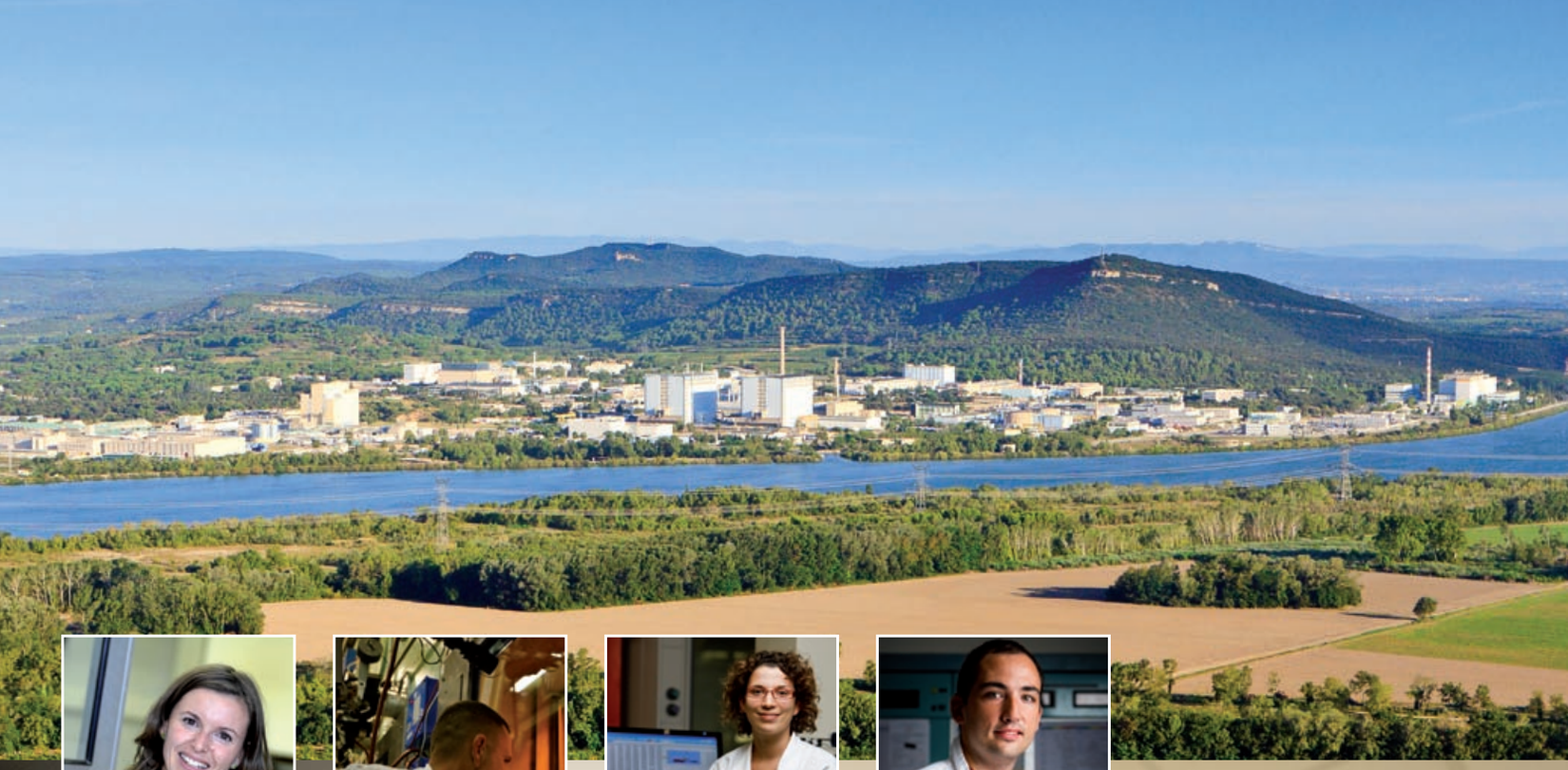
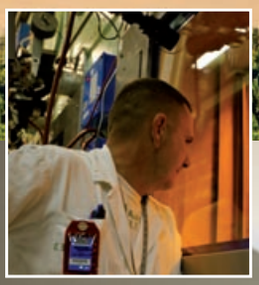
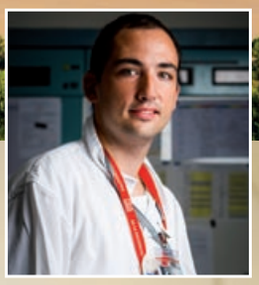






DE LA RECHERCHE À L'INDUSTRIE

cea den

Marcoule

→ energies for the future

The CEA

Energies for the future

As a leading institution in research, development and innovation, the French Atomic Energy and Alternative Energies Commission is involved in four main areas: low-carbon energies, national defense and security, information technologies, and health service technologies. It employs 15 000 persons at 10 sites in France. The CEA is at the heart of the current issues of energy efficiency and the development of renewable energy sources.

The **principal operator** at Marcoule

Marcoule, created in 1955, was the birthplace of the French nuclear industry. It is the main industrial and scientific site of the Gard departement in southeastern France, where 5000 people come to work every day. Their expertise and skills reflect half a century of scientific and technological innovations in French nuclear technology.

With 1500 employees, CEA Marcoule has become a world reference for research on the nuclear fuel cycle and on dismantling legacy facilities. With an annual budget of 500 million euros, of which 300 million are injected into the local economy, the CEA is the principal operator on the site.

CEA Marcoule: **Key figures**

1500 **employees**

700 **researchers**

500 M€ **annual budget**

300 M€ **annual expenditures in the local economy**

30 **laboratories and research facilities**

260 **active patents** filed

300 **scientific publications** each year

Addressing the **energy challenges** of tomorrow

Within the CEA's Nuclear Energy Division, Marcoule is the reference center for research on the nuclear fuel cycle. Its researchers imagine and develop the key processes for nuclear energy in the 21st century. Sustainable resources, national independence, safety and protection of the environment are at the heart of an ambition: that of sustainable nuclear energy.

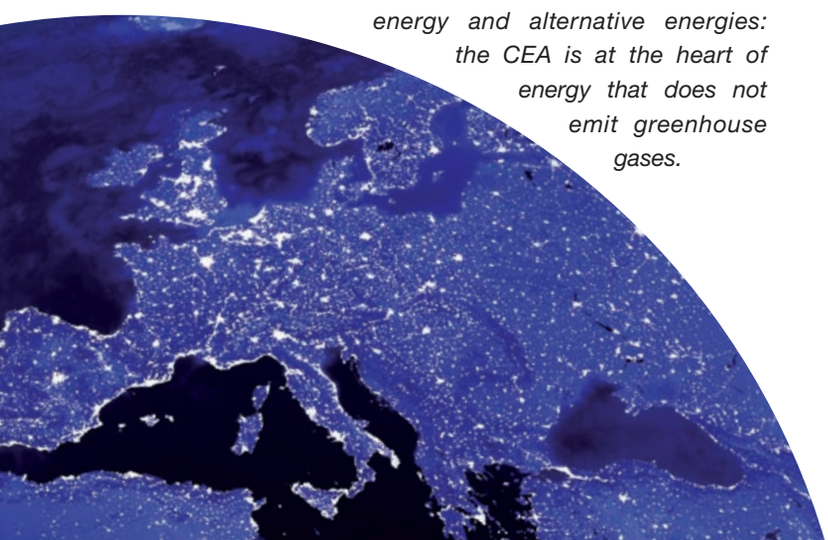
CEA Marcoule puts its scientific expertise in the service of the French nuclear fuel cycle industry, and addresses the research priorities assigned by the government, such as radioactive waste management.

The Center also conducts major cleanup and dismantling projects in some of the oldest CEA facilities, after their final shutdown. Marcoule has become a world pilot site, demonstrating that the dismantling of nuclear facilities is now an industrial and technological reality.

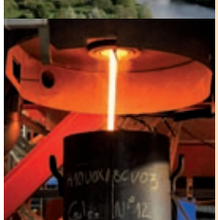
Nuclear fuel "runs" nuclear power plants. It is produced by a series of operations beginning with uranium ore extracted from mines. After removal from the reactor, the fuel is treated mainly by chemical processes. Uranium, together with plutonium formed spontaneously in the reactors, can be recycled to fabricate fresh fuel, while the other unrecyclable elements are separated as ultimate waste

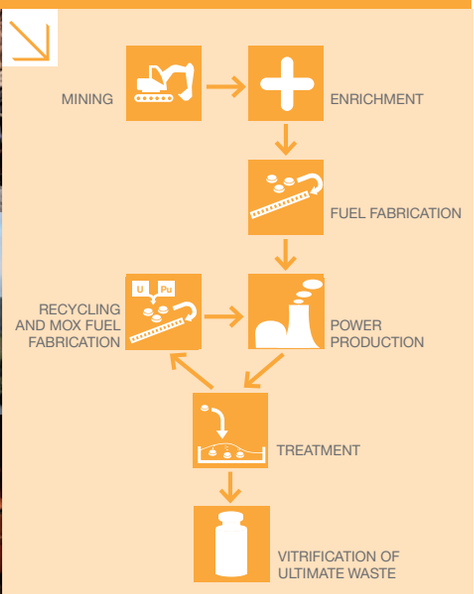
Along with the reactors themselves, expertise in the fuel cycle is the major asset of the French nuclear industry.

The energy needs of humanity will increase considerably in the 21st century. Nuclear energy and alternative energies: the CEA is at the heart of energy that does not emit greenhouse gases.



Fuel cycle





Support for the **fuel cycle industry**

The CEA provides expertise to the French nuclear fuel cycle industry to meet today's challenges and prepare for those of tomorrow.

For the front end of the fuel cycle, Marcoule researchers imagine and develop processes (extraction, conversion, etc.) to utilize uranium resources and transform them with increasing efficiency and environmental awareness. For the back end of the cycle, the CEA provides ongoing scientific and technological support for the AREVA reprocessing and recycling plant at La Hague, from fuel dissolution to waste vitrification. Adapting or defining new processes, experimentation at laboratory scale, pre-industrial demonstrations, development of simulation tools — the expertise of Marcoule scientists serves a competitive and reliable industry.

In the perspective of developing fuel cycle plants abroad, CEA Marcoule imagines processes capable of being implemented in compliance with safety and nonproliferation requirements.

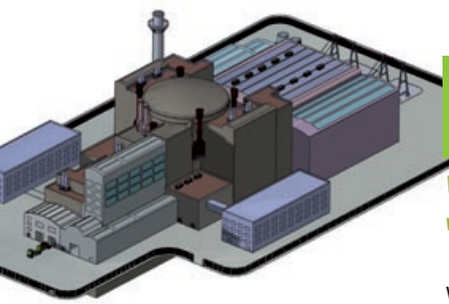
A national priority: **research on radioactive waste**

CEA Marcoule is at the forefront in addressing the issues defined by the sustainable radioactive materials and waste management act of 28 June 2006.

The work focuses on selective separation of the constituents of spent nuclear fuel. Separation by radiochemical processes already allows recycling of energy-producing materials and reduces the volume and radiotoxicity of the ultimate waste.

Experts at Marcoule developed a vitrification process capable of immobilizing the most hazardous wasteforms in a solid, durable material: glass. The safety of waste packages can thus be guaranteed over very long time periods for geological disposal. In this reference process, CEA Marcoule provides the French national radioactive waste management agency, ANDRA, with indispensable scientific data on the long-term behavior of waste packages.

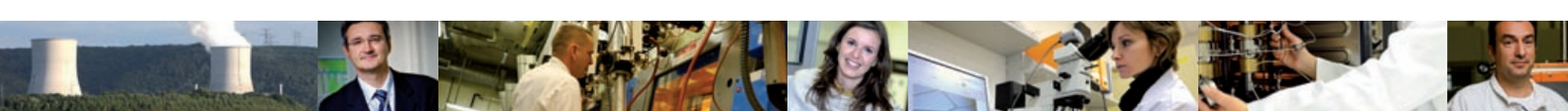
All these research programs are carried out in the major nuclear facilities on the site. Examples include Atalante, an unparalleled infrastructure dedicated to process radiochemistry, the joint CEA-AREVA Vitrification Laboratory, a veritable applied R&D facility, and other resources ranging from laboratories to pre-industrial prototypes.



Focus on **nuclear power for the future**

Within the CEA, Marcoule contributes to the development of the 4th generation of nuclear power, which after 2040 will combine innovative reactor and fuel cycle concepts.

With ongoing R&D work in major countries around the world, 4th-generation nuclear power will combine competitiveness, safety and reliability with resistance to proliferation and aggression. The new systems will take over from the existing 3rd-generation "EPR" reactors. With an optimized fuel cycle, these facilities will generate more electricity than existing units from the same quantity of uranium. Under the French national program of investments for the future, the "ASTRID" reactor project is currently being designed by the CEA. By 2020 it could become an innovative and safe pre-industrial demonstrator.

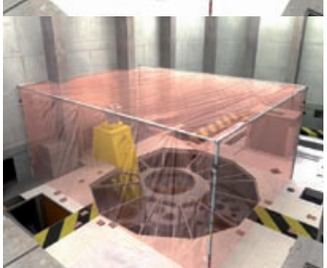


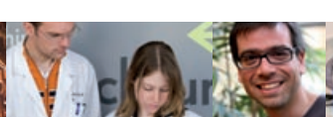
Mastering **decommissioning**

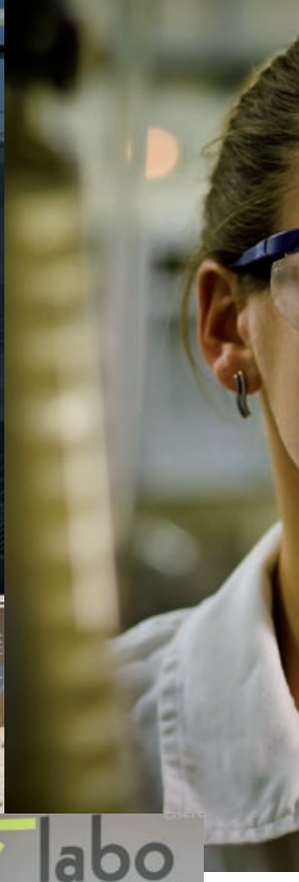
It is just as important to be able to dismantle a nuclear facility as to build it. The cleanup and dismantling of the oldest facilities at Marcoule (the G1, G2 and G3 reactors and the UP1 plant commissioned in the 1950s) is a world's first by the scale and scope of the project. The Phenix nuclear power plant, an emblematic facility definitively shut down in 2009 after 35 years of decisive scientific advances, will soon be dismantled.

In compliance with very stringent safety and radiation protection requirements, the CEA applies highly innovative technologies to the final step in the lifetime of its nuclear facilities: robotics, virtual reality, etc.

Outside Marcoule, the project teams lead and manage cleanup and dismantling projects at other CEA sites: Fontenay-aux-Roses, Saclay, Grenoble and Cadarache.



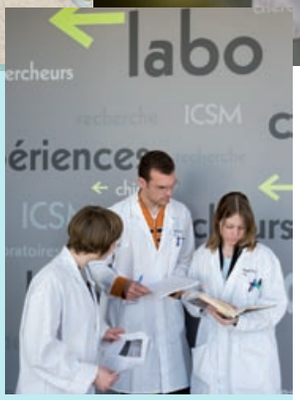




Collaborative research and **training:** an open center

As a founding member of the Balard Languedoc-Roussillon Chemistry cluster, Marcoule is an active participant in the scientific excellence of the region

The Marcoule Separation Chemistry Institute (ICSM) was inaugurated in June 2009 jointly by the CEA, the CNRS, the University of Montpellier 2 and the École Nationale Supérieure de Chimie de Montpellier. The ICSM is a European center of excellence in separation chemistry: a necessity for tomorrow's nuclear industry and the promise of far-reaching technological spin-offs. The site also hosts a biology department involved in nuclear toxicology and biosecurity studies. CEA Marcoule is a partner in LabEx CheMISyst.



Each year the National Institute for Nuclear Science and Techniques (INSTN) at Marcoule provides a thousand hours of professional training in nuclear energy. CEA Marcoule permanently hosts more than a hundred doctoral students, post-doctoral fellows and interns in research training programs.

A **pool of innovation** for the local economy

Applying its scientific excellence, contributing to job creation: an ongoing commitment!

Three technology transfer platforms ensure that the advances of the CEA are made available to regional economic sectors in areas such as sealing, extraction, supercritical fluids, and nanomaterials. Non-nuclear applications are numerous: aromatic extraction, recycling of strategic metals, exploitation of algae biomass, etc. As a founding member of the TRIMATEC (Tricastin-Marcoule-Technologies) competitiveness cluster, CEA Marcoule was awarded the trophy of the French National Institute of Industrial Property (INPI) for innovation in the Languedoc-Roussillon region.

Safety: our top priority

The safety of site employees and of the surrounding communities — and control of the environmental impact of site activities — are top priorities of the CEA.

CEA Marcoule has suitable means for effective protection and relief (local security brigade, radiation protection department, medical department) adapted to the potential risks — mainly chemical and radiological — on the site.

The nuclear safety of the facilities at Marcoule is supervised independently by the French civilian and defense nuclear regulatory authorities (ASN and ASND). Inspections, audits, verifications and exercises are part of everyday life for the personnel at CEA Marcoule.

Preserving the environment

Each year the accredited CEA Marcoule laboratories perform 30 000 analyses of the surface water, air, sediments, groundwater, plants and food chain around the site.

The results — which confirm the absence of any significant impact — are available online on the government portal (www.measure-radioactivite.fr) and at **www-marcoule.cea.fr.**

Additional information

The radiological impact of CEA Marcoule remains significantly lower than that of the radioactivity naturally present in the environment.

Informing the public

The CEA regularly informs the Marcoule-Gard Local Information Commission (CLI) of the health and environmental impact of its activities. Each year, it publishes a "Transparency and Nuclear Safety" report available to the public at ***www-marcoule.cea.fr.***

20 000 people each year visit the permanent exhibition at the Visiatome, a public information center unique in Europe, located just outside the main entrance of Marcoule. For more information refer to **www.visiatome.fr**

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