FROM RESEARCH TO INDUSTRY

French Alternative Energies and Atomic Energy Commission
STRATEGY

Low-Carbon Energies
(Nuclear and renewables)

Information and Health Technologies

Very Large Scale Facilities

Defence and Security

Basic Research
≈ 30% of the subsidies

Training and dissemination of knowledge

Technology development and transfer
Established in October 1945 by General de Gaulle, CEA leads research programs, on behalf of the French government, aiming at increasing scientific knowledge and contributing to innovation and technology transfer in a limited number of areas. In 2010, CEA became the Alternative Energy and Atomic Energy Commission.

CEA, by its scientific and technological research programs and by its ability to propose research formation, is committed to face major societal challenges:

- Support for the industry through innovation
- Energy transition to a low-carbon energy mix
- Health
- Defence and Security

The CEA organization is based on shared values: sense of public interest, acceptance of responsibility, commitment, requirement, acceptance of complexity, solidarity.
CEA IS PRESENT IN 9 REGIONS OF FRANCE

10 Research centers in France

- Saclay
- Fontenay-aux-Roses
- Metz
- Bruyères-le-Chatel
- Valduc
- Grenoble
- Nantes
- Le Ripault
- Bordeaux
- Cesta
- Gramat
- Toulouse
- Marcoule
- Cadarache
- CESTA
- Lasers & plasmas
- Aquitaine
- NCC: Nuclear:
  - Nuclear fuel cycle and waste management
  - Fusion, fission
  - Bioenergies, solar

Physical sciences, software technologies
high performance computing, biomedicine
**Ile-de-France**

Materials Centre, Bourgogne

Micro-Nanotechnologies
Nanobiotechnologies
New technologies for energy
**Rhône-Alpes**

Vulnerability assessment
Detonics
**Midi-Pyrénées**

Regional platforms of technology transfer

4 Regional platforms of technology transfer
KEY FIGURES 2014

- 16,000 Employees
- €4.3 Billion budget (Civil: 2.6 B€ - Defence: 1.7 B€)
- 1,504 PhD students, 276 post-doctoral researchers
- 5,600 Patent families
- 751 Delivered priority patents in 2013: 3rd national patent filer
- 115 Innovative technology start-ups created since 2000
- €119 Million budget H2020 European funds (success rate: 28% in funding)
- 53 Agreements with universities and research establishments
- 51 Joint research units
- 27 Competitiveness clusters
World TOP 100 for innovation since 4 years (Thomson Reuters ranking)

More than 5,022 publications per year in refereed journals

More than 500 industrial partnership agreements

First public research organization in the world ranking of the PCT patent applicants

First partner of the public investments program « investissements d’avenir - PIA »

Captures 40% of the R & D entrusted by the private sector to the public sector in France

Continued growth of external revenue since 2006 (+ 62%) : > 900 M€, including 500 M€ of industrial funding
LOW-CARBON ENERGIES (NUCLEAR AND RENEWABLES)

- **Nuclear energy**
  - Future industrial nuclear systems
  - Optimization of present nuclear systems
  - Large tools for the development of nuclear energy
  - Clean up and dismantling

- **New technologies for energy**
  - Materials
  - Energy efficiency (processes, smart grids, electric vehicles)
  - Renewable energies (solar energy, hydrogen and biofuels)

- **Basic research for energy**
  - Controlled thermonuclear fusion
  - Climate and environment sciences
  - Future technologies for energy

- **Life sciences research for energy**
  - Radiobiology - Toxicology
  - Bioenergies - Energy efficient processes
TECHNOLOGIES FOR INFORMATION AND HEALTH

- **Micro & nanotechnologies**
  - Micro-nanoelectronics
  - Information et communication
  - Micro-nanoelectronics for health and security

- **Digital system technologies**
  - On-board and interactive systems
  - Manufacturing and numerical engineering
  - Numerical technologies for health

- **Basic research**
  - Nanosciences
  - Condensed matter physics and statistical physics

- **Health technologies and biotechnologies**
  - Molecular and cellular mechanisms, structural biology
  - Biomedical imaging (in vivo), genomic
  - Global methods for functional analyses
Approximately one third of the grant dedicated to basic research program in CEA

An associated basic research: fundamental laws of the universe, HPC and simulation, accelerators and cryotechnologies, matter-laser interactions

Feedbacks from technological design and operating activities
Simulation
- France’s guarantee for future capacity of deterrence without any nuclear test

Design, manufacturing, operational maintenance, dismantling of nuclear weapons warheads

Nuclear propulsion
- Design and maintenance of reactors for nuclear propulsion (submarines and aircrafts carrier)

Security
- Prevention of nuclear proliferation and terrorism,
- Monitoring and survey of international treaties

Conventional Defence
To contribute to meet the needs of recruitment & manpower in the nuclear industry for the next years and to develop the French nuclear sector.

To intensify the effort of training in nuclear engineering, to valorize the French offer in synergy with I2EN and AFNI, including nuclear for medical purpose.
A COLLECTIVE VISION FOR THE MEAN AND THE LONG TERM ► PMLT 2013-2022

Governmental, societal and industrial needs

Integrated research for a sustainable economical values creation

FROM RESEARCH TO INDUSTRY

Internationals actions
Worldwide network

Low-Carbon Energies (Nuclear and renewables)
Defence and Global Security
Information technologies
Health technologies

Scientific and technological questions

Governments, societal and industrial needs

Research infrastructures
Fundamental and applied research
Strategic academic partnerships

Technological platforms
Integrated valorization strategy

Government Support mission in the nuclear field

All industrial sectors
Sustaining and creating about 14,000 indirect jobs, mainly in the field of innovation, enabled by an amount of 2.4 Billion/year of purchases.

- > 500 direct R&D partnerships with industrial companies
- € 454 Million of industrial funding in 2014
- ~ 30% of private R&D outsourced in France

A direct support to innovative key enabling technologies: nanoelectronics, energy, defence… and a regional, national and European capability to federate clusters.

Integrated set of tools for the valorization process:
- 5,600 patent families
- 115 start-ups created since 2000
- 3,500 jobs

Industrial partnerships
Investor creator of start-ups
High technology purchases
Federative actor for innovative clusters
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APPENDICES

French Alternative Energies and Atomic Energy Commission
Some significant advances in the field:
LOW CARBON ENERGIES, NUCLEAR AND RENEWABLES

Major version of the neutronics code APOLLO delivered to AREVA. Flamanville EPR core expertise

First version of CATHARE-3 (thermo hydraulics code) delivered to EDF and AREVA

Implementation of the HelioBiotec platform for 3rd generation biofuels

Demonstration platform for ENR – H₂ storage integration
CEA – Corsica Univ. - HELION Collaboration

New world record for CPV 44.7% PV conversion efficiency
CEA – FhGISE - SOITEC Collaboration

CO₂ recycling by a new catalytic reaction

CEA – FhGISE - SOITEC Collaboration

LA PLATEFORME M Y R T E

CEA – Corsica Univ. - HELION Collaboration

CEA – FhGISE - SOITEC Collaboration

CO₂ recycling by a new catalytic reaction

CEA – FhGISE - SOITEC Collaboration

CO₂ recycling by a new catalytic reaction
Some significant advances in the field: INFORMATION TECHNOLOGIES AND HEALTH TECHNOLOGIES

- Achievement of first LEDs with GaN nanowires on 200mm wafers. Transfer to Aledia, start-up created in 2011
- Transfer to Technip of a cobotics solution for folding flexible rods and to RB3D for manufacturing the cobots
- Demonstration of the technological and industrial credibility of FDSOI
- Parkinson’s disease: a major breakthrough thanks to gene therapy
Some significant advances in the field:
LARGE SCALE RESEARCH INFRASTRUCTURES DESIGN AND OPERATION, AND ASSOCIATED BASIC RESEARCH

Identified in Atlas and CMS with a high level of confidence (99.97%), Higgs Boson has been presented worldwide on July 4th 2012

First simulation of Plasma instabilities by the European Code of plasma transportation ETS (European Transport Solver)

Implementation in Saclay, under the responsibility of CEA, of the XFEL cryo-modules assembly line, developed by ALSYOM

Cryotechnologies for several major projects (LMJ, ITER, ISEULT, …)
CEA IS DEVELOPING KEY ENABLING TECHNOLOGIES

Key enabling technologies KETs

Aeronautic & Vehicle Building ...
Space & Information Defence & Energy Health
Sécurité

Pre industrial pilot lines

Conception Nanocarac Nanotec300 Mems200 3D Nanobio Clinatec ...

Technology platforms

Software technologies Nanomaterials Photonics Nanotechnologies KETs
Advanced Manufacturing systems Advanced materials Micro-nano-electronics Biotechnologies Key enabling technologies

Matter science and Life science Energy, Information technologies, Health technologies Basic research
CEA LARGELY CONTRIBUTES TO THE DEVELOPMENT OF KEY SECTORS

- Nuclear electricity and cycle: National sector 410,000 jobs
- Solar energy: National sector 25,000 jobs
- Micro-Nanoelectronics: National sector 70,000 jobs
- Nuclear decommissioning dismantling
- Electricity storage for the vehicle
- HPC (High Performance Computing)
- 2nd - 3rd generation biofuels
- Large scale research infrastructures design
- Manufacturing - Computational engineering: National sector 3,000,000 jobs
A coherent and sustainable strategy for the energy research

Technology by 2020-2030

- **Electricity production**
  - Centralised nuclear production
  - Localised PV and CSP production

- **Demand/response Management**
  - Indirect storage
  - Demand/response Adaptation
  - 2G Batteries
  - Electrolysis
  - Hydrogen
  - 2G biofuels
  - Smart grids

**New applications**

- Electric and hybrid vehicle
- Industry
- Building
- Building, cities, regions, country

**Efficiency/sobriety**

- Unused energy
- Efficiency/sobriety

**Basic research in energy**

**> 2040-2050**

- Energy storage
- 4th Generation
- Nuclear fusion

**Control the impact on environmental**

- **Climate**
- Strategic raw material resources

**Technico-economy**

- Control the impact on environmental
- **Climate**
- Strategic raw material resources
A STRONG CONNECTION BETWEEN THE STATE AND CEA REFLECTED BY ITS MODE OF GOVERNANCE

President
- Policy Development and French Nuclear Strategy Development
  Council of Nuclear Policy
  Defence Council

Prime Minister
- Exchanges and Validation of orientations and of the French Nuclear Strategy
  Atomic energy committee

Ministers
- **Orientations and continuous control of CEA**
  Minister of Foreign Affairs and International Development
  Minister of Ecology, Sustainable Development and Energy
  Minister of National Education, Higher Education and Research
  Minister of Finance and Public Accounts
  Minister for the Economy, Industrial and Digital Affairs
  Minister of Defence
  Executive Board & specific committees about major projects

General Administrator
- CEA Strategic and operational management
  Operational division directors
  Administration division directors

High-Commissioner for Atomic Energy
- Advise, Scientific & Technical Expertise
  Scientific council of CEA
Thank you for your attention

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