument to promote initiative and encourage innovative, original approaches. Designed for Project Coordinators who completed their doctorate less than ten years before

submitting the project, the instrument enables them to develop work independently on their own specific theme, put together or strengthen a team and quickly express their capacity for innovation. The instrument is also a springboard for young French researchers who, thanks to an initial support from the ANR, can more easily consider submitting a project to calls from the European Research Council (ERC) with an improved chance of success.

14% of the budget allocated to calls for proposals in 2017. In 2017, the budget allocated to JCJC rose by 12% compared with 2016, supporting an additional 39 young scientists.



THE ANR'S FUNDING OPPORTUNITIES

11 instruments to finance research projects through calls for proposals:

- ▶ 4 instruments in the Generic Call for Proposals (AAPG): PRC, PRCI, PRCE, JCJC. The main ANR call represents 88% of submissions, 77% of selected projects and 85% of the budget allocated to calls for proposals
- ▶ 7 instruments covered by so-called "specific" calls for proposals responding to particular objectives: supporting the participation of French teams in European projects; promoting partnership-based research and innovation. They are Labcom shared laboratories, Industrial Chairs, MRSEI, Springboard-ERC, international calls, Flash and Challenges.

1 Carnot programme to finance certified Carnot Institutes following a call for applications

REINFORCING SCIENTIFIC COOPERATION IN EUROPE AND WORLDWIDE

SUPPORTING PARTICIPATION IN EUROPEAN PROJECTS: DEDICATED INSTRUMENTS (SPRINGBOARD-ERC, MRSEI)

With the goal of supporting European and international cooperation, the ANR works to help French researchers put together European projects. Despite a high level of success in European framework programmes, France's scientists are among the least likely to apply. For this reason, the Setting up European and International Scientific Networks (MRSEI) instrument was introduced in 2015. Designed to support the creation of transnational networks coordinated by French researchers, it aims in particular to facilitate access to Horizon 2020 calls for proposals.

In 2017, the fourth and fifth⁽¹⁾ editions financed 50 networked projects. With a selection rate of 54%, the instrument boosts the visibility and reach of French research

Another means of support offered by the agency is the Springboard-ERC (T-ERC) instrument. Introduced by the 2017 Work Programme, this new instrument aims to reinforce French participation and to offer a further chance of success to young researchers in calls issued by the European Research Council. The ANR assists candidates who were not offered ERC funding, despite submitting high-quality, well-received projects, by helping them improve their proposal and resubmit their application.

Two calls were launched in 2017, the first for the ERC's Starting Grant call and the second for the Consolidator Grant call.

PROMOTING BILATERAL AND MULTILATERAL COLLABORATIONS

To accelerate and extend cooperation between French researchers and the best European and international teams on key subjects, and to promote partnerships with emerging countries in the global scientific landscape and to create high-level transnational teams, the ANR promotes bilateral partnerships through the International

Collaborative Research Projects (PRCI) instrument and specific calls for proposals. The PRCI instrument enables French teams to submit projects involving one or more foreign teams to the generic call.

Alongside this, the agency also offers bilateral collaborations through specific calls for proposals. These one-off calls correspond to themes for collaboration identified as priorities by the ANR, the ministry and the agency in the partner country.

In 2017, the ANR funded 98 PRCI projects, 10 more than in 2016.

The ANR also funds French teams through multilateral partnerships. As part of its contribution to building the European Research Area, it acts through multilateral programmes with European agencies involving instruments such as ERA-NET and ERA-NET Cofund and multilateral calls associated with Joint Programming Initiatives (JPIs). The agency also forges specific multilateral international partnerships with foreign funding agencies through frameworks such as the Belmont Forum.

In 2017, the ANR funded 152 projects involving French teams, 20% more than in 2016.

ENCOURAGING INNOVATIVE, ORIGINAL APPROACHES AND PROMOTING INNOVATION AND TECHNOLOGY TRANSFER THROUGH COMPETITIVE MECHANISMS: PRCE, LABCOM, INDUSTRIAL CHAIRS, CARNOT PROGRAMME

Part of the Generic Call for Proposals (AAPG), the Collaborative Research Projects involving Enterprises (PRCE), refocused since the 2017 Work Programme on commercial companies carrying out R&D work, are dedicated to collaborations between academic or public-sector research laboratories and a company. They aim to achieve research results that benefit both parties, enabling public laboratories to develop new research questions or approach them differently, taking better account

(1) The projects funded through the 5th edition are allocated from the 2018 budget.

of industrial needs in academic work, reinforcing the transfer of results and knowledge from public results towards businesses and developing their capacity to innovate. Collaborating on a shared project, the two sides are mutually supportive and pool both the financial, technological and scientific risks and the results.

14% of the budget allocated to calls for proposals in 2017. 126 PRCE were funded in 2017.

Complementing the collaborative projects involving enterprises, the ANR has introduced several specific instruments and programmes to encourage partnerships between the public and private sectors. **The programme to support the creation of shared laboratories (LabCom)** between public research bodies and small and medium-sized enterprises (SMEs) or middle-market companies aims to develop the potential for industrial partnerships and transfer that already exists among academic researchers.

With 99 LabCom projects funded between 2013 and 2016, the programme was renewed in 2017, allocating funds to 19 new LabCom projects. Building on this success, a new instrument, **LabCom Consolidation**, has been set up to put partnerships on a longer-term footing and guarantee their financial independence for 18 months following the end of the initial project.

As another instrument benefiting partnership-based research, the **Industrial Chairs** are designed to reinforce the potential for innovative strategic research in French industry's priority fields. Rooted in research institutions, Industrial Chairs are co-funded by the ANR and the partner companies.

Five Industrial Chairs were co-funded in 2017⁽¹⁾ with a selection rate of 55.6%, representing €3.6M of the ANR funding.



THE CARNOT PROGRAMME

Created in 2006 by the French Ministry for Research, the Carnot Institute label recognises and supports French laboratories engaged in positioning partnership-based research, and particularly bilateral contractual research, at the heart of their research strategy.

The ANR, which manages the programme, grants an annual financial allowance, based on partnership revenues, to institutes selected by the French ministry following a call for applications. This additional

allowance enables them to develop their skills to maintain the scientific lead they need for their performance and to be attractive to companies, while professionalising their contractual approach.

The positive results of the first two certification phases led to the launch of a third phase in 2016. This included two components: the Carnot label itself, and a system known as the Carnot Springboard⁽²⁾. This component is a three-year preparatory phase for research units that aim to acquire the label but do not yet fulfil all the criteria of the Carnot charter.

The label has now been awarded to 29 laboratories or groups of laboratories, and nine more are benefiting from the Carnot Springboard programme.

In 2017, the 29 organisations were audited by the ANR as part of the monitoring process for calculating the allowance, and the nine beneficiaries of the Carnot Springboard programme were allocated a grant at the suggestion of the Carnot committee. The Carnot programme represents 9.3% of the agency's global funding budget, amounting to €57M.

(1) Partners co-funding Industrial Chairs in 2017: Thales Alenia Space, Total, Suez, Atos-Bull, Transvalor, Aubert & Duval, Cefival, Areva NP, Arcelor Mittal, CMI, SAFRAN, Faurecia, Industeel, Lisi, Montupet and Sciences Computers Consultants.

(2) Carnot Springboard is financed through the Investments for the Future programme.

RESPONDING TO SPECIFIC URGENT RESEARCH NEEDS

The agency's Work Programme also provides two mechanisms for responding to specific one-off situations: **the Flash** and **Challenges** instruments.

The **Flash** (or accelerated call) system is activated to support urgent research that addresses scientific questions around a large-scale event or natural disaster. It allows for an accelerated procedure that is well suited to natural disasters requiring a high level of responsiveness in targeted areas.

In 2017, the ANR and the French Ministry for Research launched the **Hurricanes 2017: Disaster, Risk and Resilience** call following the extreme weather events in the Lesser Antilles and the Gulf of Mexico (Irma, José, Maria, Harvey).



THE CHALLENGES INSTRUMENT

In 2017, the ANR opened up its **Challenges** funding instrument to a wider range of disciplines and to partnerships in order to reinforce its funding capacity across all scientific fields. Historically, the eight previous Challenges had focused primarily on digital technology and robotics. The major actors in French research can thus access partnership opportunities, either spontaneously or in response to a targeted call, in order to initiate funding and research programmes tailored to the issues they encounter and to compare the evolution and results of the work generated by these programmes.

Put together in 2016, three Challenges were launched in 2017:

- In partnership with the French Defence Procurement agency (DGA): **MALIN** (mastering indoor location) and **DEFALS** (detecting falsification in images).
- In partnership with the French Ministries of Agriculture and of the Ecological Transition: the **ROSE** challenge (robotics and sensors to support the Ecophyto pesticide reduction plan), whose goal is to contribute to the development of innovative technological solutions able to reduce the use of pesticides in weed control.

The specific nature of the Challenges

Each ANR research Challenge is a research consortium funding programme targeting a specific theme, initiated through a single call for proposals. The system encourages several teams to work on the same problem simultaneously in order to identify new solutions. The goal is to stimulate creativity, inspire researchers to contrast their ideas and promote the establishment of standards to compare different approaches. Several teams are thus selected to tackle a single scientific issue and funded to develop scientifically and technologically innovative solutions, testing them at regular intervals during joint trial campaigns in a spirit that combines cooperation and competition.

€4.1M of the ANR funding allocated to Challenges in 2017

COMPETITIVE, INDEPENDENT SELECTION TO SERVE SCIENTIFIC EXCELLENCE

– **Independent scientific peer review, fair treatment, transparency, respect for the rules and best practice of scientific ethics and integrity – these are the principles behind the evaluation and selection process operated by the ANR.**

To organise an efficient selection process for the projects submitted for the Generic Call for Proposals (AAPG) and specific calls, with a view to fundamental international principles, the ANR uses a selection process based on peer review. The agency calls on two types of independent reviewers belonging to the research community:

- ▶ **Scientific Evaluation Panels (CES)**, formed with qualified scientific personalities from France or abroad who assess several projects individually on the basis of strict criteria specific to the call, discuss the projects at panel meetings and reach agreement on the list of projects they propose for funding.
- ▶ **Ad hoc / External peer reviewers**, French or foreign specialists in the scientific field involved in the project. Proposed by members of the evaluation panel and contacted by the ANR, they assess projects independently based on criteria specific to the call and with total confidentiality, without discussing with the panel.

IMPARTIAL, TRANSPARENT SELECTION: DEDICATED PROCEDURES

Respect for ethical rules and scientific integrity is an essential condition for an impartial selection and the transparency of the ANR's processes.

To be eligible, panel members must commit to respecting the provisions of **the agency's ethical code**, the principles of its policy on scientific ethics and integrity and the confidentiality of the information before they examine any project submissions.

They are also obliged to declare any links that may affect their impartiality or independence at every stage of the review process or that could constitute a conflict of interests in the exercise of their role⁽¹⁾. If potential conflicts of interest arise, the members must inform the panel and leave the session when the project(s) concerned are discussed.

If a project is not selected, the agency has a **internal appeal procedure**. An appeal can be filed within two months after receiving notice that the project was ineligible or was not selected. The procedure questions the chair-representative of the evaluation panel concerned and the ANR and issues a final decision to the Project Coordinator.

(1) Previous collaborations, co-publications, competition, management relationships, personal relationships etc.



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THE GENERIC CALL FOR PROPOSALS: A TWO-STAGE SELECTION PROCESS

– **Representing about 85% of funding allocated to calls for proposals, the ANR's Generic Call for Proposals is characterised by a two-stage selection process.**

In 2017, to simplify the review process and limit the need to involve the community, **the first stage of the process** was placed under the responsibility of the evaluation panels, whose composition was adjusted to cover all the thematic fields relevant to the projects submitted. Two panel members, a rapporteur and a reader, examine each project. The panel, following a discussion, decides a list of the projects invited to submit a detailed proposal in stage two. External peer reviews, previously required for all projects, are now only requested under specific circumstances, including interdisciplinary projects. About 41% of the projects submitted in 2017 were selected for the second stage.

In stage two, the size and composition of the panel are adjusted to the scientific scope of the projects invited to apply. Each full proposal is allocated to a rapporteur and a reader, usually the same as in the first stage, who suggest a list of potential external peer reviewers. The aim is to obtain at least two reviews for each proposal, rising to three or four for interdisciplinary projects. The external peer reviews are sent to the Project Coordinators for a response, so that they can highlight any factual errors in the reviews. After conducting their own assessment, the rapporteurs and readers access the external peer reviews and any response made by the Project Coordinator in order to produce a summary to present to the panel. After collective discussion, the panel ranks the best projects on a primary list and drafts a supplementary list of projects to be funded if the ANR partners offer co-funding or if budgets are reallocated due to cancellations or postponements of third-party funding programmes.

CRITERIA SPECIFIC TO THE INSTRUMENT

The evaluation is based on three main criteria, specified in the text of the 2017 AAPG: **the quality and originality of the proposed research, the organisation of the project and the committed resources, and finally the impact and potential benefits of the project**. Three sub-criteria specific to each instrument offer guidance for applicants to put their projects together and for panel members to produce their reviews. The details of these sub-criteria depend on the format of the document being submitted (pre-proposal or full proposal).

A HIGHER GLOBAL SELECTION RATE IN 2017

The number of projects submitted for the 2017 Generic Call for Proposals, and the overall selection rates at both stages, were all higher than in 2016. For the PRC, PRCE and JJC funding instruments, 7,259 pre-proposals submitted in stage one were judged eligible in 2017, compared with 6,446 in 2016. At the end of the first stage, 3,060 pre-proposals were invited to submit a full proposal in stage two (up from 2,845 in 2016).

In all, **1,063 projects** were funded through the 2017 Generic Call for Proposals, representing an extra 205 projects funded relative to 2016, **an overall selection rate of 13.3%** in 2017 compared with 12.9% in 2016.

Breakdown of projects funded:

- ▶ **541 Collaborative Research Projects (PRC)**, with an average selection rate of 12.6%
- ▶ **298 Young Researchers (JJC) projects**, with an average selection rate of 14.4%
- ▶ **126 Collaborative Research Projects involving Enterprises (PRCE)**, with an average selection rate of 14.1%
- ▶ **98 International Collaborative Research Projects (PRCI)**, with a selection rate of 12.6%

This increase should be seen in the context of a higher initial budget allocated to the 2017 Generic Call thanks to additional sums from co-funding for ANR partner projects and budget reallocations during the year. Initially set at €398.3M, the budget dedicated to the AAPG rose to €420.9M by the end of the 2017 financial year.

The first results of the Generic Call for Proposals were announced on 13 July 2017 and finalised in December 2017 with a funding review of about fifty further projects from the supplementary lists.

INCREASING SUPPORT FOR BASIC RESEARCH, SSH AND YOUNG RESEARCHERS

There was a rise in the number of collaborative research projects submitted in 2017 (+15.4% compared with 2016) and projects funded (+22.4% compared with 2016). In line with the simplification plan launched by the French Ministry for Higher Education and Research in 2016, **basic research received the large majority of the support, representing 89% of the PRC funded.**

As a priority expressed by the French Ministry for Research in its **plan to support SSH launched in 2016**, supporting projects in the social sciences and humanities (SSH) was also strengthened in the 2017 Generic Call for Proposals. Thanks to a dedicated budget of €8M, 23 additional SSH projects were funded in 2017.

An extra 39 Young Researchers' projects were also financed in 2017 thanks to the budget priority (+12% in 2017) introduced following the increase in project submissions for this instrument. These results correspond to one of the support measures for young researchers targeted by the French Ministry for Research.

KEY FIGURES FOR THE 2017 AAPG EVALUATION

STAGE 1:

7,259
PRE-PROPOSALS ELIGIBLE OUT OF 7,291 SUBMITTED

41
SCIENTIFIC EVALUATION PANELS (CES)

925
PANEL MEMBERS

15
PROJECTS ON AVERAGE ALLOCATED TO EACH PANEL MEMBER

3,060
PRE-PROPOSALS INVITED TO SUBMIT IN STAGE 2

STAGE 2:

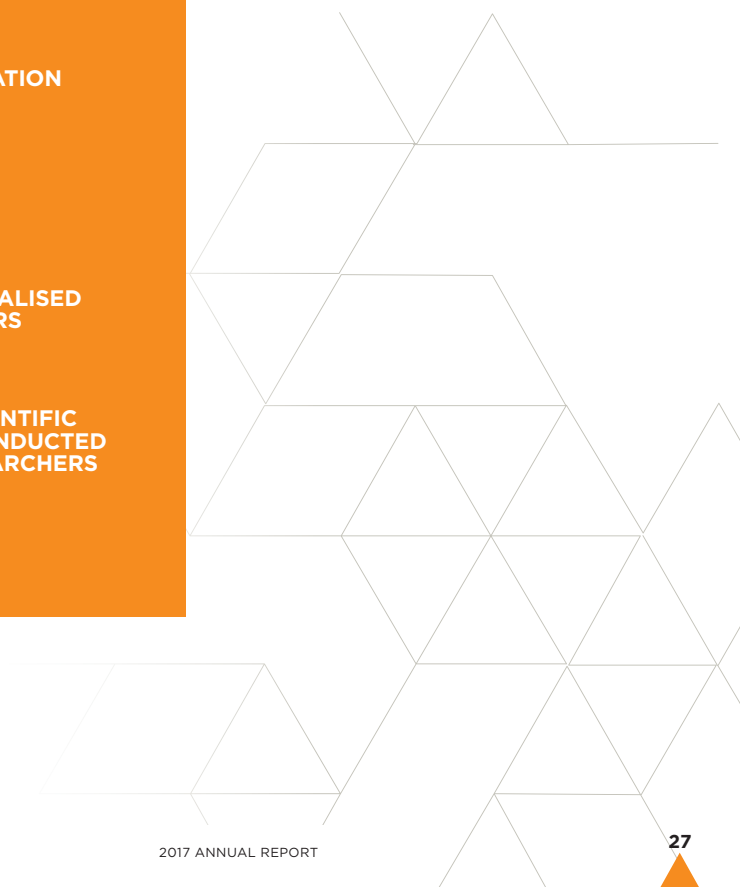
2,996
FULL PROPOSALS ELIGIBLE OUT OF 3,001 SUBMITTED

41
SCIENTIFIC EVALUATION PANELS (CES)

917
PANEL MEMBERS

9,797
PEER REVIEWS FINALISED BY 8,368 REVIEWERS

58%
OF EXTERNAL SCIENTIFIC PEER REVIEWS CONDUCTED BY FOREIGN RESEARCHERS

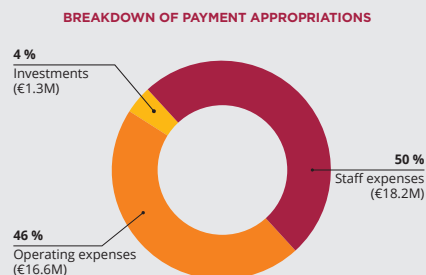


THE BUDGET

– The ANR budget consists of a funding budget, dedicated to financing research, and an operating budget to ensure the proper management of the agency and all its evaluation processes.

THE OPERATING BUDGET FOR THE AGENCY'S EXPENSES

This represents spending on staff, operations and investment. It amounts to €34.6M of credit authority and €36.1M of payment appropriations. The payment appropriations are broken down as follows:



The operating budget is financed primarily by a public subsidy of €29.1M, with other revenues including:

- ▶ the management fees received by the ANR from organisations co-funding research projects (such as the European Commission);
- ▶ and the French General Secretariat for Investment (SGPI) payment for the ANR's expenses in managing the Investments for the Future programmes.

OPERATING BUDGET IN 2017

€34.6M

THE RESEARCH FUNDING BUDGET

In 2017, the ANR provided funding for research projects amounting to a **commitment authority of €624.5M**.

The funding budget enables committing grants for projects selected in 2017 that will run over several years. The resources come mostly from the funding subsidy allocated by the French Ministry for Higher Education, Research and Innovation, representing **€603.8M in 2017** after a transfer to the reserves and a credit cancellation of €15.5M in

2017 FUNDING BUDGET

€624.5M

July 2017. **The agency's funding budget has seen significant increases since 2016: +€63.9M in 2016 and +€44.7M in the initial 2017 budget.**

Funding for 2017 AAPG projects rose by +€38.9M compared with 2016.

Co-funding from public bodies and contributions from the European Commission represent €20.6M in 2017, 3.3% of the total funding budget. Nearly 73% of co-funding comes from the DGA, the agency's biggest co-funder, and almost 20% from the European Commission.

Disbursements in 2017 represent €615.6M, an increase of €26.1M relative to 2016.

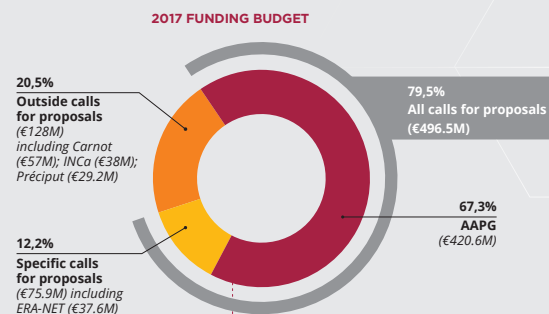
BREAKDOWN OF THE FUNDING BUDGET

The 2017 funding budget is divided between:

- ▶ the AAPG ;
- ▶ specific calls for proposals;
- ▶ projects outside the calls for proposals.

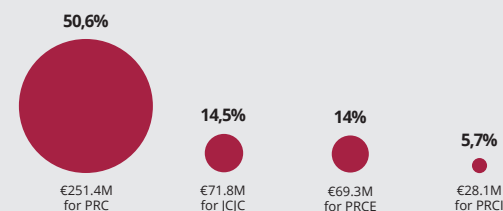
In total, calls for proposals represent €496.5M, 79.5%.

Other projects represent €128M, 20.5%.

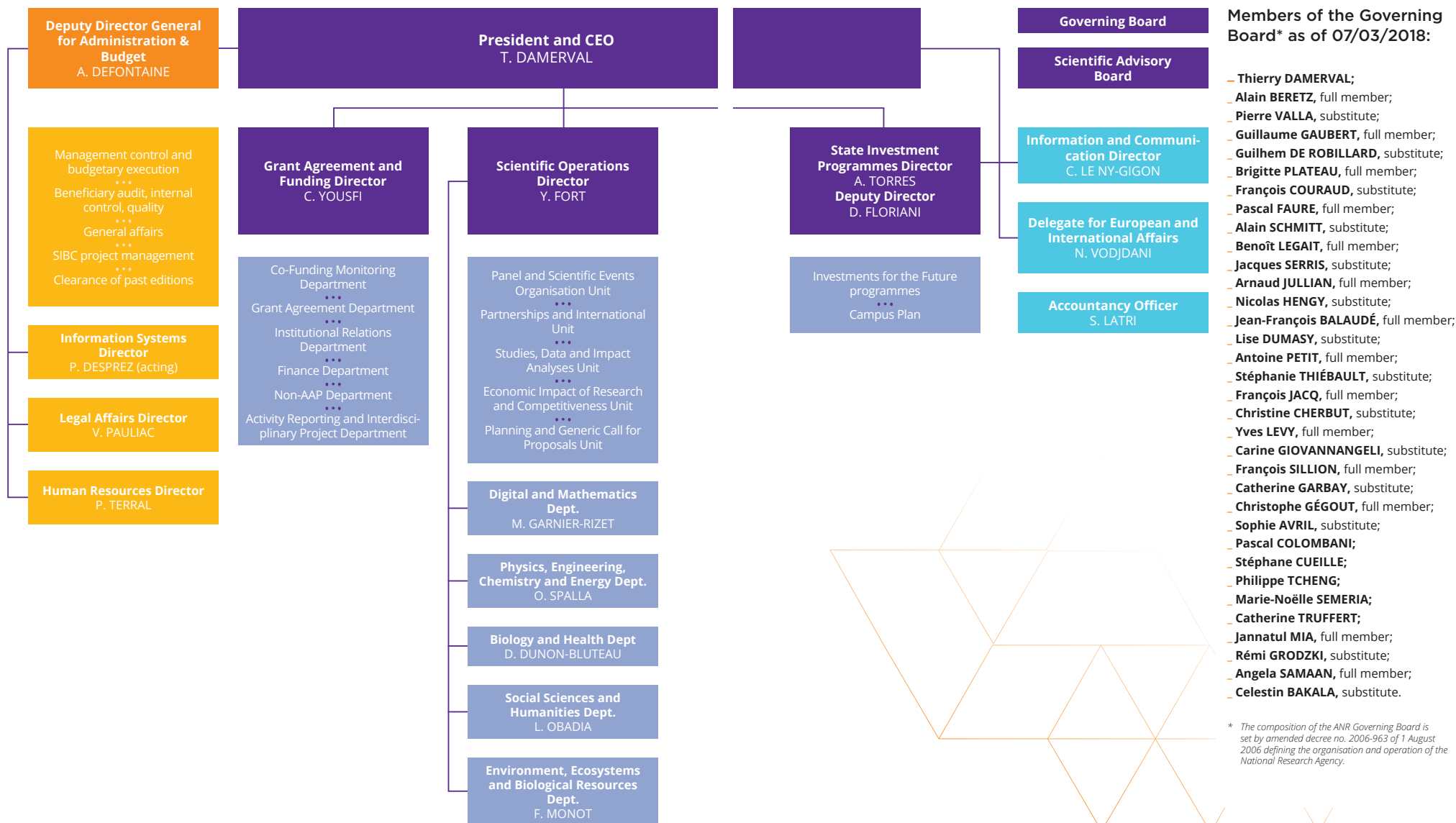


THE GENERIC CALL FOR PROPOSALS (AAPG)

The percentages refer to the total funding budget for all calls for proposals.



GOVERNANCE AS OF 3 JULY 2018



* The composition of the ANR Governing Board is set by amended decree no. 2006-963 of 1 August 2006 defining the organisation and operation of the National Research Agency.

2. **OPTIMISING OUR PROCESSES ON BEHALF OF OUR SCIENTIFIC COMMUNITIES**

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OPTIMISING THE AGENCY'S PROCESSES TO MEET THE CHALLENGES OF RESEARCH FUNDING IN FRANCE

– In 2017, the ANR introduced several programmes to improve its procedures in line with its 2016-2019 Contract of Objectives and Performance (COP) and the measures in the government plan to simplify higher education and research. These programmes aim to make its actions clearer, strengthen dialogue with scientific communities, lighten their workload, reinforce the transparency and impartiality of its selection processes and make the agency more efficient.

THE COP, AN IMPROVEMENT PROGRAMME AGREED WITH THE GOVERNMENT

As part of the 2016-2019 Contract of Objectives and Performance (COP) signed jointly with the French government, the ANR is committed to an improvement programme to meet the current and future challenges of research funding in France. Cementing the agency's ambition to be France's leading competitive project-based research funding organisation, the contract sets out five priority areas with 18 objectives, 129 actions and 24 indicators:

- ▶ **A guarantee of scientific excellence and a high-quality project selection process** for research and innovation projects: ensuring that project selection respects international standards and the regulations in force;
- ▶ **Prioritising and optimising European and international cooperation:** proposing the actions best suited to achieving the goals of national research policy and consolidating the European Research Area;
- ▶ **Impact assessments and open data:** developing and publishing impact analyses and studies to describe the ANR's effects on the scientific landscape and wider society;
- ▶ **The quality of the service delivered:** reinforcing the quality of the agency's service and improving satisfaction and interactions with service users;
- ▶ **The efficiency of the agency and its activities:** reinforcing the ANR's efficiency by improving its management and monitoring tools and the processes of its support functions.



2017 saw the launch or the continuation of about sixty actions as part of the continuous optimisation of the agency's procedures. In terms of selection processes, the whole feedback received from the evaluation panels has been formalised, previous evaluations have been analysed and initial work has been conducted to achieve certification for the selection process in 2018.

The agency has also reinforced the planning of its international activities by preparing a provisional review of European and international actions up to 2020. An analysis of how relations with scientific stakeholders are managed was carried out in 2017 and the second ANR Tour was organised to inform researchers about the agency's activities and calls for proposals and to increase dialogue. Finally, internal control and its coordination with the quality programme were strengthened in 2017, improving risk management.



61 ACTIONS IN 2017

including 23 completed and 19 in progress



11 MONITORING AND PERFORMANCE TARGETS ACHIEVED

CLEARER ACTION AND DEEPER DIALOGUE

– To make its initiatives and calls for proposals easier to understand, the ANR has revised the structure of its Work Programme and organised several discussion days with scientific communities as part of its ANR Tour.

During the first half of 2017, a consultation was conducted with institutional research actors on how to make the 2018 Work Programme more legible (see p. 16). The four components of the Work Programme were redefined to dedicate a single component to the 2018 AAPG, and the generic call was structured into research themes, each with its own scientific evaluation panel (CES). These measures aim to make these documents easier to understand and offer greater visibility for individual disciplinary fields in line with the societal challenges, which constitute the background to the call.

THE ANR TOUR: INFORMING, SUPPORTING AND PROMOTING DISCUSSION

Building on the success of the first ANR Tour, organised in 2016, the agency repeated the initiative in September 2017 with a series of meetings with research organisations, universities and schools. Over 20 meetings were held in Paris and across France to present changes to the 2018 Work Programme and the calls for proposals, to explain the processes for submission, evaluation and selection and to answer questions from scientific communities.

Thanks to support and hospitality from regional offices of The National Center for Scientific Research (CNRS) and universities, the events attracted over 2,500 people. Particular attention was paid to the constructive, in-depth discussions between participants and the representatives of the ANR's scientific departments in order to enrich the FAQs section of the agency's website and incorporate feedback into the continuous optimisation of its procedures.



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THE FIRST GUIDE FOR THE 2018 AAPG APPLICANTS

Another new initiative in 2017, a Guide for the 2018 AAPG applicants, was offered to Project Coordinators to clarify the distinction between the scientific, operational, legal and administrative aspects specified in the text of the call. The guide explains the nature of the funding instruments, how to submit a proposal, the conditions for eligibility and the selection process.

REINFORCING THE TRANSPARENCY AND IMPARTIALITY OF PROJECT SELECTION

– Two key measures in the 2017 AAPG reinforce the transparency and impartiality of the ANR's selection processes, one extended from last year and one new: universalising the "chair-representative" model and introducing a right of reply from Project Coordinators to external peer reviewers.

THE CHAIR-REPRESENTATIVE, THE GUARANTOR OF AN INDEPENDENT, IMPARTIAL SELECTION

Trialed in 2016, the scientific evaluation panel chair-representative has been made universal in the agency's 2017 Generic Call for Proposals. Appointed by the ANR for one year⁽¹⁾ following a call for applications, the chair-representative guarantees the independence of the selection process and ensures their panel applies the principles of the selection process. All chair-representatives were given training in 2017 before the campaign began.

Initially, each chair-representative proposes a list of scientific figures, from which the ANR appoints two or three vice-chairs to constitute an office⁽²⁾. Then, the office suggests a list of French and international scientists to bring together the evaluation panel, and the agency contacts them (maximum 35 members).

Scientifically independent of the ANR, the chair-representative ensures the panel respects the ethical principles defined in the agency's charter, the rules on ethics and scientific integrity and the confidentiality of the submissions – all essential conditions for the organisation of an impartial selection. The chair-representative is supported by the agency's scientific project officers to guarantee that conflicts of interest are managed effectively.

THE INTRODUCTION OF A RIGHT OF REPLY TO EXTERNAL REVIEWERS

To improve the transparency of its evaluation and selection processes (see p. 25), the agency has introduced a right of reply to reviewers in the 2017 AAPG. This system aims to enable the Project Coordinators of projects submitted for phase 2 of the call to make comments in response to the external peer reviews and to inform the scientific evaluation panel of any inaccuracies in the reviewers' reports. The Project Coordinators' responses will be examined at a meeting of the evaluation panel and taken into account in the final evaluation, placing the external peer reviews in perspective.



SIMPLIFYING PROJECT SUBMISSION AND ADMINISTRATIVE AND FINANCIAL MONITORING

– The year 2017 saw the deployment of measures aiming to facilitate project submission for the Generic Call for Proposals and to accelerate the grant agreement process and administrative and financial management in order to reduce the time spent by researchers on these formalities.

SCALING DOWN THE DOCUMENTATION REQUIRED WHEN SUBMITTING PROJECTS

To help researchers prepare their applications in response to the Generic Call and to reduce the amount of work involved, the ANR has streamlined the format of the application form and provided a template for the information requested.

There is no longer a requirement for the legal representative of each partner to sign an administrative and financial document when submitting a project for stage two of the Generic Call; this now only happens when contracts are agreed for funded projects. The agency also sends a list of the proposals submitted to the institutions concerned to enable them to follow the projects closely.

IMPROVING THE CONTRACT AGREEMENT PROCESS

At the same time, steps have been taken to optimise the process of agreeing contracts for the selected projects. For each project, the ANR agrees contracts with beneficiaries on an individual basis as they submit their signed agreements and financial appendices. The first advance can thus be paid once the signed agreement has been received, independently of contracting progress with the other project partners.



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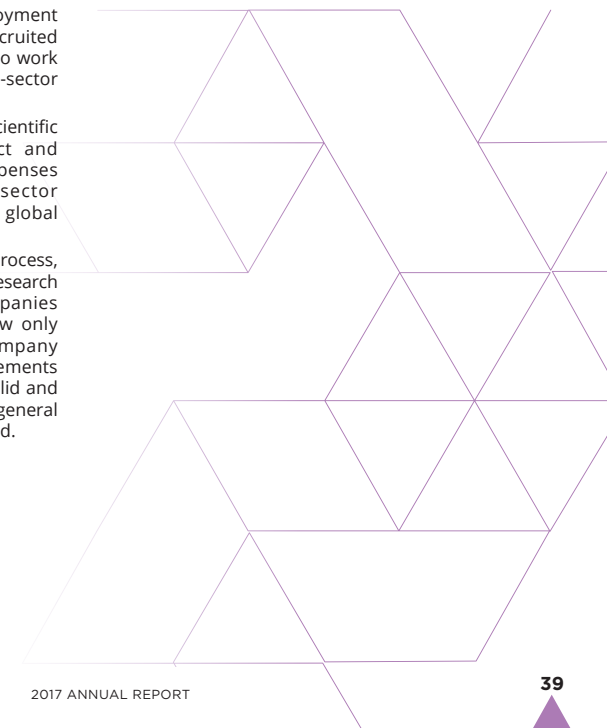
REVISION OF THE 2017 FINANCIAL REGULATION

The agency also revised its financial regulation in 2017 to make them easier to understand and to speed up the formalities relating to the administrative and financial monitoring of the funded projects. These changes involve:

- ▶ Bringing the eligible expense categories into line with the eligible costs in the European Union's Framework for State Aid for Research and Development and Innovation to provide a common frame of reference for all partners;
- ▶ Introducing a fixed environmental cost of 8% of eligible spending up to the limit of the grant allocated for marginal-cost public-sector beneficiaries;
- ▶ Eligibility for spending between partners in a single project, as long as they are proportionate, linked to the project and justified by an invoice;
- ▶ Eligibility for costs relating to unemployment self-insurance systems paid to staff recruited on temporary contracts and assigned to work on the project for marginal-cost public-sector beneficiaries;
- ▶ The delivery of just one intermediate scientific report halfway through the project and the streamlining of intermediate expenses statements for full-cost private-sector beneficiaries, requiring just a single global amount for each expense category;
- ▶ Changes to the consortium agreement process, which is obligatory for projects bringing research organisations and commercial companies together. The second payment is now only dependent on this process for company beneficiaries. The analysis of the agreements is limited to ensuring the contract is valid and there is no indirect aid according to the general principles of the Framework for State Aid.

To explain the new arrangements, stimulate debate and introduce the measures appropriately, ten meetings were organised in March 2017 with beneficiaries (research organisations, foundations, associations and companies). These events were also an opportunity to survey the service users' needs with a view to preparing changes to the 2018 financial regulation in order to make improvements based on the issues and operational difficulties they face.

The scale of the legal, administrative and financial changes involved in simplifying the financial regulation led to wide-ranging collaboration with the staff of the beneficiaries involved and contributed to optimising the agency's processes.



INTRODUCING A GENDER ACTION PLAN

– Gender inequality is a continuing problem in higher education and research, as in other fields, which is why the ANR is contributing to the deployment of a policy to promote equality between sexes and to move scientific culture towards a systematic awareness of the sex and/or gender dimension in research across all scientific fields.

In line with the policy of the French Ministry for Research, and following the 9th European Conference on Gender Equality, the agency has developed an Action Plan to include sex and gender in its annual road map⁽¹⁾.

FIVE MAIN FOCAL POINTS

- ▲
Reinforcing gender equality in scientific evaluation panels;
- ▲
Contributing to the inclusion of a sex and/or gender perspective in research projects;
- ▲
Raising awareness, through training, among all the stakeholders involved in selection;
- ▲
Building on an analysis of the submissions/ selections for the various programmes;
- ▲
Highlighting the presence and activity of women in science.

INITIAL WORK AND PROMOTION IN 2017

- ▶ **Initial analyses of the data on the 2014-2016 Generic Call for Proposals** were conducted, breaking down the results by challenge and by funding instrument. The results showed that the number of projects coordinated by women (during the submission and selection stage) is proportional to the number of women among teaching and research staff and remains relatively stable across all the editions of the Generic Call for Proposals. However, women's representation remains fragile and unequal across research fields and funding instruments. The initial results were published on International Women's Day on 8 March 2017.
- ▶ **An exploratory study examining the question of gender in selection bias and a literature review of work on research evaluation in sociology and anthropology** were conducted. Compared with statistical analyses of the 2017 AAPG, this first approach showed that trying to ensure parity in scientific evaluation panels is not enough to reduce gender bias in selection processes.
- ▶ To mark the International Day of Women and Girls in Science on 11 February 2017, the ANR wanted to highlight the role and activity of women in research. It collected **three statements from female researchers funded by the ANR or involved in scientific panels**⁽²⁾.

STRONGER INVOLVEMENT AT NATIONAL AND EUROPEAN LEVEL

- ▶ The agency is a member of the working group on **"Obstacles to Women's Careers in Higher Education and Research"** alongside other French research bodies and institutions (such as the CNRS, the INSERM, the CPU, the HCERES, the DGESIP and the DGRI). The group aims to establish recommendations on how to achieve greater professional equality.
- ▶ The ANR is a partner of the **Gender Plus ERA-NET**, which funds gender research projects through a European call for proposals. France's contribution is €300k.
- ▶ Alongside 8 European partners, the ANR has responded to a H2020 call for proposals by submitting a **"Gender-Smart"** project, aiming to enrich the gender action plan with educational tools and shared comparative analyses.

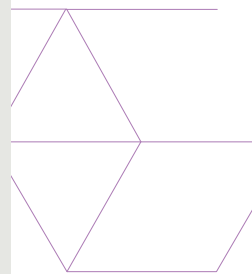
WHAT IS GENDER?

DEFINITIONS

Sex: determined anatomically and physiologically
Gender: determined socially and culturally

Every society evolves ways of being and behaving, **norms** that individuals **internalise** through the education they receive at home and at school. These norms differ for men and women. **Gender is the social and cultural construction of femininity and masculinity** and determines the roles and responsibilities society defines for men and women within a culture. The representations we all form of what a man or a woman "should" be constitute **unconscious gender biases**.

Gender is a concept that questions the idea of natural differences based on biological sex that justify inequalities between men and women. **Gender is an analysis tool** that should be used in all disciplinary contexts to guard against perpetuating or reinforcing inequality.



(1) 2017 Work Programme

(2) <http://www.agence-nationale-recherche.fr/informations/agenda/femmes-et-filles-de-science-2017/>



MEASURES TO INCREASE THE EFFICIENCY OF THE AGENCY AND ITS ACTIVITIES

– In line with the objectives defined in the 2016-2019 COP, the ANR carried out an initial risk analysis in 2017 with the twin goals of auditing the H2020 accounts and achieving quality certification for its selection processes and relations with its users.

The first tasks in 2017 were to produce a mapping of the major risks and define an associated action plan relating to the ANR's missions, i.e.:

- ▶ The national research policy;
- ▶ The consolidation of the European Research Area;
- ▶ Project selection;
- ▶ The government's major investment programmes;
- ▶ Analysing the evolution of research;
- ▶ The impact of funding;
- ▶ Measuring the quality of the service provided.

A MAPPING FOR BETTER RISK MANAGEMENT

According to this initial mapping, 13 risks were identified and classified as either management and governance risks, external risks or operational risks. Two steps needed for corrective action were identified for each one, preparing for the introduction of control procedures, performance indicators and tools for monitoring specific risks. By scoring the risks for severity (based on impact and probability of occurrence) and level of control, **six major risks were identified for priority treatment and addressed in an associated action plan.**

SIX MAJOR RISKS:

- ▲ Difficulty responding to beneficiaries' expectations;
- ▲ Insufficient anticipation of evolutions in the agency (in terms of programming and management) relating to changes in the strategic orientations of research;
- ▲ Insufficient analysis of costs and activity indicators;
- ▲ Difficulty integrating the agency's different operational information systems and producing reliable data;
- ▲ Difficulty responding in human, financial and operational terms to changes of strategic direction or specific evolutions;
- ▲ Inadequate internal control (in accordance with France's GBCP public budget and accounting reforms).

The action plan associated with the risk mapping involves coordinating the internal control and quality systems. Internal control is responsible for implementing a full range of resources (internal procedures for circulating information, information systems for identifying and analysing the main risks, tools and inspection methods relevant to the issues etc.) to ensure regulations, instructions and orientations are respected and to suggest areas for improvement.

The quality approach operates across the agency in line with the themes defined in the COP: ISO 9001 Certification for the "selection processes", relations with the agency's users, introducing a charter to standardise feedback and improve the quality of the agency's responses to external contacts, traceability of operations and capitalising on knowledge.

CLEARANCE OF THE 2006 TO 2010 EDITIONS: A WELL-ESTABLISHED PROJECT

Endorsed by the Governing Board on 27 September 2016, the clearance plan of previous editions relates to projects funded between 2006 and 2010 that have yet to be finalised because documentary evidence is lacking. Thanks to the simplification of administrative processes, the remaining payments for many projects have now been made.



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Over 5,000
PROJECTS CONCERNED
OVER THE PERIOD



€42.8M
OF OUTSTANDING AMOUNTS
PAID SINCE THE PLAN BEGAN



Over 2,800
PROJECTS CLOSED IN 2017



2006 EDITION
CLOSED

A KEY YEAR FOR JOBS AND SKILLS MANAGEMENT PLANNING (GPEC) AND QUALITY OF LIFE AT WORK

– To support the evolution of its work, the agency has been engaged since 2016 in a programme to clarify its Human Resources model, taking into account predictable changes in the scope of its activities and improvements in quality of life at work.

THE GPEC, AN AGREEMENT PREPARED AND SHARED

In 2017, the ANR undertook a process to negotiate a policy of jobs and skills management planning (GPEC). Over the year, several meetings were held with trade union organisations. This consultation will make it possible to reach an agreement in 2018.

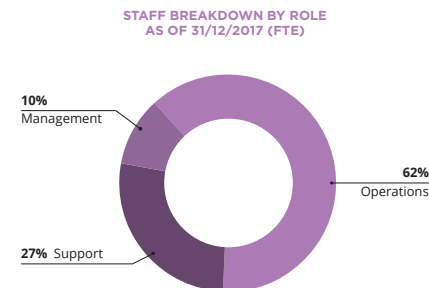
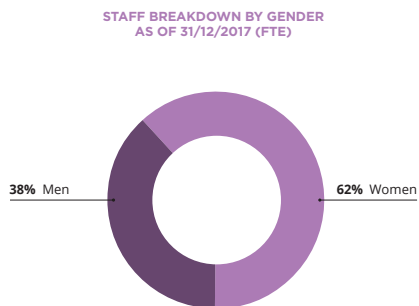
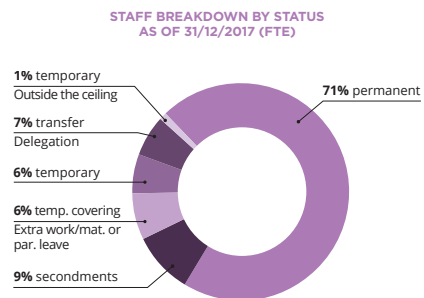
Several workshops have been set up to work on the future agreement, which will incorporate support measures relating to training, career interviews, support for employees' professional mobility and gender equality. The main progress achieved so far in this negotiation concerns:

- ▶ The introduction of career interviews and the creation of a career planning committee, a forecasting body looking at how roles and jobs could evolve;

- ▶ Promoting women to positions of responsibility;
- ▶ Support measures for jobs identified as sensitive, with priority access to training and support for internal or external mobility;
- ▶ The process for welcoming and integrating new arrivals has also been revised, capitalising on the knowledge and skills of a network of trainers within the agency to establish a training programme focusing on the specific nature of the agency's job functions.

DEVELOPMENT OF THE QUALITY OF LIFE AT WORK PLAN

Beginning an initiative to look at quality of life at work in 2015, the agency continued this process in 2017 with an examination of psychosocial risks. In particular, a procedure was put in place for reporting these risks. This is based on an internal network of contacts and involves a mediation process between stakeholders. The agency also offers employees the option of consulting a psychologist.



Two-thirds of the agency's staff are women (62%, compared with 38% men), and the average age is 41.7 years. 62% of its staff work in operational roles (scientific and finance), 27% in support roles and 10% in managerial positions.

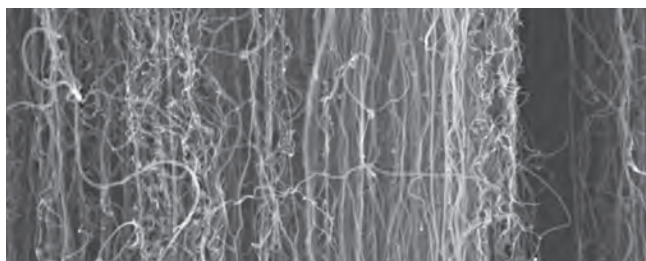
In 2017, the ANR's total headcount was 265.3 FTEW⁽¹⁾, compared with 260 in 2016. This figure includes 245.8 FTEW paid directly by the ANR and 19.5 FTEW corresponding to staff transferred or seconded.

(1) FTEW: full-time equivalent worked.



3. FUNDING EXCELLENCE

NATIONAL COLLABORATIVE PROJECTS	P. 48
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PUBLIC-PRIVATE COLLABORATIVE PROJECTS	P. 61
INTERNATIONAL COLLABORATIVE PROJECTS	P. 66
INVESTMENTS FOR THE FUTURE	P. 69



Array of long, dense, aligned carbon nanotubes formed on an aluminium current collector sheet.

© CEA, NIMBELEDNA, Mathieu Pinault

Development of innovative supercapacitor electrodes made with aligned carbon nanotubes and modified with electronically conductive polymers and manganese oxide

In the framework of the ASTRID programme 1, the H2E-CAP project aims to develop innovative electrode materials using vertically aligned carbon nanotubes (VACNT) for use in supercapacitors. The proposed materials are different from those currently used in commercial products (activated carbon) to meet demand for better energy density and power in energy storage systems. The project has managed to produce nanocomposite VACNT-based materials directly on a flexible aluminium collector.

The H2E-CAP project has developed new electrode materials based on VACNT modified by electronically conductive polymers (ECP) and manganese oxide deposited in a controlled way or by surface treatments. The scientific and technical advances of the H2E-CAP project have made it possible to develop direct VACNT growth on flexible aluminium substrates by lowering the growth temperature (patent registration licensed to the start-up NAWATEchnologies). The speed of CNT formation is at the level of the global state of the art, and the very low diameters measured combined with the significant nanotube densities achieved enable electrode capacitance levels far higher than those obtained on stainless steel with CNTs alone. This major advance in low-cost dense VACNT growth on metal substrates, with potential for use in supercapacitor electrodes, opens the way for the development of innovative VACNT/ECP combinations with metal oxides in work following on from the project, by adapting the conditions leading

to a uniform deposit in the VACNT (two patents). The best-performing methods of modifying VACNT lead to electrodes with high capacitances. These electrodes can be used in symmetrical and hybrid supercapacitors.

(1) Specific support for work of defence interest, fully funded by the French Defence Procurement Agency (DGA).

Perspectives

The successful demonstration of the feasibility of developing certain combinations of materials over a large area up to the level of industrial prototypes (up to 10x10 cm²) represents a high degree of technological maturity (TRL>5). The scientific and technical success of this initial ANR ASTRID project encourages the H2E-CAP consortium, which includes university laboratories and an industrial partner, to continue its efforts to develop and mature these approaches (ASTRID Maturation, also fully funded by the DGA). This would constitute the starting point for the exploitation of the civil and military research and technologies resulting from H2E-CAP in the field of energy.

H2E-CAP

High-energy hybrid supercapacitors based on aligned carbon nanotubes

ANR PROGRAMME:
ASTRID

EDITION, PROJECT DURATION:
2013; 3 years + 6 months

PARTNERS:

CEA 
CEA (DRF-IRAMIS-NIMBELEDNA);
LPPI-University of Cergy-Pontoise, PCM2E-
University of Tours,
NAWATEchnologies

ANR GRANT:
€286k

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ECCHYMOSE

Electrochemical studies of iron hydrogenases: mechanism and optimisation for photosynthetic hydrogen production

ANR PROGRAMME:
Chemistry of solids, colloids, physical chemistry
(Blanc - SIMI 8)

EDITION, PROJECT DURATION:
2012; 48 months

PARTNERS:
Bioenergetics and Protein Engineering Laboratory, CNRS/AMU, Marseille Photocatalysis and Biohydrogen Laboratory (LPB), CEA, Gif-sur-Yvette Biological Systems and Process Engineering Laboratory (LISPB), INSA-CNRS, Toulouse Department of Biotechnology and Biosciences, University of Milan-Bicocca, Italy Department of Physics and Astronomy, University College, London, UK

ANR GRANT:
€544k for a global cost of about €2,300k (French partners only).

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<https://anrechymose.wordpress.com/>

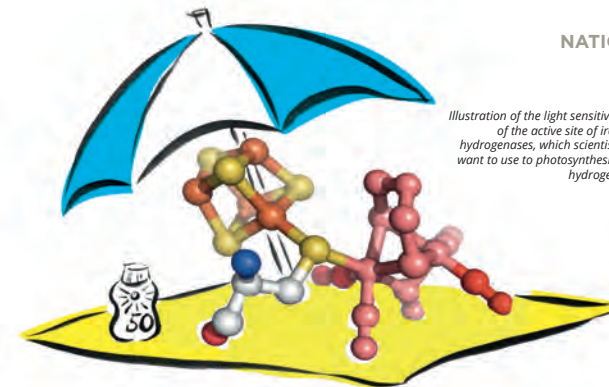


Illustration of the light sensitivity of the active site of iron hydrogenases, which scientists want to use to photosynthesise hydrogen.

© American Chemical Society, 2018

Understanding the inactivation of the metalloenzymes that produce solar fuels

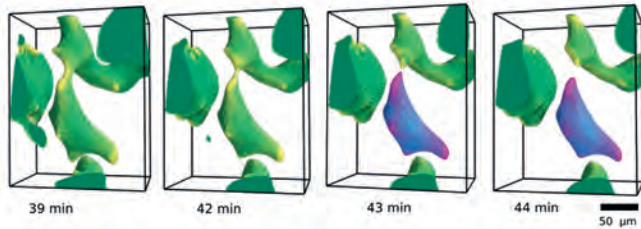
Using new multidisciplinary methods combining biochemistry, electrochemistry and theoretical chemistry, the ECCHYMOSE project studied fundamental aspects of the reactivity of metalloenzymes, which catalyse important reactions in the field of energy: the production and oxidation of hydrogen.

Hydrogenases are complex metalloenzymes that catalyse H₂ oxidation and production at a conserved inorganic active site, the so-called H-cluster. They are studied in various contexts, ranging from bioenergetics to inorganic chemistry, but the main motivation is probably that both these enzymes and the knowledge acquired by studying them will prove useful for synthesising the catalysts needed to store renewable energy. Current attempts to use isolated hydrogenases or photosynthetic algae to produce H₂ from water and light are hampered by the fact that the hydrogenase of this organism is inactivated by the oxygen produced by the photosynthetic

oxidation of water, and that its H-cluster is damaged by light in the UV-visible range. The researchers used electrochemistry and photoelectrochemistry to study several hydrogenases in order to understand the mechanism and the molecular determinants of their inactivation by extreme redox conditions, oxygen and light, working closely with theoretical chemists. The biologists working with the project were able to produce a number of homologous hydrogenases with different catalytic properties, while the electrochemists developed and used methods for characterising precisely the kinetic properties of these enzymes (including their inactivation under various conditions). The researchers revealed significant differences between the properties of homologous enzymes with identical active sites and immediate environments, contributing to the study of how certain elements structurally distant from the active site can partly determine the catalytic properties of these complex metalloenzymes. The project is certified by the Capénergies competitive cluster (www.capenergies.fr).

Perspectives

Combining experimental results with calculations in theoretical chemistry using various techniques (DFT, TDDFT, QM/MM, MD) to study different aspects of hydrogenase reactivity at molecular level has constituted a major methodological development. The approach could be applied to the study of other metalloenzymes.



Fragmentation during phase separation in liquid glass, observed at high temperature by *in situ* microtomography [Bo15].

Visualising the behaviour of materials in four dimensions, spatial and temporal, at a very high resolution under heat and mechanical deformation

One interesting avenue for improving the properties of materials involves producing textured or composite materials, whose properties depend heavily on the details of their internal structure. To be able to visualise this structure and its evolution through the thermal or mechanical history of the material, EDDAM has developed X-ray microtomography techniques at the ESRF (European Synchrotron Radiation Facility) that can film the different stages in the life cycle of amorphous microtextured materials, *in situ* and in 3D.

The development of innovative materials often aims to combine different and even conflicting properties within a single material. A standard strategy involves seeking to texture a composite material in three dimensions, perhaps by developing amorphous-crystalline composites with promising mechanical properties.

EDDAM has developed imaging and signal processing techniques that enable transformations of these composite materials to be studied locally. The project involved an innovative combination of the use of the ESRF's synchrotron radiation, the development of *in situ* equipment such as ovens and mechanical testing machines, and high-performance algorithms to process digital data and 3D images. In collaboration with the synchrotron's teams, the project developed ultra-fast *in situ* X-ray microtomography for materials science and observed material behaviour phenomena under extreme conditions, such as the melting of a mixture of oxide powders to create glass.

Ultra-fast *in situ* X-ray microtomography has been able to film different stages in the life cycle of amorphous materials, such as glass or architected amorphous-crystalline composites, in 3D and at a remarkable spatial and temporal resolution (on the scale of the micron and the second) – high-temperature production and transformation, deformation and damage under mechanical load – giving access to knowledge about the internal structure of materials and an understanding of their thermal and mechanical properties. For example, an original mechanism involving the fragmentation of viscous liquids was observed in a mixture of melted glasses, giving rise to the formation of droplet cascades. The project's experiments also led to the development of new algorithms, including directly reconstructing the 3D filming of deformations under mechanical load.

Perspectives

Thanks to the EDDAM project, ultra-fast X-ray tomography for observing phenomena in the behaviour of materials has achieved the status of an established technique and can be used by researchers in several scientific disciplines, with free access to the image processing algorithms implemented. Future scientific challenges in this field will include applying the methodology to new imaging techniques such as *in situ* synchrotron nanotomography, which enables materials to be visualised at a resolution well below the micron.

EDDAM

Filming materials in transformation from the interior

ANR PROGRAMME: Engineering sciences, materials, processes, energy (Blanc - SIMI 9)

EDITION, PROJECT DURATION: 2011; 60 months

PARTNERS: Emmanuelle Guillard, CNRS/Saint-Gobain SVI Mixed Research Unit Luc Salvo, SIMaP INP Grenoble
Éric Maire, MATEIS INSA Lyon
Damien Vandembroucq, PMMH ESPCI Paris
Stéphane Roux, LMT ENS Cachan

ANR GRANT: €494k

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EXO-ATMOS

Exoplanet atmospheres and evaporation

ANR PROGRAMME: Subatomic physics and associated theories, astrophysics, astronomy and planetary science (Blanc - SIMI 5)

EDITION, PROJECT DURATION: 2012; 48 months

PARTNERS: Alain Lecavelier, Paris Institute of Astrophysics Bonfilis Xavier, Institute of Planetology and Astrophysics of Grenoble

ANR GRANT: €454,246

CONTACT: Alain Lecavelier, lecaveli@iap.fr



Artist's impression of exocomet evaporation in the Beta Pictoris young exoplanet system⁽¹⁾. © ESO, L. Calçada

New knowledge about exoplanet diversity and atmospheric phenomena

The EXO-Atmos project aimed to use spectroscopic observations combined with digital modelling to deliver new knowledge about exoplanet atmospheres, and especially those that show signs of evaporation. Lower atmosphere and exosphere observations have so far been limited to a few exoplanets, but the EXO-Atmos project has gone further thanks to new observations and discoveries contributing to a better understanding of exoplanet atmospheres and evaporation.

The EXO-Atmos project aimed to study the extended exospheres of evaporating planets and the lower atmospheres of a wide variety of exoplanets using absorption spectroscopy when they pass in front of their star. To achieve that, the project:

- Used the best telescopes for observation: Very Large Telescope (VLT), Hubble Space Telescope (HST), HARPS, GTC.
- Widened the sample of planets whose atmospheres have been detected and analysed.
- Developed the numerical simulations essential for analysing and interpreting spectroscopic observations and modelling atmospheres.

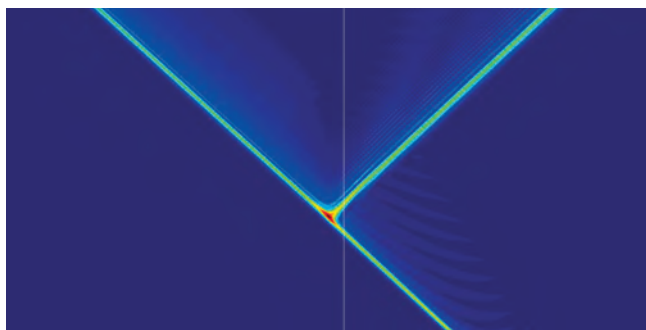
The work conducted by EXO-Atmos has underlined the diversity of exoplanets and enabled major advances. In theoretical terms, the team's development of the EVE code («Evaporation of Exoplanets»), modelling atmospheric evaporation in order to interpret the observations obtained in the ultraviolet with the Hubble Space Telescope, has significantly advanced the state of the art in modelling exoplanet evaporation. In

terms of observations, the team has made three major discoveries: the evaporation of two families of exocomets in the Beta Pictoris young planetary system; the observation of temporal variations in the atmosphere of the hot Jupiter HD189733b, which characterise the interaction between the planet and its host star; and finally the evaporation of the hot Neptune GJ436b, detected at a wholly unexpected level. The progress made goes well beyond the initial expectations: the number of planets whose atmospheres have been detected and characterised grew remarkably; and the diversity of the elements observed, including the team's discovery of new signatures such as magnesium, made it possible to observe evaporations in more systems.

⁽¹⁾ Gas observation revealed the existence of two families of comets: the youngest comets result from the break-up of a massive object, while the older comets are in orbital resonance with a giant planet (Kiefer, Lecavelier et al., Nature 2014).

Perspectives

Following the discoveries made, further observations have been scheduled using the Hubble telescope. A very large HST Treasury programme to monitor 20 new exoplanets is currently taking place. Altogether, this work contributes to a better knowledge and understanding of the physics of atmospheric phenomena under extreme conditions.



Superradiant wave packet near a charged spherical black hole.

© image de simulation numérique sous Matlab®

Studying classical and quantum effects around black holes and their influence at remote distances

Most of the unsolved problems in the field of relativity are asymptotic in nature. The AARG project aimed to develop asymptotic analysis in general relativity to advance understanding of classical and quantum phenomena around black holes. The consortium has developed new methods combining analysis and geometry, and has extended important results to physically relevant and radically new contexts including the Hawking effect (the cause of black hole evaporation), superradiance and the stability of solutions to Einstein's equations.

General relativity provides extremely precise models of the universe on a large scale and of isolated systems such as black holes. The phenomena it describes can only be accessed from great distances, through astronomical observation. Asymptotic analysis is thus the fundamental tool for the rigorous mathematical study of these phenomena in order to make detailed predictions about future observations. New asymptotic analysis methods emerged during the 1960s and 1970s, such as Roger Penrose's conformal approach and Lars Hörmander's microlocal analysis. The 1980s saw rapid growth in scattering theory and the development of quantum field theory in curved spacetime.

The goal of the AARG project was to combine these techniques and push them forward in four main directions: non-stationary and conformal scattering; quantum field theory in curved spacetime and in interaction; linear and non-linear stability of spacetimes under general relativity; and finally inverse

scattering for separable and black hole spacetimes.

From a theoretical viewpoint, important progress was made in the study of the asymptotic behaviour of classical fields in non-stationary situations, the decay of test fields and the stability of solutions to Einstein's equations. Significant results were also achieved in the study of the Hawking effect for a quantum field interacting with its environment and of the recognition of black hole geometry through inverse scattering. The consortium has also initiated a numerical study of energy extraction from a black hole by superradiance and the phenomenon of black hole bombs and developed open-source computer algebra software for general relativity, SageManifolds.

(1) Taken from the article by L. Di Menza, J-P Nicolas, *Superradiance on the Reissner-Nordström metric*, *Class. Quantum Grav.* 32 (2015), 145013 (28pp), arXiv:1411.3988=



Perspectives

The project resulted in a publication on the range of new methods for asymptotic analysis in general relativity. This material, absent from the scientific literature, should provide an interesting tool for further work by researchers and students in the field. Several projects building on AARG's work are currently being developed, including the ANR16-CE40-0012 Horizons project (JCJC).

AARG

Asymptotic Analysis in General Relativity

ANR PROGRAMME:
Mathematics and interactions (Blanc - SIMI 1)

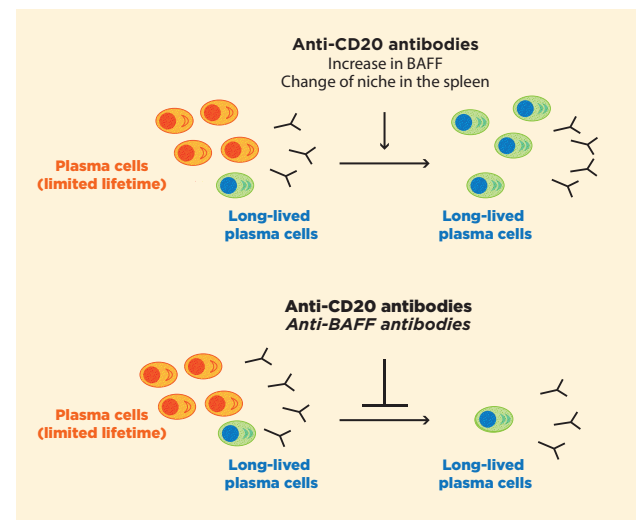
EDITION, PROJECT DURATION:
2012; 54 months

PARTNERS:
Jean-Philippe Nicolas, Brittany Atlantic Mathematics Laboratory (LMBA), UBO, France
Thierry Daude, Mathematics, Geometric Analysis and Modelling Laboratory (AGM), University of Cergy-Pontoise, France
Dietrich Häfner, Fourier Institute, University of Grenoble-Alpes

ANR GRANT:
€218,920

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WEBSITE:
http://pageperso.univ-brest.fr/~jnicolas/ANRAARG/ANR_AARG.html



Autoimmune diseases mediated by autoantibodies

Rituximab, an anti-CD20 antibody, is a therapeutic antibody that eliminates B lymphocytes from the organism. This medication is used to treat autoimmune diseases in which pathogenic autoantibodies have been identified. However, it is not always effective, and in the specific case of immune thrombocytopenic purpura, an autoimmune disease caused by the destruction of platelets, its effectiveness is of the order of 50 to 60%.

The team went on to realise that the BAFF cytokine (a substance secreted by the immune system that regulates cell proliferation) produced by neutrophils, and T-CD4+ cells on contact with spleen plasma cells play a crucial role in this mechanism. The team showed that blocking the BAFF cytokine while administering anti-CD20 antibodies could prevent the emergence of these cells in the spleen. These results were confirmed in trials on an autoimmune mouse model (NZB/NZW).

In a previous work, done by Dr Mahévas (from Professor Godeau's team at Créteil) in Claude-Agnès Reynaud and Jean-Claude Weill's laboratory at the Institut Necker-Enfants Malades (INEM), an analysis of the spleens of patients suffering from immune thrombocytopenic purpura was used to show that rituximab (anti-CD20) could encourage the emergence of long-lived cells secreting antibodies (plasma cells) in the spleen, which sustains the disease.

This year, the same team published a paper in the *Blood* journal (April 2018) demonstrating that the anti-CD20 antibody led to a modification in the micro-environment of the spleen favouring the emergence of long-lived plasma cells. The work was based on an original experimental animal model in mice, which enabled the plasmocytes to be monitored over time.



Perspectives

These results open up therapeutic possibilities, and have already culminated in a therapeutic protocol combining rituximab and belimumab (an anti-BAFF antibody) currently being developed in the autoimmune cytopenia centre at Henri-Mondor hospital (RITUX-PLUS, Professor Godeau, Professor Michel, Dr Mahévas). This therapeutic strategy is being studied for other autoimmune diseases such as systemic lupus erythematosus and Sjögren syndrome.

PC-RITUX

Interfering with autoimmune plasma cell persistence during B-cell depleting therapies

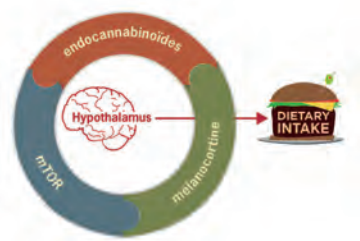
ANR PROGRAMME:
Translational Health Research Programme (PRTS)

EDITION, PROJECT DURATION:
2013; 3 years

PARTNERS:
INEM - INSERM U1151/ CNRS UMR8253 - Paris Descartes University
EFS - Henri Mondor Paris Est Créteil University
Henri Mondor Hospital - Internal Medicine Department - AP-HP

ANR GRANT:
€319,093

CONTACT:
Dr Matthieu Mahévas, matthieu.mahevas@aphp.fr



Understanding how cellular energy detection coordinates the neuronal circuits governing appetite

Obesity and its co-morbidities represent significant healthcare costs and have a major socioeconomic impact. To achieve more effective therapeutic approaches, a better understanding of the neurobiological mechanisms underlying the regulation of dietary intake and weight gain is vital. The NeuroNutriSens project aimed to develop knowledge of the molecular mechanisms that play a role in regulating the function of the hypothalamic melanocortin system, a key neuronal circuit for controlling appetite, which thus represents a possible therapeutic target.

Obesity has become a major global public health issue. The number of treatments currently available is very limited, highlighting our poor knowledge of the biological mechanisms regulating the energy balance and consequently the lack of relevant therapeutic targets. In mammals, the energy balance is closely regulated by the central nervous system. In particular, the hypothalamus plays a key role in the exchanges between the brain and the peripheral nervous system that orchestrate behavioural and metabolic responses in line with the availability of energy. In the different neuronal circuits, the melanocortin system plays a major role in these exchanges and represents a potential therapeutic target.

In this context, the goal of the NeuroNutriSens project was to understand the role of the biological mechanisms providing information on energy availability at the intracellular level, such as the mTOR pathway, and the intercellular level, such as the endocannabinoid system, and their effects on the modulation of the hypothalamic melanocortin system. The two project partners used several approaches including

transcriptomics, pharmacology, genetics, electrophysiology, chemogenetics (modulating the activity of a specific neuron type with chemical products) and optogenetics (modulating the activity of a specific neuron type with light) to manipulate the activity of neurons in the melanocortin system and study the roles of the mTOR pathway and the endocannabinoids in regulating this activity and, consequently, regulating dietary intake. The results obtained during the project made it possible to identify how energy availability is detected in the hypothalamic circuits regulating appetite, and specifically the exact role of the mTOR pathway and the endocannabinoids in modulating the activity and function of POMC neurons in the melanocortin system in response to the ingestion of nutrients.



Perspectives

This data opens new directions for a better understanding of how the hypothalamic melanocortin system responds to the energy overload resulting from consuming very calorie-rich food and how its dysfunction contributes to weight gain and the development of obesity.

NEURO NUTRISENS

Dissection of the hypothalamic mechanisms involved in detecting nutritional status and regulating dietary intake via the interactions between mTORC1, melanocortins and endocannabinoids

ANR PROGRAMME: Neuroscience (Blanc - SVSE 4)

EDITION, PROJECT DURATION: 2013; 48 months

PARTNERS: Dr Giovanni Marsicano, Neurocentre Magendie INSERM U1215

ANR GRANT: €492,960

CONTACT: Dr Daniela Cota, daniela.cota@inserm.fr

WEBSITE: <http://www.neurocentremagendie.fr/cota>



BIPA

Idealised beauty in advertising and the accessibility of negative thoughts

ANR PROGRAMME: Human development and cognition, language and communication (Blanc - SHS 2)

EDITION, PROJECT DURATION: 2013; 42 months

PARTNERS: Leila Selimbegovic, Research Centre on Cognition and Learning (CeRCA), France Sylvie Péron, Listening, Consultation and Therapeutic Activity Centre (CECAT), France Joël Billieux, Laboratory of Experimental Psychopathology (LEP), Belgium

ANR GRANT: €116,201

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WEBSITE: <http://cerca.labo.univpoitiers.fr/non-classe/leilaselimbegovic/>

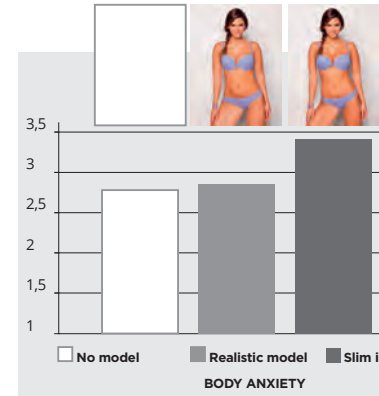


Illustration of the results of the BIPA project (Chatard et al., 2017, study 2):

Level of body anxiety in young women depending on the subliminal image to which they have been exposed. We can see that the difference between the slim ideal image and the realistic model image is small.

Consequences of the psychological automaticity of comparison with the beauty standards of advertising

In contemporary western society, the idea of female beauty is based heavily on what we call «the thin ideal». However, exposure to these standards has negative psychological consequences, especially among women. The goal of the BIPA project was to determine the automatic, unconscious nature of comparisons with these standards of beauty, and of social comparisons more generally.

At a time when most advertisements and television programmes promote standards of beauty that are often unrealistic or unattainable, particularly for women, who are subject to a «slim ideal», the BIPA project sought to find out whether women tend to compare themselves with this ideal automatically, i.e. unconsciously or uncontrollably. The project had two goals. Initially it aimed to determine whether the negative psychological effects resulting from this comparison were also necessarily automatic and unconscious. Secondly, this led to test the effectiveness of protective strategies such as a warning that an image has been retouched.

Supplementing and extending the scientific literature on the automaticity of social comparisons, the project drew on a two-faceted methodological approach.

Firstly, the team conducted several experimental studies to test the psychological automaticity of the comparison process, using criteria for the automaticity of a psychological process defined in previous studies. Secondly, it used so-called «implicit» measurements based on the reaction time of participants unaware of what was being measured. These two methodological choices made it possible to examine reactions of which the subjects are unaware and/or that it would be difficult for them to report voluntarily.

Overall, the studies conducted within this project corroborate the idea that women exposed to the slim ideal compare themselves with it automatically, leading to negative consequences in terms of conscious experience (body anxiety) but also at an implicit level (accessibility of negative thoughts). The results suggest that young women find it difficult to avoid comparing themselves with the unachievable standards of beauty that surround them in the media.

The project's studies of the effectiveness of the warning strategy show that overall this strategy is ineffective, and that it can even have undesirable effects in increasing the accessibility of negative thoughts.



Perspectives

In view of the perspectives developed by the BIPA project, an interesting avenue for research would be to study preventive strategies based on less explicit associative processes that move away from the negative consequences of exposure to the slim ideal.



Book and journal published as part of the GLOBALGENDER programme.

Sociology of the circulation and uses of equality norms in terms of gender and sexuality promoted by international organisations

... Emerging from feminist circles, gender reached the status of a public policy category in the 1990s. Promoted by international organisations, it circulates in most societies through shared normative language: equality of gender and sexual orientation, combating violence against women, women's human rights, gender mainstreaming, empowerment. The GLOBALGENDER project has analysed the uses of this system of reference and the actors that have taken hold of it.

Supported by international organisations (UN, EU), the spread of gender concepts involves the production of universally applicable governmental norms, the transnationalisation of militant discourse and transfers of political, scientific, legal and economic references between scales and sectors.

GLOBALGENDER examined the systemic dimension and local effects through original case studies. The project assembled a team of 14 researchers of varying ages and backgrounds for four years to study the relationships between activist groups, state institutions and international organisations involved in producing and receiving sets of norms relating to gender and sexuality equality in contrasting national contexts. Demonstrating that the international circulation of gender concepts is coextensive with the processes of globalisation, this original approach also revealed the local resistance to these same

processes. The circulation of gender was observed in situ at various levels, focusing principally on transnational social actions. Groups of actors, biographical information and subjectivation processes were analysed in detail to understand the localised conditions by which resources distributed by multilateral organisations are appropriated. Several interdisciplinary fields were brought together: the sociology of militancy and public action, the anthropology of international cooperation, the history of feminist movements, law and international relations. GLOBALGENDER contributes to original perspectives on the circulation of government methods and modes of militant action to the sociology of internationalisation. Since the rights of women and sexual minorities are part of many cooperation programmes (development and democratisation, peacekeeping etc.), this is a useful viewpoint for analysing geopolitical relations and contemporary hegemonic arrangements.

Perspectives

The team has structured an innovative research direction in the French-language academic sphere and contributed to the development of education (teaching, supervision for student work) relating to the most recent societal trends. The work has inspired doctoral theses and research programmes and will provide a foundation for future developments.

GLOBALGENDER

Comparative views of gender globalisation

ANR PROGRAMME: Transformation of societies. Globalisation and governance. (GLOB)

EDITION, PROJECT DURATION: 2012; 36 months

PARTNERS: Alsace Inter-University Humanities Centre (MISHA), Strasbourg
Alsace site of the CNRS

ANR GRANT: €318,000

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The Chorus Digitalis in concert: synthesised choir controlled by gestures.

Synthesised song, between science and musical creation

... The goal of the ChaNTeR project was to create and use high-quality singing synthesis systems offering two synthesis modes: a «text to singing» mode, in which the user enters the text to be sung together with the notes from the score, which the machine converts into sound in batch mode, and a «virtual singer» mode, in which the user operates the real-time interface to control the voice synthesiser like a musical instrument.

Synthesising a singing voice involves complex problems due to its intrinsic link with language and thus words. As well as the demands of musical quality (realistic timbre, pitching, precise timing), the singing voice must be realistic in terms of the words – it must be intelligible. An additional difficulty arises from the fact that the voice is an internal instrument, whose operation is difficult to measure in a living subject and impossible to separate from the performer.

The ChaNTeR project aimed to create and evaluate expressive singing synthesis systems able to calculate the sound signal corresponding to a score and words with a high level of musical quality. Two types of synthesis systems were developed at the intersection between musical acoustics, voice processing, human-machine interaction and musicology. For the «text to singing» systems, the user enters the text in French and the score. The sound signal is then calculated in batch mode using expressive rules (the Ircam Isis software and the Acapela system). For the «virtual singer» systems, the

musician uses a voice synthesis instrument, a real-time interface for controlling a voice synthesiser. The synthesiser itself is either a voice signal calculation model or a system for concatenating and modifying pre-prepared vocal samples with no linguistic limits (LIMSIS's Cantor Digitalis and Vokinesis, DUALO). The high level of sound quality of the systems developed by the project enables real musical expression. This is also underlined by their effective musical use in amateur practice, at concerts, in an experimental opera, in creative research residencies and in the award of several national and international distinctions. The project included an international evaluation of singing voice synthesis by the consortium together with research into markets and uses for singing voice synthesis.

CHANTER

Real-time singing synthesis

ANR PROGRAMME: Digital content and interactions (CONTINT)

EDITION, PROJECT DURATION: 2013; 48 months

PARTNERS: LIMSIS (Computer Science Laboratory for Mechanics and Engineering Sciences); Ircam (Institute for Research and Coordination in Acoustics/Music); Acapela; Dualo

ANR GRANT: €980,927

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WEBSITE: <https://chanter.lam.jussieu.fr/doku.php>

Perspectives

As well as developing the systems and distributing them within the musical world, the most striking scientific progress of the ChaNTeR project related to vocal style and synthetic instruments. The analysis and transformation of vocal style and real-time performance with synthesised voices support creativity and offer many musical perspectives for artists, from research to recording and live performance.



© OGRE, Gildas Merceron-Université de Poitiers

The TRIDENT project used experiments in sheep to consolidate knowledge of the relationships between diet and dental wear for application to antelope fossils from fossil sites around the Omo in southern Ethiopia.

Studying the ecology of modern and fossil herbivorous mammals by analysing their dental wear

Structured around a multidisciplinary team including agronomists, tribologists and palaeontologists, the TRIDENT project aimed to identify the parameters that control dental wear based on controlled feeding tests in domestic sheep. The goal was to confirm the use of dental wear for tracking the dietary habits of mammals, including fossil species. The project underlined the primary role of food rather than dust as a driver of dental wear. Its application to various antelope fossils has made it possible to characterise the habitats they shared with humanity's ancestors in the Horn of Africa between four and one million years ago.

The project relied on interdisciplinary collaboration. The first driver was the use of data acquired from animal experiments with agronomists, using a controlled diet in 180 ewes to evaluate the relationship between diet and dental wear. The results underlined the primary role of food as a driver of dental wear rather than dust, which had been suggested by research in recent years.

TRIDENT demonstrated that different diets (grasses, clover, corn, barley, chestnuts etc.) generate different microwear on dental tissues. Exogenous dust, while contributing to the wear, has only a marginal effect on the differences observed between dietary categories. The second driver of the project was the interdisciplinarity between palaeontologists and tribologists, specialists in wear in industrial materials. This interdisciplinarity provided real methodological benefits in exploring the ecology of modern and fossil mammals.

The project was an opportunity to apply these models to two sets of fossil data involving several species of African antelopes that shared their habitat with humanity's ancestors in the Horn of Africa between four and one million years ago. Describing the shared tree and plant resources that were potentially also available to fossil hominids, and their variation over time, is essential in order to understand the role of dietary preferences in mammal evolution.

Perspectives

The TRIDENT project generated unprecedented data that has enriched and fed into current debate on the subject, both nationally and internationally. As a springboard for the development for further studies, it has enabled the launch of a new ANR project on fossil hominids, DIET-Scratches: [http://www.agence-nationale-recherche.fr/projet-anr/?tx_lwmsuivibilan_pi2\[CODE\]=ANR-17-CE27-0002](http://www.agence-nationale-recherche.fr/projet-anr/?tx_lwmsuivibilan_pi2[CODE]=ANR-17-CE27-0002)

TRIDENT

Dental tribology and dietary testing: an innovative combination to characterise the evolution of herbivorous mammal communities

ANR PROGRAMME: Biodiversity, evolution, ecology and agronomy (IJC -SVSE 7)

EDITION, PROJECT DURATION: 2013; 42 months

PARTNERS: iPHEP (Institute of Human Palaeontology and Paleoprimum (since 01/2018) UMR 7 262 CNRS Inee and the University of Poitiers

ANR GRANT: €269k

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The tool developed by the ANR CineCitta project is tested under real conditions.

A new technique for virtual cinematography

The CineCitta project has contributed to the field of virtual cinematography by offering a new space for representing the camera, reducing the dimensionality of framing problems. The resulting technology improves the creative collaboration between a director of photography and an automated tool for planning viewpoints.

The CineCitta project focused on the problems of virtual cinematography, i.e. transposing the standard techniques of cinema (framing, camera movement, editing) to virtual environments. In this context, the researchers proposed a new space for representing the camera, known as the «toric space», which reduces the dimensionality of framing problems, a unified framework for modelling editing problems and models for learning stylistic elements from existing films. The targeted applications are tools to support creation in the previsualisation phase of film-making. The work has opened the way for further research into learning from real data (extracted automatically or annotated manually) to develop innovative interactive tools for cinematographic creation in 3D environments.



The «M Méliès» virtual camera system from SolidAnim uses the results of the CineCitta ANR project.

Perspectives

Building on this new representational space known as the toric space, the CineCitta project has helped make virtual camera control easier with a language close to the grammar of cinematography. The project has thus enabled prestigious new collaborations, including work with the Universities of Stanford, Jerusalem and Shenzhen, on the subject of controlling drone cinematography. The project results also gave rise to the creation of a software package, SolidFrame, currently used by SolidAnim, which has worked on international feature films such as Avatar 2 and 3 and Star Wars Rogue One.

CINECITTA

Interactive virtual cinematography

ANR PROGRAMME: Information science and applications (IJC SIMI 2)

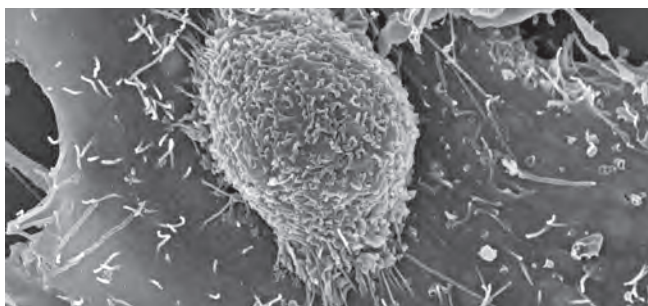
EDITION, PROJECT DURATION: 2012; 42 months

PARTNERS: Marc Christie, University of Rennes 1, INRIA, IRISA UMR 6074

ANR GRANT: €208,166

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Electronic microscope observation of contacts between a cell infected with the yellow fever virus and a plasmacytoid dendritic cell.

Understanding how infection with pathogenic viruses in humans leads to innate immune response

When a viral infection is detected, cells defend themselves by quickly triggering the so-called «innate» immune response. The goal of VIOPER0 is to understand the mechanisms by which this response takes place following infection by a range of viruses that are pathogenic in humans. Firstly, the work demonstrated the previously unknown existence of an antiviral signalling pathway in immune cells delivering the immune response; secondly, it showed that the scale of the antiviral response depends on the mechanisms by which viruses penetrate cells. Finally, the work enabled the exact nature of the viral components that stimulate immune cells to be described.

Cells defend themselves against viral infections by quickly triggering an innate immune response. The deployment of this response begins with the recognition of the viral genomes by receptor proteins. This recognition leads to a change in the conformation of the receptors followed by their interaction with adaptor proteins. Once activated, these stimulate transcription factors that cause the production of interferons (IFNs). The IFNs are then secreted by the infected cells and recognised by receptors expressed on the surface of neighbouring cells, resulting in the expression of many genes called Interferon Stimulated Genes. These genes are able to block different stages of viral replication. The goal of VIOPER0 was thus to understand the mechanisms by which the innate immune response takes place following infection by a range of viruses that are pathogenic in humans, such as dengue, yellow fever and Zika. The severity of the

diseases caused by these viruses is due to their ability to modulate the innate immune response.

To achieve this objective, the researchers worked with cell lines and primary immune cells isolated from the blood of healthy volunteer patients. They used standard biochemistry and virology techniques, together with electronic microscopy and optics. Innovative techniques such as Flow-FISH, which combines flow cytometry with FISH techniques, and deep sequencing were also used to identify the segments of viral genomes that are recognised by the receptor cells. They used existing bioinformatics techniques and developed their own tools to analyse the sequencing data. This revealed a previously unsuspected antiviral signalling pathway in these cells. The work also showed that the scale of the antiviral response depends on how the viruses penetrate the cells. Finally, the project made it possible to identify which patterns in certain viral genomes are recognised by the receptors of the host cell.

Perspectives

These results help provide a better understanding of the molecular strategies used by infected cells to defend against viruses. This knowledge could be useful in the development of new antiviral molecules that would reinforce the innate immune response.

VIOPER0

Induction of the antiviral response in immune cells

ANR PROGRAMME:
Microbiology, immunology, infectiology (JCJC SVSE 3)

EDITION, PROJECT DURATION:
2012; 48 months

ANR GRANT:
€309,442k

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PHOTOFLEX

Rewritable films on flexible surfaces for coloured photo printing: from nanostructure to colour prediction models

ANR PROGRAMME:
Nanotechnology and nanosystems (P2N)

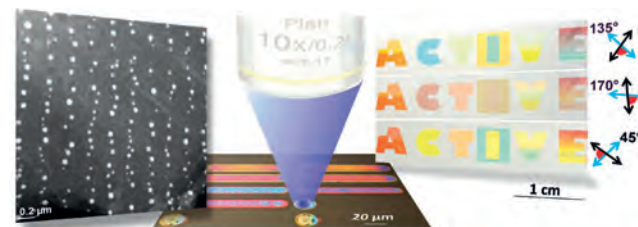
EDITION, PROJECT DURATION:
2012; 48 months

PARTNERS:
Hubert Curien Laboratory
Prime Institute
Laboratory of Pulp and Paper Science and Graphic Arts (LGP2)
Georges Friedel Laboratory
HEF-IREIS

ANR GRANT:
€1,157,827

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<https://sites.google.com/site/anrphotoflex/>



Surface colouring technology developed by PHOTOFLEX.

Controlling laser-material interaction to form large-scale metal nanostructures on flexible or rigid surfaces and control their visual appearance

The primary goal of the PHOTOFLEX project was to use a laser to write, erase, colour and - better still - create «hypercolours» that no other technology can produce on glass, plastic or paper. To achieve this, it exploited the considerable colouring power of metal nanoparticles, used thin films as light guides and revealed self-organisation phenomena that give nanostructured films a unique optical signature. Their visual appearance sets new challenges for colorimetry and offers opportunities for innovation in various socioeconomic sectors, starting with security.

Surface marking using lasers is already appreciated in many industrial sectors for its speed, flexibility, precision and adaptability to large non-flat surfaces. However, great demand remains for the ability to inscribe multicoloured information on a variety of surfaces. By combining laser marking with surface coatings using thin films of almost colourless nanocomposites containing metal precursors, the PHOTOFLEX project has developed a technology for producing coloured markings on surfaces.

It can transform transparent materials such as glass or plastic, or opaque materials such as paper, into rewritable media for data using certain light wavelengths to write and others to erase. Using a single laser, it then generates a wide variety of long-lasting nanostructures protected within thin films, each with not just a single characteristic colour but a range of non-diffractive colours

sensitive to observation and illumination conditions, called hypercolour. The PHOTOFLEX project has led to a rethinking of colour measurement and the associated models and contributed to the emergence of new research areas in the associated international scientific community.

The discovery of the self-organisation of metal nanoparticles has also led to basic research, both theoretical and experimental, to understand and simulate the optical, physical and chemical mechanisms underlying this phenomenon. Original models have been proposed, and some have been compared with the results of in situ characterisations conducted at two different synchrotrons.

Perspectives

The control over the coloured appearance of surfaces offered by this breakthrough process enables a reinvention of colour printing and a move towards the creation of multiple layers of coloured images that are revealed one by one depending on lighting and observation conditions.

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Demonstrator built into the SHERPA-LAMIH dynamic simulator.

Guaranteeing the usability and safety of autonomous vehicles

By modifying the behaviour of drivers, the development of autonomous vehicles raises new problems of human-machine cooperation in the driving seat. The CoCoVeA project offers a multi-level architecture, incorporating mechanisms for managing interactions between the driver and the vehicle's assistance systems, to solve problems of task allocation, authority, automation level, information priority and management of the various systems.

The different consortium's partners (manufacturers, equipment suppliers and public research laboratories) have pooled their expertise to define a modular architecture for multi-level cooperation enabling collaboration between the driver and the assistance system:

- Both at the level of vehicle control – guiding the vehicle along a defined route;
- And at tactical level – choosing from the possible manoeuvres (changing lane, merging, overtaking etc.)

Algorithms have been developed and embedded in the architecture's modules to resolve the problems of sharing control, managing authority and resolving conflicts in decision-making.

The information the driver needs to complete their tasks, depending on the current degree of automation (shared driving, supervision of the automated system, full delegation and taking back control), has been identified in order to prototype human-machine interfaces (HMIs). These multi-purpose HMIs – visual, manual, sound or vibration – provide information about the

system's operation and collect instructions from the driver based on the context and the current driving mode. In parallel, work was conducted on monitoring the driver (vigilance and attention), during both manual and delegated driving, to ensure the safety of the vehicle.

The CoCoVeA project resulted in the development of demonstrators for both dynamic driving simulators and real vehicles, incorporating mechanisms for transitioning between modes (manual-automatic) and adapting the system to the driver's state, and in HMIs ensuring the situation is understood and conflicts between the automatic system and the driver are resolved. These prototypes have been submitted to functional tests and experimental evaluation with a panel of drivers from varying backgrounds.

Perspectives

The CoCoVeA project has shown the need for close cooperation between driver and assistance system to ensure the acceptability and safety of autonomous vehicles. The continuation of the work will involve extending it to other driving contexts and levels of automation and developing models to describe both the driver's decision-making and sensory/motor mechanisms and the assistance system's auto-adaptation.

COCOVEA

Cooperation between drivers and automated vehicles

ANR PROGRAMME:
Sustainable transport and mobility (TDM)

EDITION, PROJECT DURATION:
2013; 42 months

PARTNERS:
Akka Technologies
Continental
INRIA
LAMIH CNRS
PSA Peugeot Citroën
Spirops
University of Caen Basse-Normandie
Valeo

ANR GRANT:
€999,248

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SOMEAT

Chemical Safety of Organic Meat

ANR PROGRAMME:
Sustainable food systems

EDITION, PROJECT DURATION:
2012; 48 months

PARTNERS:
SOMEAT involves 14 partners, including 11 public research units from INRA, ANSES, Oniris and AgroParisTech and 3 meat industry technical institutes, IFIP, ITAVI and IDELE

ANR GRANT:
€1,253,294

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First reference study of chemical contaminants in organic meat

In a report published in 2011, the French Scientific Council for Organic Agriculture underlined that food safety was the prime motivation driving 95% of the consumers to buy organic food, although very few scientific data were available to support this presumption of a health benefit. Using meat as a model, SOMEAT is the first reference study objectively assessing the potential risks and benefits of organic and conventional food production systems in terms of their chemical contaminant content.

Combining basic and applied research, the SOMEAT project aimed to quantify the contaminants, evaluate the chemical risks for the consumer and suggest solutions for tracking contamination in organic or conventional meat production. Meat contamination was evaluated based on a representative sample of French poultry, beef and pork production. To compare meat from both organic and conventional sources, 256 chemical contaminants (environmental organic micropollutants, heavy metals, mycotoxins and residues from veterinary or phytosanitary treatments) that might be found in meat were quantified below regulatory limits using highly sensitive and selective methods. At the same time, France's consumption of organic meat was studied by examining the economics of the sector and through experimental economics. Based on the data, the chemical risk was assessed using a multidisciplinary approach, including the effects of the cooking and digestion processes.

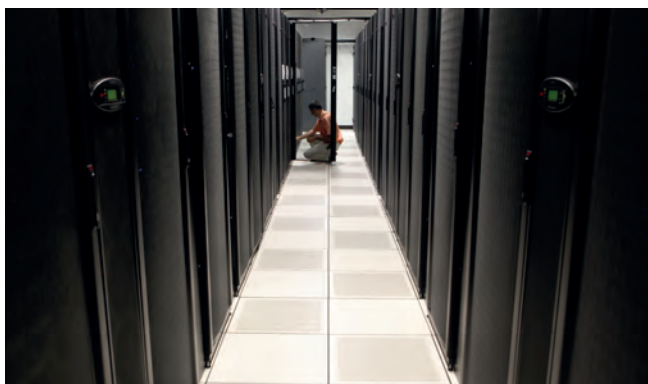
The SOMEAT project shows that French meat complies with European regulatory limits for all the chemical contaminants studied in both organic and conventional

productions. The absence of certain veterinary residues in organic meat also confirms that breeders are respecting the specifications. However, the use of analytical methods sensitive enough to quantify contaminants even at levels far below the regulatory limits revealed that organic meat had significantly higher contamination by certain environmental pollutants in all three sectors studied – beef, pork and poultry. This higher contamination of the animals could be explained by longer breeding times and systematic access to outdoor settings in organic rearing systems.

Perspectives

The main goals for the future will be to explain the differences in the levels of contamination observed, to widen the framework of the project to other sectors or socioeconomic contexts and to suggest changes to the specifications for organic agriculture. SOMEAT also opens up prospects for improvements to risk assessment systems and the development of high-speed detection tools to meet the need for better health security in the food industry.





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Network virtualisation for greater flexibility and automation

– Emerging from cloud computing, virtualisation increases the agility of infrastructure and network service management while rationalising costs. Several software-based network architectures are currently being standardised. The REFLEXION project has sought to increase the robustness and flexibility of these new architectures, particularly with regard to critical services, and to make the provisioning and chaining of these virtualised network functions more dynamic and efficient.

Operators' networks have evolved considerably in recent years. New network virtualisation technologies have emerged thanks to cloud computing. They increase the agility of infrastructure and service management while rationalising costs. In addition, they enable operators to reinforce the added value of their networks and data centres by offering new services.

Complementing the SDN (Software-Defined Networking) approach, which tends to make networks more programmable, Network Functions Virtualisation (NFV) aims to implement network functions (e.g. router, firewall, probe) purely in software so that they can be deployed in off-the-shelf hardware or in the cloud. NFV thus revolutionises the way networks are deployed and operated.

The REFLEXION project studied the diagnosis and management of NFV faults in SDN

to ensure seamless continuity of service, together with distribution techniques to increase the robustness of NFV control and management plans. The project also aimed to develop methods for designing robust virtual services, taking into account potential threats in the architecture and options to mitigate them. The project also aimed to propose innovative metrology tools to monitor virtualised network functions passively and with the lowest possible footprint. Measuring VNF resource use is vital to avoid interference and guarantee quality of service. Finally, REFLEXION investigated optimisation techniques at the scale of a whole network for dynamically (re-)deploying virtualised network functions and chaining them in order to balance quality of service and experience with network impact.



Perspectives

Virtualisation is one of the main pillars of the future 5G network technology. The progress made by the REFLEXION project makes it possible to consider automating the provisioning of 5G services quickly and completely with guarantees in terms of performance and, above all, security.

REFLEXION

REsilient and FLEXible Infrastructure for Open Networking

ANR PROGRAMME: Networks, software technology, cybersecurity and global security (CE28)

EDITION, PROJECT DURATION: 2014; 36 months

PARTNERS: Thales Communications & Security
Inria
ENS Lyon
6wind
Orange
Sorbonne University
Telecom ParisTech

ANR GRANT: €799,617

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PASITHEA

Personalised, adaptive treatment of sleep apnoea by kinaesthetic stimulation based on a Holter cardiorespiratory monitor

ANR PROGRAMME: Technologies for health and independence (TecSan)

EDITION, PROJECT DURATION: 2012; 4 years

PARTNERS: LTSI – INSERM – University of Rennes 1 UMR 1099; Sorin CRM SAS; INSERM U1042-Grenoble University Hospital; CIC-IT – Rennes University Hospital

ANR GRANT: €801,974.23

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The PASITHEA system consists of a mobile recording device, a kinaesthetic stimulation system and a signal processing and real-time control application⁽¹⁾.

A new system for the personalised treatment of sleep apnoea

– Affecting over 15% of the general population in France, sleep apnoea is a major public health problem, with nearly a billion sufferers worldwide. The PASITHEA project aimed to create a new non-invasive detection and stimulation system for treating sleep apnoea that would be easier to tolerate than the systems currently available. Preliminary clinical studies have demonstrated the system's technical feasibility and its ability to reduce the length of apnoea and hypopnoea episodes.

control system delivering adaptive stimulation tailored to the patient. The first clinical evaluation of the PASITHEA system, the HYPNOS study, was conducted at five centres in France. Tested on 46 patients, the treatment application significantly reduced the duration of apnoea or hypopnoea episodes in 75% of them, demonstrating the system's technical feasibility and offering encouraging signs for potential therapeutic effectiveness. The project led to the registration of six families of patents and the publication of two scientific papers.

⁽¹⁾ The system detects apnoea or hypopnoea events and delivers adaptive stimulation specific to the patient.

Sleep apnoea is characterised by repeated episodes of pauses in breathing (apnoea) or significant reduction in respiratory amplitude (hypopnoea) during sleep. These episodes can occur hundreds of times during the night, lasting from 10 seconds to one or two minutes. A major public health problem, severe untreated sleep apnoea can have serious cardiovascular and metabolic consequences. Despite this context and the multiple diagnostic and therapeutic approaches already proposed, the condition remains under-diagnosed and many sufferers never receive the right treatment.



Perspectives

The goal of the PASITHEA project was to create a new detection and treatment system for obstructive sleep apnoea. To achieve this, PASITHEA applied a multidisciplinary methodology including the design and development of new technologies, original signal processing methods and clinical evaluation. The system designed and developed by the project consists of three components communicating wirelessly: a cardiac and respiratory recording system, a mechanical kinaesthetic stimulation system and a signal processing and real-time

The results of the PASITHEA project have significant social and industrial potential. The project has led to a second clinical study, whose results will be available soon. If they are encouraging, a wider study of the system's therapeutic effectiveness should be conducted, together with the procedure for obtaining the CE marking. At the same time, the system's instrumentation was developed further. Two main routes for commercial exploitation are being considered: technology transfer of all the intellectual property to the industrial partner, or the creation of a new company. Finally, the improved understanding of certain physiopathological mechanisms in sleep apnoea provided by the project opens new prospects for research.



Traditional fruit and vegetable market in Morocco.

An economic and microbiological approach to food safety between the EU and South Mediterranean countries

SAFEMED was one of the first projects funded through ARIMNet, the transnational agricultural cooperation programme focusing on the Mediterranean area. It is an example of North-South cooperation on food safety.

The aim of the SAFEMED project was to analyse the conditions for an international co-regulation of food safety between North and South Mediterranean countries: Spain, France and Italy in the north; Algeria, Morocco and Tunisia in the south. This included studying the structure of competition between the supply chains on the two sides and examining the possibilities for coordinating public and private food safety strategies. The project developed a multi-criteria analysis to conciliate:

- The essential requirement for food safety, to ensure the health of European consumers via safer imported products and of North African consumers, who benefit from the evolution of agricultural best practice at international level.
- Access to the European market for producers in the South, as food exports represent a major factor of economic development in the Southern countries.
- Fair and equal competition between actors in the North and South to avoid «sanitary dumping» due to the diversity of regulations in the South and the North.

In particular, SAFEMED focused on the characteristics of the economies on the two Mediterranean sides. The marketing and brokerage sectors in the Northern and Southern fruit and vegetable supply chains were studied specifically through empirical economic and microbiological work and through an

industrial economy model developed as a basis for decision support tools. The way the value created by operators in the North and South is shared through their partnership within supply chains was also analysed as an indicator of fairness in the commercial relationships between the two sides of the Mediterranean. The project demonstrated the existence of wide disparities in the abilities of the domestic and export sectors in Southern and Northern countries to reduce food safety risk. It also showed that the ability of operators to comply with standards depends not only on the costs of adaptation but also on how sectors are organised, private logistics, local infrastructure and the quality of national control systems.

Perspectives

As well as the Moroccan team producing a guide to introducing a national strategy for managing health risks in seafood products, the SAFEMED project developed industrial economy models as a basis for future decision support software. It also enabled the training of a large number of doctoral students in economics supervised by partners in the North and South. These young researchers were given funding through the ARIMNet2 Young Researchers call for proposal to continue their work through the ongoing VALUETEAM project.

SAFEMED

Regulation of food safety, market access and international competition

PROGRAMME ANR :
ERA-NET Arimnet
(Agricultural Research in the Mediterranean Network)

EDITION, PROJECT DURATION:
2011; 48 months

PARTNERS:
SAFEMED is coordinated by INRA and involves the universities of Almeria (Spain) and Bologna (Italy), the Hassan II Institute of Agronomy and Veterinary Medicine (Morocco), the Tunisian National Institute of Agronomy, the Higher National Agronomy School (Algeria) and the University of Béjaia (Algeria).

ANR GRANT:
€127,000

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The GATE-LAB experimental economics laboratory.

Contributions of experimental methodology to macroeconomics, illustrated by questions relating to central bank communications

Influenced by the rise of cognitive science and crowned by a Nobel Prize in 2002, experimental economics has now won its spurs. However, the experimental methodology has remained relatively marginal in macroeconomics, where the hypotheses and predictions of macroeconomic models are based on tests using real data. The innovative nature of the StabEX project lies in its use of the experimental methodology in macroeconomics, and its results shed new light and extend the state of the art.

The project thus helped to develop experimentation in macroeconomics as a decision support tool. Gaining an understanding of how economic agents interact with institutional rules before implementing a monetary policy can considerably reduce the cost of implementing the policy.

In the last 20 years or so, central banks have become increasingly transparent in their management of monetary policy. However, public information can cause overreactions among market players, suggesting that more transparency can be counterproductive in some cases. Central banks need to take the interaction between these two facets of monetary policy into account. The goal of the StabEX project was thus to study the interaction between central banks' communication and stabilisation policies by using the standard theoretical tools of coordination games and monetary policy models, with the additional feature of using laboratory experiments. StabEX showed, for example, that if a central bank is seeking to stabilise inflation and production in response to shocks, communicating its inflation target can reduce the volatility of inflation, interest rates and production without affecting the level of these variables – just announcing the target reduces uncertainty about its intentions/objectives.

Perspectives

The project developed examples of using the experimental method in macroeconomics. Many other fields involving the role of central banks could also benefit from an experimental approach. For example, it could be used to test unconventional policy measures. The 2008 financial crash showed that the traditional monetary policy instruments could become ineffective. Because unconventional measures were adopted under very particular circumstances, the real data only offers very specific illustrations of their effects. However, laboratory experiments can analyse them more systematically and isolate their effects.

STABEX

Stabilisation of macroeconomic shocks: experiments on the interaction between the Central Bank and the private sector

ANR PROGRAMME:
Franco-German SSH programme (FRAL)

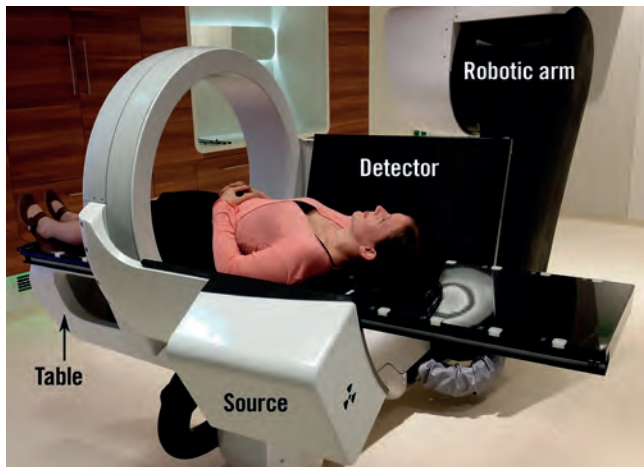
EDITION, PROJECT DURATION:
2012; 36 + 12 months (extension)

PARTNERS:
Camille Cornand, GATE - Economic Analysis and Theory Group - UMR5824 (CNRS)/France
Frank Heinemann, TU Berlin/Germany

ANR GRANT:
€49,899

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 © medPhoton (<https://www.medphoton.at/>)

Photograph of the medPhoton ImagingRing scanner prototype installed at the Austrian particle therapy centre MedAustron.

Algorithmic solutions for exploiting the new functions offered by an innovative X-ray scanner for image-guided radiotherapy

– The ImagingRing is an innovative scanner for image-guided radiotherapy that enables dual-energy acquisition and the independent rotation of the X-ray source and detector around the patient. These new functions offer many possibilities that have not yet been exploited. The DEXTER project's research has led to the development of algorithms for improving ion therapy using dual energy, reconstructing tomography images and registering 2D radiography images with a 3D reference image.

The ImagingRing is a new scanner developed by medPhoton, a spin-off of the radART laboratory. This innovative scanner can perform so-called dual-energy X-ray acquisition by rapidly alternating the voltage of the X-ray source from one energy level to another, with optional additional separation of energy spectra by inserting materials specific to each energy into the beam. This feature provides better detection of human tissues than current single-energy scanners. In addition, the X-ray source and detector can rotate independently around the table where the patient is lying for more flexible acquisition, enabling a focus on the specific anatomical area to be scanned.

An international collaborative project between CREATIS (Lyon) and radART (Salzburg), DEXTER aimed to develop algorithmic solutions to respond to the challenges posed by these new features. The research focused initially on the use of dual-energy to improve ion treatments, as the ImagingRing had first been installed at the MedAustron particle therapy centre in Austria. The researchers also developed a tomography reconstruction algorithm for the specific acquisition geometry generated by the independent rotation of the source and the detector. Finally, they worked on the registration of 2D radiography images acquired by the ImagingRing with a 3D scanned image acquired previously to plan treatment.

Perspectives

The DEXTER project will help improve the guidance of conventional radiotherapy (with photons) and particle therapy (with ions) and enable better treatment for cancer patients. The fruitful collaboration is continuing through the ROLDORÉ project, which aims to reduce the doses of X-rays delivered by all X-ray scanners, including diagnostic scanners.

DEXTER

Dual-energy X-ray imaging for targeting radiotherapy

ANR PROGRAMME: Hardware and software for systems and communications (Blanc – 2013 bilateral agreements – SIMI 3)

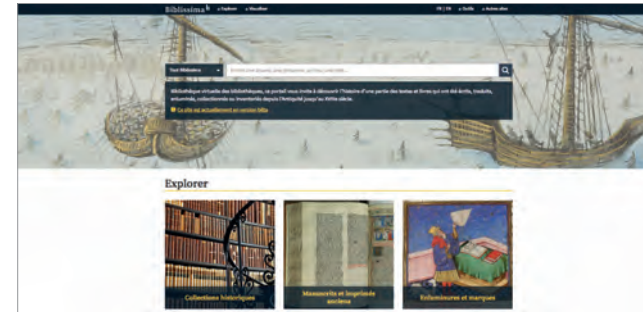
EDITION, PROJECT DURATION: 2013; 41 months

PARTNERS: Simon Rit, CREATIS, France; Philipp Steinger, radART, Austria

ANR GRANT: €174,720

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The Biblissima EQUIPEX project is a remarkable example of using semantic web technologies to access ancient manuscripts and printed documents and renew knowledge and questions about the history of the texts

– Biblissima is a web-based digital library giving access to a huge and complex set of manuscripts and printed documents, the texts they contain, their circulation and their readers, from the eighth to the 18th centuries. It provides data for research, education and dissemination and is targeted at both researchers and the wider public.

The project aims to increase our understanding of the turbulent history of ancient texts, circulated and dispersed by the forces of historic events, both private (inheritance, travel) and public (war, revolution). The project involved organising interoperability between a mixed set of resources, databases, image libraries and online editions. Biblissima brings together about 70 scientific and digital projects on the history of text circulation in the West between the seventh and 18th centuries. It has enabled a large amount of data acquired by the partners to be published online, filling the gaps in what was available. The EQUIPEX project defines and implements a scientific policy covering the digitisation, cataloguing and encoding of manuscripts and printed works in France's libraries and archives. Every year, international summer schools are organised to increase knowledge about sets of manuscripts, the texts they contain (Latin, French, Hebrew, Greek etc.), existing inventories of mediaeval and modern books, specific types of text (gloss, sermon, music etc.), together with a major electronic publishing pro-

gramme. THECAE (PUC), the first electronic collection of historical inventories, will soon be open to the public. The Biblissima portal provides a single point of access, enabling users to query all the resources and use a variety of tools to work with them (Collatinus, Eulexis, TEI editor, BaOBab toolkit). It will soon be possible to retrieve data sets and repositories. The portal, open for nearly a year, is regularly expanded. It has recently been updated with the 200,000 Mandragore illuminations, the BnF's iconographic database, and access to the scans of the Wellcome Library in London.

Perspectives

Collaborating with Stanford, Biblissima has become the French promoter of the IIF protocol (International Image Interoperability Framework), which has made France's two biggest digital libraries of historical books interoperable, Gallica and the BVMM (<http://doc.biblissima.condorcet.fr/introduction-iif/>). Its international reach is expanding, and 2018 will see the creation of a SIG (scientific interest group) enabling a borderless scientific policy to be pursued.

BIBLISSIMA

Bibliotheca novissima, observatory of written heritage from the Middle Ages to the Renaissance

ACTION : Equipment of Excellence (EQUIPEX)

PROJECT REGION: Île-de-France (coordination)

EDITION, PROJECT DURATION: 01/10/2012; 7 years

PARTNERS: The Condorcet Campus coordinates 10 founding partners: the BnF, the AN, the Universities of Tours 3, Lyon 2 and 3, Caen-Basse Normandie and Avignon-Pays de l'Adour, EHES, EPHE, Ecole des Chartes and the CNRS. About sixty other partners are involved in the EQUIPEX.

ANR GRANT: €7.1M

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BIORARE TRL4 pilot. © IS Corporate

A brand new technology for converting organic waste into chemical molecules of interest

– In a context of declining fossil fuel stocks and the energy transition, alternatives are being developed in order to use organic waste as a raw material for the chemical industry, which still depends heavily on petrochemical resources. Alongside the composting and anaerobic digestion sectors, the BIORARE project offers an innovative technological solution for producing molecules for green chemistry from biowaste.

Despite being a low-cost, readily available raw material, organic waste is mixed, complex and contaminated, which complicates its conversion into a bioresource. The BIORARE project aimed to evaluate the potential of an innovative biological process for biorefining waste, microbial electrosynthesis. Discovered in 2010 by American researchers, this is the mechanism by which microorganisms use electrons to transform carbon dioxide (CO₂) into chemical molecules such as acetate or ethanol, which are used to make solvents.

Mobilising five partners for five and a half years, the BIORARE project successfully transformed a basic scientific discovery into a technology at a pre-demonstration readiness level (TRL 1 to 5) to produce platform molecules from organic waste. Based on an electrochemical device consisting of two electrodes, the technology separates waste conversion from molecule production. The waste is first oxidised by microorganisms that produce electrons, and the electrons

are then used by the microorganisms in a second compartment to transform the CO₂ into molecules, ensuring their quality.

The project demonstrated the technical, environmental and industrial benefits of microbial electrosynthesis for biorefining organic waste. The work led to the publication of 19 articles in international peer-reviewed scientific journals and the award of three patents.

The results obtained constitute key elements of an ongoing negotiation with investors for a technology development project.



Perspectives

The BIORARE technology has significant advantages for the environment and cuts threefold the electricity required for microbial electrosynthesis alone. The technology is currently undergoing development with a technology transfer acceleration company (SATT) and four further patents have been applied for. New TRL5 pilots have also been designed and are being assembled. The goal is to achieve a technology readiness level of TRL7 in three years by demonstrating the production of a significant volume of chemicals. Following this phase, the partners plan to start a company and achieve full technological maturity in another three years.

BIORARE

Bio-electrosynthesis for refining residual waste

ACTION:
Biotechnology -
Bioresources

PROJECT REGION:
Île-de-France

EDITION, PROJECT DURATION:
1/11/2011; 67 months

PARTNERS:
IRSTEA-HBAN, Antony
INRA Montpellier - INRA-
LBE
National Polytechnic
Institute of Toulouse,
CNRS-LGC
IRSTEA-OPAAL, Rennes
Suez

ANR GRANT:
€2.21M

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SimuTED, healthcare habituation for people with autism. © SimuSanté, Nicolas TAILLANT

Europe's biggest centre of excellence in active healthcare teaching and simulation

– SimUSanté is a multidisciplinary active teaching centre developing innovative services that combine high technology with local healthcare and incorporate an original, interprofessional and interdisciplinary approach into the teaching of health sciences.

Based at the Amiens-Picardie university hospital in partnership with Jules Verne University, the active teaching centre (CPA) SimUSanté (advanced health simulation) provides «innovative educational techniques in a dedicated space shared by all health actors, from initial to continuing training, regardless of professional background, including patients and their families.» Its originality lies partly in its interprofessional, interdisciplinary approach, and partly in its chosen educational method – simulation, which safeguards both the study conditions for learners and the care given to patients. Building on simulated situations in authentic professional environments, learning incorporates all the interpersonal and technical dimensions of healthcare, increasing learners' reflexivity. As well as training, the project incorporates three areas of research: multidisciplinary in healthcare and its impact on individual and collective competence; the impact of innovative educational techniques on treatment pathways, with a central role played by simulation; and finally real-life situations in the healthcare ecology and analysis of the working environment (learning about different roles, professional retraining, making environments more user-friendly).

Funded for seven years since 2012, CPA-SimUSanté has demonstrated the leverage of IDEFI projects. Opened in 2016, the SimU-

Santé centre is now Europe's biggest flexible healthcare simulation centre with 4,000 m² of space and 51 fully-equipped high-technology teaching rooms and reconstituted work environments. The year 2017 was a turning point in its development – on 28 September 2017, teams at Amiens University Hospital achieved a world first by operating on the spinal column of a child with the ROSA® robot. SimUSanté made it possible to prepare for the operation with a simulation on a 3D model of the patient. The centre's development has also led to recognition and collaboration with business (Medtech, Airbus Helicopters).



Perspectives

Projects will continue, including one established jointly with UPJV (the Epione health campus) that will contribute to the digital transformation in the healthcare field, together with the development of the SimUTED programme. The only project of its kind in the world, SimUTED helps to accustom people with autism to medical examinations and treatment by welcoming them to simulated spaces.

SIMUSANTÉ

Development of an active teaching centre with advanced healthcare simulation

ACTION:
IDEFI

PROJECT REGION:
Hauts-de-France

EDITION, PROJECT DURATION:
18/04/2012; 92 months

PARTNERS:
Amiens University
Hospital – University
of Picardie-Jules Verne
Amiens
Institut Faire Faces

ANR GRANT:
€8.5M

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The head office of INEF4.

Supporting companies and construction actors in the energy transition

Competitiveness through innovation combines research, economic exploitation and innovation processes. The innovation process for transforming an R&D result into a new product or service must be based on a high-performance organisation adapted to the economic sector in which it operates. This is what INEF4 has achieved over the last three years: organisational innovation.

The construction sector represents 45% of France's energy consumption and is responsible for 45% of greenhouse gas emissions. The ITE (Institute for the Energy Transition) INEF4 (INnovation and Excellence Factor 4) project was launched in 2014 in response to this challenge. Based at the Nobatek technical centre in Anglet, with support from the Nouvelle Aquitaine regional council and the construction trade association Le Cercle Promodul, INEF4 has addressed the issue of sustainable construction and renovation by using open innovation to respond to strong demand from many construction actors with regard to energy efficiency questions. Beginning as a conventional grouping in 2014, INEF4 was converted into an unusual asset structure at the request of the government. The shareholders chose the legal form of a SCIC (cooperative company of collective interest) to reinforce the impact of the open innovation process. This structure makes it possible to unite all the actors in a sector around a common interest and involve local authorities. The SCIC Nobatek/INEF4 was christened in November 2016.

The ITE INEF4 continued its organisational innovation in 2017 by creating an endow-

ment fund called Cercle Promodul-INEF4. The fund's purpose is to work with professionals in the sector to conduct and sustain initiatives aiming to promote innovation to help the construction sector successfully negotiate the transitions it faces on behalf of the whole community. A key priority is to emphasise the role of users in these transitions and to help the fragmented, regionalised actors in the sector to overcome challenges with innovative training tools. Connected to technology platforms and regional incubators, INEF4 invented and is deploying the concept of the ITE, going beyond the locally based legal structure to establish a national network of open innovation dedicated to sustainable construction.

Perspectives

The construction sector is very fragmented, with nearly 580,000 companies in France, many of them small businesses or self-employed tradesmen, regionally rooted and carrying out very little R&D. Innovating in this sector is a challenge, since creating and disseminating innovative products and services requires cross-disciplinary skills and appropriation by a large number of local actors. The Batiscaf training tool from INEF4 and the Cercle Promodul, rewarded at EnerJe-meeting 2018, is an example of using innovative artificial intelligence technology to train tradesmen throughout the country.

INEF4

An innovative organisation for sustainable construction

ACTION :
Institute for the Energy Transition (ITE)

PROJECT REGION:
Nouvelle-Aquitaine

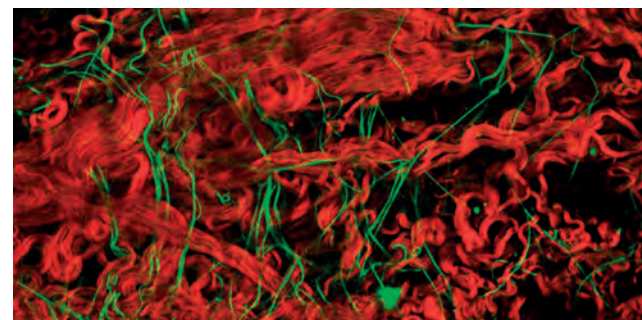
EDITION, PROJECT DURATION:
10/2013; 60 months

PARTNERS:
Cercle Promodul, Delta Dore, Coveris, CSTB, Tecnalia

ANR GRANT:
€7M

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SHG observation of collagen (red) and elastin (green) using autofluorescence in carotids under load (500 µm x 500 µm).

A unique, large-scale project giving access for the first time to a platform of innovative tools for studying the ageing of human tissues

The project focused on developing high-technology tools and offering French and European engineers, biologists and clinicians the chance to study the ageing of living tissue in order to advance research excellence and enable technology transfer for the benefit of patients. With a dual scientific approach combining biology and mechanical engineering, it aimed to improve public health by developing new therapeutic solutions.

These tools blend biological, biomechanical and imaging approaches during the tissue ageing process on the nanometre, micrometre and millimetre scales in order to:

- provide tools for regenerative medicine and transplantation;
- establish clinical databases for better diagnosis;
- offer tools for evaluating new medications and therapeutic systems;
- understand the influence of cellular activity on tissue modification.

The year 2017 saw the emergence of new research results that could not have been achieved without acquiring this equipment. These include:

- age-related or genetic diseases and the link between the mineral quality and mechanical response of bone tissues;
- osteoarthritis and the loss of mechanical properties in the meniscus and joint cartilage;
- the mechanics of arterial tissue;
- osteoporosis and the relationship between the mechanical properties of bone tissue and the skin's surface;
- bone tissue engineering and the role of mechanical stress distribution.

This work has led to patents and inspired interactions with industrial partners from various healthcare fields (pharmacy, medical and cosmetic devices) in areas relating to medications and their effects in cases of osteoarthritis, the characterisation of the skin surface and its relationship with the quality of bone tissue in the femoral neck, new coatings and texture problems in the development of artificial hips etc.

Perspectives

The project is now entering its third phase, which aims to transfer the technology of several of its discoveries for the benefit of patients. Programmes are currently being evaluated.

IVTV

Engineering and ageing of living tissue

ACTION :
Equipment of Excellence (EQUIPEX)

PROJECT REGION:
Auvergne-Rhône-Alpes
Edition, project duration:
22/02/2011; 106 months

PARTNERS:
Scientific leader: Thierry Hoc (Ecole Central de Lyon)
Coordinating institution: COMUE University of Lyon
Partners:
École Centrale de Lyon
University of Lyon
Saint-Etienne (Jean Monnet)
École Nationale Supérieure des Mines Saint-Étienne
École Nationale Ingénieurs Saint-Etienne
Centrale Innovation
Hospices Civils de Lyon
university hospital
Saint-Etienne university hospital
VetAgro Sup
Techtera
University of Lyon I (Claude Bernard)
École Normale Supérieure de Lyon
CNRS Rhône Auvergne (Villeurbanne)
IFSTTAR

ANR GRANT:
€2.6M

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N Quintin observing the first stabilised optical signal arriving at the RENATER node hosted at the University of Strasbourg IT department. The very narrow spike on the screen is the first sign of the successful arrival in Strasbourg of REFIMEVE+. (2015)

Distributing an ultra-precise optical frequency to about 20 French laboratories by optical fibre with no loss of performance, a world first

Part of the PIA 1 Equipment of Excellence initiative, REFIMEVE+ builds on a technological breakthrough using ultra-precise lasers and fibre-optic Internet to transmit signals from the best clocks over long distances with no degradation, enabling the signals to be compared. These results represent major progress for evaluating systematic errors in time and frequency metrology and precision measurement.

The project aims to distribute an ultra-precise optical reference frequency by optical fibre with no loss of performance to about twenty French laboratories using the RENATER academic network, which provides high-speed Internet throughout the country. The reference frequency comes from the SYRTE laboratory at the Paris Observatory. Optoelectronic equipment has been specially designed to correct environmental noise from the optical fibres added to the ultra-precise signal in real time.

The reference signal comes from cold atomic clocks that are among the most accurate in the world, with precision to 17 significant digits. Thanks to the REFIMEVE+

project, this kind of signal can now be transported with no loss of information. This means laboratories connected to the REFIMEVE+ network now have virtual access to the same clock as the SYRTE laboratory. An experiment involving SYRTE and the PTB laboratory in Germany, connected by a 1,400 km link, showed that their respective strontium clocks supplied frequencies that were offset by 2.10^{15} , a value a hundred times greater than the relative precision of the clocks. This offset is explained by general relativity and reflects the altitude difference of 20 metres between the two clocks, opening the way for chronometric geodesy. This spectacular result obtained thanks to REFIMEVE+ was ranked among the 10 greatest scientific advances of the year 2016 by the magazine La Recherche. The project now has the challenge of transferring its knowledge to industrial companies in order to develop equipment to industrial standards for deployment in the field, in France but perhaps also worldwide. Three French SMEs are already taking up the baton. Equipment has been deployed and put into operation in real conditions on the Paris-Strasbourg-Besançon and Paris-Lille links.

Perspectives

The REFIMEVE+ technology enables a variety of research instruments to be networked, opening up brand new possibilities such as chronometric geodesy or new methods for quantum cryptography. The REFIMEVE+ network itself can also be considered a large and ultra-sensitive instrument, where the noise added by the fibre-optic environment is interpreted as a signal. This promises the emergence of new applications for Earth observation.

REFIMEVE+

Metrological fibre network with a European vocation +

ACTION :
Equipment of Excellence (EQUIPEX)

PROJECT REGION:
Île-de-France

EDITION, PROJECT DURATION:
01/07/2012; 90 months

PARTNERS:
University of Paris XIII (Paris Nord Villetanneuse), Paris Observatory, University of Paris VI (Pierre and Marie Curie), École Normale supérieure de Paris, Institute of Optics Graduate School, University of Paris XI (Paris Sud Orsay), University of Paris VII (Diderot), University of Aix-Marseille, University of Toulouse III (Paul Sabatier), University of Franche Comté, École Nationale Supérieure de Mécanique et des Microtechniques de Besançon, University of Lille I (Science and Technology), University of Bordeaux I, Côte d'Azur Observatory (Nice), University of Nice, French National Centre of Space Studies, CEA Paris, NRS Paris B, CNRS IDF Sud (Gif), CNRS IDF Ouest Nord (Meudon), NRS Centre Est (Vandoeuvre), CNRS Centre Poitou Charentes (Orléans), CNRS Alpes (Grenoble), CNRS Provence Corse (Marseille), NRS Midi-Pyrénées (Toulouse), CNRS Aquitaine Limousin (Talence), CNRS Nord Pas-de-Calais Picardie (Lille), CNRS Côte d'Azur (Valbonne), RENATER, University of Orléans, University of Grenoble Alpes

ANR GRANT: €6.7M

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APPENDICES

Review of the 2017 calls for proposals						
Components/instruments	Projects peer reviewed in stage 2 or single stage	Projects funded	Success rate relative to the number of eligible proposals (stage 1 review or single-stage call)	Success rate relative to the number of eligible proposals (stage 2 review or single-stage call)	Overall ANR funding (€M)	% of overall ANR funding
MAJOR SOCIETAL CHALLENGES	2,262	721	13.3%	31.9%	284.5	57.3%
Collaborative research projects (PRC)	1,563	461	12.5%	29.5%	218.4	43.99%
Young researchers (JCJC)	681	250	14.5%	36.7%	60.5	12.19%
Challenges	18	10	55.6%	55.6%	5.6	1.13%
AT THE FRONTIERS OF RESEARCH	379	128	13.6%	33.8%	44.3	8.92%
Collaborative research projects (PRC)	246	80	13.4%	32.5%	33	6.65%
Young researchers (JCJC)	133	48	14.0%	36.1%	11.2	2.26%
BUILDING THE ERA AND FRANCE'S INTERNATIONAL ATTRACTIVENESS	1,318	339	19.3%	25.7%	77.3	15.57%
International collaborative research projects (PRCI)	778	98	12.6%	12.6%	28.1	5.66%
Specific bilateral calls	67	16	24.0%	24.0%	3.6	0.73%
Specific multilateral calls (ERA-NET, JPI, Belmont Forum etc.)	379	152	40.1%	40.1%	37.6	7.57%
Springboard-ERC (T-ERC)	48	48	N/A	N/A	7.4	1.49%
Setting up European and International Scientific Networks (MRSEI)	46	25	54.0%	54.0%	0.7	0.14%
ECONOMIC IMPACT OF RESEARCH AND COMPETITIVENESS	620	192	16.8%	31.0%	90.4	18.21%
Collaborative research projects involving enterprises (PRCE)	373	126	14.1%	33.8%	69.3	13.96%
ASTRID and ASTRID Maturation	130	33	25.4%	25.4%	11.1	2.24%
Labcom	108	28	25.9%	25.9%	6.4	1.29%
Industrial chairs	9	5	55.6%	55.6%	3.6	0.73%
TOTAL	4 579	1 380	14.9%	30.1%	496.5	100%

Review of the 2017 calls for proposals - Credit breakdown by beneficiary type (value)										
	Total Commitments (€)	CNRS	INSERM	INRIA	INRA	IRD	CEA	Other research bodies	Research bodies subtotal	Universities
COMPONENT 1	284,543,883	92,541,275	30,651,728	5,097,198	12,823,268	3,853,204	8,278,627	9,315,746	162,561,046	68,521,152
PRC	218,408,563	76,118,964	23,351,954	3,199,182	10,539,026	3,349,290	7,139,417	6,159,209	129,857,041	48,488,251
JCJC	60,531,573	16,422,311	7,299,774	1,469,188	2,230,321	503,915	299,160	2,428,325	30,652,994	19,314,106
Challenges	5,603,746	-	-	428,828	53,921	-	840,051	728,212	2,051,011	718,796
COMPONENT 2	44,255,662	21,983,547	245,808	40,435	940,411	-	3,006,753	616,957	26,833,911	11,254,233
PRC	33,032,230	16,352,432	245,808	40,435	577,977	-	2,191,292	450,341	19,858,284	8,305,493
JCJC	11,223,432	5,631,115	-	-	362,434	-	815,462	166,616	6,975,627	2,948,741
COMPONENT 3	77,277,051	24,927,155	6,915,284	1,079,628	4,579,951	1,035,979	2,707,385	3,851,568	45,096,951	17,010,338
PRCI	28,086,423	11,893,025	1,666,614	587,521	823,420	155,194	1,189,457	690,509	17,005,739	6,263,587
Bilateral exc. PRCI	3,586,976	1,402,686	-	-	-	290,133	221,467	-	1,914,286	1,530,400
ERANET, JPI, etc.	37,564,370	6,966,682	4,935,086	312,612	3,621,033	381,452	1,267,801	3,161,059	20,645,725	8,116,350
ERC programme	7,362,123	4,499,565	254,779	149,995	106,000	180,000	-	-	5,190,338	894,792
MRSEI	677,158	165,198	58,806	29,500	29,499	29,200	28,660	-	340,863	205,210
COMPONENT 4	90,431,174	18,507,651	2,345,626	975,186	1,531,818	464,369	4,123,431	4,048,630	31,996,710	22,272,447
PRCE	69,277,484	14,951,874	2,223,316	975,186	1,131,818	464,369	3,112,574	3,185,377	26,044,513	15,430,998
ASTRID inc. Maturation	11,060,214	2,110,777	122,310	-	-	-	110,857	863,253	3,207,197	2,828,973
Labcom	6,448,497	1,445,000	-	-	400,000	-	300,000	-	2,145,000	3,262,497
Industrial chairs	3,644,979	-	-	-	-	-	600,000	-	600,000	749,979
TOTAL CALLS FOR PROPOSALS	496,507,769	157,959,628	40,158,446	7,192,447	19,875,448	5,353,552	18,116,196	17,832,901	266,488,619	119,058,171
OUTSIDE CALLS FOR PROPOSALS										
Carnot Institutes (component 4)	57,000,000	-	-	-	-	-	-	-	-	-
Basic Technological Research (RTB)	3,800,000	-	-	-	-	-	-	-	-	-
INCA	38,000,000	-	-	-	-	-	-	-	-	-
Preciput	29,200,000	6,899,646	2,819,203	271,424	2,313,468	131,927	1,874,018	378,271	14,687,957	10,943,150
TOTAL OUTSIDE CALLS FOR PROPOSALS	128,000,000	-	-	-	-	-	-	-	-	-
TOTAL ANR BUDGET (COMMITMENT AUTHORITIES)	624,507,769	-	-	-	-	-	-	-	-	-

	Other higher education institutions	Hospitals/ healthcare	Other public sector	Public sector subtotal	Foundations	Non-profit organisations	Micro-businesses	SMES	Other businesses	Other private sector	Private sector subtotal
	28,131,935	2,839,933	1,748,405	263,802,471	15,570,131	1,714,339	251,122	2,219,005	565,311	421,504	20,741,412
	20,357,968	2,839,933	1,748,405	203,291,597	12,877,733	1,635,855	-	346,366	119,207	137,805	15,116,966
	7,618,447	-	-	57,585,547	2,692,398	-	-	-	-	253,629	2,946,026
	155,520	-	-	2,925,327	-	78,484	251,122	1,872,639	446,104	30,070	2,678,419
	5,548,010	-	144,782	43,780,937	370,881	-	-	-	-	103,845	474,726
	4,493,898	-	144,782	32,802,457	125,928	-	-	-	-	103,845	229,773
	1,054,112	-	-	10,978,480	244,953	-	-	-	-	-	244,953
	6,542,506	465,620	1,029,675	70,145,091	2,242,092	1,775,688	336,980	1,863,589	494,279	419,332	7,131,960
	2,829,124	66,838	-	26,165,287	782,750	813,713	-	92,340	-	232,333	1,921,136
	142,290	-	-	3,586,976	-	-	-	-	-	-	-
	2,882,099	369,360	1,029,675	33,043,208	1,066,680	811,975	336,980	1,771,249	494,279	40,000	4,521,162
	629,994	-	-	6,715,123	350,000	150,000	-	-	-	147,000	647,000
	59,000	29,422	-	634,496	42,662	-	-	-	-	-	42,662
	12,955,748	1,576,712	529,512	69,331,131	422,958	3,069,653	3,134,180	7,309,147	5,998,338	1,165,766	21,100,043
	8,259,933	1,516,896	529,512	51,781,853	122,958	2,265,701	2,780,308	6,304,507	4,856,390	1,165,766	17,495,631
	2,354,815	59,816	-	8,450,801	-	108,951	353,872	1,004,640	1,141,949	-	2,609,413
	741,000	-	-	6,148,497	300,000	-	-	-	-	-	300,000
	1,600,000	-	-	2,949,979	-	695,000	-	-	-	-	-
	53,178,200	4,882,266	3,452,374	447,059,629	18,606,061	6,559,680	3,722,283	11,391,741	7,057,928	2,110,447	49,448,140

Review of the 2017 calls for proposals - Credit breakdown by beneficiary type																						
	Total commitments (€)	CNRS	INSERM	INRIA	INRA	IRD	CEA	Other research bodies	Research bodies subtotal	Universities		Other higher education institutions	Hospitals/healthcare	Other public sector	Public sector subtotal	Foundations	Non-profit organisations	Micro-businesses	SMES	Other businesses	Other private sector	Private sector subtotal
COMPONENT 1	284,543,883	32.5%	10.8%	1.8%	4.5%	1.4%	2.9%	3.3%	57.1%	24.1%		9.9%	1.0%	0.6%	92.7%	5.5%	0.6%	0.1%	0.8%	0.2%	0.1%	7.3%
PRC	218,408,563	34.9%	10.7%	1.5%	4.8%	1.5%	3.3%	2.8%	59.5%	22.2%		9.3%	1.3%	0.8%	93.1%	5.9%	0.7%	0.0%	0.2%	0.1%	0.1%	6.9%
JCJC	60,531,573	27.1%	12.1%	2.4%	3.7%	0.8%	0.5%	4.0%	50.6%	31.9%		12.6%	0.0%	0.0%	95.1%	4.4%	0.0%	0.0%	0.0%	0.0%	0.4%	4.9%
Challenges	5,603,746	0.0%	0.0%	7.7%	1.0%	0.0%	15.0%	13.0%	36.6%	12.8%		2.8%	0.0%	0.0%	52.2%	0.0%	1.4%	4.5%	33.4%	8.0%	0.5%	47.8%
COMPONENT 2	44,255,662	49.7%	0.6%	0.1%	2.1%	0.0%	6.8%	1.4%	60.6%	25.4%		12.5%	0.0%	0.3%	98.9%	0.8%	0.0%	0.0%	0.0%	0.0%	0.2%	1.1%
PRC	33,032,230	49.5%	0.7%	0.1%	1.7%	0.0%	6.6%	1.4%	60.1%	25.1%		13.6%	0.0%	0.4%	99.3%	0.4%	0.0%	0.0%	0.0%	0.0%	0.3%	0.7%
JCJC	11,223,432	50.2%	0.0%	0.0%	3.2%	0.0%	7.3%	1.5%	62.2%	26.3%		9.4%	0.0%	0.0%	97.8%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
COMPONENT 3	77,277,051	32.3%	8.9%	1.4%	5.9%	1.3%	3.5%	5.0%	58.4%	22.0%		8.5%	0.6%	1.3%	90.8%	2.9%	2.3%	0.4%	2.4%	0.6%	0.5%	9.2%
PRCI	28,086,423	42.3%	5.9%	2.1%	2.9%	0.6%	4.2%	2.5%	60.5%	22.3%		10.1%	0.2%	0.0%	93.2%	2.8%	2.9%	0.0%	0.3%	0.0%	0.8%	6.8%
Bilateral exc. PRCI	3,586,976	39.1%	0.0%	0.0%	0.0%	8.1%	6.2%	0.0%	53.4%	42.7%		4.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
ERANET, JPI, etc.	37,564,370	18.5%	13.1%	0.8%	9.6%	1.0%	3.4%	8.4%	55.0%	21.6%		7.7%	1.0%	2.7%	88.0%	2.8%	2.2%	0.9%	4.7%	1.3%	0.1%	12.0%
ERC programme	7,362,123	61.1%	3.5%	2.0%	1.4%	2.4%	0.0%	0.0%	70.5%	12.2%		8.6%	0.0%	0.0%	91.2%	4.8%	2.0%	0.0%	0.0%	0.0%	2.0%	8.8%
MRSEI	677,158	24.4%	8.7%	4.4%	4.4%	4.3%	4.2%	0.0%	50.3%	30.3%		8.7%	4.3%	0.0%	93.7%	6.3%	0.0%	0.0%	0.0%	0.0%	0.0%	6.3%
COMPONENT 4	90,431,174	20.5%	2.6%	1.1%	1.7%	0.5%	4.6%	4.5%	35.4%	24.6%		14.3%	1.7%	0.6%	76.7%	0.5%	3.4%	3.5%	8.1%	6.6%	1.3%	23.3%
PRCE	69,277,484	21.6%	3.2%	1.4%	1.6%	0.7%	4.5%	4.6%	37.6%	22.3%		11.9%	2.2%	0.8%	74.7%	0.2%	3.3%	4.0%	9.1%	7.0%	1.7%	25.3%
ASTRID inc. Maturation	11,060,214	19.1%	1.1%	0.0%	0.0%	0.0%	1.0%	7.8%	29.0%	25.6%		21.3%	0.5%	0.0%	76.4%	0.0%	1.0%	3.2%	9.1%	10.3%	0.0%	23.6%
Labcom	6,448,497	22.4%	0.0%	0.0%	6.2%	0.0%	4.7%	0.0%	33.3%	50.6%		11.5%	0.0%	0.0%	95.3%	4.7%	0.0%	0.0%	0.0%	0.0%	0.0%	4.7%
Industrial chairs	3,644,979	0.0%	0.0%	0.0%	0.0%	0.0%	16.5%	0.0%	16.5%	20.6%		43.9%	0.0%	0.0%	80.9%	0.0%	19.1%	0.0%	0.0%	0.0%	0.0%	19.1%
OVERALL TOTAL	496,507,769	31.8%	8.1%	1.4%	4.0%	1.1%	3.6%	3.6%	53.7%	24.0%		10.7%	1.0%	0.7%	90.0%	3.7%	1.3%	0.7%	2.3%	1.4%	0.4%	10.0%

The ANR support for projects backed by competitive clusters through its 2017 calls for proposals

Cluster name	Number of projects funded	Funding granted to the project (€M)
Aerospace Valley	6	2.8
Agri Sud-Ouest Innovation	6	3
Atlanpole Biothérapies	4	1.3
AVENIA	2	1.4
AXELERA	10	4.7
Cancer-Bio-Santé	1	0.03
Cap Digital Paris-Région	3	1.5
CAPENERGIES	5	2.8
Cereal Valley	3	1.7
Cosmetic Valley	1	0.6
DERBI (Renewable Energy in Construction and Industry)	2	1.4
EAU	3	1.7
ELASTOPOLE	1	0.6
ELOPSYS	1	0.5
EMC2 (Metal Assemblies and Complex Composites)	2	1.1
Eurobiomed	5	2.2
FIBRES-ENERGIE	3	1.3
FINANCE INNOVATION	2	1.2
HYDREOS	2	1.4
iDforCAR	2	1.4
Images & Networks	9	4.6
IMAGINOVE	2	0.9
IAR (Industry and Agro-Resources)	5	2.6
i-Trans (association promoting land transport)	1	0.7
LUTB Transport & Mobility Systems	2	0.7
LYON BIOPOLE	13	6.1
Materialia	4	2.2
MATIKEM	3	1.3

The ANR support for projects backed by competitive clusters through its 2017 calls for proposals

Cluster name	Number of projects funded	Funding granted to the project (€M)
Medicen	6	3.6
Mer Bretagne Atlantique	4	2.2
Mer Méditerranée	2	1
Microtechniques	2	0.6
MINALOGIC	11	4.4
MOVEO	2	1.4
Novalog	1	0.5
Nuclear Valley	3	1.7
Nutrition Health Longevity	3	1.8
OPTITEC	5	2.3
PLASTIPOLIS	3	1.4
Qualiméditerranée	1	0.4
Qualitropic (Agronutrition in tropical environments)	1	0.5
Route des Lasers	4	1.3
S2E2 (Smart Electricity Cluster)	3	1.7
SAFE	5	3.1
SCS (Secured Communicating Solutions)	2	0.7
SYSTEMATIC Paris region	4	1.6
TECHTERA (Textiles and Functional Materials)	1	0.1
TENERRDIS	3	2
TERRALIA	5	3
TES (E-Secure Transactions)	2	1.3
UP-TEX	2	0.8
VALORIAL	2	1.5
VEGEPOLYS	5	2
VIAMECA	4	1.8
VITAGORA	2	1.5
TOTAL GRANTS (EXCLUDING DUPLICATES)	148 PROJECTS	€96M

Specific international calls for proposals (bilateral and multilateral) in 2017			
Call for proposals	Theme	Projects funded	Budget allocated by the ANR (€M)
Bilateral French-German ANR-DFB	Social sciences and humanities	15	3
Bilateral French-American ANR-NSF PIRE	Challenges 2, 3 and 7	1	0.6
ARIMNET 2	Agricultural research in the Mediterranean area (Young Researchers)	10	1.5
ERANETMED	Mediterranean	5	1
ERA4CS (Climate Services) - JPI CLIMATE	Climate services	9	4.7
ERA-CAPS	Molecular plant sciences	7	1.3
ERA-GAS/JPI FACCE	Greenhouse gases from agri- and silviculture	7	1.3
FACCE SURPLUS/JPI FACCE	Sustainable agriculture	3	0.6
MARTERA/JPI OCEAN	Marine and maritime technologies	5	1
JSF ASEAN-EU	Multilateral funding scheme between the EU and the ASEAN countries on the themes of health and the environment/climate	8	0.3
DIGITAL HERITAGE 2017/JPI Culture Heritage	Digital heritage	6	1.4
FLAG-ERA 2	FET Flagships "Graphene" and "Human Brain Project"	14	3.7
CHIST-ERA 2	Long-term challenges in ICT	4	0.9
CRCNS	Computational neuroscience	5	1.5
E-RARE-3	Rare diseases	8	2.5
EuroNanoMed 3	Nanomedicine	9	2.1
HDHL-INTIMIC (HDHL Challenge 2)/JPI HDHL	Interactions between the intestinal microbiome, diet and health	7	2.4
ERACoSysMed	Systems medicine	3	1.1
ERA-CVD	Cardiovascular diseases	7	1.6
NEURON	Central nervous system diseases	6	1.8
JPco-fuND/JPI JPND	Neurodegenerative diseases	5	1.7
JPI HDHL Working Groups	Transnational working groups on chronic diet-related diseases	1	0.05
CoBioTech	Biotechnologies	7	1.8
ENSUF - JPI Urban Europe	Sustainable urban development	5	0.9
EN-SUGI (JPI Urban/Belmont Forum)	Food-water-energy nexus in the context of sustainable urban planning	2	0.4
Digging into data (DID) T-AP Transatlantic Platform	"At the heart of digital data"	5	0.9
Norface DIAL	Inequality	4	1.2
TOTAL	N/A	168	41.2



Investments for the future *	
Total authorised	9,826,418,049
Total disbursed	6,912,174,800
TOTAL AGREED	9,505,627,094

Including the non-consumable grants for the 3 fully certified IDEX projects.
* excluding Campus and Saclay/excluding CVT



Investments for the Future - Project status by region on 31/12/2017*				
Main region of project	Number of projects	Total authorised (€)	Total disbursed (€)	Remaining to be disbursed (€)
Auvergne-Rhône-Alpes	103	1,356,548,939	694,320,306	662,228,633
Bourgogne-Franche-Comte	9	131,484,921	55,086,876	76,398,045
Bretagne	19	296,766,524	178,748,696	118,017,828
Centre-Val de Loire	7	50,250,805	27,122,139	23,128,666
Grand Est	34	1,322,106,267	1,178,166,590	143,939,677
Hauts-de-France	30	443,619,158	227,512,320	216,106,838
Île-de-France	250	2,884,494,184	1,885,963,392	998,530,792
Normandie	11	69,017,039	49,604,906	19,412,132
Nouvelle-Aquitaine	32	1,098,250,225	1,001,355,080	96,895,145
Occitanie	53	718,406,718	441,302,422	277,104,296
Pays de la Loire	11	161,605,505	90,168,575	71,436,930
Provence-Alpes-Côte d'Azur	36	1,244,467,763	1,062,423,495	182,044,268
TOTAL	595	9,777,018,049	6,891,774,800	2,885,243,249

Including the non-consumable grants for the 3 fully certified IDEX projects.
* excluding Campus and Saclay/excluding CVT



Investments for the Future - Disbursement status by action on 31/12/2017*				
Name of action	Number of projects	Total authorised (€)	Total disbursed (€)	Remaining to be disbursed (€)
Bioinformatics	12	17,130,082	15,549,520	1,580,563
Biotech – Bioresources	13	88,213,364	62,821,000	25,392,364
Cohorts	10	74,467,076	49,236,808	25,230,268
Thematic development consortia (CVT)	6	49,400,000	20,400,000	29,000,000
Demonstrators	4	77,993,735	58,841,385	19,152,350
Development of Experimental Digital Universities (DUNE)	5	8,000,000	2,400,000	5,600,000
Equipment of Excellence	93	591,902,706	512,022,764	79,879,942
Equipment of Excellence 2	4	131,200,000	28,246,000	102,954,000
Additional experimentation by SATTs	2	3,000,000	1,000,000	2,000,000
IDEX/I-SITE (including Labex and Idefi in IDEX)	77	971,094,424	358,154,148	612,940,276
Infrastructure	23	496,637,699	381,484,220	115,153,479
Initiatives of Excellence (including Labex and Idefi in IDEX)	75	3,580,670,643	3,449,994,170	130,676,473
Initiatives of Excellence in Digital Education	12	12,290,000	6,528,933	5,761,067
Initiatives of Excellence in Innovative Education (excluding IDEX)	24	124,755,620	91,105,159	33,650,461
Carnot Institutes	55	136,216,771	75,286,653	60,930,118
Convergence Institutes	10	103,136,000	3,582,674	99,553,326
Technology Research Institutes	8	919,954,825	365,409,668	554,545,157
Energy Transition Institutes (formerly IEED)	12	367,325,393	165,036,422	202,288,971
University Hospital Institutes (IHU)	6	349,329,163	263,074,851	86,254,312
University Hospital Institutes B	6	35,000,000	31,500,000	3,500,000
Boarding Schools of Excellence and Equality of Opportunity	1	900,000	450,000	450,000
Laboratories of Excellence (excluding IDEX)	56	539,838,256	358,344,754	181,493,502
Make Our Planet Great Again	18	11,360,543		11,360,543
Nanobiotechnology	8	18,842,529	16,325,446	2,517,083
University Hospital Cancer Centre (PHUC)	2	20,000,000	17,152,800	2,847,200
University Hospital Health Research	24	185,423,340	47,001,086	138,422,254
Technology Transfer Acceleration Companies (SATT)	14	856,800,000	495,673,998	361,126,002
Nuclear Safety	21	55,535,879	35,552,341	19,983,538
TOTAL	601	9,826,418,049	6,912,174,800	2,914,243,249

Including the non-consumable grants for the 3 fully certified IDEX projects.

* Excluding Campus and Saclay.

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