MINATEC®

Micro
and nanotechnologies
innovation campus

MINATEC,
Key facts

Education Research Industry

MINATEC

Europe's innovation campus

Grenoble, France-based MINATEC micro and nanotechnologies innovation campus is unlike any other research center in Europe. The people who make technological innovation happen—researchers, students, and professionals from the world of industry—are all too rarely encouraged to cross the traditional boundaries of their respective fields. MINATEC brings these experts together on a single 20-hectare campus, and provides them with access to state-of-the-art equipment in a unique environment that encourages them to invent the innovations of the future together.

Reaching out to the world

Each year, MINATEC opens its doors to 40,000 visitors, holds or organizes 1,000 meetings, conferences, and seminars, and receives around 100 delegations for in-depth campus tours. The MINATEC campus also works closely with other global micro and nanotechnology innovation clusters elsewhere in Europe as well as in the United States and Japan.

Research topics at MINATEC

- Micro and nanoelectronics: the design of integrated circuits and more powerful, efficient processors
- New faster and higher-capacity memory
- Microsystems: acceleration and pressure sensors, micromotors, and micromirrors
- Biochips and biosystems for medical testing and research
- Photonic microsystems for infrared vision and fiber optic communication
- RF components and systems for mobile telephony

MINATEC Europe's innovation campus

Key figures

MINATEC brings together 2,400 researchers, 1,200 students, and 600 industrial and technology transfer specialists on a 20-hectare campus in Grenoble, France. The campus boasts 70,000 square meters of workspace, including 10,000 square meters of clean rooms, and nine technological platforms designed to facilitate resource-sharing and joint programs.

The equipment available on these platforms represents investments of several hundred million euro.

Who's involved?

- **Education:** Grenoble Institute of Technology's engineering school Phelma, CIME (Inter-university Center for Microelectronics and Nanotechnology), and the Grenoble branch of the INSTN (French National Institute for Nuclear Science and Technology).
- **Research:** two major CEA laboratories (Léti and INAC), the FMNT (Micro and Nanotechnologies Federation)—which groups together four CNRS labs—and universities in Grenoble and Chambéry, France.
- **Industry:** around 20 businesses with offices on the MINATEC campus, from major corporate R&D to start-ups.

Education

Research

Industry

Innovation

Tech transfer

History

MINATEC's history officially began on January 18, 2002, with the signing of a framework agreement by the project partners: the State; the Rhône-Alpes regional and Isère departmental governments (the Isère General Council oversees MINATEC); the Grenoble-Alpes-Métropole greater metro area; the city of Grenoble; the CEA (French Atomic Energy Commission); Grenoble INP; and the Caisse des Dépôts et Consignations (a state-owned bank).

The framework agreement cemented the project partners' commitment to allocating significant resources to MINATEC with the goal of making the future campus Europe's leading center for excellence in micro and nanotechnologies.

The CEA and Grenoble INP first launched the idea behind MINATEC. The project soon garnered the support of French Research Minister Roger-Gérard Schwartzenberg during his visit to Grenoble on November 9, 2000. One of the objectives of the future center was to solidly position the Rhône-Alpes region in the international scientific, economic, and industrial arenas.

June 2008 marked a turning point in the history of MINATEC. The project partners signed an agreement governing the innovation campus' operations and management, Jean-Charles Guibert was appointed director, and a staff was set up to coordinate and promote the innovation campus' activities.

Jean-Charles Guibert,
Director, MINATEC

"MINATEC is here to churn out innovations, not Nobel prizes!"

Why put students, researchers and professionals from industry on the same campus?

There is no more effective way to accelerate the innovation process and get new products to market. Even in the age of the Internet, people collaborate better when they are physically together. This is particularly true for technological research, where progress is fuelled by the fusion of ideas, personal relationships, and casual conversations around the water cooler.

Only the most remarkable researchers are able to dream up new inventions with no help from the outside world; but MINATEC is here to churn out innovations, not Nobel prizes!

And yet many big businesses have facilities scattered all around the globe...

You're right. This is because their production is contingent on structured methods. It is possible to build two identical plants 5,000 kilometers apart, but this doesn't hold true for R&D. You won't find big businesses scattering their researchers around the globe—they are generally grouped together by specialization at research clusters where they can interact with peers.

MINATEC has only truly been up and running since 2006. Do you feel it is a success?

We have managed to bring together 4,000 people on a single campus: that's quite an achievement in itself! Our engineering students work practically right next door to some of the best researchers in Europe and rub shoulders with innovative start-ups like Ethera and Cytoo on an almost daily basis. They also interact at campus events like our weekly informational meetings—so, it comes as no surprise when they then decide to work together on common projects.

So how can you tell if the "innovation factory" is functioning properly?

Our annual consolidated operating budget is more than €300 million. Every year we file more than 300 patents and publish around 1,600 scholarly works. At least once a month I'm invited aboard to present our concept.

Although we have 70,000 square meters of buildings, they are now filled to capacity. The second phase of campus construction will add a further 60,000 square meters of workspace.

You came up with the idea for MINATEC ten years ago. Did any particular country or research center influence you?

No, nothing quite like it existed at that time. MINATEC is unique in that it brings education, research, and industry together in a single location. That said; the CEA's Léti—an applied electronics research laboratory located in Grenoble—did serve as something of an example. For years, Léti offered professionals from industry the possibility of doing joint product development work with the lab's scientists using the lab's world-class equipment. Participating businesses could then leverage the excellent—and rapid—results often obtained to gain competitive advantage.

So MINATEC is something of an extension of this concept?

Yes, but MINATEC also includes education. The universities—with their students, upline research labs, and extensive continuing education programs—are also innovation drivers.

On the other hand, persuading universities to move to a new campus is not an easy task. This is why similar initiatives in the United States, Japan, Singapore, and the Netherlands have not managed to extend their models to encompass education.

How do you see MINATEC evolving over the next five years?

We have created strong momentum within the organization. Our participation in an even broader initiative—the GIANT Global Innovation Campus—will further strengthen what we have built.
MINATEC will serve as GIANT's micro and nanotechnologies center. MINATEC and GIANT's other two centers, GREEN for new energy technologies and NanoBio for healthcare, will get a boost from our local large European instruments—EMBL, ESRF, and ILL—and high-level upstream research conducted locally.
GIANT also encompasses technology and innovation management, spearheaded by local business school Grenoble Ecole de Management. All of these projects—and investments in excess of €1 billion in GIANT—will support the growth of MINATEC in the coming years.

Innovations from the MINATEC labs...

Biological and chemical testing kit

Intended for environmental monitoring and law enforcement, this portable kit offers fast, easy testing of air and water for toxins, viruses, bacteria, chemicals, and other substances.

Imagers for scientific satellites

European satellite Herschel was launched in 2009 to observe the universe and deepen our understanding of how stars and galaxies are formed and evolve. Of particular interest is its extremely sophisticated infrared camera, which boasts a bolometric imager (the part of the camera that captures images) that was developed in MINATEC's labs.

New-generation camera phones

Higher quality digital photographs are consistently one of the main demands voiced by mobile-phone users. Therefore, it is no secret that telephone manufacturers want increasingly compact camera modules for their products! MINATEC labs have developed a new generation of imagers (the part of the camera that captures the image) that can already be found in today's telephones.

Microchips light up textiles

The latest microchips are so small that they can be attached to thread and woven right into fabric, where they are invisible to the naked eye. The fabrics can then be used to make high-tech garments. The most spectacular example is perhaps fabric that "lights up" in vibrant color thanks to luminescent diodes embedded in the chips!

High-resolution microdisplays for camcorders and video glasses

It won't be long before camcorder and digital camera viewfinders are replaced with 1 cm diagonal high-resolution microdisplays. The same microdisplay technology could also fuel the development of wireless high-definition video glasses.

Help for physiotherapists

It is not always easy for physiotherapists to measure their patients' progress—take the ability to bend a knee or elbow after an accident, for instance. Motion sensors placed on an injured limb can now be used to measure the range of motion, the angle at which a joint is bent, and other parameters with extreme precision, and then send this information to a PC.
The sensors can also be used during physiotherapy to ensure that exercises are performed correctly.

Miniature device to test for food allergens

It is now possible to quickly and easily determine whether dairy products, cooked meats, ready-made meals, and other food products have been contaminated by allergens during manufacturing. Thanks to a new miniature "lab-on-chip" (it measures just a few centimeters across), samples can be taken and tested right on the plant floor. The results take about 30 minutes and, if everything is all clear, the product can then be packaged.

Accelerometers maintain vehicle trajectories

The electronic stability programs (ESP) found in cars use trajectory information recorded by a tiny sensor called an accelerometer to keep vehicles on track when braking on curvy, slippery, or icy roads. MINATEC joined forces with a leading American manufacturer to create a new generation of accelerometers—which are today produced by the millions.

Dehydration detection for firefighters

Not only are firefighters exposed to extremely high temperatures; they also have to wear several hot layers of protective clothing. So, it comes as no surprise that they sweat! A new microsystem attached to the innermost layer of clothing has the capacity to constantly analyze sweat. When dehydration is imminent, the composition of sweat changes. The microsystem is able to detect this and issue a warning. A similar device could be developed for high-endurance athletes.

Understanding nanotechnology

New words for a new world

The prefix nano- comes from the Greek *nanos*, meaning very tiny, or dwarfish. One nanometer is equal to one billionth (10^{-9}) of a meter, the equivalent of ten atoms lined up one next to the other! Studying matter at the nanometric scale is comparable to studying the base molecules of which that matter is composed.

Nanoscience
is the study of objects between 1 and 100 nanometers in size.

Nanotechnologies
are the processes used to observe and manufacture tools and products at this very small scale.

Nanoscience and nanotechnologies embrace the fields of physics, chemistry and biology. A collaborative, cross-disciplinary approach is used to ensure that progress made in each of these branches furthers common research objectives.

Understanding nanotechnology

Overcoming new challenges, exploring new markets

When researchers study materials on the nanometric scale, they are often confronted with strange behaviors, like increased reactivity of surface atoms (useful for catalysis), changes in mechanical resistance, and new optical, electromagnetic, or thermal functions. Such properties open the door to improving existing technologies and to creating radically new inventions: this is what makes nanotechnology so interesting.

Information and communication technologies

For a long time, electronic components such as microchips were designed at a micrometric scale (10^{-6} m). With the advent of nanotechnology, a new miniaturization milestone has been reached, further increasing the power of computer processors, mobile telephones, game consoles, and other electronic devices.

Today's electronics offer a mind-boggling array of functions, process information faster, and use less energy. More efficient computers are now being designed in fields as diverse as satellite technology, terrestrial communication networks, and climate forecasting. Of course, this technology is also being used to develop faster personal mobile applications to handle music, photos, and videos.

An added benefit of this technology is its effect on prices: cheaper personal electronic devices mean greater access for more people. MINATEC, by working closely with IBM and ST Microelectronics, to name just two, is playing a key role in delivering the latest technology to the mass market.

Energy and transportation

If zero-emission cars become widespread in the future, nanotechnology will be partly to thank. At MINATEC, researchers are currently developing lighter, higher-capacity batteries for electric vehicles. As a more long-term objective, Grenoble's CEA labs are looking at fuel cells as a potential energy source for electric vehicles—and nanomaterials will play a crucial role in improving their efficiency and reliability.

Used in the aerospace industry, nanomaterials will open the door to lighter, more robust, and more energy-efficient aircraft.

Nanomaterials are also used to boost solar panel yields.

Health and quality of life

Nanotechnologies are being leveraged to develop "labs-on-chip," which will make it possible for doctors to perform common tests right in their offices, saving time, effort, and money. "Nanotransporters," expected by around 2020, are designed to deliver drugs only when they come into contact with the diseased area of the human body. This technology could significantly reduce dosages and side effects. MINATEC labs are actively involved in this research.

Researchers will also turn to nanotechnologies to design ultra-light air, water, and food testing devices to detect pollutants, legionella, or salmonella without having to send samples to a laboratory.

Nanotechnology and society

Nanotechnologies and nanoscience often spark debate—and sometimes concern. Little is known about the nano-world. Should we worry?

The toxicity of nanoparticles and nanoproducts: Due to their low mass, nanoparticles can remain suspended in the air. They are also so tiny that they can breach the biological barrier. Most at risk are those handling nanopowders in labs or factories. The European “Nanosafe 2” project—run by the CEA—is targeting systems designed to make industrial processes safer.
The OECD currently counts 691 registered nano-safety projects.

Civil liberties: Should citizens feel threatened by the advent of miniaturized systems able to track their activities? The purpose of technologies such as RFID (radio-frequency identification)—which involves the use of nanotechnology—is to make our everyday lives easier and safer, by alerting us to potentially-dangerous breaks in the cold chain for frozen foods, for instance. Of course, the technology could also be used to track individuals’ behaviors for marketing or other purposes—with all the risks this entails. The best way to protect our civil liberties is to ensure that government agencies, citizens, and advocacy groups keep a watchful eye on the use of these new technologies.

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