CEA Startup PORTFOLIO

Supporting startups

The CEA, a France-based research organization that is among the most innovative in the world, is known for its active startup policy. By supporting the creation and growth of companies to develop and commercialize its technologies, the CEA nurtures disruptive innovations, helps industrial companies become more competitive, and—by helping new ventures gain a foothold in key industrial value chains—drives job growth.

The range of support services the CEA provides to its startups is unique. Founders benefit from the CEA's technical know-how and advanced research equipment, of course, but also expertise in innovation and introductions to financers and policymakers—all for the sake of ensuring that the companies created can make a real impact. Also worth mentioning are the CEA's 700 R&D partners, valuable members of our startups' future networks.

The majority of CEA startups cover low-carbon energy, health, and digital systems, licensing the CEA's patents and playing a pivotal role in getting CEA technologies to the market.

The CEA has its own venture capital fund, CEA Investissement, and created deep tech fund Supernova Invest with Amundi. With a total of around 100 investments and more than 70 companies in its portfolio, Supernova Invest now enjoys a unique track record in deep tech, resulting in 30 successful exits and six IPOs.

You will find a selection of the CEA's startups in this booklet.

The numbers

LEADING RESEARCH ORGANIZATION BY NUMBER OF PATENTS FILED, WITH MORE THAN **700 ANNUALLY**

Represented among the **TOP 100 MOST INNOVATIVE COMPANIES IN THE WORLD** FOR THE LAST 10 YEARS

EXCELLENT SUPPORT FOR STARTUP PROJECTS TO ENSURE THEIR LONG-TERM SUCCESS:
10-YEAR SURVIVAL RATE > 90%

6,000+ JOBS CREATED

230 Strong entrepreneurial momentum, with more than **STARTUPS** CREATED SINCE 1972

2022 figures. Sources: INPI and EPO 2022 data for patents, Clarivate data

Contents

Digital

Health

Energy

AIHERD

Smart livestock monitoring

AI for automated disease detection in cattle

Founded in 2020, startup AiHerd has developed the first non-invasive automated solution for detecting pathologies and, more broadly, behavioral anomalies in cattle herds—a revolution in the world of livestock farming that translates into improved animal well-being, increased practicality for farmers, and productivity gains amounting to €500 per head per year for dairy cows.

DIGITAL

Farmers cannot be everywhere at once. But artificial intelligence can! When it comes to monitoring livestock herds, AI computer vision is a particularly effective and reliable tool that makes collecting extremely valuable data possible. Smart cameras can detect bovine pathologies, identify periods of heat conducive to reproduction, and provide feed performance indicators–reducing the farmer's workload.

The startup AiHerd was founded by a tech-loving veterinarian specialized in herd medicine who turned to the CEA to develop the concept, leveraging the organization's know-how in AI and videosurveillance. The partners are pursuing development of the solution under an R&D contract.

15%
INCREASE IN PRODUCTIVITY
PER HEAD PER YEAR

Year founded
2020

Key market
- Cattle farming

Technology used
- Artificial intelligence applied to computer vision
- Data analysis

AIHERD

www.aiherd.io

ALEDIA

3D microLEDs for next-generation displays

Smartphone displays that are 5x brighter and 2x more energy efficient than conventional displays at the same price

Aledia's brighter and more energy-efficient 3D microLEDs are ushering in a new era in backlighting for displays of all kinds, from virtual reality headsets to video walls.

Aledia, founded in 2011, offers 3D lighting devices for displays of all sizes. With brightness up to 2,000 times higher than OLEDs and LCDs, better image quality, increased contrast, and low production costs, the company's products are unique on the global market. The 3D microLEDs are protected by 250 patent families, making Aledia the number-one French startup for the number of patents filed.

The brightness and energy efficiency of Aledia's 3D microLEDs will eventually reduce the battery requirements of a smartphone or laptop by half. Not only will this facilitate outdoor use, but it will also reduce dependence on strategic metals like lithium, cobalt, and manganese. Aledia also targets many other markets, from microdisplays for virtual reality headsets to huge video walls.

The company, which was housed by the CEA until 2019, today employs 230 people at its own 4,000 m² R&D center. It is also building a production plant that will total 52,000 m². Collaboration with the CEA continues through a joint laboratory that develops advanced technologies.

ALEDIA'S **3D MICROLEDS** ARE **2,000x BRIGHTER** THAN OLEDS OR LCDS

Year founded
2011

Key markets
- Video walls
- Large television displays
- Premium smartphones
- PCs
- Virtual reality headsets

Technology
- Gallium nitride nanowires
- Epitaxial growth on 8" or 12" (200 mm or 300 mm) silicon wafers

www.aledia.com

ALKALEE

The smart vehicle

Ultra-high-performance software suite for the automotive software revolution

New use cases, trends like the autonomous vehicle, and a changing regulatory landscape are driving a profound transformation in the automotive industry. And software is at the heart of it all. Alkalee was founded to help mobility stakeholders make this strategic shift. The company's innovative software solution centralizes all vehicle functions on a single compact and flexible high-performance computer and ensures the operating safety of all on-board electronics.

Alkalee was founded in 2020 to develop joint research by car maker Renault and the CEA. The partners tasked their top experts with accelerating the automotive electronics revolution and helping create a new mobility experience. The result is a slate of solutions that enable smooth, ultra-customizable, and safe operation.

CEA scientists brought their expertise in formal methods and model-driven engineering tools to the table. Their multidisciplinary approach spanning on-board software, electronics, and design tools was decisive in the development of Alkalee's solutions. The startup is now tackling cybersecurity and the integration of its software into its customers' environments.

20% REDUCTION IN SYSTEM VALIDATIONS

Year founded
2020

Key markets
- Automotive
- New transportation technologies: UAVs, etc.
- Construction
- Agricultural vehicles
- Defense

Technology used
- Formal methods,
- Model-driven systems engineering

www.alkalee.fr

ARCURE

Smart on-vehicle pedestrian detection system

Life-saving AI-powered pedestrian detection system for safer, less accident-prone industrial vehicles

Arcure's Blaxtair® systems prevent collisions between moving vehicles and pedestrians in industrial environments and on construction sites. Two-thirds of the company's business comes from export sales.

Contact between moving industrial and construction vehicles and pedestrians causes 10,000 serious accidents per year in Europe. Blaxtair® intelligent vision systems prevent these collisions and save lives. They detect all pedestrians, whether they're standing, squatting, or partially hidden by an obstruction—even in extreme temperatures, dust, low lighting, and other challenging conditions.

Blaxtair® is built on a particularly robust and reliable detection technology that avoids false alarms and nuisance alerts so that operators can work safely and confidently. Because they know the system will alert them to dangerous situations and automatically stop the vehicle in the event of an emergency, operators can concentrate on the task at hand. Plus, the data collected feeds hazard maps, which can be used for targeted preventive measures.

Arcure is present in virtually all industries, including recycling and construction. It is based in Paris and opened a Chicago subsidiary in 2019.

Its technology is protected by eight patents. Together with the CEA, it has created a joint laboratory where it develops new image processing algorithms.

A BLAXTAIR® SYSTEM TAKES **200 milliseconds** **TO DETECT A PEDESTRIAN** IN THE VICINITY OF A MOVING VEHICLE

Year founded
2009

Frequently-equipped vehicles
- Forklifts
- Loaders
- Excavators
- Bulldozers

Technology used
- 3D vision and image processing algorithms
- Deep learning on the Edge

ARCURE

www.blaxtair.com

ARYBALLE

Artificial nose with a digital sense of smell

Simple odor analysis system with high reproducibility and reliable measurement for industrial use cases

Aryballe's artificial nose detects odors and compares them with references in an odor library, helping manufacturers develop new products and carry out quality controls.

Founded in 2014, the startup Aryballe offers its NeOse Advance odor sensor worldwide. It has a portfolio of 40 patents (including five CEA patents) and an exceptional database of 250,000 olfactory signatures.

Identifying odors is difficult—factors like humidity, the number of odorous molecules, and variations in concentrations can skew the data. Measuring less than a cubic centimeter, Aryballe's bio-inspired electronic nose meets industry standards of reliability and reproducibility and can discern hundreds of odors. The startup also offers services like remote analysis dashboards, odor studies, and more.

Based in Grenoble, Aryballe has subsidiaries in New York and Seoul and invests heavily in R&D. The company's joint laboratory with the CEA is working on more compact and efficient silicon sensors, as well as on selecting new biosensors.

THE **ARYBALLE DATABASE** HAS **250,000** DIFFERENT **OLFACTORY SIGNATURES**

Year founded
2014

Key markets
- Cosmetics and perfumes
- Automotive
- Agriculture & food systems
- Household appliances
- Healthcare

Technology used
- Silicon photonic sensors compatible with biosensor grafting
- Olfactory database and machine learning tools

aryballe
The Digital Olfaction Company

www.aryballe.com

DIAMSENS

In situ water quality monitoring

More reliable testing and lower operating costs thanks to the unique properties of diamonds

Diamond-quality water monitoring is what Grenoble-based startup Diamsens has created, with an innovative new range of electrochemical sensors that leverage the unique properties of diamonds. The high performance, durable, and low maintenance solution is manufactured using standard semiconductor processes, so it is also affordable. Synthetic diamonds offer a range of benefits for both industrial users and consumers.

The Diamsens continuous water quality monitoring solution will satisfy the needs of both BtoC and BtoB markets. In the swimming pool market, individuals will soon be able to simply and accurately measure the chlorine content of their pool in real time, a luxury only municipal swimming pools could previously afford. On a larger scale, the Diamsens solution will appeal to manufacturers who want to reduce sensor maintenance costs—the diamond sensor surfaces can clean themselves using a patented electrical technique.

To develop its innovative testing system, Diamsens built on the expertise of CEA laboratories to synthesize its diamonds and develop a proof-of-concept prototype. The partners intend to pursue their collaboration for the long haul, giving the startup access to the CEA's unrivalled fabrication and characterization resources.

MAINTENANCE COSTS **DIVIDED** BY **5** COMPARED TO CONVENTIONAL SENSORS

Year founded
2022

Targeted markets
- Swimming pools
- Drinking water and sewage treatment
- Agriculture: fertilizer concentration control, water reuse
- Environment: monitoring of natural environments
- ndustry: effluent control, water reuse

Technologies used
- Synthetic diamond
- Electrochemical sensors

DIAMSENS
SMART DIAMOND SENSORS

www.diamsens.com

ELICHENS

Greenhouse gas detection and monitoring

Lower carbon emissions, better occupational safety, and fewer costly gas leaks

eLichens miniaturized, connected, ultra-low-power, high-performance sensors continuously measure the levels of carbon dioxide (CO_2) and methane (CH_4) in the air.

Startup eLichens has developed particularly innovative gas sensors in partnership with the CEA. Dedicated to the detection of CO_2 and methane, two of the main greenhouse gases, these sensors are six times smaller than their direct competitors, consume ten times less energy, and remain drift-free over their entire fifteen-year lifespan.

The infrared sensors are coupled with data fusion and analysis tools to detect the presence of gases, measure their concentrations, and issue alerts if necessary. The objective is threefold: to guarantee health and safety at work and at home, to reduce the cost of leaks (e.g. on distribution networks), and to limit environmental impacts.

With a portfolio of 56 patents (including 19 CEA patents), eLichens generates 90% of its revenue from exports. It is developing even more sensitive gas micro-leak sensors in a joint laboratory with the CEA. For methane alone, these leaks represent losses of several thousand tons per year.

ELICHENS GAS SENSORS CONSUME **10x less** THAN COMPETING PRODUCTS FOR **EXCEPTIONALLY LONG BATTERY LIFE**

Year founded
2014

Key markets
- Industrial safety
- Natural gas supply and distribution
- Indoor air quality monitoring

Technology
- Very low power NDIR (Non-Dispersive Infrared Detection) gas sensors
- Data fusion and analysis software
- IoT devices

eLICHENS

www.elichens.com

ISORG

Large-area image sensors on plastic and glass

A large-area sensor technology that enables silicon-equivalent optical performance at a competitive cost

Isorg transforms plastic and glass into interactive surfaces that can identify people, objects, and movements. Fingerprint sensors are the main target market.

Isorg's optical sensors are made from innovative organic materials printed onto glass or plastic, bypassing the need for vacuum or high-temperature processes. The sensors are fully recyclable at the end of their useful life.

They deliver the optical performance of silicon sensors but, due to the much larger surface area, are more cost effective. This is especially true for fingerprint sensors, the startup's main target market.

Isorg products are used in smartphones, where they transform entire screens into fingerprint scanners. They also lend themselves to police, security, and controlled access applications. Isorg fingerprint modules are so reliable that two are certified by the FBI.

Isorg's technologies are protected by more than 80 families of patents. The CEA hosts and jointly operates an R&D pilot line for the development of sensor manufacturing processes with Isorg.

ISORG IS FRANCE'S SECOND-LEADING SMB FOR PATENTS

WITH MORE THAN **FAMILIES 80**

Year founded
2010

Key markets
- Smartphones
- Security, biometrics, and identification
- Automotive

Technology
- Organic materials deposited as liquids onto large glass or plastic surfaces
- High-throughput printing

www.isorg.fr

ISYBOT

Cobots for industrial sanding

Quality reproducible sanding for more productive factories, and higher-skilled factory jobs with fewer repetitive manual tasks

Lightweight, easy-to-program, and safe robots that can either work independently or assist a human operator: Isybot is reinventing jobs like sanding, polishing, and grinding.

Thanks to the CEA's force-sensor-free actuation technologies protected by seven patents, Isybot's cobots (collaborative robots) are simple, precise, lightweight, and safe for the operators they assist. Their initial setup takes only two hours. To program in a new task, all the operator needs to do is carry it out manually; the cobot will memorize the movements and control the direction and intensity of the tasks to be replicated. The operator can also designate a rectangular area for the cobot to sand exclusively within.

In just a few years, Isybot has gained a glowing reputation for large-surface industrial sanding, particularly in aeronautics, rail, and shipbuilding. Its cobots improve productivity, reduce the arduousness of manual tasks, and achieve reproducibly high-quality sanding. They also help make jobs that are hard to fill more attractive.

The startup is working in a joint laboratory with the CEA to develop a new heavy-load cobot (20 kg, compared to the current 10 kg model) and evaluate other use cases, like non destructive testing.

2 hours A TECHNICIAN CAN LEARN TO USE THE ISYBOT COBOT IN WITHOUT THE NEED FOR SPECIAL TRAINING OR THE AID OF A ROBOTICS EXPERT

Year founded
2016

Main applications
- Large-area industrial sanding
- Polishing
- Grinding
- Non-destructive testing

Technology
- Ball ramp, screw, and cable actuators
- Force measurements via motor currents

www.isybot.com

IUMTEK

Real-time *in situ* industrial chemical analyzers

Real-time industrial process quality and safety monitoring for better, faster, cleaner, and cheaper production

iUMTEK analyzers identify the chemicals present in a liquid, solid, or gas 10 to 30 times faster than laboratory analysis and with results that are more representative of the medium being tested.

The startup iUMTEK employs an analytical technique that NASA uses for its Mars rovers: LIBS, or laser-induced breakdown spectroscopy. Based on more than 25 years of R&D by the CEA and Orano, LIBS is helping industrial customers test liquids, solids, and gases.

No sampling or sample preparation is necessary to do a test, and the results are more representative of the medium being tested than laboratory analysis. The analyzer works at distances of up to several meters and in a range of configurations: above a molten bath, through a window, or even inside a vessel. Each chemical present is identified and quantified, so that the exact composition of the medium can be known.

iUMTEK has sold several devices to research centers for diagnostic use. At the same time, it is developing a solution for in-line industrial process monitoring. One potential use would be for companies that use recycled raw materials in their manufacturing processes to check the composition of the materials upline from the process.

iUMTEK is developing this technology for new use cases as part of an R&D agreement with the CEA. It also holds licenses to five CEA LIBS patents.

THE IUMTEK ANALYZER IS THE ONLY ONE CAPABLE OF **IDENTIFYING THE**

118

ELEMENTS OF THE MENDELEEV PERIODIC TABLE USING THE SAME INSTRUMENT, REGARDLESS OF THE PHASE OF THE MATERIAL ANALYZED

Year founded
2017

Key markets
- Government and private-sector research centers
- Small Modular Reactors (SMR/MSR)
- Metallurgy
- Recycling

Technology
- Laser ablation of liquid, solid, or gaseous material
- Emission spectroscopy analysis
- Artificial intelligence

iumtek real-time analytics

www.iumtek.com

KALRAY

Hardware and software solutions for intensive, high-performance data processing

Data-intensive applications and infrastructures that are smarter, better performing, and more energy efficient

Decades-old processors can't always cope efficiently with today's huge data volumes. Kalray is responding to this new landscape with processors, accelerators, and software designed to deliver exceptional performance.

It's a CEA spin-off that's already proven itself a pioneer in smart processors, with its MPPA® DPU processor—currently Europe's only high-performance, low-power DPU processor dedicated to intensive data processing and one that offers one of the most competitive performance per dollar/watt ratios around. Protected by 30 patent families, it has an 80-core processor and can manage several applications simultaneously with guaranteed processing times and performance.

This DPU processor only consumes a few dozen watts. It is programmable with standard languages, offers fast high-volume interfaces, and delivers real-time, on-the-fly data processing. It is integrated onto the K200-LP™ accelerator.

Kalray also offers software solutions for data storage and management.

The French company has operations in Germany, the United Kingdom, the United States and Japan. Its partnership with the CEA continues through collaborative projects, particularly on ultra-high-performance processors.

THE **KALRAY PROCESSOR IS**

3-5x MORE EFFICIENT

(PERFORMANCE PER DOLLAR/WATT) THAN OTHER SOLUTIONS ON THE MARKET

Year founded
2008

Key markets
- Data centers
- 5G infrastructure
- Edge computing (automotive, Industry 4.0, etc.)

Technologie
- DPU processors, based on a massively parallel 80-core MPPA® architecture
- High-performance programmable accelerators incorporating Kalray DPU processors
- Software solutions for data storage and management

KALRAY

www.kalrayinc.com

KENTYOU

Data intelligence for smarter cities

Tools to help communities navigate digital transformation

Kentyou helps cities harness digital technology to build smarter, more sustainable urban environments. This Grenoble startup develops digital twins based on open-source technologies and offers IoT solutions for simple, transparent connectivity with existing systems.

Cities are sitting on mountains of data—IoT devices and open data platforms being the main sources. Kentyou's mission is twofold: firstly, to facilitate data access, unification, and processing. Secondly, to help communities obtain actionable information for decision-making. Kentyou's philosophy is open source: The technology leverages an interoperable platform (sensiNact) that supports twenty different IoT communications protocols (ZigBee, LoRa, Sigfox, etc.). Any one of these protocols can be used to remotely access unified data sources, and new data sources can be integrated in less than 10 minutes. The number of use cases is staggering, from city traffic optimization to pollution and climate data applications.

Kentyou's innovation is the result of nearly ten years of CEA research in the fields of artificial intelligence and data platforms. Partnering with the CEA allowed the startup to connect with many municipalities around the world. Today, its solution is being rolled out in fifteen cities in Europe, South Korea, and Japan.

10 minutes
THE AVERAGE TIME IT TAKES
TO INTEGRATE
A NEW DATA SOURCE

Year founded
2020

Key markets
- Transportation and mobility
- Buildings
- Government

Technology
- AI and sensiNact data platform

kentyou

www.kentyou.com

KRONO-SAFE

Automated development of real-time embedded applications

Faster, cheaper development of safe-by-construction real-time applications

Krono-Safe's Asterios software automates the development of real-time applications, guarantees their safety, and helps keep projects on schedule. Customers include Safran, which chose Asterios as its companywide solution, as well as Alstom, Aptiv, and Schneider Electric.

The Krono-Safe Asterios software suite is the result of fifteen years of R&D at the CEA in operating safety in the nuclear and automotive industries. Protected by six patents, the software automates the spatio-temporal integration of real-time embedded applications. Advantages for users include shorter design cycles, sustained high performance, reliable and reproducible application behavior, and more.

Operating safety and adherence to a given application's time constraints are guaranteed by construction. Users also benefit from a simulation environment and 30% to 40% faster integration into hardware platforms.

The time savings are even more significant when porting existing applications to multi-core processors—down to just a few weeks from a year with conventional tools. These advantages have attracted many customers, including Safran, which has made Asterios its companywide solution for real-time embedded systems.

SAFRAN REDUCED THE TIME IT TAKES TO DEVELOP ITS REAL-TIME EMBEDDED APPLICATIONS BY
40%
THANKS TO KRONO-SAFE TOOLS

Year founded
2011

Key markets
- Aeronautics and space
- Defense
- Automotive
- Industrial IoT

Technology
- Automated development of real-time embedded applications
- Safe by construction
- Porting existing applications to multi-core processors

KRONO-SAFE

www.krono-safe.com

MICROOLED

Miniature OLED displays and modules

Crisp, sharp images and long battery life for augmented reality and other innovative applications

With high image quality, very low power consumption, and competitive cost, Microoled's miniature displays and modules are equipped to stand up to the global display industry's leading products. Augmented reality is their prime target market.

Thanks to an OLED technology originally developed by the CEA, startup Microoled has made waves in the market for microdisplays—tiny screens measuring less than 2 cm diagonally. High luminance, stellar image quality, and very low power consumption have earned Microoled a slot as the second-largest supplier in the world behind Sony.

The company has expanded its offering to ultra-light (7-gram) microdisplay modules for connected sports eyewear. Users can view heart rate, speed, distance, elevation gain, and other performance data collected by their smartphone or watch. The microdisplays are also ideal for augmented reality for GPS navigation and access to train schedules or tourist information, for example. Microoled offers an open development platform to facilitate the creation of applications compatible with its products.

The startup is collaborating with the CEA on high-luminance color microdisplays and holds licenses to several CEA patents.

AT JUST
1 MILLIWATT,
MICROOLED'S
ACTIVELOOK DISPLAY
CONSUMES
30X LESS
ENERGY THAN
THE COMPETITION

Year founded
2007

Key markets
- Binoculars and scopes
- Cameras
- Connected sports eyewear for augmented reality

Technology
- High-luminance, ultra-low power OLED displays
- Microdisplay modules for augmented reality

microoled
INNOVATIVE AMOLED SOLUTIONS

www.microoled.net

PRIMO1D

RFID tags in textile threads

Digital identification for inventory management and the circular economy

Primo1D replaces rigid RFID tags measuring several square centimeters with miniaturized devices that can be integrated into textile threads and that are resistant to washing, chemicals, and high temperatures.

Primo1D miniaturizes the RFID tag almost to the point of invisibility—the startup's chip can be integrated into textile fibers, car tires, wires and cables, and more. Its read performance is close to 100%, for example during on-the-fly scanning of clothing stored in boxes. In addition, it can withstand the common mechanical, chemical, and thermal stresses it may be subjected to during its useful life.

The startup has a production capacity of several million units per year. Its top market is apparel, where it helps manage inventories and support the development of the circular economy—by facilitating the sale of second-hand clothing, clothing rental, and end-of-life recycling.

Also targeted are the car tire and wire and cable markets, where it could provide product traceability and help manage maintenance and repairs.

Primo1D has a portfolio of 24 patents, including eight CEA patents under exclusive license. The company continues to work with CEA laboratories to characterize new RFID tags as needed.

PRIMO 1D RFID
TAGS CAN WITHSTAND
100
MACHINE WASHINGS

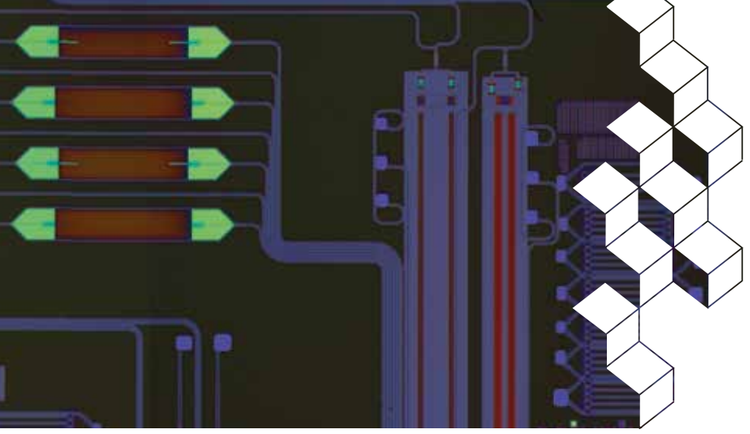
Year founded
2013

Key markets
- Apparel
- Automotive tires
- Electrical wire and cable

Technology
- E-Thread™ technology with miniaturized, thread-integrated RFID tags

Primo1D

www.primo1d.com



SCINTIL PHOTONICS

Integrated silicon photonic laser sources

■ *Volume-manufacturable integrated photonic circuits with optimal optical connectivity*

Based in Grenoble and Toronto, Scintil Photonics designs and supplies advanced silicon photonic circuits with integrated lasers and optical amplifiers. A breakthrough technology developed by Scintil Photonics paves the way for ultra-fast, compact optical connectivity—key to reducing the power consumption of specialized processors and meeting the exponential computing and data transmission needs of an increasingly connected world.

With its silicon photonic integrated circuits, the startup intends to significantly improve connectivity in high-performance systems and processors. Scintil Photonics develops single-chip solutions that integrate active and passive components manufactured using standard semiconductor industry CMOS silicon photonics processes. This unique, single-chip integration, including lasers and optical amplifiers, enables extremely compact ultra-high-speed communications, from 800 Gbit/s to 3,200 Gbit/s.

Scintil Photonics' technology, which leverages more than fifteen years of CEA laser and silicon photonics research and development, is ideal for data centers and high-performance computing (HPC).

3.2 TERABITS
DATA TRANSMISSION SPEED TARGET FOR PHOTONIC INTEGRATED CIRCUITS

Year founded
2018

Key markets
- Data centers
- HPC (high-performance computing)

Technology
- Integrated silicon photonic laser sources

SCINTIL PHOTONICS

www.scintil-photonics.com

SIQUANCE

The quantum computer

■ *The transformational potential of quantum*

With the capacity to solve problems that are currently intractable—even by the world's most powerful supercomputers—the quantum computer could bring unprecedented benefits to all industries.

Siquance was founded to develop and, ultimately, commercialize the first million-qubit quantum computer. The startup's strategy is to use proven semiconductor technologies to bring this operable quantum computer to the market.

The technology leverages the physical properties of semiconductors to fabricate quantum dots—the basis for top quality quantum bits (qubits). But Siquance brings an additional asset to the mix: deep expertise in proven semiconductor industry processes that have already been used to manufacture chips with billions of transistors. The startup's technology plus this clear path to manufacturability will lead to quantum accelerators that deliver truly revolutionary performance.

Siquance's disruptive innovation expected to make a huge impact, including on France's technological sovereignty. And all industries will be concerned. Among the early adopters will be industrial companies with strong demand for high-performance computing—especially in the pharmaceutical, energy, and transportation industries.

Created in 2022, Siquance is built on joint research between the CEA and the CNRS and has already generated a portfolio of about 40 patent families. Its three co-founders, from the CEA and CNRS, bring complementary skills essential to the creation of a quantum computer.

1 MILLION QUBITS
POTENTIAL FOR INTEGRATION ON A SINGLE CHIP

Year founded
2022

Targeted markets
- All industries, including health, energy, and transportation

Technology
- FD-SOI semiconductor technology

siquance

www.siquance.com

SNOWPACK

Unprecedented data anonymization and security

■ *Online invisibility and secure data exchange*

Based in Paris and Vienna, Snowpack develops and operates an invisibility network to guarantee data anonymization and security. The startup's solution fragments information into "snowflakes" of randomized, but related, data. These snowflakes are anonymized and sent down separate pathways, also constructed anonymously, making it impossible for hackers to access the data.

On the internet, information is conveyed in the form of data packets that contain the usable information itself as well as the metadata needed to get the information from one place to another. While the usable information can be protected via encryption, the metadata can still be accessed—making conventional data packets vulnerable to hackers.

The Snowpack solution is an answer to today's growing personal and professional data security needs. Unlike competing solutions, it does not require the use of a trusted third-party and offers a level of security unmatched by existing anonymization techniques.

This disruptive technology, developed at the CEA, has many advantages: It is robust to mass network surveillance, drastically reduces the visible attack surface, and does not require a trusted third party. The solution's feasibility and performance had already been demonstrated at the CEA before the startup was founded.

3 EXCLUSIVE PATENTS FILED IN THE FIELD OF **CYBERSECURITY**

Year founded
2021

Key markets
- Cybersecurity solution providers
- Stakeholders that collect data online

Technology
- Snowpack technology with architecture and major protocol principles protected by exclusive patents

Snowpack

www.snowpack.eu

SPORT QUANTUM

Connected interactive electronic shooting targets

■ *Fun, interactive targets with score sharing and analysis to revolutionize shooting sports*

Paper shooting targets will become a thing of the past with electronic displays that offer up not only interchangeable targets, but training and competition management features, too. Shooting sports enthusiasts of all levels are raving about Sport Quantum.

Since 2017, Sport Quantum has been revolutionizing shooting sports by replacing paper targets and mechanical cable devices with an electronic display connected to a tablet. The system electronically locates impacts, calculates scores, and transmits them live.

The screen can display conventional targets, fun patterns, or training targets to improve skills like control or concentration, making it attractive to beginners, experienced practitioners, and top athletes alike. A system that detects shock waves on the polycarbonate plate that protects the display locates impacts to within 100 µm, the precision required in official competitions.

Sport Quantum is growing fast and opened a subsidiary in Germany in 2022. It holds exclusive licenses to four CEA patents and works with the CEA through a joint laboratory to improve the solution's measurement accuracy, the robustness of the target, the operating safety of the competition scoring software, and more.

SPORT QUANTUM TECHNOLOGY LOCATES THE IMPACTS OF PELLETS AND ROUNDS AT AN **ACCURACY** OF UP TO **0.1 mm** thanks to **four sensors**

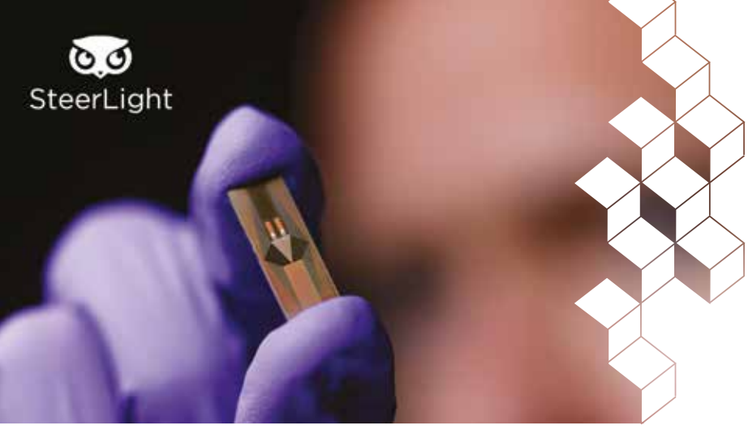
Year founded
2017

Key markets
- Sport shooting clubs
- Official competitions

Technology
- High-brightness screen protected by a polycarbonate plate
- Location of impacts by four piezoelectric sensors
- Collection, processing, and sharing of shooting score data

sportquantum

www.sportquantum.com



STEERLIGHT

A new generation of LiDAR sensors

Reliable, three-dimensional optical sensors to protect people and goods in motion

SteerLight is a deep tech startup founded in 2022. It has developed a new generation of LiDAR: laser-based optical systems that can perceive the environment in 3D with unparalleled precision and resolution. The quality of these systems translates into decisive advantages in a range of use cases, including guaranteeing that autonomous vehicles and robots can move around safely.

The SteerLight solution is based on a disruptive coherent infrared LiDAR architecture. The LiDAR is fully integrated onto silicon photonic chips using standard microelectronics processes and does not have any moving mechanical parts. Long-range, high-resolution SteerLight LiDAR-on-chip is compact, robust, and—because it is volume-manufacturable—affordable.

It is the result of fifteen years of research in CEA laboratories in the fields of silicon photonics, electronics, and embedded computing. The roadmap for the next few years is packed: the startup will be finalizing its team and designing its first product, before fundraising and scaling up the technology for manufacturing.

DETECTION RANGE **MULTIPLIED** BY **4**

Year founded
2022

Key markets
- Logistics and manufacturing: mobile autonomous robots
- Urban transportation: people and goods
- Urban security: securing dangerous areas

Technology
- Silicon photonic FMCW architecture

SteerLight

www.steerlight.com

TRUSTINSOFT

Quality and security for C & C++ software

Dramatically faster, cheaper verification for guaranteed software reliability and robustness to cyberattacks

TrustInSoft helps software developers achieve source code reliability and immunity to known types of cyberattacks, a unique offering available worldwide.

Using the Frama-C source code analyzer developed by CEA and Inria, TrustInSoft has developed a full suite of C & C++ software analysis tools and services. They provide mathematical evidence of their reliability (zero bugs) and immunity from known types of cyberattacks.

These tools make software validation much, much simpler. Usually, software is validated by performing an array of test attacks, with no way to guarantee that all possible scenarios have been covered. TrustInSoft runs a single analysis and provides guarantees to its customers. In aeronautics industry use cases, software validation time and cost have been reduced by 75%.

The startup holds a license to a CEA patent. Initially focused on critical applications (nuclear, aeronautics), it now focuses on the automotive and consumer electronics industries. It generates 70% of its revenue from exports, 50% from sales to customers in the United States.

TRUSTINSOFT TOOLS CURRENTLY **SECURE** **57 million** **ELECTRONIC DEVICES**, IN ENERGY, GAMING AND TELECOMS

Year founded
2013

Key markets
- Critical industrial systems
- Automotive
- Consumer electronics

Technology
- Comprehensive analysis of C and C++ source code
- Mathematical proof of code security and reliability

TRUST IN SOFT

www.trust-in-soft.com

WIN MS

Real-time cable monitoring and diagnostics

Expert cable network monitoring for high-uptime production, transportation, and building management equipment

Expert cable network monitoring for high-uptime production, transportation, and building management equipment

The startup WiN MS has built a reputation both in France and internationally on the performance of its fault detection and location solutions for cable networks. The company's technology works with all types of cables: electrical, data, radio, and fiber optic. Its electric arc detection solution, with its extremely low false alarm rate, is, along with several other WiN MS solutions, unique on the market.

These user-friendly solutions are designed for non-experts in the aeronautics, automotive, air transportation, and defense industries. In aeronautical maintenance, for example, they cut troubleshooting time by 80%.

WiN MS solutions can be used for the entire equipment lifecycle, including during service life, making systems and infrastructures more reliable. Arc detection and power distribution network monitoring provide increased safety. As electric mobility and microgrids gain traction, the opportunities for WiN MS will continue to grow.

The startup has a portfolio of nine patents, including five exclusive CEA patent licenses. WiN MS is present in 20 countries, with subsidiaries in the United States and Singapore.

WIN MS GENERATES **75%** OF ITS REVENUE FROM **EXPORTS**

Year founded
2012

Key markets
- Aeronautics manufacturing and airlines
- Automotive
- Renewable energy, microgrids

Technology
- Detection and localization of faults via reflectometry
- Arc detection

www.win-ms.com

WISE INTEGRATION

Innovative power electronics

Chargers that are simpler to use without sacrificing performance

Created in 2020, the startup Wise Integration is offering a disruptive technology that enables industrial customers to manufacture more compact and energy-efficient chargers. It's based on a GaN (gallium nitride) technology developed at the CEA. The properties of this material, leagues ahead of silicon, improve energy conversion performance significantly.

Wise Integration combines a GaN-based integrated circuit with a high-performance control software architecture for much more compact power supply units. Myriads of use cases come to mind, not least of which are consumer electronics—mobile phones, laptops, e-bikes, electric scooters, and more. However, Wise Integration solutions also have a role to play in manufacturing and data centers, allowing them to drastically reduce their energy consumption. The company has international ambitions, particularly in Asia, as demonstrated by the opening of a sales office in Taiwan.

Wise Integration uses GaN technology, a breakthrough developed in CEA laboratories over more than ten years and protected by numerous patents. After the development of a proof-of-concept prototype, the company scaled up the technology for manufacturing and began commercializing its solutions in 2022.

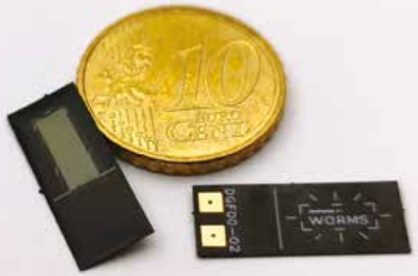
CHARGERS **3x** more **COMPACT** & more **EFFICIENT**

Year founded
2020

Key markets
- Mobile phones/laptops
- Electric mobility (e-bikes, electric scooters, etc.)
- Manufacturing plants and data centers

Technology
- GaN Technology
- Digital control

https://wise-integration.com



WORMSENSING

Ultra-sensitive vibration sensors

A new record in vibration and deformation measurement accuracy

Wormsensing is revolutionizing vibration measurement for industrial and consumer applications with ultra-sensitive, universal sensors.

Vibration measurement is conventionally carried out using strain gauges or accelerometers. Wormsensing sensors are 1,000 times more accurate than strain gauges and 10,000 times less bulky than accelerometers! The patch-format sensors are no thicker than a human hair and can be applied to any object or structure in any environment in just minutes.

Beyond the traditional instrumentation, measurement, and testing scenarios, the Worms sensor brings vibration measurement to a much wider range of applications, including new ones like human-machine interfaces and vital sign monitoring.

The startup, created by two CEA scientists, operated for three years at the CEA in Grenoble and will invest in a pilot production line in 2023. Collaboration in R&D continues in a joint laboratory.

AT JUST

150

MICRONS

WORMSENSING'S
VIBRATION SENSOR IS NO
THICKER THAN A HUMAN HAIR
AND CAN BE USED ANYWHERE

Year founded
2020

Key markets
- Instrumentation and quality control
- Predictive maintenance
- Embedded electronics for the automotive and health markets

Technology
- Sensing element: thin-film piezoelectric ceramic (10 µm)
- Flexible and conformable electronic substrate

WORMS

www.wormsensing.com

ADMIR

High-speed spectroscopic imaging

Faster, simpler, more secure medical diagnostics

ADMIR designs, develops, and manufactures a particularly innovative ultra-fast spectroscopic infrared imaging system that makes bioanalysis more reliable and, above all, 100 times faster. The technology is revolutionizing public health.

100x
FASTER
BIOANALYSIS

HEALTH

ADMIR's instruments, designed for pathologists, biologists, and biochemists, are breaking new ground in cancer, infectious disease, and microplastics screening. The technology developed by the startup turns results around in just one hour vs. the several days needed by current bioanalysis technologies. In addition, it does not require reagents, dyes, biomarkers, or other chemicals, and is more reliable than conventional testing.

Today, ADMIR leverages the CEA's know-how in infrared technology through a portfolio of twelve patents. Its software suite combining instrumentation and artificial intelligence is on track to address new markets other than health.

Year founded
2022

Key market
- Health: Oncology, microbiology, and analysis of microplastics in the body

Technology
- Spectroscopic infrared imaging
- Machine learning

ADMIR

www.admir-analysis.com

AJELIS

High-performance industrial pollution filters

■ *New-generation filters for air and water depollution and strategic metal recycling*

Startup Ajelis is the fruit of a partnership between the CEA and Paris-Saclay University. Its new-generation polymer fiber filters are designed for the depollution of liquid and gaseous industrial effluents. The company also offers specialized fibers for the recovery and recycling of metals. This breakthrough innovation is built on a selectively sorbent fiber technology developed at the CEA.

This new generation of filter medium, capable of filtering both pollutants and metals, outperforms conventional activated carbon or resin filter media. First, it can absorb lower metal concentrations, giving users a head start on increasingly stringent environmental standards. Second, fiber selectivity can be adapted to different target metals. Finally, treatment speed is at least ten times faster than that of conventional materials, at one-tenth the treatment cost. And, because the fibers are easy to regenerate, they are more sustainable.

The startup's solutions found success with many industrial customers in France and other European countries practically on day one. This efficient, economically-viable, and more environmentally-friendly technology from Ajelis helps customers create their Factories of the Future.

200

WATER TREATMENT AND METAL RECYCLING PROJECTS SUCCESSFULLY COMPLETED WITH FRENCH AND EUROPEAN CUSTOMERS

Year founded
2014

Key markets
- Depollution of liquid industrial effluents
- Air purification
- Decontamination of nuclear effluents
- Recycling of critical metals
- Mobile treatment units

Technology
- Selectively sorbent polymer nanofibers for toxic and strategic metalss

www.ajelis.com

AVALUN

A connected, portable biological testing lab

■ *Anytime, anywhere biological testing from a single drop of blood*

Avalun is the startup behind the LabPad® Evolution, a pocket-sized lab that can perform multiple biological analyses from just a finger prick of blood.

A miniature, automated microscope built from two CMOS sensors is what allows the LabPad® to perform multiple lab-quality measurements. The reagents required for the tests take the form of consumable micro-cartridges. Blood tests can be done anywhere from a single finger prick, and the results are sent via Bluetooth to a smartphone or tablet.

Avalun's device, widely distributed in France and other European countries, facilitates point-of-care testing in hospitals, and is also of interest to biology laboratories, general practitioners, nurses, nursing homes, and other healthcare stakeholders.

It can measure blood clotting time in patients on anticoagulants, C-reactive protein to detect viral or bacterial infections, and D-dimer if cardiac embolism is suspected.

Founded by two CEA engineers, Avalun's IP portfolio includes nine CEA patents. In 2021, the startup was acquired by Biosynex.

AVALUN OFFERS THE **LIGHTEST** BIOLOGICAL ANALYSIS DEVICE ON THE MARKET AT ONLY

300grams

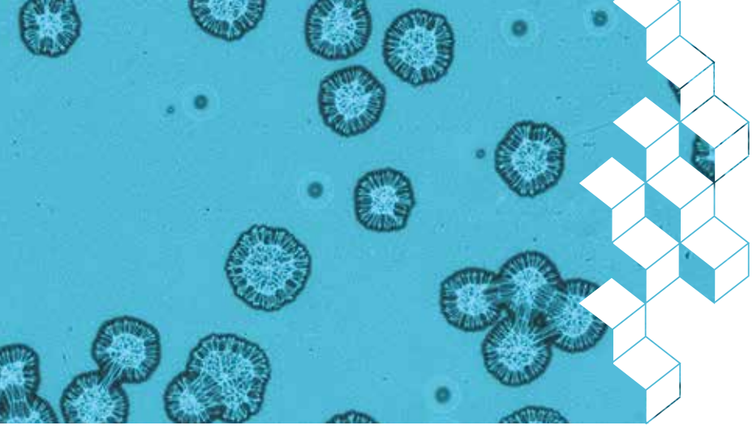
COMPARED TO **1.5 KILOGRAMS** FOR ITS CLOSEST CONTENDER

Year founded
2013

Key markets
- Hospitals
- Outpatient medicine
- Medical offices
- Home care

Technology
- Lensless microscopy
- Microfluidics
- Rapid reading of fluorescent optical measurements
- Transmission of results via Bluetooth

www.avalun.com



BAIO-DX

Rapid bacteria identification using holographic imaging and AI

■ *Antibiotic sensitivity screening results in a quarter of the usual time*

BAIO-DX is developing a new medical diagnostic tool that leverages artificial intelligence and lensless holographic imaging. The company's augmented microbiological analyses can identify the bacteria responsible for infection, and then rapidly and automatically indicate the best antibiotic.

To determine which antibiotics will be effective against an infection, biological samples are cultured, and then the bacteria present are identified using MALDI-ToF mass spectrometry. The BAIO-DX lensless holographic imaging device, coupled with artificial intelligence algorithms, accelerates this step. It continuously observes the Petri dish, detects bacteria as soon as they appear, and identifies them without sampling. It then performs an antibiotic sensitivity test.

With this technology, which can be integrated into existing lab processes, healthcare professionals are improving patient care by prescribing better-targeted antibiotics more quickly and slowing the onset of antibiotic resistance. Process automation increases the productivity of analysis laboratories, as well as the traceability and reliability of their operations.

BAIO-DX, created in January 2022, conducts tests on patient samples with a prototype in use at the Grenoble Alpes University Medical Center as part of a partnership. The startup, founded by one CEA researcher and one CNRS researcher, holds licenses to four CEA patents.

ACCORDING TO THE WHO, **ANTIMICROBIAL RESISTANCE** COULD CAUSE AROUND

10 million

DEATHS WORLDWIDE BY 2050

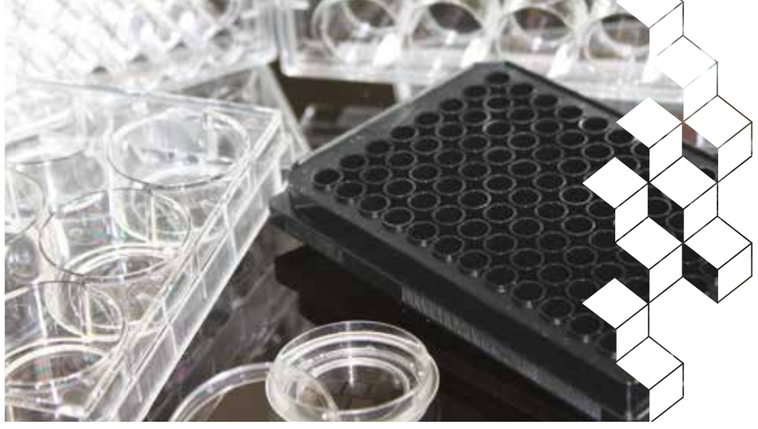
Year founded
2022

Key markets
- Hospitals
- Private analysis labs

Technology
- Lensless holographic imaging
- Artificial intelligence algorithms

baio-dx

www.baio-dx.com



CELL&SOFT

In vitro culture plates for drug discovery

■ *Faster, cheaper, more successful drug discovery*

Cell&Soft develops flexible, textured culture plates that mimic human tissues for more realistic *in vitro* trials and faster drug discovery.

In vitro cell cultures are plagued by a lack of predictability: 98% of promising results obtained *in vitro* turn out to be clinical failures. The low success rate is due in part to the plastic culture plates used in labs. A million times stiffer than human tissues and organs, the plates subject cells to a very different environment than that of their original organs, skewing the results.

Cell&Soft's hydrogel culture plates mimic the physiological rigidity of the lungs, heart, brain, and other organs and tissues. Several academic research laboratories have confirmed that the cellular models developed on these plates are more realistic, providing *in vivo* conditions for the testing of new drug candidates for cancer, inflammatory diseases, fibrosis, and myopathies.

The startup has developed an initial line of eleven products and co-develops custom plates with biotech companies. The CEA saw the potential of these technologies at an early stage and financed the first market studies.

TODAY, ONLY **1% TO 2%** OF DRUG CANDIDATES TESTED *IN VITRO* ARE **EFFECTIVE IN CLINICAL TRIALS**

CELL&SOFT'S GOAL

10% **IS TO INCREASE THIS FIGURE TO**

Year founded
2018

Key markets
- Oncology
- Development of stem cells for personalized medicine

Technology
- Synthetic hydrogels designed using microelectronic techniques
- Photopolymerization through lithography masks enables local rigidity representative of a given organ

Cell&Soft
Let's reinvent cell culture!

www.cellandsoft.com

CERES BRAIN THERAPEUTICS

A drug candidate for a rare neurometabolic disease

Treatment for a previously untreatable disease to improve quality of life for children, caregivers, and families

Ceres Brain Therapeutics is developing a drug candidate for a rare neurological disease that causes severe intellectual disabilities, autistic behaviors, and seizures. The drug could be made available by 2027.

X-linked creatine transporter deficiency is an inherited disease linked to a genetic mutation on the X chromosome that prevents creatine (an amino acid that provides energy to cells) from reaching neurons. With an initial clinical trial scheduled for 2024, Ceres Brain Therapeutics is currently the company in the world closest to developing a drug for this disease.

The drug, CBT101, is a pro-creatine that, thanks to a chemical vector graft, can cross the blood-brain barrier, supplying neurons with creatine. Animal tests have shown very significant improvement in cognitive behavior.

Ceres Brain Therapeutics has a portfolio of six patents, including four CEA patents. As part of an R&D agreement with the CEA, the startup is deepening its understanding of the mechanism of its drug candidate and developing new candidates targeted at other rare neurological diseases.

16,000

ESTIMATED NUMBER OF **CHILDREN WORLDWIDE** AFFECTED BY **CONGENITAL CREATINE TRANSPORTER DEFICIENCY**

Year founded
2019

Technology
- Active ingredient coupled with a chemical vector to cross the blood-brain barrier and neuronal membrane
- Nasal administration to reach the brain via the olfactory and trigeminal nerves

www.ceres-brain.com

DIABELOOP

Interoperable self-learning diabetes management solutions

Better blood sugar regulation, a lighter mental load, and improved quality of life for people living with diabetes

Diabeloop's first-of-its-kind solution for automated type 1 diabetes treatment calculates the insulin doses patients need throughout the day and administers them in an automated and personalized manner. The solution is already in use in seven European countries.

People living with type 1 diabetes are constantly at risk of either hypoglycemia or hyperglycemia. To manage the disease, they must perform countless insulin dose calculations every day. And, depending on metabolism, physical activity, and diet, the doses can vary by a factor of three. Diabeloop's DBLG1 System lightens this mental load by continuously monitoring the patient's glucose level, calculating the right insulin dose, and automatically administering it.

Fifteen clinical studies have validated the effectiveness of this device, which improves the regulation of blood sugar levels and patients' quality of life. It obtained CE certification in 2018 and France's national health insurance provider approved the device for reimbursement in 2021. Diabeloop's product is already available in seven European countries, and the company is now accelerating its international development.

The technology is protected by a portfolio of 21 patents, including ten CEA patents. And, as part of a joint laboratory with the CEA, Diabeloop is continuing to improve its AI algorithm to further refine insulin dose calculation based on each patient's specific needs.

ONE YEAR AFTER LAUNCH, MORE THAN

10,000

people in Europe

HAVE BEEN EQUIPPED WITH THE **DIABELOOP** DBLG1 SYSTEM

Year founded
2015

Technology
- Dexcom glucose monitor
- Diabeloop technology compatible with multiple insulin pumps
- Artificial intelligence algorithm for glycemic management: prevention of hypoglycemia, adaptation to carbohydrate and fat intake from meals, physical activity, correction bolus in case of hyperglycemia

www.diabeloop.com

DIRECT ANALYSIS

For better food safety

Detecting microbial contamination four times faster

Detecting bacteria like *Salmonella, Listeria* and *E. coli* as quickly as possible on production lines is a major challenge for food manufacturers. The technology developed by startup Direct Analysis cuts PCR test time by 75%. Rapid testing is vital to keeping consumers healthy and limiting product recalls and the associated food waste.

The Direct Analysis detection system is based on state-of-the-art DNA extraction and microfluidics technologies CEA labs have been developing for over ten years. The startup's lab-on-chip makes microbial analysis faster, easier, and more secure.

Direct Analysis has a portfolio of ten patents, including exclusive licenses to CEA patents.

The company's first detection system was commercialized in a simplified version in 2022 and will be ready for large-scale deployment in 2024.

DETECTS BACTERIA

4x

faster than conventional tests

Year founded
2021

Key market
- Food manufacturing and farming: production plants and analysis laboratories

Technology
- Microfluidics
- DNA extraction
- Biomolecule detection (PCR)

www.direct-analysis.com

ETHERA

Air quality monitoring sensors

Solutions for controlling both indoor air quality and building energy use

Ethera's compact, accurate, and easy-to-maintain sensors continuously monitor indoor air pollutant concentrations so that building operators can take action.

Building occupants are chronically subjected to air pollutants like formaldehyde, fine particles, nitrogen dioxide, ozone, carbon monoxide, and volatile organic compounds, to name a few. Ethera has developed sensors and measuring stations to detect them, quantify them, and report any readings that exceed regulatory thresholds.

These miniaturized, energy-efficient devices achieve the same level of sensitivity (one microgram/m3) as laboratory measurements—and they do it in real time, on-site, and at a much lower cost.

Ethera combines these solutions with services for collecting, managing, displaying, sharing, and post-processing data.

In particular, these services help optimize building ventilation strategies to guarantee air quality without letting more heat out of the building than necessary.

The startup, a SEB company, holds exclusive licenses to two CEA patents.

ETHERA SENSORS DETECT formaldehyde, the primary indoor air pollutant, at a **record sensitivity** of **7ppb**

Year founded
2010

Key markets
- Commercial buildings
- Smart buildings
- Schools
- Swimming pools and sports facilities

Technology
- Porous materials functionalized to react to pollutants
- Data collection, processing, and provision
- Post-processing of data to control air purifiers, ventilation systems, etc.

www.ethera-labs.com

FLUOPTICS

Fluorescence imaging for surgery

Image-guided surgery for improved patient care and fewer complications

Fluoptics imaging systems highlight features like the exact locations of the parathyroid glands or tissue vascularization during procedures, making it a valuable tool for surgeons.

Surgeons conventionally rely on diagnostic imaging done in advance to prepare for their procedures. Fluoptics provides them with additional real-time information invisible to the naked eye: its cameras detect contrast media circulating in the vascular or lymphatic systems or accumulating in a lymph node or vessel.

This allows surgeons to operate with even greater precision, for far more effective procedures and a vastly reduced risk of damage to healthy tissues. Fluoptics technologies were developed and validated by clinicians across the globe and are currently sold in more than 20 countries.

Fluoptics is the result of more than 10 years of research in CEA laboratories. Today the startup is a world leader in fluorescence imaging for thyroid surgery. It is also active in breast reconstruction surgery. Acquired in 2022 by the Swedish company Getinge, Fluoptics possesses a portfolio of 20 patents, including ten CEA patents for which it has exclusive licenses.

SINCE ITS INCEPTION IN 2009, **FLUOPTICS** HAS COMMISSIONED MORE THAN

500

IMAGING SYSTEMS

Year founded
2009

Key markets
- Thyroid surgery
- Reconstructive surgery
- Lymphatic surgery

Technology
- Fluorescence imaging
- Detection of contrast media through biological tissues
- Images as accurate as X-ray

FLUOPTICS
Part of Getinge

www.fluoptics.com

MAG4HEALTH

More affordable magnetoencephalography

A powerful, competitive new neuroimaging technology to improve the treatment of brain conditions

Magnetoencephalography is a powerful brain imaging technique, but it is not helping as many patients as it could due to its high cost. Mag4Health is democratizing MEG scans with a device that is more versatile and just as powerful as conventional machines but at one-third the cost.

Mag4Health utilizes a magnetometry technology developed over two decades of CEA space research. The startup is bringing this twelve-times-patented innovation to healthcare, where it is reshaping magnetoencephalography.

Mag4health's quantum sensors operate at ambient temperature, replacing conventional sensors that need to be cooled to –269 °C with a cryostat. The magnetic shielding required is ten times lighter, which means that the sensors can be placed on a helmet, in contact with the patient's skull, for better brain signal reception. The simplicity of the device opens the door to many use cases, including image acquisition on moving patients or children.

The total purchase and maintenance cost of these machines is one third that of conventional machines for the same level of performance. Mag4Health has now eliminated the main obstacle to the development of the only imaging technology that can record and locate all brain activity. Currently there are only around 150 MEG scanners in the world, and just five in France. The startup plans to ship its first products at the end of 2023.

MAG4HEALTH'S MEG SCANNER HAS A ONE-TON MAGNETIC SHIELD; THAT'S

10x

LIGHTER

THAN CURRENT SYSTEMS

Year founded
2021

Main applications
- Preparation for epilepsy surgeries
- Preparation for brain tumor surgeries
- Diagnosis of concussions
- Early diagnosis of Alzheimer's disease

Technology
- Helium-4 quantum sensors operating at room temperature
- Headset acquisition system incorporating 48 sensors

MAG 4He alth

www.mag4health.com

REMEDEE LABS

Endorphin stimulation for chronic pain relief

A customizable, drug-free long-term pain treatment solution for better quality of life

Remedee Labs has developed the first millimeter-wave-emitting bracelet that stimulates the production of endorphins, the body's natural analgesics. It also offers an online service platform to bring patients multidisciplinary pain management backed by personalized support.

Millimeter-wave treatment was used successfully on millions of pain patients in the1970s. Over time, however, the treatment, which could only be administered in hospitals due to the large equipment used, has been replaced by pain medication. Remedee Labs is putting millimeter-wave technology at everyone's fingertips with a simple bracelet equipped with a microelectronic chip that stimulates natural endorphin production.

The solution is currently being tested with patients suffering from fibromyalgia, osteoarthritis, and migraines at Grenoble University Medical Center. The goal is to obtain medical device approval for the bracelet in 2024.

The startup is offering an initial non-medical bracelet, Remedee Well, to improve users' day-to-day well being. The package includes the bracelet plus access to the online platform.

Remedee is collaborating with the CEA on imaging-based brain evaluation of the physiological effects of its technology.

12 MILLION PEOPLE IN FRANCE SUFFER FROM **CHRONIC PAIN**, AND

70%

OF THEM **DO NOT RECEIVE APPROPRIATE TREATMENT**

Year founded
2016

Possible uses (clinical trials in progress)
- Fibromyalgia
- Osteoarthritis
- Chronic migraines

Technologies
- 2 cm^2 miniaturized electronic module integrated into a bracelet
- 60 GHz millimeter-wave-emitting silicon chip

www.remedee.com

SUBLIMED

Relieving osteoarthritis knee pain via neurostimulation

Pain relief for a rapid return to normal activities and better quality of life

Sublimed relieves chronic pain associated with osteoarthritis of the knee using a discreet and flexible transcutaneous neurostimulation patch. It is available in France and several European countries.

Transcutaneous electrical neurostimulation has been used for 30 years to fight chronic pain. It inhibits pain signals and triggers the secretion of endorphins, the body's natural analgesics. However, conventional equipment is cumbersome and impractical; 40% of patients give up using it for practicality reasons.

The startup Sublimed, born from the meeting between a CEA engineer and a pain center doctor, now offers a lightweight, miniaturized, and discreet device controlled via smartphone. A clinical study carried out on 110 patients confirmed its effectiveness for osteoarthritis of the knee, a result that led France's national health insurance provider to approve the device for reimbursement. Thanks to a web platform, the patient can find their neurostimulation data and track quality of life indicators like sleep and resumption of walking and other daily activities.

Sublimed is based on a portfolio of six patents, including five CEA patents under license. It is collaborating with university medical centers to improve its technology and has been FDA-approved for the US market since 2021.

MORE THAN

20,000

PATIENTS
IN FRANCE HAVE ALREADY USED THE **ACTITENS** SOLUTION DEVELOPED BY SUBLIMED

Year founded
2015

Prescribed for
- Osteoarthritis of the knee

Technology
- Slim, conformable pulse generator patch
- Miniaturized, wireless skin electrodes
- Remote electronic control

www.subli-med.fr

THERANEXUS

Treatment for rare neurological diseases

Innovative drug candidates for devastating and currently-untreatable neurological diseases

Theranexus is an innovative biopharmaceutical company born from the CEA. It is developing what is currently the most advanced drug candidate in the world to slow the progression of Juvenile Batten disease, a neurodegenerative disorder that affects children starting at the age of four. The drug could be made available in 2026.

Batten disease is a genetic disorder that affects children as young as four. It results in loss of vision, motor and cognitive impairment, and seizures. There is no treatment available, and the disease is fatal after 20–25 years on average.

Batten-1, the drug candidate developed by Theranexus in partnership with the US-based Beyond Batten Disease Foundation, addresses this condition by targeting both neurons and astrocytes, non-neuronal brain cells. It acts on the process that recycles toxic molecules from cells, which the disease disrupts. Theranexus will begin a pivotal clinical trial in 2023, with the hope of getting the drug onto the market in 2026.

Beyond this flagship project, Theranexus, a startup created by two CEA researchers, is working collaboratively with the CEA to discover other innovative therapy drugs. Possible future avenues include targeting one or more of the 40 rare neurological conditions close to Batten disease.

RARE NEUROLOGICAL DISEASES FOR WHICH **NO TREATMENT EXISTS** AFFECT

350 MILLION PEOPLE WORLDWIDE

Year founded
2013

Prescribed for
- Treatment of Batten disease

Technology
- Proprietary pharmaceutical specialty
- Action mechanism: prevents brain cell death by blocking glycosphingolipid accumulation and neuroinflammation
- Method of administration: oral solution

THERANEXUS

www.theranexus.com

ENERGY

APIX ANALYTICS

In situ analysis of industrial gases and liquids

■ *Real time, in-process measurement for higher yields and better product quality*

Apix Analytics is bringing industrial gas and liquid analysis to a wide market with its miniaturized gas chromatography modules. They are half the price and ten times the resolution of laboratory equipment.

Apix Analytics leverages advanced silicon technologies developed by the CEA and Caltech and protected by 25 patents to produce miniaturized gas chromatography modules of less than a liter. With the company's continuous on-site analysis solution, users no longer need to send samples to a lab and wait for the results to come back—they can optimize their processes in real time.

The startup's analyzers are simple enough to be used by anyone. They detect all gases and liquids, from hydrogen to heavy oils—a versatility unmatched on the market.

These compact and competitive analyzers can carry out quality controls, verify the correct level of odorization of natural gas, or calculate caloric value for pricing purposes.

Apix Analytics is developing new generations of multi-gas detectors with the CEA. Its customers include major energy companies such as Air Liquide, Engie, and TotalEnergies.

APIX ANALYTICS

www.apixanalytics.com

APIX ANALYTICS
HAS ALREADY DEPLOYED
500
SYSTEMS
TO INDUSTRIAL SITES
WORLDWIDE

Year founded
2014

Key markets
- Renewable natural gas (RNG) production
- Natural gas production
- Hydrogen energy industry

Technology
- Nano electromechanical systems (NEMS)
- Miniaturization and integration of the gas chromatography chain into a 0.7-liter module

EXTRACTHIVE

A recycled carbon fiber that's easy on the environment

An eco-friendly, competitively-priced, high performance product for a more secure carbon fiber supply chain

Extracthive recovers carbon fiber from used composite parts and gives it a second life in new parts. An initial industrial demonstrator will launch in 2023.

Carbon-fiber composites are booming, with an 11% CAGR expected over the next decade. However, producing new carbon fibers generates 20 tons to 40 tons of carbon dioxide (CO_2) per ton produced. Extracthive is developing a process for recycling carbon-fiber-containing composite materials. Called solvolysis, the process, which reduces CO_2 emissions by 80%, separates the matrix from the fiber with a heated solvent.

The recovered fiber does not cost any more than new fiber and achieves 98% of its fracture toughness and tensile strength. It is compatible with multiple polymer matrices.

Tests are underway with sporting goods, boat, and aeronautics manufacturers to validate its performance under representative conditions.

Extracthive is based on more than ten years of CEA R&D and continues to collaborate with CEA researchers on lifecycle analysis (LCA), fiber characterization, and degraded polymer resin recycling. In 2023, it will launch an initial industrial demonstrator in France, where its customers are. At the same time, it is developing new recycling processes for lithium batteries and silicon carbide, used in chemistry and metallurgy.

THROUGHOUT ITS USEFUL LIFE, **EXTRACTHIVE'S** RECYCLED CARBON FIBER PRODUCES

80%

LESS GREENHOUSE GASES THAN NEW FIBER

Year founded
2015

Key markets
- Boating
- Sports and recreation
- Electric vehicles

Technology
- Solvolysis of end-of-life composite parts
- Matrix depolymerization, carbon fiber recovery
- Solvent regeneration and reuse

EXTRACTHIVE
Creating value from waste

www.extracthive-industry.com

HELIUP

Ultralight roof-mounted photovoltaic panels

Rooftops that generate revenue and secure electricity rates for 20 years

Heliup has designed ultralight, easy-to-install solar photovoltaic panels designed for the structural limitations of metal-frame buildings. The panels can meet 15% to 100% of a building's electricity requirements.

The roofs of many industrial and commercial buildings are not compatible with conventional solar photovoltaic panels, which, with their supporting structures, weigh 15 kg/m². A Heliup innovation reduces PV panel weight by more than 60% without sacrificing profitability. The electricity generated can be used by the building or fed back into the grid for income.

The reduced weight is made possible by ultra-thin glass that provides both mechanical and physicochemical protection for the PV cells. This innovation is protected by three CEA patents for which Heliup holds exclusive licenses. The panels are being certified, and 1:1 tests will take place in 2023.

The startup will bring the product to market in the second half of 2023, targeting large construction and energy companies. It will continue to work with the CEA on R&D to optimize its panels, evaluate their performance, validate new materials, and conduct panel lifecycle analyses.

HELIUP ROOF-MOUNTED PHOTOVOLTAIC PANELS WEIGH

5 KG/M²,

COMPARED TO **15 KG/M²** FOR CONVENTIONAL PANELS INCLUDING THE MOUNTING STRUCTURE

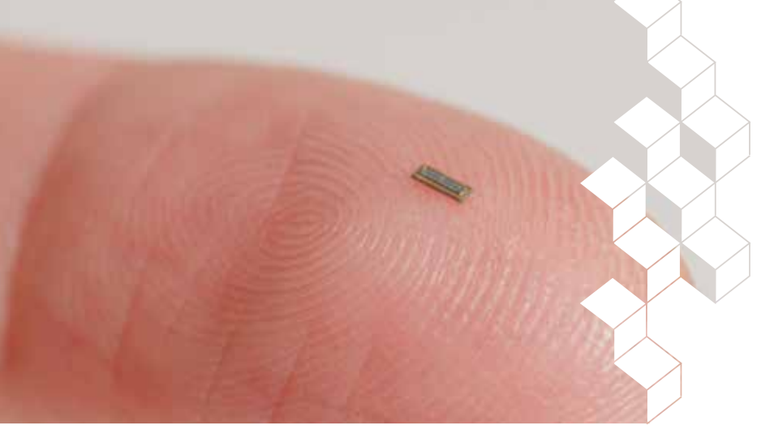
Year founded
2022

Key markets
- Industrial and commercial buildings
- Warehouses
- Retail
- Agricultural buildings

Technology
- Lightweight, high-strength glass capable of protecting photovoltaic cells
- Innovative roofing systems for flat and sloped roofs

Heliup

www.heliup.fr



INJECTPOWER

A new generation of microbatteries for implantable medical devices

Non-invasive continuous intraocular, intracranial, and blood pressure monitoring

Today, one of the major challenges for implantable medical devices is battery size. Injectpower is addressing this challenge with a new generation of rechargeable microbatteries for longer-lasting, less invasive medical devices.

Injectpower is revolutionizing the microbattery market by offering ultra-miniaturized, high-energy-density batteries that are easier to integrate than ever before. The rechargeable microbatteries have a lifetime of more than ten years, opening the door to new medical applications that require continuous measurement. Implantable eye-pressure monitors could finally make the effective treatment of glaucoma a reality. Innovations in continuous post-stroke monitoring and blood pressure monitoring could dramatically improve the management of neurological and cardiovascular disease.

The startup Injectpower is the result of more than eighteen years of microbattery R&D at the CEA—a long scientific adventure that has generated more than 40 patent families. The company holds an exclusive license to a CEA patent for the medical field.

10x THINNER
10x ENERGY DENSITY
10-YEAR LIFESPAN

Year founded
2020

Key markets
- Ophthalmology
- Neurology
- Cardiology

Technology
- Microbatteries, solid thin-film technology

injectpower

www.injectpwr.com

INOCEL

Compact, very-high-power, high-performance fuel cells

A faster transition from fossil fuels to efficient and clean energy to decarbonize mobility and stationary energy storage

Inocel, with its PEMFC (proton exchange membrane fuel cell) technology, is removing hurdles to the widespread adoption of fuel cells. The company's fuel cell, which offers unrivalled power for its size, will be available in a 300 kW format in 2024.

Inocel's very-high-power PEMFC is based on two years of research and development conducted by 30 scientists and engineers. The company holds licenses to fifteen CEA patents on the technology, which has set a new state of the art in terms of power for a fuel cell this compact. At just 100 kg and 110 liters for the 300 kW version, the fuel cell is three times more powerful for its size than the solutions currently on the market.

Several modules can be combined to build systems from 300 kW to 3 MW, with the latter packaged in a standard shipping container. The fuel cell achieves efficiencies of 60% and a lifespan that puts it at the state of the art.

And it is also very responsive, ramping up to full power in just 1.5 seconds.

The startup, which has set up shop in at 2,000 m² facility in Grenoble, has 35 employees, and continues to work with the CEA on R&D, taking advantage of the organization's advanced development and testing capabilities to optimize the technology.

FOR ITS SIZE, **INOCEL'S** FUEL CELL IS
3x **MORE POWERFUL THAN OTHER FUEL CELLS ON THE MARKET**

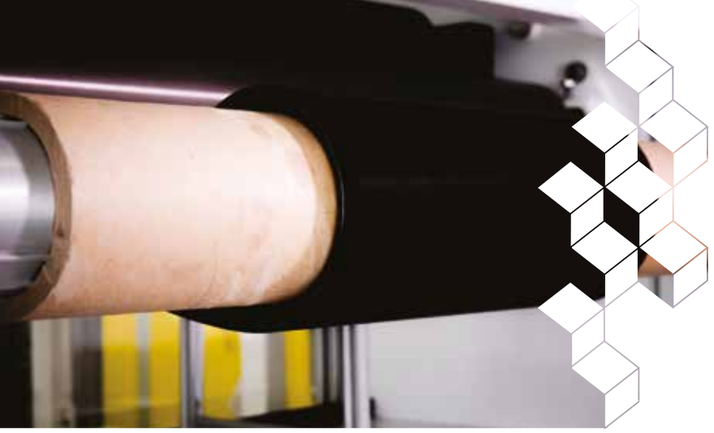
Year founded
2022

Key markets
- Maritime transportation
- Heavy land vehicles: trucks, buses, construction vehicles
- Stationary applications: commercial buildings, multi-unit residential buildings

Technology
- High-power PEMFC
- Integration into all kinds of energy systems

inocel

www.inocel.com



NAWA TECHNOLOGIES

Environmentally friendly batteries to combat climate change

Faster, more sustainable, and more ethical energy storage

NAWATechnologies is a deep tech startup tackling climate change head on with a new generation of batteries. The company is developing and commercializing batteries with higher capacities, faster charging speeds, and longer lifespans. Its electrode material made from aligned carbon nanotube mats is helping revolutionize batteries.

A novel manufacturing process guarantees top performance for phones, IoT devices, vehicles, and more. The material is solvent-free, made from CO_2 captured from the atmosphere, recyclable, and can be bio sourced, making it an excellent contributor to the fight against climate change and the preservation of natural resources.

NAWATechnologies is leveraging a technology developed over 20 years of CEA research conducted in collaboration with Cergy Paris and Tours Universities, mainly on the development of a carbon nanotube-based material that packs in more than 300 billion nanotubes per cm^2. This innovation makes NAWATechnologies a world pioneer in this type of material.

CARS CHARGED IN **LESS THAN**

10 minutes

Year founded
2013

Key markets
- IoT
- Power tools: cordless handheld tools

Technology
- Carbon nanotube materials

NAWA TECHNOLOGIES

www.nawatechnologies.com

POWERUP

The Li-ion battery manager and lifespan extender

The right balance between performance, safety, and availability for the leading battery technology

Li-ion batteries are one of the pillars of the energy transition. PowerUp offers high-value-added services to optimize battery charging cycles, maintain like-new battery capacities, and extend battery lifespans.

PowerUp leverages fifteen years of Li-ion battery degradation research, including ten years at the CEA, to bring its customers software and services to improve battery cycling, a decisive factor in aging. PowerUp provides indicators like battery health, safety (prevention of thermal runaway), and remaining lifespan.

With a 2% margin of error for the battery health indicator, PowerUp is more accurate than conventional battery management systems (BMS), which have a 10% margin of error on average. The indicators provided by PowerUp are also used to dimension storage batteries for surplus renewable energy production.

The startup has a portfolio of more than ten patents, including six CEA patents under exclusive license. It is developing machine learning approaches that will eventually allow batteries to be modeled as digital twins to monitor their lifecycle and degradation without having to describe the associated physiochemical phenomena.

BY **OPTIMIZING THE CHARGE CYCLES** OF LI-ION BATTERIES, POWERUP INCREASES THEIR **LIFESPAN** BY

20%-30%

Year founded
2017

Key markets
- Large storage battery systems for renewable energy producers
- Electric mobility
- Backup power supplies

Technology
- Embedded software in charging modules
- Cloud platform for processing battery data
- Calculation of battery health, safety, and remaining lifespan indicators

PowerUp
Manage & extend batteries life

www.powerup-technology.com

STEADYSUN

Solar energy production and weather forecasting

■ *A reliable solar forecasting service to help producers fulfil their contractual obligations and avoid penalties, available as a subscription that pays for itself in two months*

Steadysun's software predicts solar power plant production with a high degree of precision—anywhere in the world and for any type of solar photovoltaic panel technology. It also provides weather forecasting services.

Solar energy is intermittent and difficult to predict, and therefore does not easily lend itself to production forecasts. Still, power plant operators, grid managers, and electricity traders need it to optimize their operations and maximize profits.

Steadysun provides subscription-based forecasting services adapted to customers' particular facilities and prediction needs, with time horizons ranging from a few minutes to two weeks. The software is the result of ten years of CEA R&D and delivers some of the most reliable forecasts in the world calculated from pictures of the sky, satellite images, weather forecasts, and production data.

The company, present worldwide, is one of the global leaders in solar forecasting. As part of an R&D agreement with the CEA, it is adapting its tools to tomorrow's panel technologies. Since 2022, it has diversified into weather forecasts, with a service that is 20% more reliable than that of the main players in the field.

STEADYSUN'S SOLAR FORECASTING SOFTWARE TRACKS

14,000

PHOTOVOLTAIC PRODUCTION SITES

WORLDWIDE IN 25 COUNTRIES

Year founded
2013

Key markets
- Grid managers
- Plant operators
- Energy traders
- Energy microgrids

Technology
- Statistical approach
- Physical approach
- Artificial intelligence

steadysun

www.steady-sun.com

SYLFEN

Local energy storage and production with a single piece of equipment

■ *Locally-produced clean energy at a price that competes with major utilities*

The same piece of Sylfen equipment can produce hydrogen, electricity, or heat depending on energy prices and user needs. It's a competitive and extremely flexible solution.

The Sylfen Smart Energy Hub is the result of more than twelve years of R&D conducted at the CEA and is protected by nine patents. It is a fully reversible high-temperature electrolyzer that can also be used as a fuel cell. It is available in several versions, from a few dozen to several hundred kilowatts.

In electrolyzer mode, it converts electricity into hydrogen. In fuel cell mode, it produces electricity. Generated heat is recovered as well, which translates to overall efficiency much higher than that of conventional equipment. Battery hybridization allows short-term electricity storage.

User needs determine the appropriate mode of operation: storing renewable energy, powering hydrogen vehicles, recharging batteries, or heating buildings. Sylfen meets user needs by modulating local energy production and consumption and adapting to major utilities' price fluctuations.

SYLFEN IS ONE OF 20 FRENCH STARTUPS ON THE 2022 **"FRENCH TECH GREEN20"** LIST

Year founded
2015

Key markets
- Public and industrial buildings
- Logistics facilities
- Subsidized housing

Technology
- High temperature electrolyzer (700 °C–800 °C), reversible for fuel cell use

Sylfen

www.sylfen.com

WATTALPS

Energy storage solutions

Safe, high-performance batteries for industrial vehicle electrification

More efficient, less expensive, and safer—the innovative lithium-ion batteries developed by WattAlps are electrifying a wide range of industrial vehicles, a major technological breakthrough that boosts productivity and profitability. Cleaner, quieter work sites mean that WattAlps batteries are good for the environment and for workers, too.

WattAlps three founders have brought their diverse experiences to a company that has managed to create a breakthrough innovation in only a few years: a modular, immersion-cooled lithium-ion battery. Designed for small and medium series, it offers manufacturers the key advantages of adaptability, performance, and safety. Not to mention savings—the battery's development cost is 20 times lower than that of conventional high-performance batteries.

WattAlps batteries are reusable and recyclable, evidence of the company's commitment to the energy transition.

Two of the three founders of the startup came from the CEA, where they developed and patented the technologies exclusively reserved for today's WattAlps solution.

BATTERY FORM FACTORS UP TO

2

MORE COMPACT

Year founded
2018

Key markets
- Industrial and construction vehicles
- Agricultural machinery
- Logistics
- Maritime
- Niche vehicles: sports cars, vintage cars, etc.

Technology
- Lithium-ion batteries with immersion cooling

wattalps®

www.wattalps.com

CREDITS

DIGITAL

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HEALTH

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ENERGY

Page 49: The Chrompix, an analysis system that embeds up to 4 plug & play chromatography analysis cartridges. ©Apix Analytics
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DESIGN
Coordination: CEA- Céline Lipari, Claire-Noël Bigay
Authors: Benoît Playoust, Sophie Lavergne
Layout: Florence Pillet
English translation: Sara Freitas, SFM Traduction

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startups at
cea.fr/english