



**ANNUAL
REPORT
2021**

ABOUT THIS REPORT

CNES's annual report highlights elements of our corporate social responsibility (CSR) strategy. It was coordinated by the Communication Directorate, supported by editorial correspondents at the agency's other directorates and at its Sustainable Development Office. The members of the Executive Committee also helped to produce the report, which was validated under the authority of the Chairman & CEO and the Chief Operating Officer.

We thus hope to provide a closer appreciation of what we do and to show how we are benefiting and committed to society at large, the environment, citizens and the agency's people.



MAKING SPACE SUSTAINABLE

— Within a few decades, we have transformed space. The distant, unreachable cosmos—a seemingly foreign and even threatening place feared by our ancestors—has become a new territory that for the most part only exists through the technologies we have marshalled to explore it. Space is now and above all what we do with it, and what we do there. But this singular state of affairs makes us all the more responsible for protecting it, keeping it safe and safeguarding its future. While here on Earth we must listen more intently to the nature we have inherited, with which we must learn to live more sustainably, our shared intelligence, imagination and wisdom is all we have to lay the future foundations of space. For that is where humankind's future lies, not like a treasure that awaits us, but rather a project to be accomplished. —



JACQUES ARNOULD

CNES Ethics Officer

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July 2022

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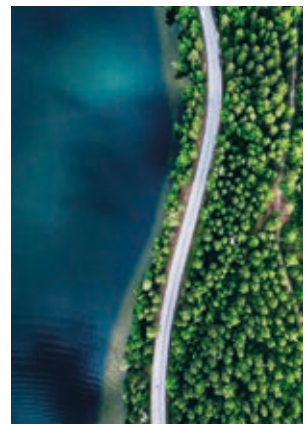
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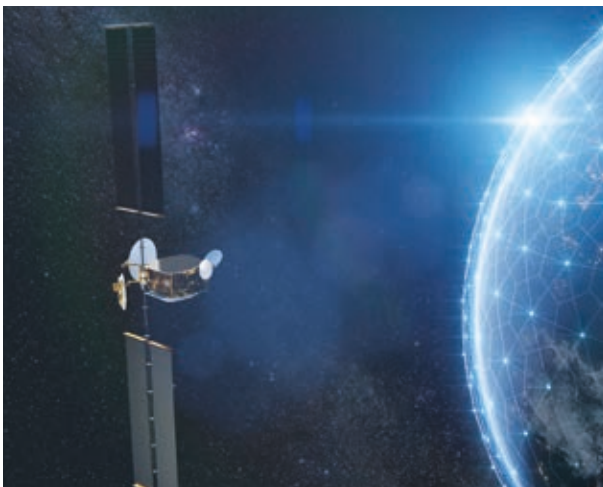
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FROM THE CEO'S DESK

PHILIPPE BAPTISTE

CNES Chairman and CEO

— 2021 is a pivotal year for CNES, with the arrival of a new Chairman & CEO, work on preparing the new Objectives and Performance Contract (OPC) and a new organization... How do you reflect on this first year in charge and what are your ambitions for our agency as it celebrates its 60th anniversary?

Philippe Baptiste. I'm very proud of our agency, the results we've achieved and the image we've built, particularly in the international arena.

2021 was a very busy year also marked by a return to more normal social interactions that enabled us to strengthen the ties between us and with our partners. The arrival of new players in the space ecosystem is sometimes a source of concern and we must respond to that. A lot happened in 2021 and a lot of questions were raised that we need to address.

In effect, all of this is charting our course for the road ahead: we must pursue our efforts, answer the questions from our people and from researchers, continue to project CNES on the global stage and of course fulfil our commitments to government and the scientific community.

— You regularly underline the importance of exploiting space data and have made it one of your priorities. Can you tell us why, and what is your goal?

P. B. Today we need to ask ourselves if we're getting the most out of the wealth of space data at our disposal. They have enormous economic and social potential, so it's no surprise that most firms entering the space ecosystem are working in the downstream sector. This potential is important for our nation because it's a source of wealth, jobs, development and prestige. It's also a tool serving sustainable development, which makes it a priority.

— The ELA4 launch complex will soon be ready to operate Ariane 6, with a maiden flight planned in 2023, and the Guiana Space Centre (CSG) is pursuing its modernization. What is your vision for future space transportation?

P. B. In the short term, we have a few difficult months ahead of us. But Europe has everything it needs to regain a leading role in the space transportation market. Indeed, we'll be playing a very active role with Ariane 6 in the coming years, with a lot of launches. The future lies in our ability to gain proficiency in reusability with small



launchers, and we're helping French players in this sector to stimulate the market and innovate. We're also working on the Callisto programme that's going to enable us to step up a gear.

In the long term, future space exploration missions—notably to Mars—will require a very-heavy-lift launcher that could also bring down the cost to orbit. If that's the route we want to take, we have to start working on the required technology building blocks now.

Tomorrow's space transportation systems will be different from today's, in particular with more space tugs capable of placing, retrieving and refuelling satellites.

And lastly, it's vital that we sustain strong investment in the CSG as a cornerstone of Europe's future space transportation. The CSG needs to become greener, more digital and more modern, and that's where we're investing today.

— **The OPC reaffirms science as central to everything CNES does. How do you intend to maintain this and French excellence in space science?**

P. B. The way space science is organized in France is excellent. We've gained world renown through our fine research laboratories and thanks to CNES's engineering and technical oversight capabilities.

We're accomplishing firsts that are extending our national and European scientific excellence, and inspiring young talents to take up careers in science and technology.

— **In an increasingly complex international context, how is CNES's historic partnership with the defence community supporting France's intention of seeing space as a strategic theatre?**

P. B. The nation's military space strategy has given us a clear roadmap. CNES will be working to support the



2021 was a very busy year also marked by a return to more normal social interactions that enabled us to strengthen the ties between us and with our partners.

ramp-up of Space Command and its ambitious mission of defending our space assets, including through active measures. At the same time, we're continuing to work closely with the defence community, particularly the defence procurement agency DGA, to plan its future space capabilities and lead military space programmes. This partnership has proved effective for several decades now in giving France highly sophisticated military space systems that cover a very wide spectrum, which is something that few nations can boast.

— **Space cooperation enables amazing feats like the James Webb Space Telescope, launched by Ariane 5 in late 2021. How do you see the future of cooperation in space?**

P. B. Yes, there's Webb but also other major very-high-profile missions like Perseverance or InSight, in partnership with NASA. We're also pursuing some great scientific collaborations with Japan, India, China and the United Arab Emirates, in addition to our key European partnerships. I believe we need to maintain this balance dictated not only by geostrategic requirements but also by science needs, which we must strive to meet effectively.

— **As a climate-driven space agency with an ambitious corporate social responsibility policy, CNES is affirming its position with regard to environmental and social issues. How is it turning this commitment into actions?**

P. B. Data from Earth-observation satellites are crucial to our climate models and to understand the broad trends affecting our planet. The remarkable joint commitment of ESA and the European Commission in this respect is working well. Space data are also being exploited through the Space for Climate Observatory (SCO), initiated by CNES under the impetus of President Emmanuel Macron. This is a key commitment that has secured strong support from our major international partners.

Lastly, as an agency we're working to achieve greener energy consumption, particularly in French Guiana. We also have a responsibility as an employer. We take pride in guaranteeing our people's safety and maintaining work relations based on respect—these are key elements in defining our line of conduct. —

A 60-YEAR SPACE ADVENTURE

Sixty years ago, France formed its space agency to federate national initiatives and join the race to space. Ever since its inception on 19 December 1961, CNES (Centre National d'Etudes Spatiales) has been a key player in this adventure and is today gearing up to face new challenges.

We are working to assure France and Europe's strategic independence, guaranteeing the freedom to act that is essential to making our voice heard in a constantly shifting and fiercely competitive geopolitical context.

In 60 years, we have acquired a level of technical excellence that we continue to cultivate today, as we seek to support the competitive development of legacy players and new entrants alike, and we are laying the groundwork for our society to derive maximum benefit from space solutions.

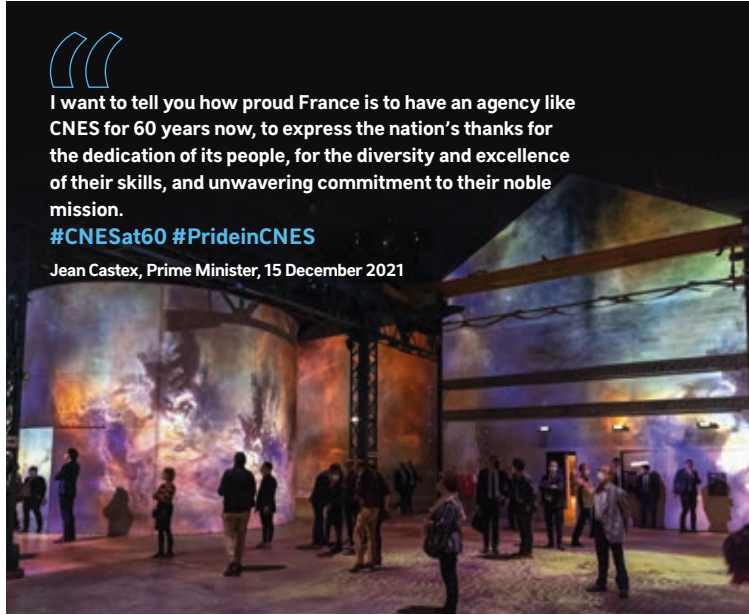
We owe all of these accomplishments to the people that have devoted so much effort over the last six decades to their shared passion for space.



I want to tell you how proud France is to have an agency like CNES for 60 years now, to express the nation's thanks for the dedication of its people, for the diversity and excellence of their skills, and unwavering commitment to their noble mission.

#CNESat60 #PrideinCNES

Jean Castex, Prime Minister, 15 December 2021



60 YEARS IN 15 DATES

1961



19 December: President Charles de Gaulle signs into law the statute creating CNES.



1973

31 July: The Ariane programme is born. Ariane 1, whose production is delegated to CNES, would make its maiden flight on 24 December 1979.



1982

24 June: Jean-Loup Chrétien becomes the first French astronaut in space, on the French-Soviet PVH mission to the Salyut 7 space station.

1993

Creation of the CADMOS centre, which helps astronauts on the Russian space station Mir, then the ISS, to conduct experiments in microgravity.



1964

14 April: CNES chooses Kourou to replace Hammaguir (Algeria) as the location for Europe's future spaceport, the Guiana Space Centre (CSG).



1965

26 November: Diamant, France's first space launcher, places Asterix, the country's first satellite, into orbit and France becomes the world's third space power.



1978

Creation of Argos, a global satellite-based location and data collection system dedicated to studying and protecting our planet.



1986

The SPOT-1 satellite revolutionizes Earth observation.



CNES CELEBRATES ITS 60TH ANNIVERSARY

The end of the year was marked by the start of our 60th anniversary celebrations. Our Communication teams worked hard to offer the agency's people and the public collectible products and unique experiences.

EVENTS

An exhibition retracing CNES's 60-year history was displayed at the agency's field centres and in our offices around the world.

In collaboration with Culturespaces, CNES presented *Destination Cosmos*, an original immersive experience looking back on the French space adventure. From 22 October to 20 November, 26 exceptional shows were held at the Atelier des Lumières in Paris and others are planned in 2022. Employees at the agency's Paris centres were treated to a special show on 15 December in the company of Prime Minister Jean Castex.



PUBLICATIONS

Published by CNES in partnership with Flammarion, *À la Conquête du Cosmos* (Conquering the Cosmos) is a box set of 60 photos and a book reliving the main milestones of France's space adventure. Illustrators Mathieu Persan and David Ducros created two original works for this special occasion: a poster entitled *Dans l'air du temps* (In tune with the times) and a fresco called *Soixante ans de succès spatiaux* (60 years of success in space). CNESMag also devoted its end-of-year issue to the agency's 60th anniversary.

FILMS

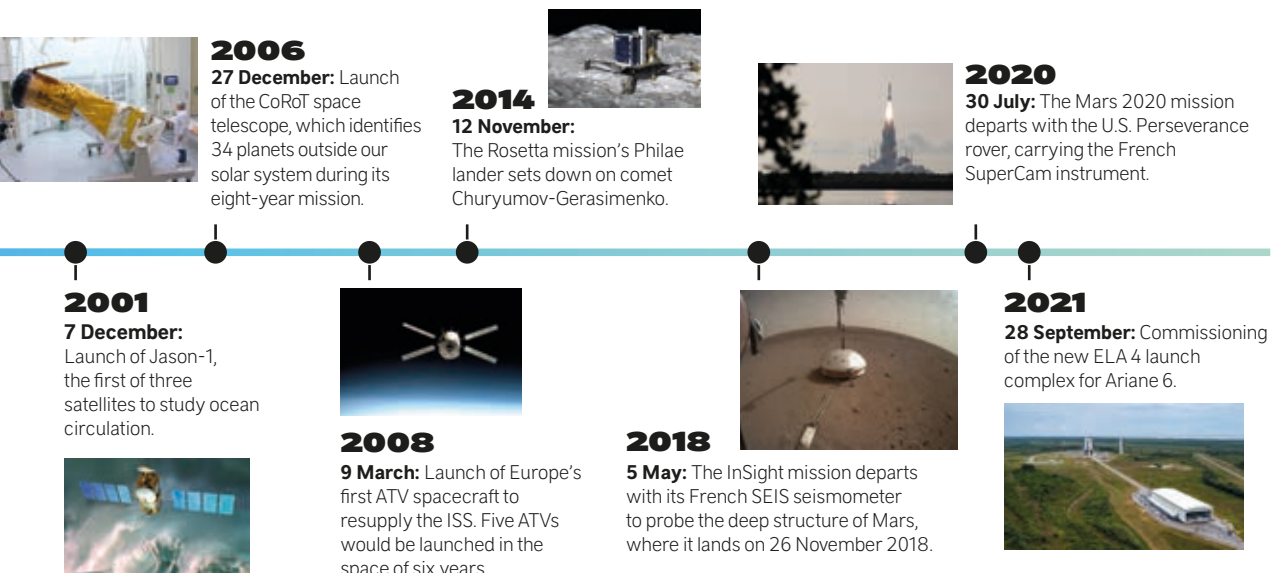
Two films paid tribute to 60 years of CNES, one retracing its history and the other a compilation of archive footage from French television.

AND A NEW POSTAGE STAMP!

Produced in partnership with La Poste with artwork by David Ducros, a special 60th anniversary stamp issue represents CNES's main areas of activity. More than 500,000 stamps are available from post offices since 11 October 2021.



A host of other content was created at the end of year and will be coming on stream throughout 2022, with podcasts, profiles, quizzes and more, all viewable on www.cnes.fr.



ORGANIZATION CHART

AT 30 APRIL 2022



Philippe Baptiste
Chairman & CEO



Lionel Suchet
Chief Operating Officer



Pierre Tréfouret
Chairman & CEO's
Chief of Staff



Pierre Amidey
State Controller



Bernard Chemoul
Inspector General
& Director of Quality



Philippe Steinger
Military Adviser



François Alter
Adviser to the
Chairman & CEO



Gilles Rabin
Adviser to the
Chairman & CEO



Pierre Fond
Chief Accountant

BOARD OF DIRECTORS

Philippe Baptiste
CNES Chairman & CEO

Joël Barre
Ministry of Armed Forces

Hélène Ben Aim Drieux
Employee representative for CFE-CGC

Coline Claude - Lachenaud
Representing the Prime Minister's Office

Evelyne Cortiade - Marche
Employee representative for CFDT

Thomas Courbe
Government Commissioner -
Director General for Enterprise

Hélène Dantoine
Ministry for Europe and Foreign Affairs

Françoise Delcelier Douchin
Employee representative for CGT-UTG

Daniel Galarreta
Employee representative for CFTC

Julie Galland
Ministry of the Economy, Finance and the
Recovery

Benoist Grossmann
CEO Eurazeo Investment Manager

Alban Hautier
Ministry of the Economy, Finance and
the Recovery

Sylvie Joussaume
IPSL

Vincent Leudiere
Employee representative for CFDT

Cyril Moulin
Ministry for Higher Education, Research
and Innovation



Pauline Pannier
Secretary General



Laurence Monnoyer-Smith
Sustainable Development
Office



François Sillion
Technology & Digital



Jean-Marc Astorg
Strategy



Liliane Sebas
Human Resources



Marie-Anne Clair
Guiana Space Centre



Carine Leveau
Space Transportation



Caroline Laurent
Orbital Systems
& Applications



Christophe Venet
Europe & International



Marie-Claude Salomé
Communication



Gérald Dupré
Procurement & Sales



Thierry Levoir
Central Industrial
Security & Safety



Antoine Seillan
Finance



Jean Aussaguel
Accounting

AUDIT COMMITTEE

Anne Paradis

Employee representative for CGT/UTG

Bruno Sainjon

Chairman & CEO of ONERA

Barbara Siguret

Ministry of the Economy, Finance and the Recovery

Florence Verzelen

Executive Vice-President, Dassault Systèmes

Benoist Grossmann (Chair)

Alban Hautier

Florence Verzelen

Pierre Amidey, State Controller, and Pierre Fond, Chief Accountant and Administrator General of Public Finances, also take part in planning meetings with the agency's overseeing ministries and in Audit Committee meetings.

2021

A STRATEGIC TURNING POINT FOR CNES

NEW SPACES IN SIGHT

Every five years, the government and CNES chart the course of France’s space strategy through an Objectives and Performance Contract (OPC). In 2021, CNES worked with its three overseeing ministries—the Ministry of the Economy, Finance and the Recovery, the Ministry for the Armed Forces and the Ministry for Higher Education, Research and Innovation—to draft the new OPC that will guide its missions up to 2025.

Under the banner of New Spaces, the OPC for 2022-2025 comes at a time when space is once again seeing increased competition. It revolves around four strategic pillars:



SOVEREIGNTY

Maintaining and furthering France and Europe’s strategic independence.



ECONOMIC COMPETITIVENESS

Sustaining the French space sector’s scientific excellence and extending its reach.



ENVIRONMENT

Supporting efforts to combat climate change and staying in the vanguard of sustainable space development.



SCIENTIFIC COOPERATION

Leveraging space’s potential to drive growth, boost industry’s competitiveness and foster a new ecosystem.



+ The new OPC

also emphasizes how CNES is devising new ways of working, with more subsidiarity, more stakeholders and more agility, while preserving and honing our technical expertise. Through these new lines of action, CNES is committed to accomplishing operational goals that seek to further excellence and ambition.



NEW CHAIRMAN & CEO, NEW ORGANIZATION

At its cabinet meeting on 14 April 2021, the government appointed Philippe Baptiste as Chairman & CEO of CNES. At his confirmation hearings before the French National Assembly, he underlined the multiple strategic challenges facing the agency in the years ahead: the importance of data, the shifting value chain, new innovation models, the militarization of space and the scientific reach of France and Europe's space programmes, notably through space exploration and Earth observation. He also strongly reaffirmed CNES's commitment to Ariane 6 and voiced his support for the European satellite constellation project announced by Thierry Breton, EU Commissioner for the Internal Market.

Philippe Baptiste's arrival marked a turning point for the agency. During the second half of 2021, focus groups defined a new internal organization that is simple, clear and capable of supporting cross-functional working methods while improving agility and efficiency.

A visible strategy led by a Strategy Directorate, the combination of support functions within a Secretariat General and pooling of skills within a Technology and Digital Directorate are some of the standouts of this reorganization effective since 1 January 2022. —

A SIGNIFICANT BUDGET AND STRONG PRIORITIES IN 2021

CNES receives funding from multiple sources, including government subsidies, the PIA future investment programme, the space budget line of the government’s stimulus plan, external sources for programmes where we have delegated responsibility (DGA, ESA, Eumetsat, etc.) and in 2022 from the France 2030 plan.

CNES also bears the cost, on behalf of the government, of the French contribution to ESA, where it represents France. Subsidies are voted each year by the National Assembly as part of the national budget and CNES’s accounts are signed off by its auditors at the end of the year and regularly controlled by the Cour des Comptes, France’s financial watchdog. The national budget, France’s contribution to ESA and the European Union budget therefore combine to provide multiple channels of funding. CNES leverages the advantages of each of these sources while avoiding duplication, its aim being to maximize synergies and industrial, scientific and diplomatic multiplier effects.

In 2021, CNES’s budget remained high, showing the strong priority given to space in a tight economic environment and enabling the agency to maintain the pace of its activities despite the COVID-19 crisis.

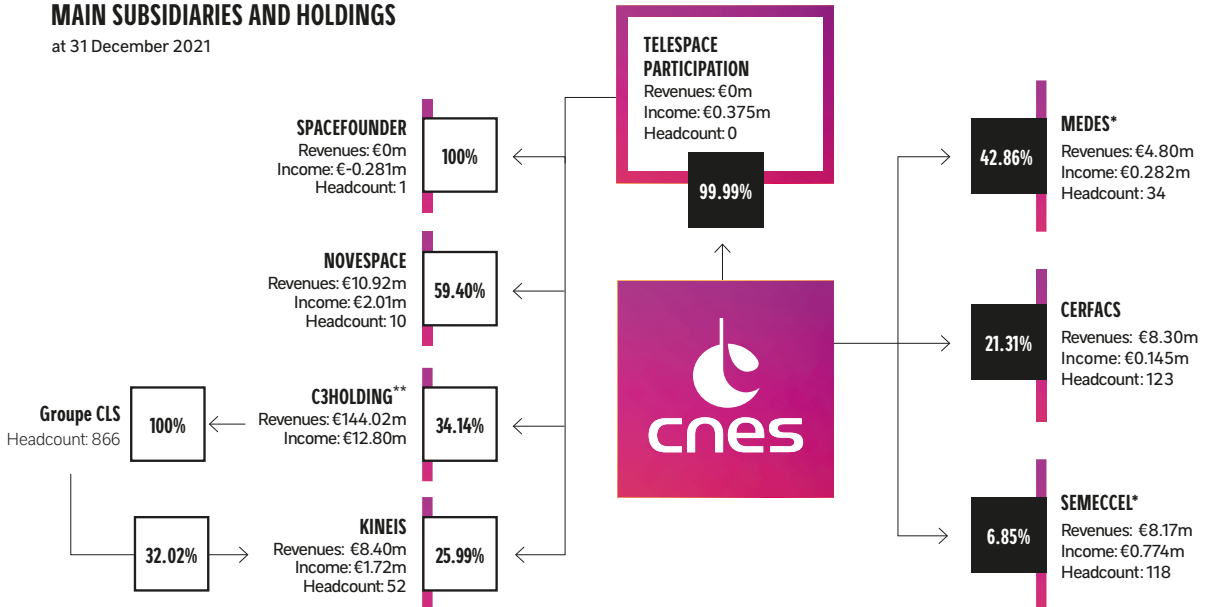
PIA since 2010

Since 2010, the government has decided to invest in innovation for industry sectors with high potential in terms of economic spin-offs and jobs. Space, a domain where French industry excels, was chosen as one of the nation’s promising sectors with high added value, high-tech expertise and a significant economic multiplier effect.

A Space line of action was therefore included under projects of excellence funded by the PIA future investment programme. CNES has been assigned to lead this action, having concluded an agreement with the government in 2010 for PIA 1, amended in 2014 for PIA 2 and then again in 2019 for PIA 3. The total budget of €609.5 million allocated to CNES under this agreement has thus far enabled 15 projects to be undertaken. The last eight of these—for a budget of €44.7 million—got the go-ahead in 2020 under PIA 3, and seven are projects to develop and demonstrate innovative orbital system technologies mainly from small and medium-sized enterprises. Their results will help to sharpen French industry’s competitive edge for new multi-mission spacecraft buses, commercial nanosatellites and in-orbit services.

MAIN SUBSIDIARIES AND HOLDINGS

at 31 December 2021



*Provisional annual accounts
**Consolidated figures

SPACE STIMULUS PLAN

AND ENERGY REFURBISHMENT IN 2021

In May 2021, under the space stimulus plan decided to cushion the impacts of the pandemic on the economy, the government appropriated a budget of €365 million to CNES to cover the needs of all sectors of activity and eligible businesses—start-ups, SMEs, mid-tier firms and original equipment manufacturers—across the nation. To obtain quick results from this injection of public funding, CNES, in charge of the plan's space strand, initiated a whole series of procurements and calls for projects, leading to 25 projects given the go-ahead in 2021 and involving 94 firms, nearly 80% of them start-ups and SMEs.

SPACE STIMULUS PLAN €365m

ESA LAUNCHERS €165m

Additional contribution from France to ESA (Ariane 6)

INNOVATION FRANCE €200m

Vernon strand

- Engine test stands
- Hydrogen recovery

Strand A – Theme-based calls for projects

Civil and dual-use future technologies

Strand D – Nanosatellite plan

- Ramp up in-orbit validation
- Structure ecosystem

Strand B – Collaborative calls for projects

- Flexible comsats
- Optical communications
- Satcom terminals
- Virtual ground segment
- Data-driven economy

Strand C – Space Tour 2021 call for projects

Space applications as a springboard for the economy and society

ACHIEVING ENERGY EFFICIENCY

Further to its corporate social responsibility (CSR) policy, CNES is committed to reducing its environmental footprint through energy savings at its field centres. To this end, the agency responded at the end of 2020 to a call for building refurbishment projects under the government's economic stimulus plan. Two projects were selected and allocated a budget of €9.913 million: the first for the refurbishment of the Ampère building at the Toulouse Space Centre and the second to a solar field at the Guiana Space Centre.



+ France 2030 plan in 2022

The government decided end 2021 that the France 2030 plan would include a space strand with a budget of €1.5 billion, notably to catch up in certain key market segments like reusable launchers and constellations, and to invest in new applications. CNES will be working with public investment bank Bpifrance to implement this plan.

BUDGET ALLOCATION

REVENUES

€2.387bn



EXPENDITURES

€2.387bn



+4%

Increase in government subsidies to CNES from 2020 to 2021 for its multilateral programme (€703 million in 2021 against €675 million in 2020), funding its own activities outside France's contribution to ESA. This is a testament to the priority given to space.

INTERNATIONAL SPACE COOPERATION ON ALL FRONTS

CNES is a prime player in space cooperation, pursuing bilateral and multilateral partnerships with no fewer than 45 countries and international organizations. Such collaborations serve the threefold aim of executing the agency's scientific and programmatic priorities, sustaining France's commercial ecosystem in export markets and broadly supporting the nation's diplomacy efforts. They are thus instrumental in implementing CNES's Objectives and Performance Contract (OPC).

International cooperation is more than ever before the only way forward for Earth and universe sciences, as well as for space exploration and human spaceflight driven by scientific, strategic, political and economic ambitions. Returning to the Moon is a first stepping stone towards a possible crewed mission to Mars.

The numerous social and ethical issues this entails resonate strongly with the public, from sustainable and autonomous energy management to medical autonomy and the ability to live together in a hostile, confined environment.

Although 2021 was marked by the COVID-19 crisis, it nonetheless proved a prolific year for international cooperation, with more than 20 agreements signed covering key topics for public policies and French firms' competitiveness, such as Earth observation through the Space for Climate Observatory (SCO), launchers, and space exploration and surveillance.

Through its perceptive analysis and ability to adapt, CNES has repositioned itself and forged close ties with new entrants while continuing to work with its longstanding partners.

The agency's international partnerships fall into three categories:

- **European partnerships** through the European Space Agency (ESA) and the European Union (EU), and bilateral partnerships through which we remain a pivotal player, as ESA's leading contributor and the chief inspiration behind the EU space programme.



- **Historic and foundational partnerships** with leading space powers, in particular the United States, India and Japan, which are central to projecting CNES's international reach.

- **Partnerships with new space powers** like the United Arab Emirates, Singapore and Morocco, whose ambition is to advance their societies and economies through space.

WORKING IN ALL DIRECTIONS

This cooperation has spawned numerous projects, putting CNES centre stage in the international space arena. Whether for **climate science** (SCO, MicroCarb, MERLIN, Trishna, SWOT and CFOSat), **exploration** (MMX, Perseverance) or **innovation and applications** (reusable launchers, maritime surveillance, etc...), CNES is working all over the planet. —

+ Key figures

24

cooperation agreements signed in 2021.

90%

of space missions conducted today by France are with European or international partners.

36

space agencies have joined the Space for Climate Observatory (SCO).



OUR FIVE CSR COMMITMENTS

CNES has an ambitious corporate social responsibility policy aligned with the UN's Agenda 2030 and 17 Sustainable Development Goals (SDGs), which constitute a universal call to action to eradicate poverty, tackle inequalities and protect the planet while working towards a sustainable development social model.



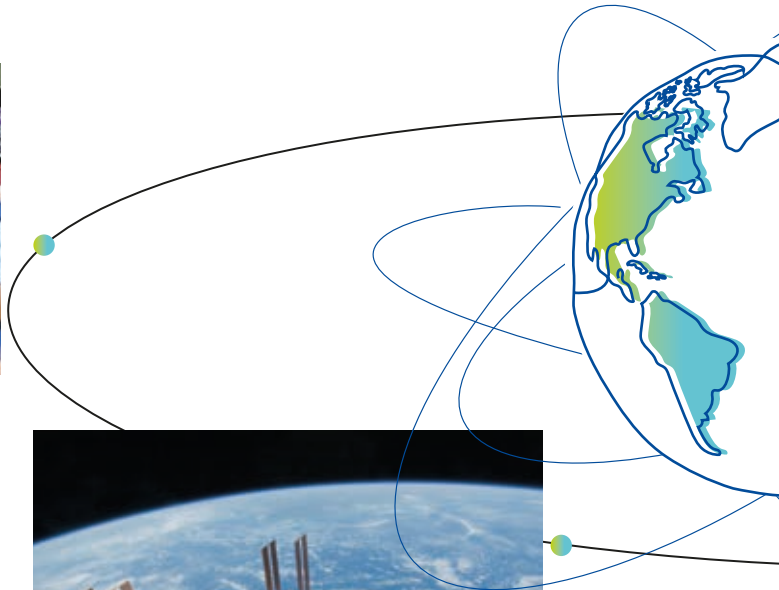
BEING A SOCIALLY RESPONSIBLE EMPLOYER

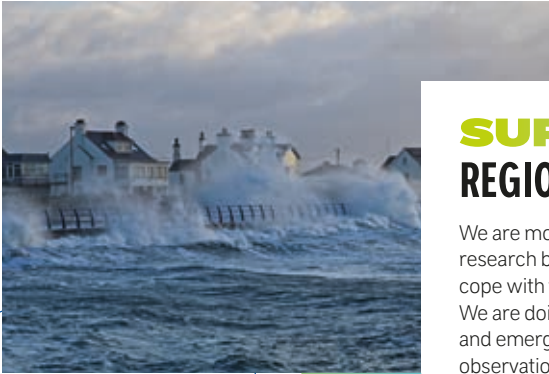
CNES pursues a pro-active human resources policy based on fostering technical competencies, promoting gender equality and nurturing a work environment that favours diversity, well-being and inclusiveness, as well as constructive labour relations. The agency's governance is built on values of exemplarity. Ethical behaviour and transparency define how we go about our daily work and form the foundation of our relationship with stakeholders.



PROMOTING PROTECTIVE AND SUSTAINABLE SPACE

CNES is striving to keep space as the province of all humankind. To this end, we are seeking to reduce or eliminate space debris generated by our missions or those we operate. We are also helping to prevent conflict situations by supplying space and processing systems to meet the government and the military's surveillance, eavesdropping and deterrence needs.

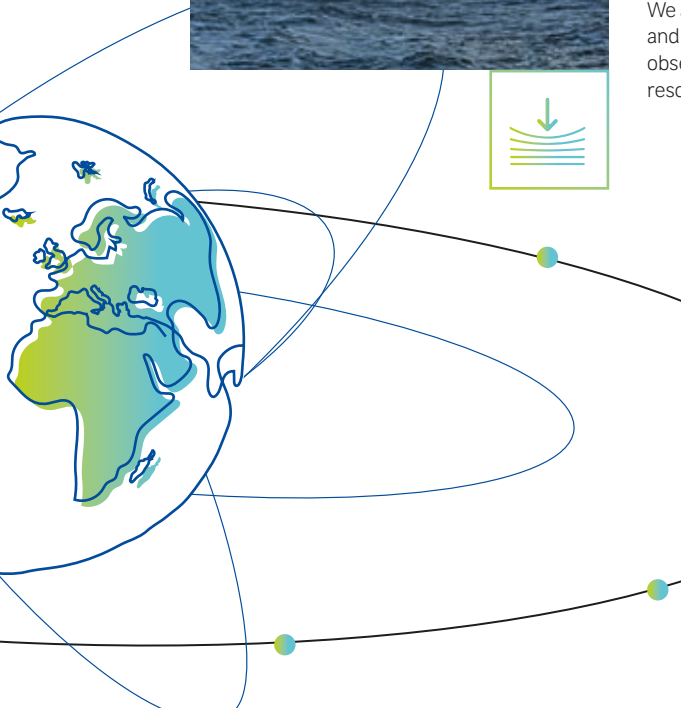




SUPPORTING REGIONAL RESILIENCE

We are mobilizing our expertise and close ties with research bodies to help territories and their populations cope with the challenges of a changing climate.

We are doing this by fostering uptake of risk prevention and emergency management tools, and leading Earth-observation and oceanography projects to improve resource management (surface waters and oceans).



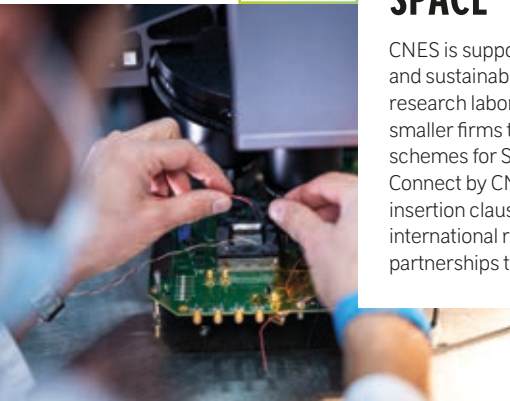
REDUCING OUR ENVIRONMENTAL FOOTPRINT

CNES is engaging the ecological transition. To this end, we are working to achieve energy efficiency and transition to renewable energies at our field centres and pursuing a proactive approach with a view to achieving net-zero emissions by 2050. We are taking action across the value chain to reduce the environmental footprint of our projects and activities. We are also preserving biodiversity through our Act4Nature commitments.



CREATING SHARED VALUE FROM SPACE

CNES is supporting the competitiveness and sustainable growth of French industry, research laboratories, start-ups, SMEs and smaller firms through incubators, accreditation schemes for SMEs, activities boosted by Connect by CNES and social integration and insertion clauses in its contracts. Through our international relations policy, we are fostering partnerships to benefit sustainable development.



CSR IN ACTION AT CNES

In 2021, CNES focused its attention on social responsibility while strengthening the governance of its CSR policy. Here are the main results of this policy.



TOWARDS A LOW-CARBON, LOW-ENERGY STRATEGY

CNES has completed a thorough assessment of its greenhouse gas emissions—going further than regulatory requirements—in order to arrive at a comprehensive carbon inventory.

This inventory encompasses all emissions across the value chain, including procurement. We are the first government agency to conduct this kind of assessment.

Our findings have led us to adopt measures to craft a low-carbon and low-energy strategy that forms the backbone of our efforts to reduce the agency's environmental footprint, based on achieving energy efficiency and switching to renewable energies.

Such measures include energy audits at each of our field centres and our programme to “green” the Guiana Space Centre.

This strategy will include our real-estate policy, which mandates the energy efficiency of buildings being refurbished under the CSG-NG and CST-NG projects. It will also address the need for training in climate and energy issues.

NEW SUSTAINABLE PROCUREMENT STRATEGY

Achieving sustainable development goals implies that CNES's contracts must also address social and environmental considerations. To this end, we have conducted an analysis of purchasing segments (space engineering, logistics, events, real estate, etc.). A requirements matrix now indicates which CSR clauses need to be included in requests for proposals. Purchasers are already employing this matrix and a socially responsible procurement charter is being drafted for 2022.

+ National Sustainable Procurement Plan (2021-2025)

By 2025,

100%

of contracts notified to include at least one environmental consideration.

30%

of contracts notified to include at least one social consideration.

INCORPORATING CSR IN REVENUE CONTRACTS

CNES's sustainable supplier procurement policy also flows down to its customers (European Commission, French defence procurement agency, etc.). A corpus of documents is being defined to meet standard requirements, while specific requests will continue to be dealt with on a case-by-case basis.

ETHICS CHARTER

During the course of the year, CNES finalized a charter to consolidate the ethics principles that guide the agency, its people and leaders. This charter covers the ethics of our space missions with regard to safety of people and property, protection of the terrestrial and space environments, and the future of humankind. A governance framework guides the charter’s implementation through a mission ethics committee open to qualified experts from outside the agency, the agency’s in-house ethics committee and a compliance and ethics officer.

The charter’s principles are built on three foundations:



CNES is thus striving to apply these principles across the agency in all its proposals, assessments and decisions.

CSR ROADMAP RESULTS



BEING A RESPONSIBLE EMPLOYER

▶ **450,000**
beneficiaries of
educational actions

▶ **89/100**
gender equality score

▶ **Promoting**
space careers for women

▶ **111**
research grants

▶ **CSR criteria**
included in employee
profit-sharing agreement

▶ **Platform**
set up for micro-
donations and rounding
up pay

▶ **New ethics**
and compliance charter

▶ **Monitoring of
supplier risk:**
293 third parties
assessed



PROMOTING SUSTAINABLE AND PROTECTIVE SPACE

▶ **Space Command
(CDE)**
set up at the Toulouse Space
Centre

▶ **Planning**
of ASTERX exercise
simulating space threats

▶ **Orbital pollution
risks**
systematically addressed by
operating reviews

▶ **Space traffic
management:**
guidelines to reduce
conjunction risks and
generation of new debris



CREATING SHARED VALUE THROUGH SPACE

- ▶ TechTheMoon incubator:
5 start-ups supported
- ▶ SpaceFounders accelerator:
10 start-ups selected
- ▶ **19 new product** and/or service accreditations for SMEs
- ▶ Connect by CNES:
144 firms supported
- ▶ **Involvement** in France Relance stimulus plan
- ▶ **Purchasing** contracts with work insertion clauses
- ▶ **Space economy observatory**
- ▶ **Partnerships** to foster sustainable development



SUPPORTING REGIONAL RESILIENCE

- ▶ **Agreements** signed with 11 regional councils under government stimulus plan: FLAude, COSPARIN projects
- ▶ **Telemedicine** deployed in French Guiana: 17 remote sites managed from Cayenne Hospital
- ▶ **Partnerships** with start-ups under Connect by CNES
- ▶ **Activations** of International Charter Space & Major Disasters
- ▶ **Space for Climate Observatory projects** (healthcare, climate science, natural disaster resilience, resource management, etc.): CLIMHEALTH, ARBOCARTO-2
- ▶ **Projects** SWOT, TRISHNA, Microcarb,...



REDUCING OUR ENVIRONMENTAL FOOTPRINT

- ▶ **BEGES*** (incl. Scope 3) and energy audit
- ▶ **Launch** of low-carbon strategy project
- ▶ **Projects at Guiana Space Centre** CBK1&2 (biomass), photovoltaic 1&2, Hyguane (green hydrogen) and BIFROST (biomethane for rockets)
- ▶ **New travel policy**
- ▶ **Environmental** recommendations incorporated in Toulouse Space Centre refurbishment projects
- ▶ **New sustainable procurement policy**
- ▶ **Act4Nature** international accreditation achieved (biodiversity)
- ▶ **Biodiversity** management plan at Guiana Space Centre (2021-2030) Argonautica, Argonimaux, EduSCO, ESERO and other educational projects
- ▶ **Climate** Collage workshops rolled out

BEGES*: Greenhouse gas emissions assessment

CNES SUPPORTING SUSTAINABLE DEVELOPMENT GOALS

CNES's CSR strategy is built around the 17 Sustainable Development Goals (SDGs) defined by UN member states, which aim to transform the world for populations, the planet, prosperity and peace, and through partnerships. We are contributing directly or indirectly through our missions and management practices to the 17 SDGs, making us a top-tier sustainable development player.



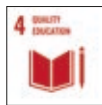
CNES is helping to combat poverty through applications, for example supplying indicators to mitigate flood and damage risks in vulnerable regions (SCO FloodDam/Betsiboka Madagascar programme).



CNES is involved in efforts to end hunger, using its applications (geolocation and Earth observation) to monitor soil conditions, rational management of inputs, plant health products, water usage and also forecasting of harvests and yields. E.g.: Trishna project, VIMESCO-RICE SCO project (rice crops in Vietnam).



CNES is striving to ensure well-being at work for its employees and funding health infrastructure and research projects. We are helping with satellite telecommunications to ease access to health services in remote regions (e.g. remote dispensaries in French Guiana). Through data and applications, we are enabling deeper understanding and better prevention of epidemics and environment-related diseases (Arbocarto-V2 SCO project combating mosquito-borne epidemics).



CNES is pursuing an ambitious skills development policy for its employees, co-funding doctoral and post-doctoral graduate students and forging partnerships with universities and technology institutes. Training actions are provided for teachers, young students and the lay public through our TTVS, Nanolab Academy, PERSEUS, Argonautica, Spatiobus and mini-rocket science projects leveraging space technologies and tools.



CNES is working to combat discrimination, ensure pay parity, guarantee access for women to high-grade and leadership positions and support their advancement in scientific careers.



Through its space missions (SMOS, SWOT, Trishna and Sentinel satellites), **CNES is helping to monitor surface waters** and preserve wetlands, rivers and lakes. We take great care to prevent pollution from our activities, as illustrated by the water treatment station at the Ariane 6 launch complex.



CNES is pursuing a low-carbon strategy geared towards achieving net-zero carbon emissions in 2050. This includes a policy of building construction and refurbishment based on HQE (green building) and QEA (French Guiana) environmental standards, the use of renewable energies (biomass and solar at the Guiana Space Centre, Sustainable Energy network in Toulouse), and innovative financing tools.



CNES is supporting the competitiveness of French manufacturers, small and medium-sized firms, start-ups and laboratories. To this end, we are providing support for the telecoms sector and for applications using satellite data, including navigation, through our French Space Industry Capabilities Catalogue.

We are also overseeing the French contribution to ESA missions as well as supporting EU projects. CNES is also helping young job-seekers to enter the labour market by forming partnerships with associations or by including social integration and insertion clauses in its contracts.



CNES provides support for innovative architecture, material, energy and technology concepts designed to reduce the environmental impact of ground facilities, launch vehicles and satellites, space segments (stations, processing centres), and transport and buildings. The agency gives preference to suppliers who apply sustainable and eco-friendly practices in their operations and in their choice of technical and managerial innovations.



CNES gives employees the opportunity to get involved in sustainable development as part of its 2020-2022 profit-sharing agreement, which introduced a CSR criterion making up 25% of the total profit to be shared.



Through its partnerships, CNES seeks to promote solutions and services that use satellite data to meet the needs of populations affected by climate change, the challenges of urban development and mobility requirements. CNES's facilities are resilient, sustainable and actively committed to reducing their environmental footprint.



CNES is pursuing a programme to reduce the quantity of resources consumed in space missions (eco-design of ground launch facilities and demonstrators, life cycle analysis of orbital projects) and to reduce movements of people and resources. We are also seeking to promote sustainable procurement policies. The agency is pursuing a space operations safety policy designed to limit space debris.



Through space projects and data derived from them downstream, **CNES is putting space to work for users everywhere to understand and anticipate the effects of climate change** (e.g. the Sentinel, Trishna and IASI-NG satellites, and the Space for Climate Observatory). We are adopting a low-carbon strategy for our operations.



CNES is supplying space assets to help better understand and monitor the health of oceans and combat overfishing (e.g. through the Sentinel, CFOSat, SARAL/AltiKa, Argos and SWOT projects) and supporting development of the European Observing System and operational oceanography applications.



CNES is leading missions delivering data to monitor ecosystem health (through the Sentinel, SMOS, Trishna, Pleiades and VEN μ S satellites) and track species (Argos).

The agency has achieved Act4Nature international accreditation, demonstrating its commitment to factor biodiversity into its corporate strategy.



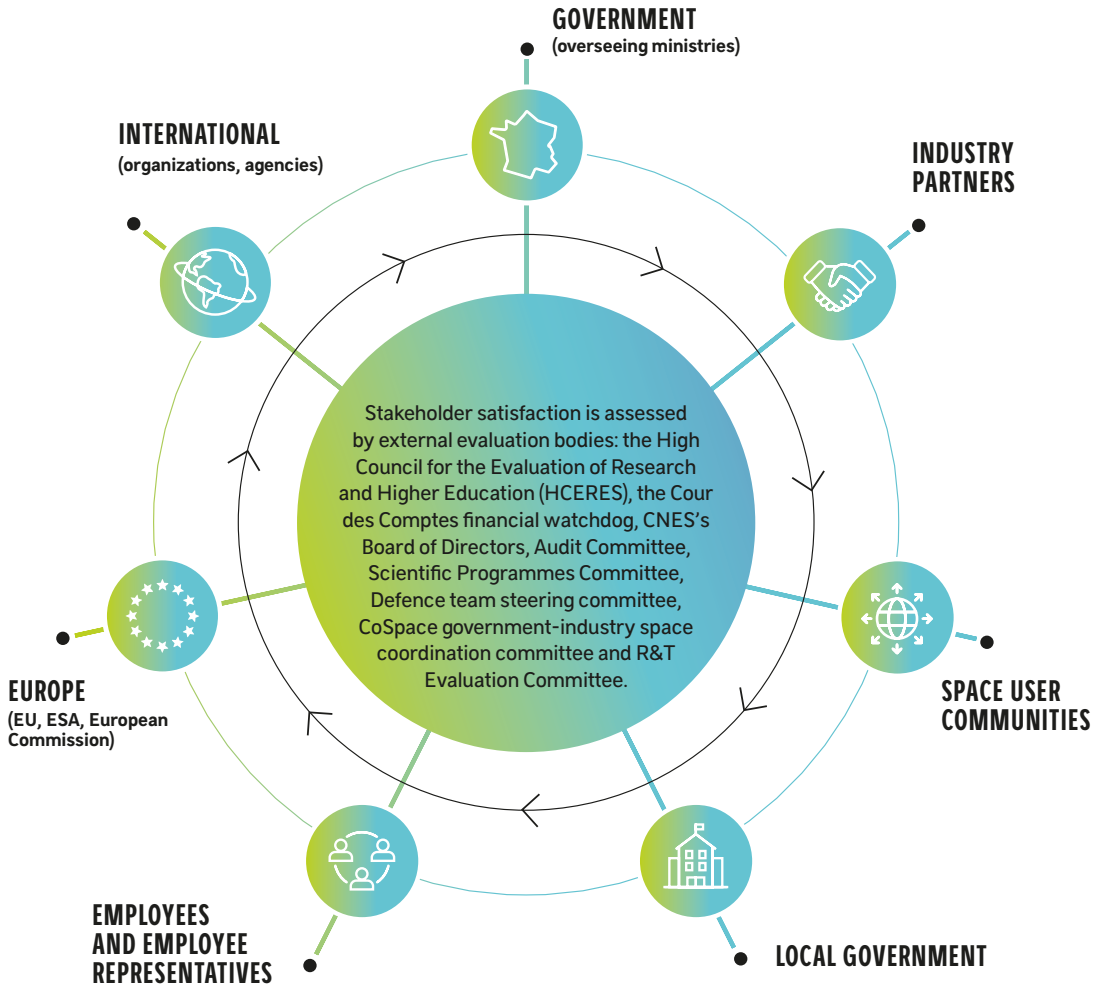
CNES is providing access to space, space systems and processing systems for surveillance and signals intelligence required by the military to avert conflict situations. The agency ensures that corporate ethics and exemplary governance underpin everything it does.



CNES is fostering partnerships for space missions and other missions using satellite data designed to achieve better environmental stewardship, deliver new insights into climate change and aid disaster management. For missions and applications, the agency is supporting the Copernicus and Galileo programmes in Europe and the Space for Climate Observatory (SCO).

BUILDING CONSTRUCTIVE DIALOGUE WITH STAKEHOLDERS

CNES's relations with its stakeholders are based on transparency, accountability, ethical behaviour and trust. We tailor how we work to our ecosystem's needs with a view to delivering a sustainable value proposition.



AN EFFECTIVE MANAGEMENT SYSTEM

The audit of CNES's management system by certifying body AFNOR Certification in October 2021 delivered excellent results. For the fifth year running, no non-compliances were noted with respect to the ISO 9001 and ISO 14001 standards.

SOME STRONG POINTS

Buy-in of CNES teams to the agency's progress drive



Centres' great resilience in response to the COVID-19 pandemic



CNES's key role in the government's economic stimulus plan and space economy observatory



Robust project and environmental management



The audit noted "a remarkable gain in maturity in the way environmental considerations contribute to processes and projects over the last five years". This is illustrated by numerous measures, including the agency's travel policy, carbon inventory, energy strategy at the Guiana Space Centre, efforts to protect biodiversity, sustainable procurement methods, sustainable mobility, greening of field centres, regulatory compliance and a management system incorporating CSR.

OUTLOOK FOR 2025

CNES's management system is evolving to address the challenges set out in its Objectives and Performance Contract (OPC) for 2022-2025.

An ambitious CSR policy emphasizes a number of initiatives:

- Gender equality roadmap
- Diversity policy and accreditation
- Environmental and social clauses in the agency's contracts
- Reducing its environmental footprint
- Fostering the competitive edge and sustainable growth of the space ecosystem
- SCO accreditation of international projects
- Partnerships supporting regional resilience

In 2022, the agency's organization is also evolving to address CSR issues under the responsibility of the Sustainable Development Office, and central quality issues under the responsibility of the Inspectorate General & Quality Directorate.

CNES's MODEL FOR VALUE CREATION

CNES is the government agency and field centre that shapes and executes France's space policy, working for the future and fostering the space ecosystem.

RESOURCES



STRATEGIC



HUMAN CAPITAL

2,349 Employees, 39% women, working at 4 centres
5% of payroll devoted to training
84% Engineers and executives



FINANCIAL, INTELLECTUAL & TECHNICAL CAPITAL

€2,387m in subsidies and income
€244m for innovation
1 Dynamic subsidiaries and shareholdings policy
404 Doctoral and post-doctoral researchers
1 Space economy observatory
2 Field centres for orbital systems, space infrastructures and launch systems
1 Launch base, Europe's spaceport



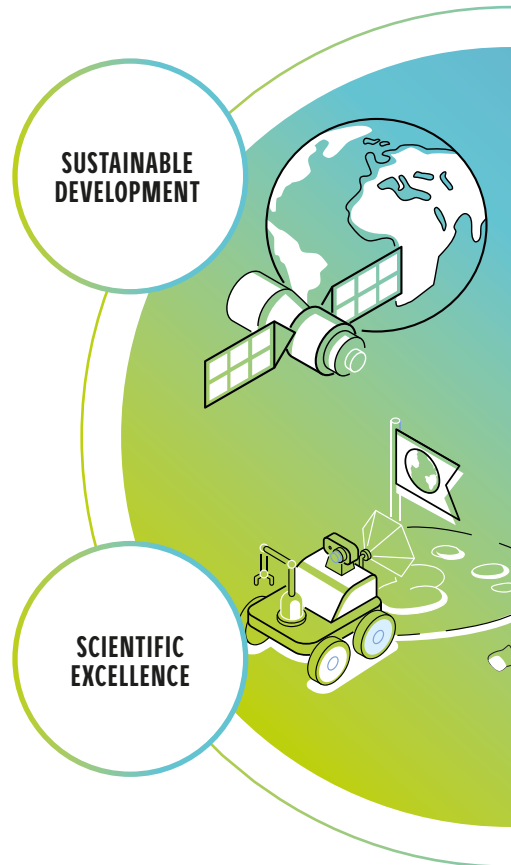
STAKEHOLDERS

Government, ministries (Economy, Finance & Recovery, Higher Education, Research & Innovation, Armed Forces)
Space user communities
Industry partners
Local and regional authorities
ESA, European Union, international space agencies



SOCIAL & ENVIRONMENTAL CAPITAL

Space missions for the environment, science and the military
Policies to sustain industry, support the scientific community, develop the space ecosystem and foster international cooperation.
Structures to assure safety of space operations and aid military space strategy
Commitments to preserving the environment and biodiversity at facilities



CNES'S FOUR CENTRES



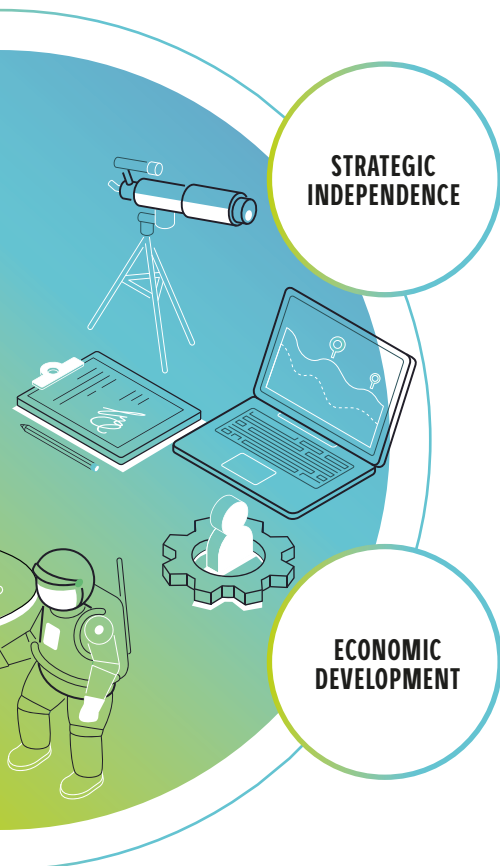
Paris Les Halles



Daumesnil

CNES aims to work full out
to serve sovereignty, competitiveness,
climate and science.

FOCUSES



Toulouse



French Guiana



RESULTS



FOR STAKEHOLDERS

- 1 Data access infrastructure (PEPS)
- 1 Data hub infrastructure (Data Terra)
- 7 Launches from Kourou in 2021
- 34 Space missions in development
- 24 Preliminary projects and 618 R&T actions
- 730 Scientific research proposals
- 144 Start-ups supported
- 20 Agreements with authorities or organizations outside the space ecosystem
- 140 International cooperation agreements



FOR SOCIETY & THE ENVIRONMENT

- 48 Activations of International Charter Space & Major Disasters
- 36 Space agencies/organizations signed up to the Space for Climate Observatory (SCO)
- 36 SCO France accredited projects
- 420,000 Beneficiaries of educational actions
- 2,000 teachers trained
- 13 Biodiversity goals (Act4Nature)
- 2,184 species of flora and fauna recorded at Guiana Space Centre
- 17 Sustainable Development Goals (Agenda 2030) to which CNES is contributing



FOR EMPLOYEES

- 1 Policy emphasizing work/life balance and well-being at work
- 89/100 Gender equality score
- 40,264 Hours devoted to training

— With space becoming a fiercely competitive commercial and strategic arena, CNES's missions are to help assure Europe's independent access to space and effectively serve France's military space needs.

To this end, CNES is working hard on the Ariane 6 programme and readying the launchers of the future, while also making the Guiana Space Centre the global benchmark. To adapt to the latest shifts in our sector, the agency's Launch Vehicles Directorate (DLA) is now the Space Transportation Directorate (DTS).

We are also playing a key role serving the defence community, supplying capabilities to support joint forces operations and actions in space. CSO, CERES and Syracuse 4A have all been placed into orbit in recent months, while the YODA demonstrator programme has also been launched. And in Toulouse, we are assisting with the roll-out and ramp-up of operations at Space Command.

SOVEREIGNTY

Space transportation and defence



ON FLIGHT VA255,
THE ARIANE 5 LAUNCHER
PLACED THE SYRACUSE 4A
MILITARY SATELLITE
INTO ORBIT.

1

new launch
complex at the
Guiana Space
Centre: ELA4.

6

military satellites
deployed
in three years.

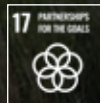
Transition

towards

- 90%** green energy,
- 30%** reduction in our
energy carbon footprint
in French Guiana,
- 50%** reduction in the
CSG's electricity bill.



These activities meet the UN Sustainable Development Goals (SDGs)



...and CNES's commitments.



**PROMOTING
SUSTAINABLE
AND PROTECTIVE SPACE**



**REDUCING
OUR ENVIRONMENTAL
FOOTPRINT**



SPACE TRANSPORTATION

ELA4

READY FOR ARIANE 6

In French Guiana, the Ariane 6 launch complex developed under CNES's prime contractorship successfully came through a series of technical qualification tests in 2021. ELA4's main systems—the BAL launcher assembly building, ground support equipment (power, air conditioning, safety systems, etc.) and all of the fixed and mobile mechanical systems, including the new cryogenic arms and MANG new-generation fuelling lines—are now fully operational. The control console that operates ground facilities and communicates with the launcher is in place at the CDL3 launch control centre. Lastly, initial combined tests simulating satellite encapsulation under Ariane 6's fairing have been completed using a mock-up of the launcher. ELA4 was inaugurated on 28 September 2021 in the presence of Philippe Baptiste and the Minister for Overseas Territories, who paid tribute to the unrelenting efforts of CNES and industry teams. 2022 will be devoted to combined testing of the launcher and its launch complex.



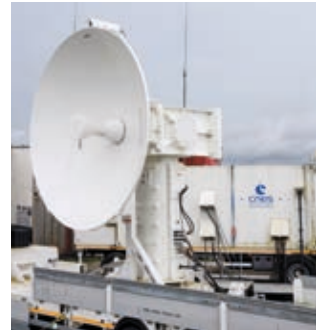
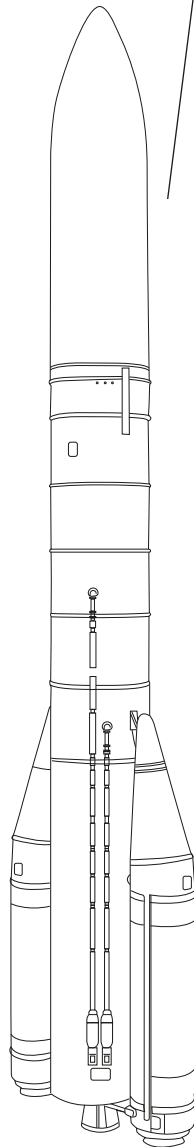
GUIANA SPACE CENTRE

EUROPE'S SPACEPORT IN KOUROU

To ensure the Guiana Space Centre (CSG) remains one of the world's top launch bases, CNES is working with ESA to deploy an ambitious programme to upgrade its facilities in readiness for the challenges and opportunities ahead. Confirming its excellence, in 2021 the CSG successfully accomplished seven launch campaigns, finalized the ELA4 launch complex and adapted the base to accommodate Ariane 6, while pursuing its digital and energy transition.



ARIANE 6



Amazonie-1 radar qualified

After tracking the flights of Vega on 29 April 2021 and Ariane 5 on 30 July 2021, the new Amazonie-1 radar confirmed its integration in the CSG's operational configuration, thus contributing to the continuous improvement of the launch base's availability. In April, its excellent results enabled it to track the Crew 2 mission that took Thomas Pesquet to the International Space Station (see page 57).

P8.3 readying for tomorrow

14 April 2021, at the Lampoldshausen facility in Germany, the German space agency DLR and CNES inaugurated the P8.3 test stand set to support liquid propulsion research. While the P8 stand is already a unique tool improving insight into the physics of the combustion process, the P8.3 is geared towards meeting new R&T needs to develop low-thrust reusable engines.



More than
300

tests already completed in 2021 on ELA4's cryogenic arms and fuelling lines.

GREENING THE LAUNCH BASE

GREENING FRENCH GUIANA

Working closely with local authorities and electric utility EDF, CNES engaged the CSG energy transition plan, which includes decarbonizing its processes. Four projects initiated in 2021 will be deployed to enter service in 2023-2024 and are expected to have a significant impact on the economy through local jobs.

- **Two solar farms** will be funded by the France Relance recovery plan and ESA and CNES's CSG-NG programme. Voltalia, a leading renewable energy firm, won the bid to build them.
- In the Amazon environment conducive to such solutions, the preliminary project and system concept for **two biomass plants** were filed with the energy regulation board.
- **An industrial consortium** is developing the HYGUANE (Hydrogène GUYanais A Neutralité Environnementale) demonstrator designed to ensure green production of roughly 20% of Ariane 6's hydrogen requirements.
- Our teams finalized the **preliminary project phase of BIFROST**, which aims to build a biomethane facility that will fuel the Themis **reusable stage demonstrator**, the MAIA light launcher and Vega-E.



Two R&D Launcher Challenges

CNES's Space Transportation Directorate (DTS) is working closely with the start-up ecosystem that it is nurturing notably through R&D Challenges aimed at incubating new players imagining concepts for the future. This initiative started in 2020 moved up a gear in 2021, with three calls for projects issued in the space of a month, two of them focused on upper stage reusability and launch system disruptive technologies. Original concepts were proposed, like a launcher upper stage that could be used for another system already in orbit, or electric thrusters capable of being refuelled in space. After only three months assessing proposals, a judging panel heard the best ones at two pitch days, after which 19 laureates each signed contracts on the spot with CNES worth €50,000 to €100,000.

46

firms have signed a contract with CNES through the R&D Challenges since 2020.



2022 HIGHLIGHTS

- **July**
Maiden flight of Vega-C.

- **Autumn**
First Perseus campaign at CSG.

- **End of year**
Full operation qualification of ELA4.

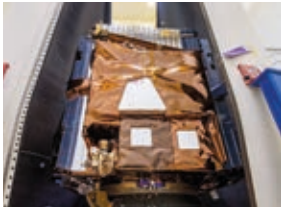
SEVEN LAUNCHES FROM THE CSG IN 2021

28 April

First successful flight of the year for Vega, orbiting **Pleiades Neo3**, **NorSat-3** and four **CubeSats**.

**16 August**

For its second flight of the year, Vega accomplishes a flawless launch to orbit **Pleiades Neo 4** and four **CubeSats**.

**16 November**

Vega successfully launches the three **CERES** defence and security Earth-observing satellites for the Ministry of Armed Forces.

**25 December**

The year ends on a high note with the historic launch of the **James Webb Space Telescope (JWST)** by Ariane 5.

**30 July**

Ariane 5 orbits two telecommunications satellites, **Star One D2** and **Eutelsat Quantum**.

**23 October**

Two telecommunications satellites, **SES-17** and **Syracuse 4A**, are successfully launched by Ariane 5.

**4 December**

Soyuz accomplishes its mission to place the 27th and 28th satellites of the **Galileo** constellation into orbit.



DEFENCE

COMMUNICATING WITH SYRACUSE 4A

Conceived and led by an integrated French defence procurement agency (DGA) and CNES team, Syracuse 4A is the first of a new generation of military communication satellites. Launched by Ariane 5 on 22 October 2021, the satellite achieved geostationary orbit over the next seven months, propelled by its four PPS®5000 electric thrusters (see page 41). Our teams supported DGA during satellite positioning operations and are continuing to do so for the in-orbit checkout phase. Designed to bring the military extremely secure broadband communications, Syracuse 4A operates in X-band and K_u -band with the PNT3G transparent digital processor developed through CNES's TelemaK and FAST programmes. Capable of locating sources of interference and resistant to cyberthreats, jamming and nuclear attack, its dual-use innovations afford it an unmatched degree of resilience.



x 10

Syracuse 4A offers a tenfold increase in speed versus Syracuse 3, equivalent to going from ADSL to fibre on the battlefield.

AsterX

EUROPE'S FIRST MILITARY SPACE EXERCISE

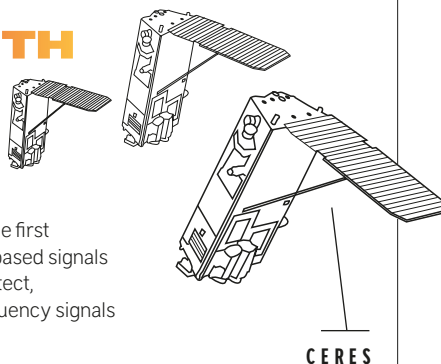
Military personnel, CNES, ONERA and manufacturers converged on the Toulouse Space Centre from 8 to 12 March 2021, where 60 participants tested their ability to establish a space picture and protect orbital systems under the watchful eye of Space Command (CDE). The teams responded—effectively—to events in a crisis scenario in which the nation's interests were under threat. CNES assigned 14 of its people to prepare for and execute this exercise. On 12 March 2021, President Emmanuel Macron, accompanied by the Minister for Armed Forces and military officials, watched the scenario that involved defending a French satellite approached and threatened by an adversary's satellite.



LISTENING WITH CERES

Launched by Vega on 16 November 2021, the trio of CERES satellites makes France the first European nation to acquire its own space-based signals intelligence capability. The satellites can detect, locate and precisely characterize radiofrequency signals anywhere in the world, day and night.

Drawing on a 25-year defence heritage, CERES has been able to capitalize on the results achieved with the ESSAIM and ELISA demonstrators. DGA tasked CNES with assisting oversight of the overall CERES system, as well as satellite positioning, in-orbit checkout and stationkeeping operations.



Seeing with CSO

Another trio of military satellites, the CSO optical component, is deploying according to plan. Launched from the CSG in December 2020, CSO-2 is fully operational since the first quarter of 2021.

+ Watchpoint

CNES and the Ministry of Armed Forces are already preparing the successors to CSO and CERES. In 2030, IRIS and CELESTE will be the military's eyes and ears. The agency's teams are also working on the ARES space action and resilience programme.



Space Command

Space Command (CDE) continued its ramp-up at the Toulouse Space Centre with the inauguration of a temporary infrastructure on 7 December 2021.

2022 HIGHLIGHTS

- **1st semester**
In-orbit checkout of CERES and Syracuse 4A.
- **End of year**
Launch of Syracuse 4B by Ariane 5.

— Space is driving advances in telecoms, digital, data and applications that are shaping the modern-day New Space adventure. In such burgeoning markets, CNES is adapting the way it works with the ecosystem to accompany this trend.

We are making French space telecommunications more competitive by betting on disruptive technologies, from propulsion, satellites and payloads to ground systems and user terminals. Thanks in particular to a high-performance digital processor, France is opening up an extremely promising new market segment for small series of standardized flexible satellites (flexsats) that are faster to build.

At the same time, big data is reaching into every corner of our lives, boosted by digital technologies and transformed by artificial intelligence. To enable space data to irrigate this emerging economy, we are stepping up our Connect by CNES initiative.

ECONOMIC COMPETITIVENESS

Telecommunications, Data & New Space



**MORE THAN
2.3**

billion Galileo users
all over the world.

71%

French manufacturers
Airbus Defence &
Space and Thales Alenia
Space won five out of
the seven competitively
bid comsat contracts
signed in 2021.

**MORE THAN
€15m**

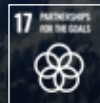
injected across
the board in 2021
into the new French
space ecosystem.

**MORE THAN
200**

firms supported
by CNES in 2021.

ONESAT

+ These activities meet the UN Sustainable Development Goals (SDGs)...



...and CNES's commitments.



**CREATING
SHARED VALUE
THROUGH SPACE**



**SUPPORTING
REGIONAL
RESILIENCE**



**REDUCING
OUR ENVIRONMENTAL
FOOTPRINT**



PNT6G

REVVING THE DIGITAL REVOLUTION

To achieve the required level of flexibility, flexsats rely on a digital processing core and active beam-forming antennas. Our dual-use sixth-generation PNT6G transparent digital processor is poised to form the heart of commercial flexsats (Space Inspire), as well as the future generation of military comsats. Leveraging CNES's R&D and France's best engineering and engraving technologies, the PNT6G reached several milestones in 2021, including fabrication of printed circuit boards for the qualification model. Delivered in September, the first sixth-generation ASIC test chip—measuring just two centimetres on a side—is being put through its paces to validate this technology.

+ Boost from PNT5G

Operating on the SES 17 satellite since end 2021, the PNT5G processor is **three times lighter** than its predecessor but delivers **20 times more digital processing capacity!**



Success buoyed by dual-use technologies

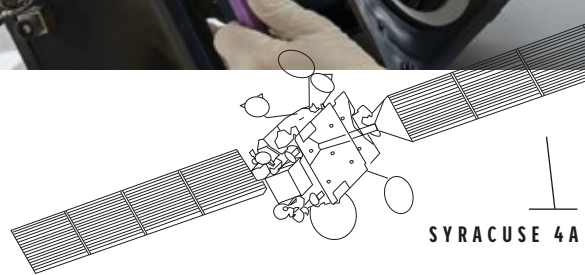
CNES has always worked with the defence community to develop dual-use civil/military technologies.

This is no truer than in telecommunications, ever since the first satellites from Telecom-1 and -2 to Syracuse 4, and with demonstrators like TelemaK, FAST and CASTOR, for which the PNT6G has been developed.

PPS 5000

TAKES WING

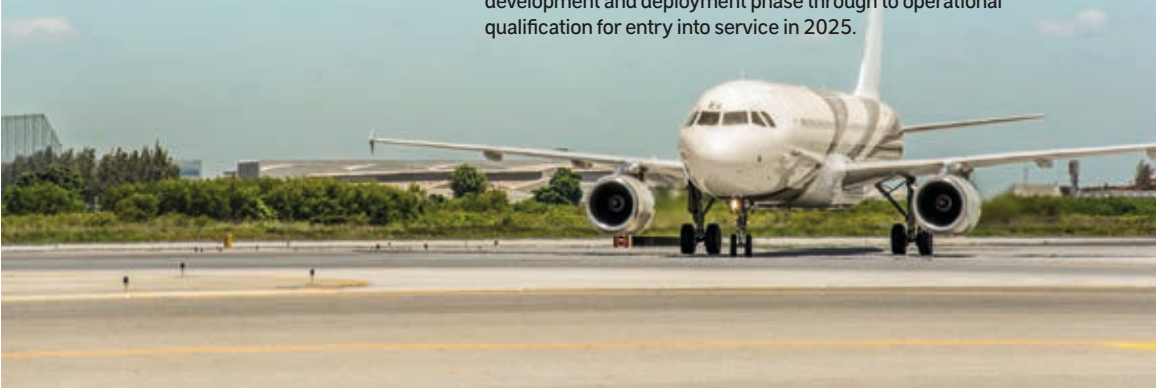
The French PPS®5000 thruster was fired for the first time in space on 24 October 2021 to raise the Syracuse 4A military communications satellite into its orbit (see page 36). This plasma thruster is the result of close collaboration since the late 1990s between CNES and Safran, a world leader in electric satellite propulsion. This promising technology was developed with funding from the government's PIA future investment programme (see page 14). With electric propulsion, weight savings from no longer having to carry fuel—making up about one-third of a satellite's mass—are directly benefiting the payload and mission performance. While most operators are converging towards this technology, the PPS®5000 has stamped its credentials as its development has progressed. End 2021, Airbus Defence & Space, Thales Alenia Space, Boeing and OHB Systems had already ordered some 100 thrusters. The PPS®5000 is also the go-to thruster for the second generation of Galileo satellites.

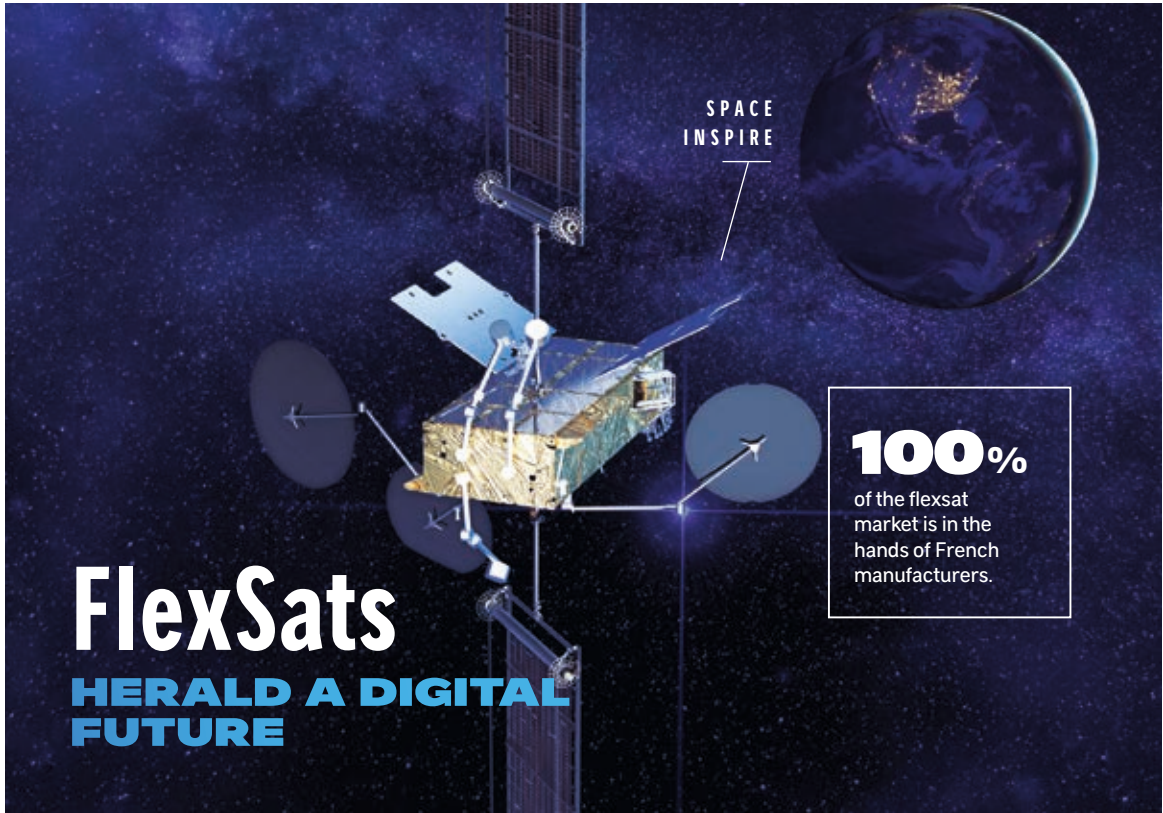


SBAS

TAKING HOLD IN AFRICA

Designed to give airlines reliable and precise positional fixes, the European EGNOS system augments GPS navigation signals. Since 2011, CNES has been working with ASECNA, the Agency for the Safety of Air Navigation in Africa and Madagascar, to develop SBAS (Satellite Based Augmentation System), a similar system to deliver a certified safety-of-life service to airlines over all of Western Africa and Madagascar. The system's preliminary design has now been approved and ASECNA has asked CNES to extend its oversight assistance in coordination with ESA, covering the infrastructure development and deployment phase through to operational qualification for entry into service in 2025.





Faced with a growing Internet market and falling revenue from audiovisual broadcast content, operators need flexibility to make the transition, all the more so when sending satellites into geostationary orbit for 15 years. Building on key advances in digital technologies, CNES is supporting development of new lines of satellites capable of adapting their coverage and services to keep pace with new market trends. To reduce costs and lead times, we are working on two standardized product lines with the main French primes: OneSat with Airbus Defence & Space under ESA's ARTES programme, and Space Inspire with Thales Alenia Space, funded by the PIA.

And their first successes have been quick to come. In March 2021, OneSat signed its seventh firm order even before the final design review was complete. After optimizing its design, Space Inspire secured its first sale end 2021, quickly followed by three more early in 2022.

Space inspiration, Act 1

When a player from outside the space sector is looking to invest in space, we come to their aid, as we did for Liebherr Aerospace, helping them to mature their technology. In 2021, the Toulouse-based firm was selected by Thales Alenia Space to supply heat exchangers for the mechanically pumped loop (MPL), which enables telecommunications satellite payloads to be more compact and offer more capacity.

2022 HIGHLIGHTS

- **September**
Launch of Konnect VHTS (built around Thales Alenia Space's Spacebus NEO electric platform).
- **2nd semester**
Launch of HotBird Next (first satellite built around Airbus Defence & Space's Eurostar Neo all-electric spacecraft bus).
- **End of year**
Declaration of initial Galileo High Accuracy Service.



DATA AND NEW SPACE



THE NEW DATA ECONOMY

Digital technologies and artificial intelligence are boosting data uptake. Everywhere we look, data are becoming crucial to generate new value-added indicators, applications and services. And space is playing a key role collecting, conveying and geolocating vast amounts of precise and regularly refreshed data. Whether for the Data Terra research infrastructure and data hub, the PEPS Sentinel Product Exploitation Platform or data storage and processing solutions, CNES is leading numerous initiatives to qualify space data and ease access and uptake across all sectors.

The recipe for New Space

New Space is bringing space to a wider audience with new players employing disruptive methods, combining a range of ingredients including ground-breaking technologies, innovative processes, agility, cost-cutting business models and a greater willingness to take risks. This powerful cocktail is shifting the space value chain towards more commercial services.

Anywaves success story

Supported by CNES and founded by one of its engineers, Toulouse-based start-up Anywaves is experiencing exponential growth. Besides the success of its miniature antennas, Anywaves is part of the New Symphonie consortium awarded a €1.4-million six-month contract in December 2021 by the European Union. Their mission is to come up with innovative ideas for a secure constellation of European broadband communications satellites.



Technical expertise for all

Via Connect by CNES, the agency's three field centres are helping to provide space data and solutions through Lab'OT for Earth observation, NavLab for geolocation and CESARS for telecommunications.

CONNECT BY CNES EXTENDS ITS OFFERING

CNES created Connect by CNES to foster and lead the ecosystem of space solution users. Having successfully applied the concept to the downstream sector, we are now focusing our attention upstream—on space technologies and infrastructures, in-orbit industry and the lunar economy—and stepping up our support efforts accordingly.

www.connectbycnes.fr



+ Key figures

220 **450**

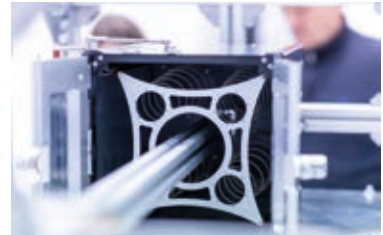
CNES patents ready to be exploited on line.

space ambassadors trained to foster development of space tools and solutions.



Tech the Moon

In June 2021, CNES and the Occitanie regional council's Nubbo accelerator launched TechTheMoon, the world's first lunar incubator, with a call for projects focusing on infrastructures, resources and life-support systems. In October 2021, five start-ups were selected for their innovative technology solutions ready to be deployed on the Moon and here on Earth.



Space Founders

Managed jointly by CNES and Bundeswehr University Munich (UniBw), the Space Founders accelerator is helping space start-ups with their development, strategy and financing. Ten laureates and potential star performers followed an intensive 10-week programme in 2021 with top experts from the French, German and European space agencies. Two new cohorts are expected in 2022.



Space inspiration, Act 2

When a player from outside the space sector is looking to invest in space, we come to their aid, as we did for CMA CGM, the global logistics specialist, which envisions doing business in orbit or on the Moon (supplying tugs, resupply and repair vehicles, etc.). On 10 June 2021, CNES and CMA CGM signed a unique partnership agreement to nurture innovative solutions together to serve shipping, logistics and the space industry.

BOOSTING EMERGING PLAYERS



In 2021, calls for projects issued thanks to the government's stimulus plan (see page 15) enabled us to accelerate our New Space roadmap. Two calls under Strand B of this plan were aimed directly at the data economy. The first concerned virtualizing ground segments, a new approach to satellites and satellite data. The other one, seeking to establish a space

data ecosystem around a marketplace combining suppliers and users, selected the platform led by Dawex. The call issued under Strand C took the form of a Space Tour dedicated to space applications fuelling regional economies and society. Out of 100 bids received in 11 partner regions, 33 start-ups signed contracts worth €50,000 to €100,000 each with CNES.

2022 HIGHLIGHTS

- **28 to 30 June**
Sea & Space symposium at the Euromaritime exhibition in Marseille.
- **7 and 8 July**
Assises du New Space summit event at Station-F, Paris.
- **18-22 September**
IAC 2022 (International Astronautical Congress) in Paris, organized by CNES.

— Space-based Earth observation has a crucial role to play in responding to the unprecedented environmental challenges that face us. With its renowned expertise in this domain, CNES is making the environment and climate science an operational priority.

We are conceiving innovative science missions like SWOT, eagerly awaited in the field of hydrology, to meet major challenges facing society. We are also extending the lives of those already delivering remarkable performance, like IASI and SMOS, which have supplied a steady stream of data over the years to enhance modelling of the atmosphere's chemical composition and of climate change.

Because we believe all of these satellite data hold so much potential to be unlocked, CNES has been driving forward the international Space for Climate Observatory (SCO) initiative, which is already confirming its utility with its first results in France.

And as Earth's environment and climate are everyone's concern, we are enlisting the efforts of our people to make CNES as virtuous an agency as possible.

ENVIRONMENT

Earth Observation, Climate & Sustainable development

MORE THAN

500

scientific papers
based on IASI data.

753

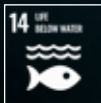
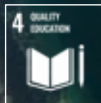
activations of the
International Charter
Space and Major
Disasters since
2000.

WATCHPOINT

Half of the essential
climate variables (ECVs)
we monitor depend on
satellite measurements.

Long time-series of
satellite data are vital
to gain insight into
phenomena spanning
decades.

+ These activities meet the UN Sustainable Development Goals (SDGs)...

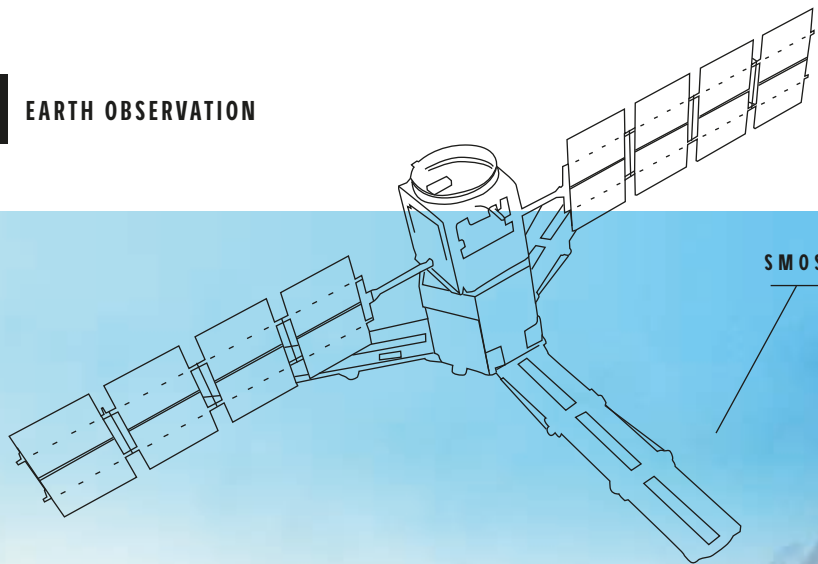


...and CNES's commitments.





EARTH OBSERVATION



SMOS

12 YEARS OBSERVING THE WATER CYCLE

Launched in 2009, the European SMOS satellite has been granted a mission extension through to end 2025. And for good reason, as its excellent operations and science have made it a much more prolific mission than imagined when it was conceived. With its radiometer designed to sense microwave radiation emitted by Earth, SMOS initially sought to measure ocean salinity and soil moisture. This latter measurement also enables calculation of root-zone moisture and other drought indicators for assessing vulnerability of soils to flooding. Today assimilated in models at the European Centre for Medium-range Weather Forecasts (ECMWF), SMOS data are also used to monitor icebergs, and freezing and thawing of soils and sea ice. The Carbon-Monitor project (*see page 51*), which received SCO accreditation in 2021, is using them to generate an indicator of aerial biomass capturing atmospheric CO₂.



STRATEOLE-2

IN THE THICK OF ATMOSPHERIC EXCHANGES

From October to December 2021, 20 balloons were released from the Seychelles for the Strateole-2 campaign. Led by the French scientific research centre CNRS and operated by CNES, this international project is seeking to measure exchanges of air masses between the troposphere and stratosphere that govern many global changes.

The balloons stayed aloft for one to two months, taking a dozen different instruments to an altitude of 18 to 20 kilometres. Operating in the intertropical zone where air exchanges are the most turbulent, the balloons—the result of CNES's expertise—accomplished the unique feat of collecting rare in-situ data that are a great complement to satellite data and vital to improve scientific models. The Meteo-France national weather service was able to assimilate the data from one of the sensors in its weather forecasting models, while another balloon, caught in a cyclone as it started to form, experienced the phenomena at play first hand. The next Strateole flight campaign is planned in 2024.

IASI

15 YEARS SURVEYING THE ATMOSPHERE

Every day since 2006, Infrared Atmospheric Sounding Interferometer (IASI) instruments have been measuring atmospheric concentrations of more than 25 gases, in the process revealing phenomena not visible to the eye. In 2021, IASI data showed a marked increase in methane, a potent greenhouse gas, as well as a larger-than-usual ozone hole over the Antarctic. The mission also enabled analysis of sulphur dioxide (SO₂) plumes from the eruption of Etna, unusually low temperatures in Houston and devastating tornadoes in Kentucky. A study published in October 2021 in the *Nature* journal *Climate and Atmospheric Science* compiling IASI data between 2008 and 2017 provides the first ever picture of changes related to each gas and their impact on the radiative flux escaping the atmosphere and thus contributing to global warming.

Of the three IASI instruments in orbit, the first bowed out at the end of 2021 when its MetOp host satellite was de-orbited.



+ Working closely with MetOp's operator Eumetsat,

CNES conducted eight technology experiments before the satellite was passivated, tweaking parameters to see how the instrument's behaviour and performance would be affected. The results are going to inform development—already well underway—of the next generation of IASI-NG instruments.



SWOT

EAGERLY AWAITED BY HYDROLOGISTS AND OCEANOGRAPHERS

In August 2019, we delivered to NASA's Jet Propulsion Laboratory (JPL) the Radio Frequency Unit (RFU), the heart of the KaRIn altimeter that is the main instrument on the SWOT mission to measure surface heights of lakes, rivers and oceans. In June 2021, it was JPL's turn to deliver the complete SWOT payload to Thales Alenia Space in Cannes. No sooner was it mated with the spacecraft than testing began. CNES and NASA have agreed to launch the satellite before the end of 2022.

Space charter aiding humanitarian efforts

Founded by the European Space Agency (ESA), CNES and the Canadian Space Agency (CSA), the International Charter Space and Major Disasters entered service on 1 November 2000. Once activated in response to a disaster, the Charter rapidly delivers satellite imagery of affected areas free of charge. It is being activated increasingly often, its latest annual report recording 55 activations in 2020, for which 5,900 images were provided. Today, with 17 members contributing 61 satellites, this remarkable international initiative celebrated its 20th anniversary at the plenary session of the International Astronautical Congress (IAC) in 2021. All present paid tribute to the efforts it is engaging, among other things to take the number of users authorized to activate the Charter to 80 in 75 countries.

2022 HIGHLIGHTS

- **August**
30 years of satellite altimetry.
- **November**
Launch of SWOT.
- **Until end November**
CNES is chairing the Committee on Earth Observation Satellites (CEOS).



CLIMATE & SUSTAINABLE DEVELOPMENT

SCO

SPACE FOR CLIMATE OBSERVATORY

Set in motion by France through CNES in 2019, the Space for Climate Observatory (SCO) now has 36 members—space agencies and UN bodies—who have finalized its international governing charter. Together, they are proposing to provide satellite data to operationalize scientific research and inform decisions in response to the impacts of climate change. Its methods must be developed locally to meet regions' real-world needs, and transposable to other places.

Paving the way for national SCO branches, CNES has federated 22 key partners in France to put together an annual call for projects and an accreditation scheme. We are offering our space expertise to each laureate and leading this new community.

www.spaceclimateobservatory.org

STRENGTH TO STRENGTH

SCO France accredited 22 projects in 2021, while the class of 2020 started delivering the first operational tools, notably FORO, a platform monitoring hydro-meteorological events in the Aude region of Southwest France. Institutions, local authorities, research laboratories and private operators all bore testament to the efficacy of the SCO approach at the first SCO France Congress on 7 December 2021. Like CNES, the French biodiversity office OFB and ADEME, the French agency for the ecological transition, have put aside funding to support SCO projects.

43

projects have received SCO accreditation in two years, 36 of them from SCO France.

19

CNES engineers are supporting SCO France projects.



SATELLITES PROTECTING BIODIVERSITY

At the World Conservation Congress of the International Union for Conservation of Nature (IUCN) in September 2021 in Marseille, CNES set up stall alongside its partners—the Conservatoire du Littoral coastal conservancy, the French oceanographic institute Ifremer, the national research institute for agriculture, food and the environment INRAE, the IRD development research institute and the National Natural History Museum—under the Biodiversity Dome, a 150-sq.m. half-sphere illustrating everything space is doing to advance understanding and preservation of biodiversity. And near the France Pavilion, Connect by CNES teams welcomed start-ups offering innovative environmental solutions, while an SCO conference gave a platform to three SCO projects devoted to biodiversity.



FIRST RESULTS FROM ACT4NATURE

In obtaining international Act4Nature accreditation, CNES is affirming its commitment to factor biodiversity issues into everything it does at all its facilities, with notable results achieved in 2021:

- We supported work to advance knowledge and projects to tackle biodiversity loss, with 13 projects accredited by the SCO and 19 calls for marine biodiversity research projects.
- We integrated biodiversity issues in our value chain, with a new biodiversity management plan for the Guiana Space Centre and the launch of an analysis of the balloon life cycle.
- We got our interested parties on board, enhancing our educational offering for youngsters, students and teachers in partnership with OFB, publisher Milan Presse and other stakeholders.



COP26

From 1 to 12 November 2021, CNES was at the COP 26 conference in Glasgow. As France's space agency and the representative of SCO France, we put on three events with our partners focused on the value of satellite data informing climate change policies. We also signed an agreement with our counterpart the United Kingdom Space Agency (UKSA) on the MicroCarb mission to observe CO₂.

MICROCARB



CLIMATE COLLAGE

What direct impacts is CNES having on climate and what can our people do to change things? All the answers are in the Climate Collage! This fun learning workshop led by Geckosphere helps to shape a shared vision of climate issues and discuss individual and collective solutions.

Some 160 people, including the members of CNES's Executive Committee, took part in the hugely successful 2021 workshop.



In 2022,

employees trained to lead this community will be rolling out the initiative across the agency.

2022 HIGHLIGHTS

- June**
 Event at the Cité de l'espace in Toulouse to ratify the SCO International Charter.
- September**
 SCO plenary at IAC and opening of SCO call for projects.
- November**
 Present at COP 27 in Sharm-el-Sheikh, Egypt.

— CNES has been sustaining French scientific excellence for 60 years. Working mostly within the framework of ESA's science programme and in partnership with other international space agencies, we are helping France's research laboratories to build instruments for the most ambitious missions. As a result, our agency's scientists are playing a key role in defining missions and processing their data.

On the International Space Station (ISS) with Thomas Pesquet, and on Mars with Perseverance, Curiosity and InSight, 2021 concluded with the fantastic launch of the James Webb Space Telescope (JWST) by Ariane 5. More great discoveries now await, and CNES—as ever in close collaboration with ESA's programmes—is pursuing a top-level science programme.

JAMES WEBB SPACE
TELESCOPE

SCIENTIFIC COOPERATION

Exploration & Universe Sciences



60%

of European science experiments conducted on the ISS by Thomas Pesquet were operated under the responsibility of CADMOS at CNES.

1/2

SuperCam and ChemCam are operated every other week alternately from the FOCSE at the Toulouse Space Centre and Los Alamos National Laboratory (LANL) in the United States.

5 years

of mission life gained by JWST thanks to Ariane 5.



These activities meet the UN Sustainable Development Goals (SDGs)...



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



17 PARTNERSHIPS FOR THE GOALS

...and CNES's commitments.



CREATING SHARED VALUE THROUGH SPACE



PROMOTING SUSTAINABLE AND PROTECTIVE SPACE



BACK IN TIME WITH JAMES WEBB

At a cost of \$10 billion and 30 years in development, the James Webb Space Telescope (JWST) was sent aloft from French Guiana on 25 December 2021. Developed by NASA in partnership with the European Space Agency (ESA) and the Canadian Space Agency (CSA), it is set to help us date and delve deeper into the many discoveries of its remarkable predecessor the Hubble Space Telescope. To accomplish this feat, JWST has the first—and largest—mirror deployable in space and infrared vision enabling it to see through thick clouds of gas to the first stars 13½ billion light-years away. It will also observe exoplanets in our galaxy, a goal added during development and met by France with the imager for MIRI (Mid-InfraRed Instrument), developed under CNES's responsibility by the French atomic energy and alternative energies commission CEA and the LESIA space and astrophysics instrumentation research laboratory, the IAS space astrophysics institute and the LAM astrophysics laboratory in Marseille. Operating in the mid-infrared, MIRI sees much further than the three other infrared spectrometers and is already garnering most observation requests from scientists. To ensure the sharpest vision possible, JWST is in orbit around the L2 Lagrange point 1.5 million kilometres from Earth. While the entities involved in developing MIRI have preferred access to its data, JWST observations will be exploited by many other French laboratories including the IRAP astrophysics and planetology research institute and the IAP astrophysics institute in Paris.

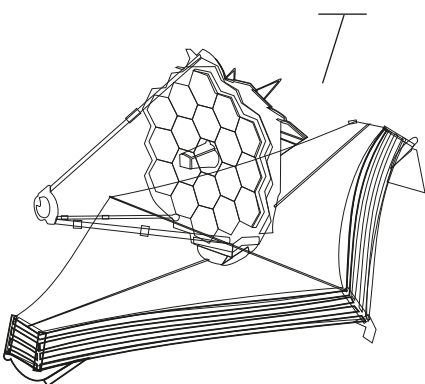


An exceptional launch

JWST is a marvel of technology weighing 6½ tonnes that NASA chose to launch on Ariane 5. Carrying the telescope in a stowed position under a specially adapted fairing, our European launcher hit the specified orbital injection spot on, saving enough fuel to extend the mission by at least five years.



JAMES WEBB



THOMAS PESQUET'S

ALPHA MISSION

For his second sojourn aboard the ISS, from April to November 2021, Thomas Pesquet conducted some 200 experiments, 44 of them European. Among them, 12 experiments were developed at CNES by the CADMOS centre for the development of microgravity applications and space operations for the Alpha mission. Besides being a great operational success, this mission was also a huge media success for space and science outreach.

Alpha's experiments hold great potential for life and material sciences, life support, technologies and many more domains. For example, a sleep headband was carried in gingerbread for launch, showing the utility of recyclable or edible packaging for reducing waste on the ISS.

Then there were the Telemaque tweezers, capable of handling small objects without touching them in levitation inside an acoustic vortex, making them useful not only on the ISS— for example to safely move samples— but also to avoid certain intrusive medical procedures. Preparations for the future exploration of space are thus bringing many benefits in our daily lives here on Earth.

+ **Key figure**

199 days

Duration of the Alpha mission.

PERSEVERANCE

GOES PROSPECTING

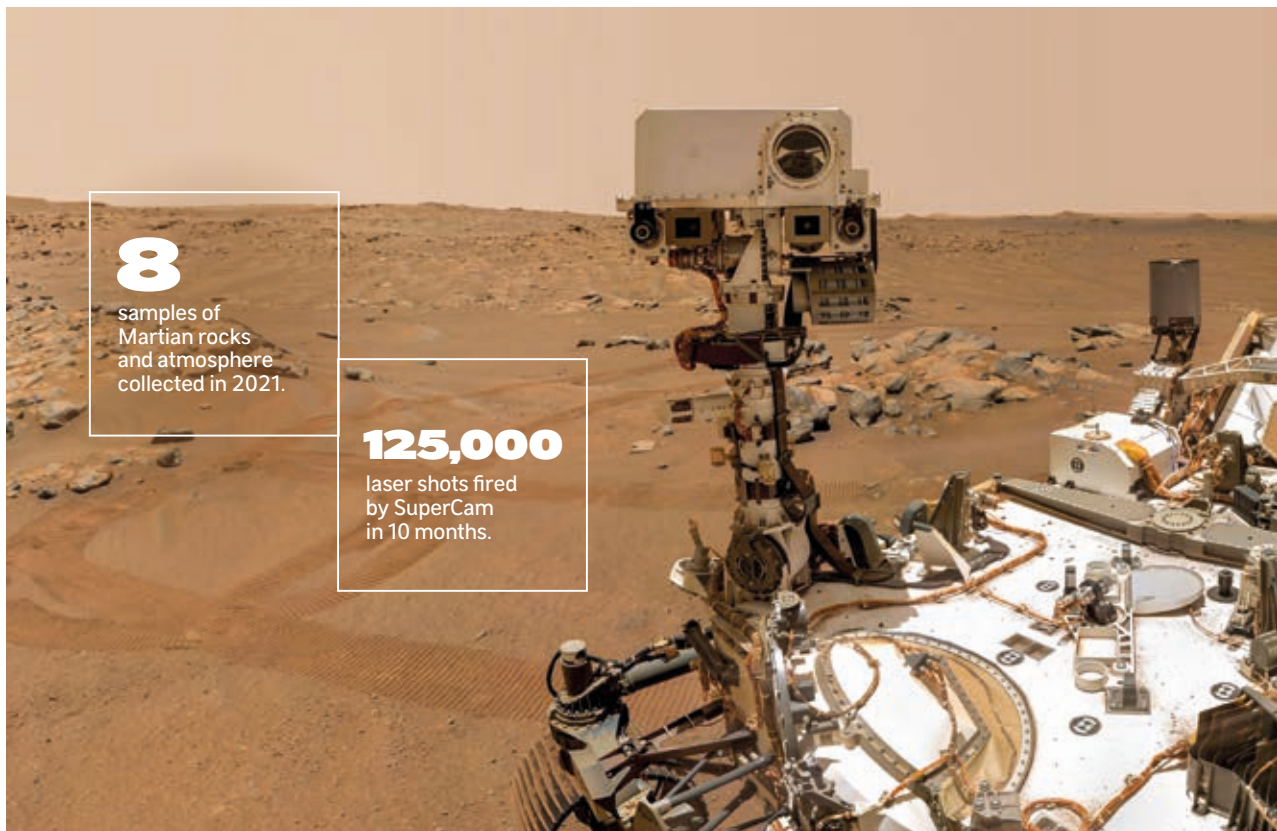
Launched on 30 July 2020, the U.S. Perseverance rover set its wheels down on the surface of Mars on 18 February 2021. In its search for traces of past life, it is roving for samples to be returned later to Earth within the 2031-2033 timeframe. For this it has 40 sample tubes, a drill and the French-U.S. SuperCam instrument on its mast.

An enhanced version of the ChemCam instrument operating on the Curiosity rover since 2012, SuperCam's laser has two wavelengths to analyse chemical elements and molecules in Martian rocks. A camera, infrared spectrometer and microphone complete the panoply of systems on SuperCam, developed jointly by the Los Alamos National Laboratory (LANL) and a French consortium led by IRAP. CNES worked alongside them and with Thales Alenia Space to build this dual-use laser.



First results guiding sample collection strategies

In Jezero Crater where Perseverance landed, the evidence from SuperCam's measurements point to it being the site of an ancient lake. The sediments characteristic of the type of river deltas we know on Earth, where organic matter accumulates, make it a likely place to look for signs of life. Confirming results already obtained with Curiosity, SuperCam has formally identified perchlorates, a potent oxidant potentially able to support life.



8

samples of
Martian rocks
and atmosphere
collected in 2021.

125,000

laser shots fired
by SuperCam
in 10 months.



INSIGHT'S REVELATIONS

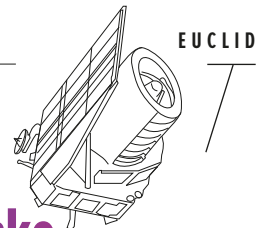
The three main science goals of the French-U.S. InSight mission, published in the journal *Science* in summer 2021, have been reached. The internal structure discovered thanks to the French SEIS seismometer has enabled scientists to establish a consistent picture of the red planet's interior. The core's radius—1,830 kilometres, larger than first thought—suggests consistent geological conditions could have formed Mars' massive volcanoes and led to the loss of its atmosphere. The lithosphere—the upper layer of the mantle—is so thick

(400 to 600 kilometres, versus just 80 kilometres on Earth) that plates could not have broken into drifting pieces. This would explain the absence of plate tectonics on Mars. Lastly, and mysteriously, there are two layers of crust beneath InSight's landing site, one 20 kilometres and the other 35 kilometres thick. Unless a dust devil comes to the rescue and scours its solar panels clean to restore power, InSight is likely to become inoperative before the end of the year.



Voyage 2050

CNES's universe science activities are dictated largely by ESA programmes. In 2021, after consulting broadly with the European scientific community, a committee of experts submitted its recommendations for the Voyage 2050 programme, identifying 20 medium-term science missions and technology obstacles to be overcome over the next 20 years. For the programme's three cornerstones, to be developed over the next 20 years, they recommend exploring the moons of Jupiter or Saturn, looking for temperate Earth-like exoplanets and seeking to answer questions surrounding the early universe. As always, CNES will be working alongside French scientists involved in these missions.



Short take

Supported by CNES, French research laboratories delivered instruments in 2021 for the European Euclid mission to probe dark matter and JUICE to explore Jupiter's icy moons, as well as the French-Chinese SVOM mission to study gamma-ray bursts.

2022 HIGHLIGHTS

- **Mid-year**
Publication of DR3 of the Gaia star catalogue.

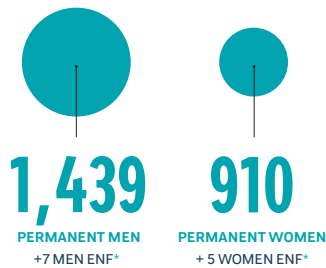
- **Mid-year**
Publication of final results from Microscope.

HUMAN RESOURCES IN FIGURES

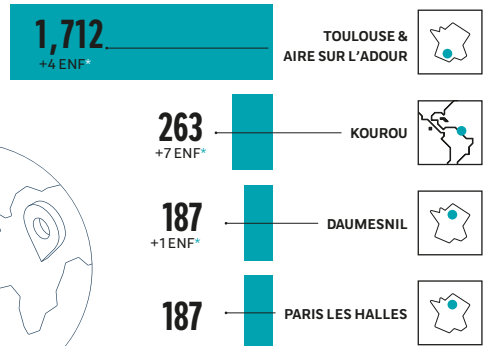
DATA AT 31.12.2021

2,349 PERMANENT HEADCOUNT

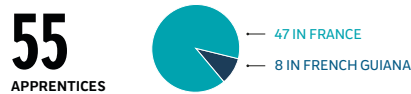
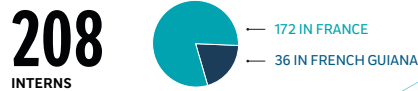
TOTAL HEADCOUNT (MEN AND WOMEN)



HEADCOUNT PER FIELD CENTRE
(PERMANENT)



INTERNS AND WORK/STUDY
PLACEMENTS IN 2021



10 WORK/STUDY CONTRACTS

INTERNAL MOBILITY

5 MOVES OUTSIDE AGENCY

0.2%

63 RELOCATIONS

2.7%

264 FUNCTIONAL MOVES**

11.2%



122
permanent hires
in 2021

Mean age of recruits hired on
permanent contract:

32

Mean age of CNES
employees:

48½

* Non-French-speaking Europeans.

** Not including end-of-career leave.



A SOCIALLY RESPONSIBLE EMPLOYER

Being a socially responsible employer is one of the five commitments of our agency's corporate social responsibility (CSR) policy. For CNES, well-being at work—through gender equality, diversity and ethics—is an undeniable social responsibility and a guarantee of performance.

In 2021, our Human Resources teams pursued measures to encourage our people's personal development, as well as a range of solidarity initiatives.



ROUNDING UP PAY IN SOLIDARITY

Mighty oaks from little acorns grow, as the saying goes, and solidarity often relies on small gestures that together add up to bigger numbers. This is the philosophy behind rounding up pay. As an employee's net salary is never a round figure, those who wish can donate a few cents or euros to good causes.

The agency's employees have fully embraced this idea, and in mid-2021 they shortlisted 22 non-profit associations whose activities are aligned with one of the three pillars of our CSR strategy: education, diversity and environment. After a vote, they then chose four of these associations:

- **Bloom**, working to protect the oceans and marine species while encouraging sustainable employment
- **Rigolopito**, entertaining children and other patients in hospitals in the Occitanie region
- **Autisme 31**, helping parents with autistic children's education and learning leisure pursuits
- **JungleVet Guyane**, helping wild animals in distress in French Guiana.

The first donations were deducted from pay in January 2022.

GENDER EQUALITY INDEX

CNES calculates its gender quality index every year as now required under French law. This gives a score out of 100 based on five indicators:

1. Mean pay gap
2. Pay rise gap
3. Promotion gap
4. Pay rise for employees returning from maternity leave
5. Gender distribution of the top ten highest-paid employees



For its 2021 index,
CNES scored

89/100

This is the result of four successive gender equality agreements.



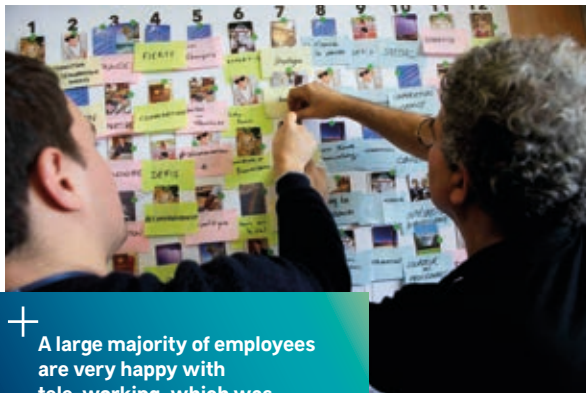
WORKPLACE WELL-BEING SURVEY

The Workplace Well-being survey conducted end 2020 with all CNES employees gives a broad picture of how they feel and which areas to focus on. Among the first results to emerge in 2021, 92% are satisfied and 87% recommend working at CNES to their friends and family.

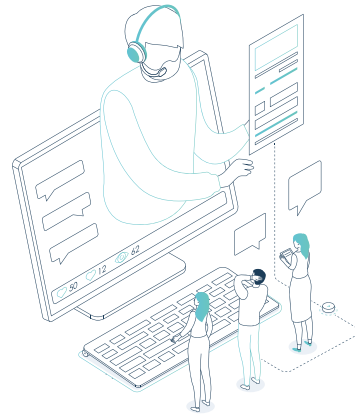
This high level of satisfaction is confirmed by the very good scores (80% or more) for nine indicators of workplace well-being out of 17 assessed in the survey: human relations, job satisfaction, management support, engagement, premises and equipment, training, work organization, tele-working and brand image.

The main areas for improvement identified were pay and workload.

The results of the survey were assessed with union representatives and negotiations on the Workplace Well-being and Work Conditions agreement will get underway in 2022.



+ A large majority of employees are very happy with tele-working, which was extended to **two days** a week in December 2021.



TAILORED DIGITAL TRAINING

The impact of the COVID-19 pandemic this year gave extra impetus to CNES's distance training and digital content efforts.

Employees were offered a range of virtual formats—workshops, conferences, webinars, etc.—on a range of topics tailored to the situation, including how to manage energy levels when working from home, regulating cognitive load and the right to disconnect, as well as charting a way out of the crisis, hybrid organization, returning to the office or managing uncertainty.



+ Key figures

In 2021

1,157

employees received distance training.

67%

of training was in distance-learning format, a 30% increase over 2020.

AGREEMENTS SIGNED IN 2021

- Agreement on tele-working and modernization of work conditions at CNES
- Agreement on career development and support at CNES
- Memorandum of understanding on recovery from the COVID-19 health crisis (4 June 2021)

- Amendment n°1 to the MoU on recovery from the COVID-19 health crisis

- Amendment n°5 to the agreement of 14 November 2018 on the establishment of CNES's Economic and Employee Relations Committees (CSEs)

- Amendment n°2 to the agreement on union rights and labour relations

- Amendment n°2 to the 2020/2022 profit-sharing agreement

CNES IN THE EYES OF ITS NEW RECRUITS

2021 was a record recruitment year for CNES, with 122 new hires on long-term contracts. Thanks to our strong employer brand, we are getting attention for space careers through events, student exhibitions and other actions in partnership with associations. Sixty years after the agency's inception, we share how four new recruits see us through the prism of this milestone.



Ghania Fau
Quality Assurance Specialist,
Satellite Operations and
Exploitation
Toulouse Space Centre
Hired in July 2021

“ I discovered CNES when I was a student, as some of our instructors were from the agency. Their expertise and professionalism really made me want to join its ranks. Once I'd been hired, my vision of the agency was confirmed: CNES is engaged on all fronts in both legacy and modern projects. Through all these years, it has succeeded in maintaining a high level of excellence and expertise. I was surprised by the sheer range of job profiles here, and by the fact that we don't need to look for expertise elsewhere. We have such a rich pool of talent! I want to pursue my career at CNES to continue learning different things and build my skills. —



Stéphanie Victor
Community manager
Guiana Space Centre
Hired in June 2021

“ I moved to French Guiana after graduating in mainland France. When I arrived at the CSG, I soon realized it was more than a launch base. It's innovating, modernizing and going the extra mile. I've also seen this trend in my job. Recognizing that social media are today a key communication channel, CNES created the post of community manager within the CSG's communication department in 2021. Sixty years after its inception, the agency's moving with the times and investing in new technologies to build its reputation and that of the CSG. And I'm delighted to be along for the ride! —



Christian Mustin
Exobiology, Exoplanets and
Planetary Protection subject
matter expert
Paris Les Halles
Hired in September 2021

“ After 30 years as a researcher with the national scientific research centre CNRS, joining CNES was the opportunity for me to get involved in exploring terra incognita and give a new lease of life to my specialist field of metal extraction processes. And I haven't been disappointed! Here at CNES, temporality, strategy and technical prowess combine to develop a space instrument in pursuit of a scientific quest. The agency's strength lies in this methodological wisdom that draws on its heritage and marks each step in a space mission; a method underpinned by its collective vision and faith in the abilities of its people. I believe that is what enables CNES today to propose a robust range of skills and to approach new challenges with confidence. —



Jordan Chevalier
Collaborative Enterprise
Solutions Engineer
Paris Daumesnil
Hired in January 2021

“ When I joined CNES last year in an IT position, it was to help modernize this great French agency with its 60-year history, and I was very pleasantly surprised. CNES wants to make the latest digital processes central to what it does, and is working hard to achieve that goal. It's establishing new ways of working that call for agility and more iterative processes requiring greater responsiveness to be able to offer innovative and modern solutions. In the last year, I've learned a great deal and I'm continuing to learn every day. —

HEAD OFFICE PARIS LES HALLES



This is where CNES fulfils the two key missions of crafting French space policy and coordinating the agency's national, European and international programmes. Our 187-strong team works to build the agency's projects through multilateral agreements, events and gatherings.



EVENTS MAKE COMEBACK IN AUTUMN

Despite the continuing COVID-19 crisis in 2021, events at Head Office were able to go ahead in compliance with health protocols. Two major public events were organized by the Observatoire de l'Espace, CNES's cultural arm. In September, an exhibition on the construction of the Guiana Space Centre was held for the European Heritage Days, and in October visitors were treated to a programme of films inspired by audiovisual footage from the agency's archives for the Nuit Blanche all-night festival. —



PREPARATIONS FOR MOVE TO NEW PREMISES STEP UP A GEAR

At the end of the year, Head Office closed out a long process with a presentation to employees of the results of the Evolusiège-NG review of its future evolution.

The next phases of the project were also laid out with a view to making the move to new premises in 2024. —



TOULOUSE SPACE CENTRE



The Toulouse Space Centre (CST) is CNES's largest technical and operational centre. The agency has more than 1,700 people working here, and 800 from industry partners. All directorates except the Guiana Space Centre are present. The site also hosts teams from ESA, EUSPA, Space Command (CDE) and soon France's national mapping, survey and forestry agency IGN, and is opening up to local, national and international space ecosystems. From ideation through to operations, our engineers, executives, technicians and clerical staff have all the expertise required to conduct orbital system projects. Their work also involves fostering uptake of satellite data for the benefit of all, while continuing to create and innovate.

CST 2030: BUILDING THE FUTURE CAMPUS TOGETHER

With new buildings, new partners and new challenges to face, the Toulouse Space Centre is reinventing itself. Its ambition for 2030 is to strengthen its position as a high-tech operations hub connected to its environment and open to the world. To chart its roadmap, CNES has engaged a consultation process involving not only its own people but also the partners and subcontractors it is working with to shape France's space policy. This broad investigation spanning multiple domains—the environment, labour and social relations, technology and the economy—is being led by the CST 2030 working group launched in March 2021. The goal is to compile a sociological map of the CST and envision how it might look in 2030, imagining how its people will be living and working at the centre.

Seeking to ground its analysis in how the centre's "residents" themselves see things, the CST 2030 working group invited them to a series of roving topical debates in September 2021 on the subject of living together at the CST in 2030. The findings from these debates will enable the agency to build a campus tailored to its users' aspirations. —



15 hours

of discussion with residents
(roving debates and public meetings).



FabLab makes ideas real

Three years after CreaLab, it was the FabLab's turn to open in October 2021. While the former provides a place for employees to get together and bounce ideas off one another, the latter gives them the means to turn ideas into reality, with a laser cutting and engraving machine, a 3D printer, a printed circuit board etching machine and microcontroller development boards. Training on these tools is planned in 2022.





PARIS DAUMESNIL

The one thing teams at our Paris Daumesnil facility all share is a focus on space transportation. Within its various directorates, our experts are working to advance future projects like reusability, advanced propulsion concepts, in-orbit servicing systems or human spaceflight. Most of them come under the Space Transportation Directorate (DTS) and are helping to develop Europe's launch systems, notably as prime contractor for Ariane 6 ground support systems and providing launcher oversight assistance for ESA-STX (Space Transportation System).



SPACE TRANSPORTATION SPECIALISTS FIND ECO-FRIENDLY WAYS OF TRAVELLING

What means of transport do employees prefer to get to work? How can their home-work journeys be made more eco-friendly? In 2021, the Paris Daumesnil centre committed to addressing these questions with a view to finding mobility solutions that tread more lightly on the environment. A survey of employees' usual means of travel, a study of where they live and an analysis of the centre's accessibility culminated in a revamped mobility plan for the centre.

And for those forced to rely on a petrol or diesel car, the centre offered training sessions in eco-friendly driving.



After donning virtual-reality headsets, employees worked with instructors from CEC* Conseil to see the kind of fuel savings that can be achieved by applying eco-friendly driving principles. This commitment to sustainable mobility will be continued in 2022. —

*Eco-Citizen Driving

GUIANA SPACE CENTRE



Located near the equator and with its broad ocean frontage, the Guiana Space Centre (CSG) offers exceptional conditions for launching all types of satellites into all orbits. Europe's spaceport guarantees independent access to space for ESA's member states.

Its 1,600 personnel—including 270 at CNES—from 40 European companies conduct launch preparations and operations. As it gears up for its energy transition, the CSG is modernizing its facilities to accommodate the two new European launchers, Ariane 6 and Vega-C, reusable vehicle demonstrators and mini- and micro-launchers.

SUPPORTING GUIANESE MUNICIPALITIES

On 26 July 2021, Philippe Baptiste signed at the CSG partnership agreements between CNES and French Guiana's 22 municipalities for the next seven years. The budget envelope of nearly €13 million will enable the municipalities to fund economic development, education and social insertion projects—the opportunity for the agency to reaffirm its commitment to the region's development. —



OPERATIONS CENTRE BREAKS GROUND

The aim of the future Operations Centre (CDO) is to centralize teams and systems to gain in efficiency. This new building, a key component of the CSG-New Generation programme, will have five floors housing an agile and collaborative organization to bring more flexibility to operations, optimize turnaround times and enhance the base's availability and robustness. Earthworks are scheduled to be completed in April 2022 and construction work plans to start in the third quarter of the year to have the CDO ready for delivery by end 2024. —



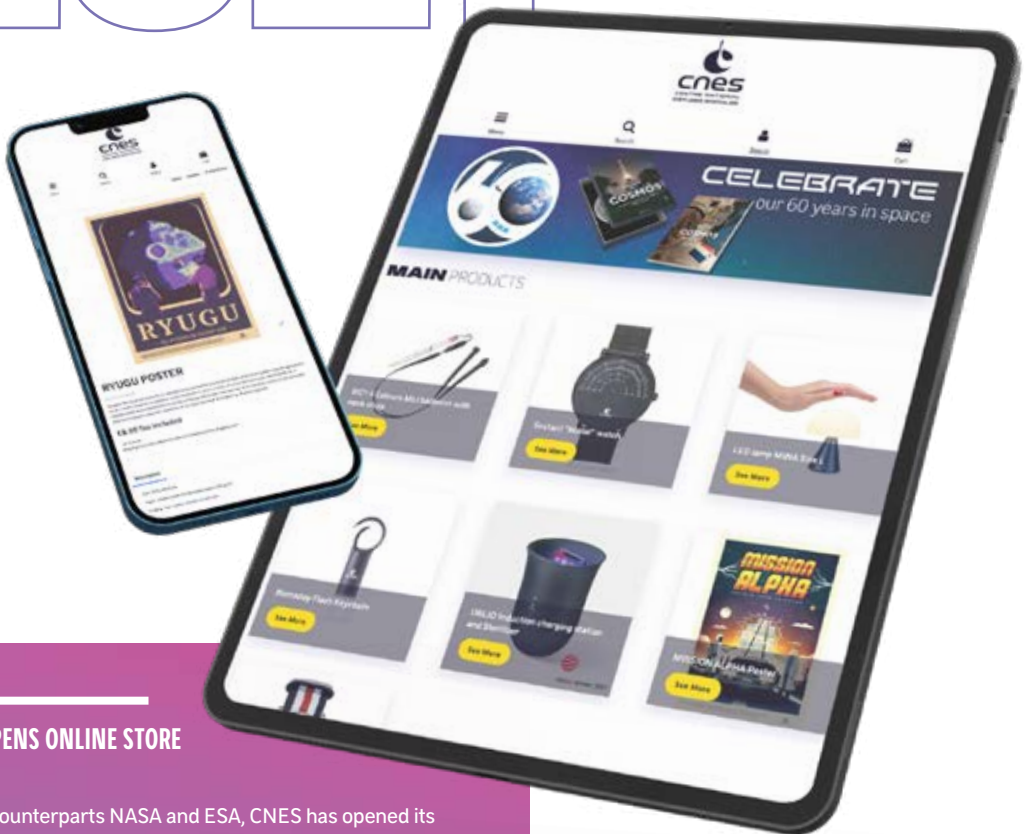
+ From Diamant to ELM

Located on the former Diamant launch site, the ELM micro-launcher complex will accommodate the Callisto and Themis reusable technology demonstrators, as well as commercial micro-launchers. ELM will comprise several launch pads, preparation areas and a landing zone for reusable stages. Work began in 2021 on the trench for the high-voltage power line and nitrogen fuel line, followed early in 2022 by earthworks that are expected to be completed in December 2022. Construction of the facilities for future operators will last throughout 2023.



THE YEAR'S HIGHLIGHTS

2021



CNES OPENS ONLINE STORE

Like its counterparts NASA and ESA, CNES has opened its online merchandise store. Launched in October, *Ma boutique CNES* offers a range of mostly French-made quality products, with caps, mugs, umbrellas, posters and watches to suit all tastes and budgets!

The store is a key tool for extending the agency's reach and reputation at a time when most other space agencies have their own online store. We want to share our passion for space with the widest possible audience and give everyone the chance to become an ambassador for France's space programme through the kind of objects we use in our daily lives. The product catalogue is set to grow in the months ahead.



+ Go to
www.maboutique.cnes.fr/en/



PERSEVERANCE WOWS AUDIENCES

On 18 February 2021, CNES livestreamed the Perseverance rover's landing on Mars for four hours. This large-scale event got a boost on digital channels due to the COVID-19 pandemic, involving more than 100 people and mobilizing technical resources on a par with a TV broadcast, simulcasting on four different platforms and with numerous moderators leading the chat on Twitch. The result: more than 1½ million cumulative views!

For CNES's digital communication, it's also the result of an audiovisual and social media strategy that has shifted up a gear in recent years, with the launch of our Twitch channel, a completely revamped editorial template on YouTube and a more pro-active media approach.

CNES IN DUBAI

CNES was on hand for the 2021-2022 World Expo in Dubai, screening an immersive film in the France Pavilion that took visitors on a journey around the solar system, as well as organizing conferences on space exploration and a photo exhibition during the space-themed fortnight. It also held a meeting of the Space for Climate Observatory's steering committee during the climate-themed fortnight. After six months of events where more than 190 nations were represented, the World Expo closed its doors on 31 March 2022.



GETTING YOUNG WOMEN INTERESTED IN ENGINEERING CAREERS

CNES's female engineers and technicians met with high-school girls in December 2021 for a first-ever careers outreach operation of its kind to talk about their jobs and share their passion for what they do. Giving girls the benefit of their background and science and engineering experience, they aim to act as role models and inspire vocations while helping to combat stereotypes.



+
12
CNES female mentors met some 1,200 high-school girls at this outreach event.

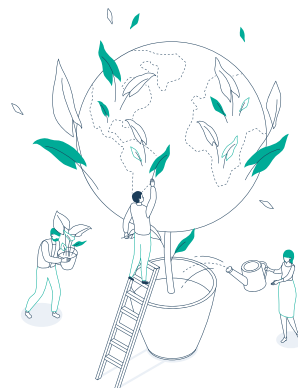
BUDDING SCIENTISTS KEEP BLOBS UNDER CLOSE WATCH

In October 2021, 350,000 pupils at 4,500 French schools replicated the same experiment as Thomas Pesquet on the ISS for the #EleveTonBlob (#RaiseYourBlob) operation. Using a kit comprising three to five blobs and filter paper, they observed the behaviour of this mysterious organism and compared results obtained in the classroom with those in the microgravity conditions of the space station. The operation received an unprecedented response and offered the opportunity to get large numbers of kids interested in science experiments.



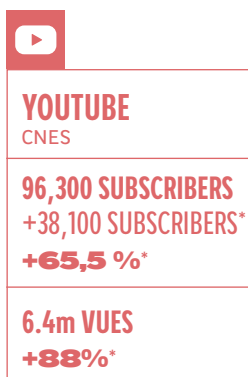
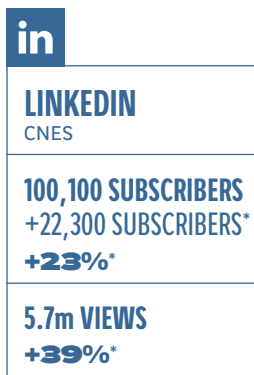
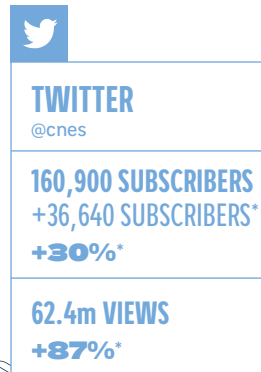
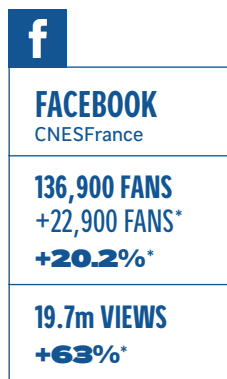
EDUCSCO RAISES YOUNGSTERS' AWARENESS OF CLIMATE ISSUES

Launched in partnership with the Space for Climate Observatory (SCO), EducSCO is a new educational initiative revolving around the observatory's projects. It offers training for teachers and produces educational videos covering the various domains addressed by the SCO, like for example heat islands and floods. Other actions are being readied to step up efforts to raise young people's awareness of global warming issues.



SOCIAL MEDIA REVIEW OF 2021

A RECORD YEAR FOR VISIBILITY AND UPTAKE



These figures are the result of engagement with Thomas Pesquet's Alpha mission, the landing of Perseverance and the launch of the James Webb Space Telescope, which attracted many new subscribers to CNES's social media channels.

They also stem from a digital communication strategy geared towards crafting original content and initiatives that set CNES apart by proposing new online experiences.



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