RÉPUBLIQUE
FRANÇAISE
Liberté
Égalité
Fraternité

cnes
CENTRE NATIONAL
D'ÉTUDES SPATIALES

ANNUAL REPORT 2022

ROUTE MAP

CNES's annual report incorporates 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 Sustainable Development Office. The members of the Executive Committee also helped to produce the report, which was validated under the authority of the Chief Operating Officer and the Chairman & CEO.

We thus hope to provide a closer appreciation of what CNES does and to show the benefits we bring to society at large, the environment, citizens and the agency's people.

“For the sake of those who will presently be on hand to attempt this voyage, let us establish astronomy maps, Galileo, you of Jupiter, and me of the Moon.”

In 1610, when he addressed these words to his fellow astronomer, Johannes Kepler laid the foundations of astronautics—the art of navigating in space. Not for a moment did he imagine it possible to navigate the stars without first mapping out a route. But he knew these celestial voyages would one day open up a third dimension for Earthlings, previously the preserve of birds and angels alone. What he didn’t know, however, was that to blaze such a trail—to reach such outrageous destinations—those navigators of the future would need to find a way to travel in a vacuum…

Hence, the strange philosophy of the space rocket: action, reaction. To achieve forward motion in space, you have to push a little part of you away and leave it behind. To master the void, you have to empty yourself. Until then, only the wise had shown such boldness, such courage to climb the mountains of the sacred and ascend the ladders of mysticism. But now, engineers and astronauts apply the same detachment as they leave Earth to tread the planets, to approach the stars.

In this void, where space and time intertwine, the route charted by these vessels might just achieve the perfection of the most skilled calligrapher and write a new destiny for humans in the very place the seers of ages past could only attempt to fathom. A masterful turnaround: with a trail of fire in the sky and a majestic interplanetary curve, humanity signs the act of possible liberation, but always with one condition—that we must control our acts and not seek to control nature.

JACQUES ARNOULD
CNES Ethics Officer

CONTENTS

June 2023

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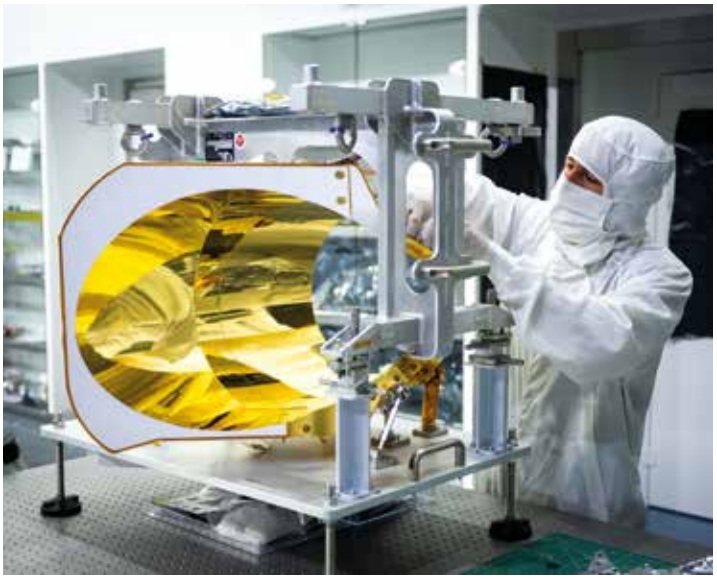
06 EDITORIAL & STRATEGY

16 CSR STRATEGY



26

FOUR STRATEGIC PILLARS

58

HUMAN RESOURCES

62

FROM THE CENTRES

66

COMMUNICATION

INTERVIEW

PHILIPPE BAPTISTE

CNES Chairman & Chief Executive Officer

After a stellar year for France's space programme, with the signing of the agency's new Objectives and Performance Contract (OPC), the ESA Ministerial Conference, the International Astronautical Congress (IAC) in Paris, France's mandate as EU president and record levels of funding announced, what is the course now being charted for the years ahead?

Philippe Baptiste The past year has indeed been an exceptional one. IAC saw record levels of attendance and the ESA Ministerial Conference was a huge success, with most members—France among them—increasing their budget contributions. Moreover, the Prime Minister announced that the nation will be investing more than €9 billion for research and industry in the space sector over the next three years.
I would add to that the great things accomplished by the French-U.S. partnership, like the signing of the Artemis Accords and the establishment of a Comprehensive Dialogue on Space. France's space programme is thus pursuing an ambitious path as we build the flagship missions of the future.

CNES also reorganized in 2022, with a new Secretariat General, Strategy Directorate and Technology & Digital Directorate. What are the first results of these changes?
P. B. This reorganization has enabled us to make good headway in implementing our strategy, but without overly fragmenting teams. We've thus achieved a good balance. With the Secretariat General, we're fostering subsidiarity and a cross-cutting approach. Our Strategy Directorate is central to our fast-changing ecosystem, as the agency's foresight capacity and activities must remain tightly linked. And through our Technology & Digital Directorate, we're driving engineering efficiencies with very good results.

In a fiercely competitive context, independent access to space is fundamental for France and Europe. Development of micro- and mini-launchers and the modernization of the Guiana Space Centre are progressing well, but the failure of Vega-C's commercial flight and delays to Ariane 6 have impacted schedules. How is the current decade shaping up for European launchers?
P. B. Things are complicated, because today we no longer have the ability to launch all of Europe's sovereign satellites. However, we're working through the issues and the Ariane 6 programme is ramping up, with a succession of milestones now being reached. We still have work to do, but we're doing a great job overcoming the obstacles to put Europe back in prime position in the space transportation market. I'm optimistic and confident, as Ariane 6 already has a large number of future launches on its manifest.

The ramp-up of Space Command at the Toulouse Space Centre, the development of space surveillance operations and the French Space Operations Act all underline the fact that space is today a domain that needs to be regulated, watched over and protected. Where does CNES fit into this landscape?
P. B. CNES has always maintained a dual-use perspective through our civil activities and our role serving the Ministry of Armed Forces. It's fundamental that our nation should benefit from synergies between civil and military expertise in a fast-moving environment where space has become a conflictual arena. We're fully supporting the ramp-up of Space Command and military space operations. Many space manufacturers and entrepreneurs are offering turnkey service solutions for the military. In this context, CNES's know-how and expertise are more vital than ever before, especially for large-scale custom developments.

"France's space programme is pursuing an ambitious path as we build the flagship missions of the future."

One of the operational objectives in the OPC is to drive development of the French and European space ecosystem and to spur innovation for future space systems. What does this actually mean for CNES?
P. B. We've always worked through R&D programmes and developed new tools and systems with industry. The successes we're seeing today prove that. We now need to think about how we can support new space players and help them innovate, by spinning off technologies or purchasing services, for example. CNES and legacy players are innovating of course, but it's also valuable to have new kinds of entrepreneurs rounding out the French and European space ecosystem.

2022 was a banner year for science, with some great space exploration missions being readied that are the result of the strong ties scientific stakeholders and national space agencies have forged together. Does that mean scientific excellence and cooperation are the keys to success?
P. B. I believe that to be the case, and several reasons dictate the need for cooperation. First, cross-participation reduces risks. Second, such missions are designed for scientists who need data to build their models, write research articles and so on. Multiplying contributions gives them a greater volume and variety of data, which is what science is all about. And third, leveraging international networks to put missions together is how we attract the best and brightest talents. When the United States turns to us for our proven expertise in altimetry, for example, it's a mark of recognition for our know-how of which we're very proud.

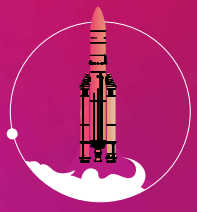
In 2022, France and CNES reaffirmed their commitment to climate science and the environment, for example through France's presidency of the Committee on Earth Observation Science (CEOS). The agency is also pursuing a strong societal vision through its ambitious corporate social responsibility policy. What are the challenges driving this new vision?
P. B. Society has changed in so many ways and these challenges are today a source of inspiration for many of us. It's fundamental for our people—and for CNES and the wider space sector—that we pay close attention to our environmental footprint. We have a responsibility in this respect and we must lead by example. We're working actively on these issues with actions to transform our system. Well-being at work is another equally important issue on which we're laser-focused.

CHARTING CNES'S FUTURE COURSE

THE FOUNDATION OF FRANCE'S SPACE AMBITIONS

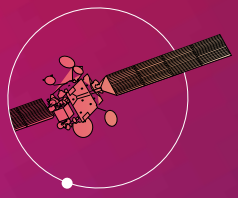
Signed in 2022 by CNES's Chairman & CEO and the agency's three overseeing ministries, our Objectives and Performance Contract (OPC)—under the banner of "New Spaces"—will shape CNES's missions through to 2025. The OPC consolidates our position as the arm of government deploying a space policy to serve the social challenges of the decade ahead.

FOUR STRATEGIC PILLARS



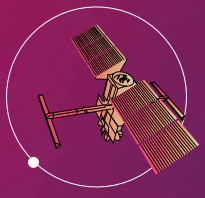
SOVEREIGNTY

Strengthening our strategic independence while preserving France and Europe's space launch capability and defending our military space power.



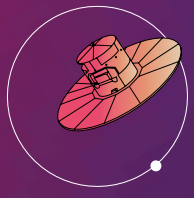
ECONOMIC COMPETITIVENESS

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



CLIMATE SCIENCE

Striving to achieve a sustainable world and helping regions to combat climate change and cope with its impacts.



SCIENTIFIC COOPERATION

Maintaining French scientific excellence, extending its international reach, deploying ambitious missions and engaging in future exploration endeavours.

OPERATIONAL GOALS AND STAKES FOR 2025

- **Support** our military space strategy
- **Step up** innovation for future space systems and their applications
- **Drive** development of the French and European space ecosystem
- **Promote** space in society and around the world
- **Secure** the French scientific community's place in key missions
- **Be in the vanguard** of sustainable space development and efforts to combat climate change

TO REACH THESE GOALS...

... CNES has put in place since 1 January 2022 an organization that is:

- Simple
- Clear
- Efficient
- Capable of ensuring cross-functional methods

... And is changing how it works to achieve:

- More subsidiarity
- More diverse players
- More agility

ESA MINISTERIAL CONFERENCE

Europe steps up its space ambitions

The ESA Ministerial Conference of 22-23 November 2022 in Paris was a success for Europe's space programme, securing an exceptional budget envelope of €16.9 billion for the next three years. This record level of funding represents a 17% boost to the last budget allocated in 2019 in Seville. In the current fast-moving landscape, ESA's 22 member states clearly signalled their ambition to keep pace with China, the United States, India and Japan.

France is a pivotal player in European space in terms of funding and industrial influence. Its space budget is trending strongly upwards, as the second largest contributor to ESA with 18.4% of the budget, behind Germany (22.7%).

Member states supported all items on the agenda that France had identified as priorities:

- **Independent access to space** was confirmed as central to Europe's sovereignty, with the maiden flight and ramp-up of Ariane 6 among the top priorities.

- **Climate also remains a key concern for ESA.** Earth-observation satellites and programmes like Copernicus are a priority to anticipate and combat climate change. France underlined its strong commitment to climate science by upping its contribution to Earth observation by 26%.

- **France's contributions to satellite telecommunications are up 70%.** It intends in particular to devote up to €300 million to the IRIS² secure connectivity constellation, a project strategic to Europe's independence and competitiveness.

- **France's continuing commitment to human and robotic space exploration** is reflected in a 49% increase to our funding contribution. The new recruits to ESA's Astronaut Corps were also announced at the conference. Two French candidates were selected, Sophie Adenot as career astronaut and Arnaud Prost as reserve astronaut. Joining Thomas Pesquet in the ranks of ESA's career astronauts, Sophie Adenot thus becomes France's second female astronaut after Claudie Haigneré.

Europe also intends to consolidate the prime role that ESA's Scientific Programme is playing on the international stage.

ESA's member states therefore stepped up to the plate to affirm Europe's space ambitions in an increasingly competitive global environment where sovereignty is paramount.

"The outcome of this ministerial conference is a testament to our unity and ambition in space. We must combine our strengths: the record funding secured for Earth observation, telecommunications and space exploration consolidates Europe's leadership position in space. Thanks to the key agreement between France, Germany and Italy on future launch vehicles, this summit is a boost for Europe's independence and sovereignty and the competitiveness of France's space sector, and promises ever more benefits from space for citizens everywhere."

BRUNO LE MAIRE
Minister of the Economy,
Finance and Industrial and Digital Sovereignty

Pierre Amidey
State Controller

Pierre Fond
Chief Accountant

Lionel Suchet
Chief Operating Officer

Philippe Baptiste
Chairman & CEO

Laurence Monnoyer-Smith
Sustainable Development Office

Bernard Chemoul
Inspector General
& Director of Quality

Pauline Pannier
Secretary General

Jean-Marc Astorg
Strategy

Christophe Venet
Europe & International

Jean Aussaguel
Accounting

Gérald Dupré
Procurement & Sales

Thierry Levoir
Central Industrial
Security & Safety

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- **M. Philippe Baptiste**
  CNES Chairman & CEO
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  Employee representative
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- **M. Emmanuel Chiva**
  French defence procurement
  agency (DGA)
- **Mme Coline Claude - Lachenaud**
  Representing the Prime
  Minister's Office
- **Mme Evelyne Cortiade - Marche**
  Employee representative
  for CFDT
- **M. Thomas Courbe**
  Government Commissioner -
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  Ministry for Europe
  and Foreign Affairs
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  Employee representative
  for CGT-UTG
- **M. Daniel Galarreta**
  Employee representative
  for CFTC
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  CEO Eurazeo Investment
  Manager
- **M. Alban Hautier**
  Ministry of the Economy,
  Finance and Industrial
  and Digital Sovereignty
- **Mme Sylvie Joussaume**
  IPSL
- **M. Vincent Leudiere**
  Employee representative
  for CFDT

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Chairman & CEO's Chief of Staff

François Alter
Adviser to the Chairman & CEO

Philippe Steininger
Military Adviser

Caroline Laurent
Orbital Systems & Applications

Carine Leveau
Space Transportation

François Sillion
Technology & Digital

Marie-Anne Clair
Guiana Space Centre

Marie-Claude Salomé
Communication

Liliane Sebas
Human Resources

Nicolas Hengy
Finance

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  Employee representative for CGT-UTG
- **M. Bruno Sainjon**
  Chairman & CEO of ONERA
- **Mme Carole Vachet**
  Ministry of the Economy, Finance and Industrial and Digital Sovereignty
- **Mme Florence Verzelen**
  Executive Vice-President, Dassault Systèmes

AUDIT COMMITTEE

- **M. Benoist Grossmann (Chair)**
- **M. Alban Hautier**
- **Mme 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.

A big budget and consolidated priorities in 2022

The national budget, France's contribution to ESA and the European Union budget combine to provide multiple channels of funding. CNES leverages the advantages of each of these sources to maximize synergies and industrial, scientific and diplomatic multiplier effects. In 2022, exceptional announcements confirmed the high priority given to space in a context of tight budget restraints, the ongoing recovery from the COVID-19 pandemic and the war in Ukraine.

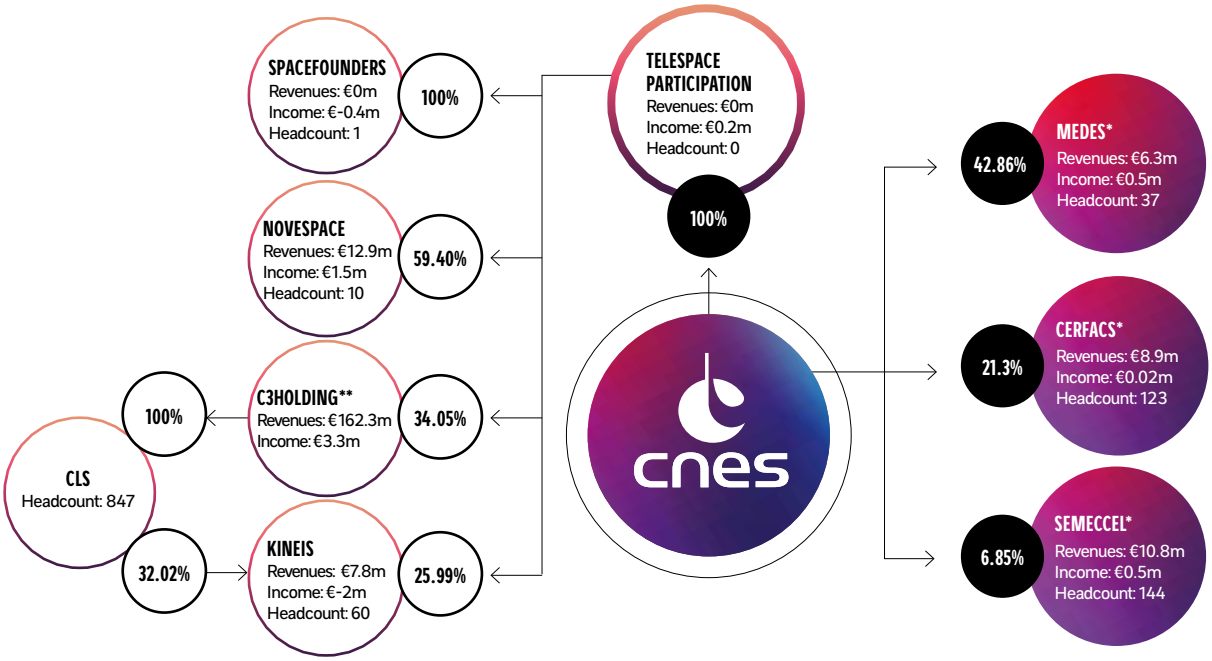
2022: NEW OPC AND RECORD EUROPEAN FUNDING

The new Objectives and Performance Contract (OPC) signed between the government and CNES in April 2022 consolidates the agency's role and secures its funding for the 2022-2025 period. This contract reflects France's strong space ambitions. The Prime Minister announced at the International Astronautical Congress (IAC) in September 2002 that the nation will be devoting a budget of €9 billion to space over three years, an increase of nearly 25% over the previous three-year period, most of it coming from the "Space Research" Programme 193 and the France 2030 plan. This budget comes in addition to a record €16.9 billion for the next three years voted at ESA's Ministerial Conference in November 2022 (see page 9). The government also decided to give a €500 million boost to CNES's multilateral budget through the envelope appropriated in the research spending plan, to initiate foundational projects for science, telecommunications and future launchers.

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 since 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.

MAIN SUBSIDIARIES AND HOLDINGS

(AT 31 DECEMBER 2022)



*Provisional annual accounts
**IFRS consolidated figures

FRANCE 2030 PLAN

Approved end 2021, the France 2030 plan includes a space strand with a budget of €1.5 billion, intended notably to catch up in certain key market segments like reusable launchers and constellations, and to invest in new applications. In September 2022, the government, public investment bank Bpifrance and CNES signed an agreement under which the agency and Bpifrance will execute the plan on the government's behalf through calls for projects issued by Bpifrance and public procurements (CNES solicitations). The first solicitations were issued in 2022.

SPACE STIMULUS PLAN

In May 2021, under the space stimulus plan decided to cushion the pandemic's impacts on the economy, the government appropriated a budget of €365 million to CNES to cover the needs of all sectors of activity. 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 84 projects in less than 18 months with 117 firms, more than 75% of them start-ups and SMEs. Since end August 2022, all projects coming under the space strand are underway, with 95 contracts awarded by CNES in all.

PIA FUTURE INVESTMENT PROGRAMME

Since 2010, the government has decided to invest in innovation for industry sectors with high potential in terms of economic spin-offs and jobs. As a domain of excellence of French industry, space was chosen as one of the nation's promising sectors with high added value, high-tech expertise and a major 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 18 projects to see the light of day. The last 11 of these—for a budget of €47 million—got the go-ahead in 2020 and in 2022 under PIA 3, of which 10 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 in new multi-mission spacecraft buses, commercial nanosatellites and in-orbit services.

FULL DISCLOSURE

Subsidies are voted each year by the National Assembly as part of the national budget and CNES's accounts are signed off by our auditors at the end of the year and regularly controlled by the Cour des Comptes, France's financial watchdog.

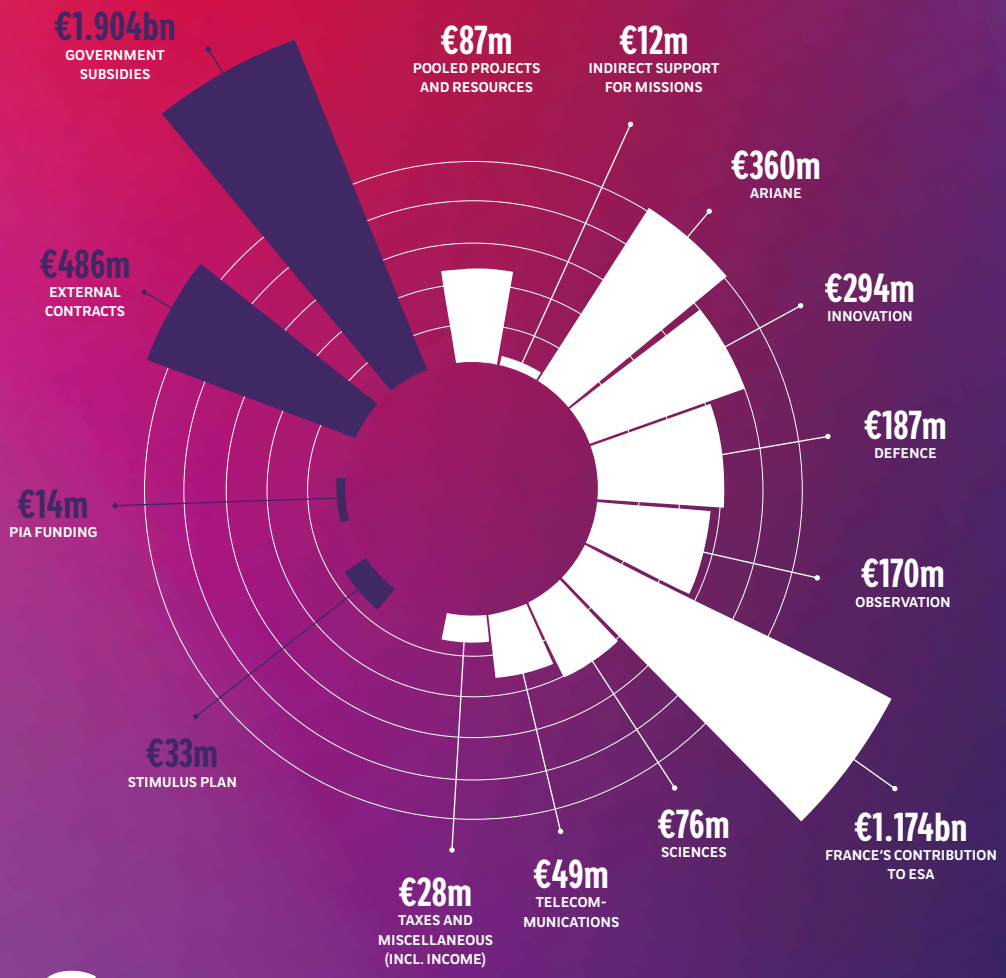
ENERGY REFURBISHMENT PLAN

Pursuing our commitment to reducing the agency's environmental footprint through energy savings at all facilities, we responded at the end of 2020 to a building refurbishment call for projects under the 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 for a solar field at the Guiana Space Centre.

CNES BUDGET

REVENUES €2.436bn

EXPENDITURES €2.436bn



+6%

Increase in government subsidies to CNES from 2021 to 2022 for its multilateral programme, funding its own activities, and those undertaken within the framework of the PIA and stimulus plan, not including France's contribution to ESA (€777 million in 2022 versus €731 million in 2021). This is a testament to the priority given to space.

Sustaining our international reach

CNES is a pivotal player in space cooperation, pursuing bilateral and multilateral partnerships with 50 countries and international organizations. Our collaborations aim to serve the agency's programmes, support France's foreign policy and nurture the French space ecosystem.

The agency's international partnerships fall into three categories:
- **European partnerships** with the European Union (EU) and the European Space Agency (ESA), and bilateral partnerships through which we remain a prime player, as a leading contributor to ESA and the chief inspiration behind the EU space regulation.
- **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 Indonesia, Morocco, Singapore and the United Arab Emirates, whose ambition is to transform their societies and economies through space.

2022 proved a particularly prolific year for CNES on the international front.

In Europe, our technical expertise and our strategic and political insights were sought after to help lay the groundwork for and organize two key events for space:
- **France's EU Presidency** during the first half of the year, which secured significant advances in several key areas of space for France.
- **the ESA Ministerial Conference** in Paris in November, whose funding decisions will enable France to remain a leading European space player.

Outside Europe, opportunities to work with our strategic partners moved ahead or came to fruition in space exploration (Dragonfly, LuSEE and FSS with the United States; MMX with Japan; crewed spaceflights with India; Rashid rover with the United Arab Emirates, etc.) and in Earth observation and climate science (SWOT and AOS with the United States).

Space cooperation featured as a key tool of diplomacy in a number of intergovernmental dialogues pursued or decided in 2022 (with the United States, the United Arab Emirates, India and Japan). CNES also lent its support to French players operating in export markets, notably backing up major bilateral events with communication efforts focused on industrial and commercial relations (in the United States, Japan, South Korea and Singapore).

In space we trust

French-U.S. cooperation in space was stepped up in 2022 with France's signing of the Artemis Accords in Washington D.C. in June, its enrolment in the U.S. Atmosphere Observing System programme (AOS) and the launch of the French-U.S. SWOT satellite. NOAA signed the governing charter of the Space for Climate Observatory (SCO, see page 51), which was presented to Vice President Kamala Harris when she played host to President Emmanuel Macron in December. Lastly, three agreements signed with NASA will see France making major scientific contributions to the Dragonfly, LuSEE (Lunar Surface Electromagnetics Experiment) and FSS (Farside Seismic Suite) missions.

*U.S. National Oceanic and Atmospheric Administration.

13
cooperation agreements signed in 2022.

90%
of space missions conducted today by France are with European or international partners.

36
space agencies and international organizations have signed the Space for Climate Observatory's governing charter.

5 CORPORATE SOCIAL RESPONSIBILITY COMMITMENTS

In line with the UN's Agenda 2030 and 17 Sustainable Development Goals (SDGs), which constitute a universal call to action to transition our societies towards a sustainable development model, France has charted its national roadmap. In response, CNES has instituted an ambitious corporate social responsibility (CSR) policy enshrined in five commitments.

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, intelligence and deterrence needs.

CREATING SHARED VALUE THROUGH 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 our contracts. Through our international relations policy, we are fostering partnerships to benefit sustainable development.

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. We are 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.

SUPPORTING REGIONAL RESILIENCE

We are mobilizing our expertise and close ties with research bodies to help regions 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).

CSR in action at CNES

LOW-CARBON STRATEGY IS GO!

In 2022, CNES initiated a low-carbon strategy geared towards achieving net-zero emissions by 2050. This strategy approved by our Executive Committee in December is founded on three pillars:
1. Curbing emissions at our facilities and throughout our value chain
2. Steering our ecosystem and partners towards a low-carbon approach
3. Playing an active role advancing knowledge in the domain of climate science

The strategy underpins everything CNES is doing to tackle climate change and includes our energy-saving plan that aims to reduce energy consumption by 10% by the end of 2024, focusing especially on green energies at the Guiana Space Centre in Kourou (see page 29). This year will be devoted to rolling out these actions and conducting a new greenhouse gas emissions assessment to gauge the effectiveness of actions already undertaken and establish what remains to be done.

The new Titan building constructed to high environmental quality standards at the Guiana Space Centre

STAKES AND IMPLEMENTATION OF SUSTAINABLE PROCUREMENT

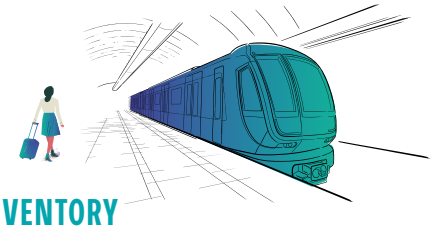
In response to ever tighter regulatory constraints, the Procurement and Sales Directorate (DAR) is strengthening the agency's sustainable procurement policy. Purchasing is a powerful lever for curbing CNES's environmental footprint, creating value for our ecosystem and helping to make the agency more sustainable and socially responsible. DAR has therefore set up a working group with 50 representatives from the agency's technical and functional directorates. Together, they have established a matrix of prescribed CSR clauses to be applied in purchasing. As a result, all proposals will henceforth be subjected to close scrutiny against environmental and—wherever possible—social benchmarks.

CSR & CSE MOMENTUM GROWING

The Climate and Resilience law in force since 25 August 2021 stipulates how environmental and ecological transition matters should be addressed in labour relations. In 2022, the Economic and Employee Relations Committee (CSE) at the Toulouse Space Centre set up a dedicated CSR commission to oversee labour relations, social and environmental issues at the facility.

SUSTAINABLE SPACE CHALLENGE

Moving towards a more sustainable space environment, imagining innovative and disruptive concepts, and stepping up partnerships with the Newspace ecosystem were the ambitious goals of the Sustainable Space challenge launched by CNES in October 2022.
Candidates were asked to submit a concept falling under one or more of three topics: pooled services for sustainable use of space, the circular space economy and active space debris removal.
We received responses from 25 firms on our Connect by CNES platform, five of which were selected for €400,000 in contracts with the agency to be executed in 2023.



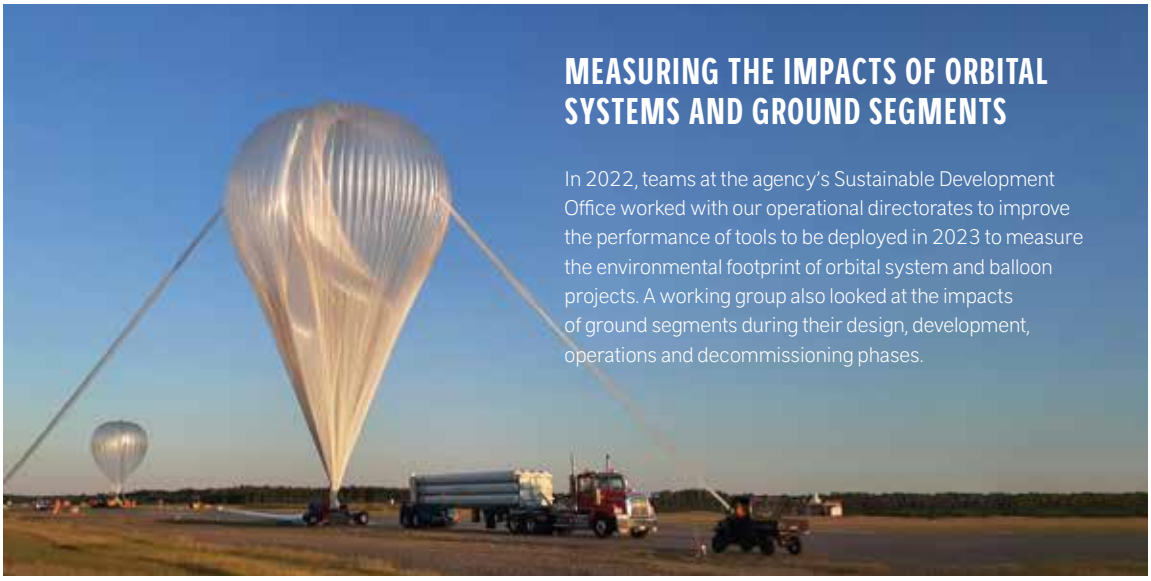
CARBON INVENTORY FOR WORK-RELATED TRAVEL

With 23% of CNES's greenhouse gas emissions coming from work-related travel*, we are aiming to reduce this figure by 30% by 2025. A tool developed with our in-house travel agency in 2022 to estimate emissions from plane and train travel will enable us to track this indicator in the annual management system review, and to guide travel choices on the basis of emissions criteria.
On the strength of the results posted for the first three quarters of the year, this goal will be reached before 2025.

* Based on 2019 greenhouse gas emissions data for CNES.

MAKING COMMUNICATION MORE ECO-FRIENDLY

Whether we are using eco-friendly papers and plant-based inks, calculating carbon inventories or seeking environmental certification for our events, CSR is today a key feature of the agency's communication practices.
Levers for change and baselines, however, have not all reached the same levels of maturity across functions.
Diagnostics were therefore established in 2022 for all communication practices to ensure a uniform approach. The resulting action plan revolves around three priority lines of action: graphic charter, digital communication and events management.



MEASURING THE IMPACTS OF ORBITAL SYSTEMS AND GROUND SEGMENTS

In 2022, teams at the agency's Sustainable Development Office worked with our operational directorates to improve the performance of tools to be deployed in 2023 to measure the environmental footprint of orbital system and balloon projects. A working group also looked at the impacts of ground segments during their design, development, operations and decommissioning phases.

CSR ROAD MAP REVIEW

BEING A RESPONSIBLE EMPLOYER

- **Gender equality plan** committing CNES for 2022-2024 period.
- **Promoting** space careers for women.
- **Gender equality** index: 95/100.
- **Diversity:** 39% of CNES personnel are women, 33% of them engineers or executives.
- Paternity leave extended to **45 calendar days.**
- Ramp-up of **sustainable procurement plan for 2021-2025**:
  - **2.3% of contracts awarded** include at least one social consideration.
  - **30.2% of contracts awarded** include at least one environmental consideration.

PROMOTING SUSTAINABLE AND PROTECTIVE SPACE

- **First tests of Themis European reusable stage** demonstrator and first hot-fire tests of Prometheus European future reusable engine.
- **Water resources management:** launch of SWOT satellite to track oceans and surface water.
- **Passive infrared remote sensing:** delivery of IASI-NG instrument to fly on MetOp-SG satellite.
- **Measuring sources and sinks of carbon dioxide:** delivery of MicroCarb instrument.
- **Protecting populations:** positioning of Syracuse 4A military telecommunications satellite.
- **Space and conflict prevention:** supporting skills acquisition and ramp-up of Space Command at the Toulouse Space Centre.
- **French Space Operations Act (FSOA):** 13 orbit control authorizations granted.

CREATING SHARED VALUE THROUGH SPACE

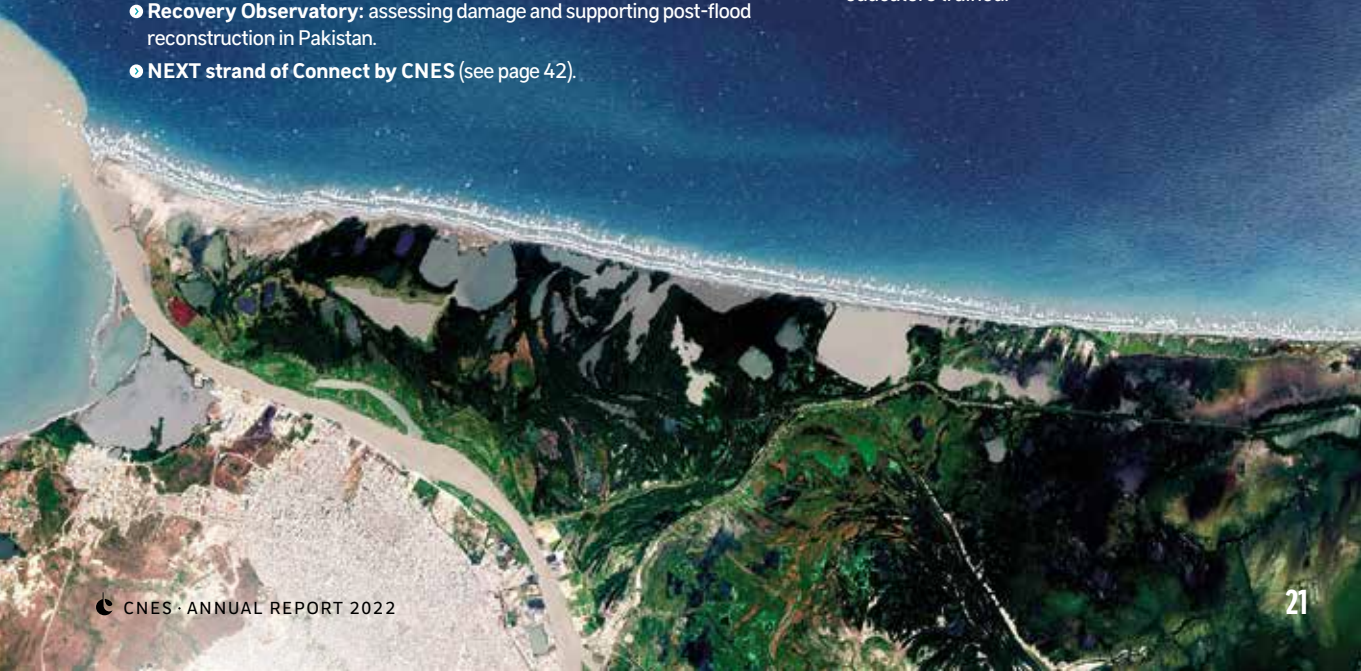
- **New Entrants committee** helping large primes, mid-tier firms, SMEs and start-ups into space or related activities: 22 new entrants supported.
- **France Relance economic stimulus plan:** leading two groups focused on Space Applications for Society and Nanosatellites.
- **Sustainable Space Challenge:** five firms granted a budget envelope of €400,000.
- **Launch the Future competition:** open to students on the theme of space transportation. Most projects selected aim to reduce carbon footprints, and to recover, reuse and de-orbit space debris.
- **PERSEUS:** engaging and inspiring younger generations into careers and entrepreneurship in the field of launchers.

SUPPORTING REGIONAL RESILIENCE

- **Space for Climate Observatory (SCO) projects:** tools for combating and adapting to the impacts of climate change (TropiSCO, FLAude, Thermocity, ADOPT, etc.).
- **International Charter Space and Major Disasters:** aiding emergency response teams in the event of natural or human-induced disasters. 51 activations in 2022.
- **Recovery Observatory:** assessing damage and supporting post-flood reconstruction in Pakistan.
- **NEXT strand of Connect by CNES** (see page 42).

REDUCING OUR ENVIRONMENTAL FOOTPRINT

- **CNES-government Objectives and Performance Contract (OPC)** for 2022-2025 signed by the agency's overseeing ministries (with strong CSR ambitions compared to previous OPC).
- **Renewed ISO 14001 environmental management certification.**
- **Launch of low-carbon strategy** for CNES operations and core space activities.
- **Validation of energy-savings plan.**
- **First review of Act4Nature commitments** (made in 2020) submitted to French biodiversity office OFB.
- **Network created to factor biodiversity** into everything CNES does.
- **Work-related travel:** indicators established to raise employees' awareness of travel carbon footprints.
- **Guiana Space Centre restaurant:** recycling of used oils as biofuels, eco-contribution for single-use packaging, distribution of reusable packaging, local food sourcing wherever possible.
- **Real-estate plan:** Titan building at the Guiana Space Centre built to QEA Amazon environmental standards.
- **Climate collage:** 220 employees and 9 internal educators trained.



CNES supporting Sustainable Development Goals

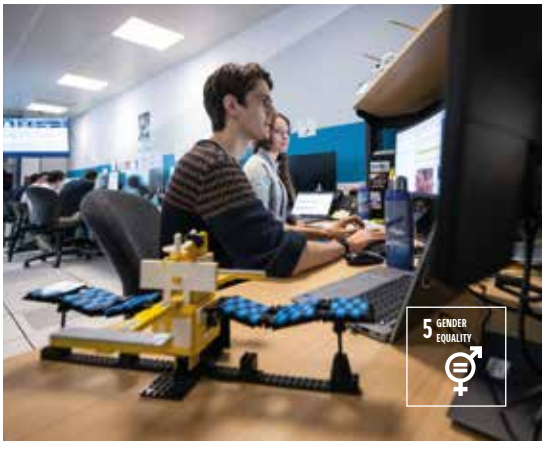
CNES's CSR strategy is built around the 17 Sustainable Development Goals (SDGs) defined by UN member states, which aim to transform the world for populations, the planet, prosperity and peace, and through partnerships. We are contributing directly or indirectly through our missions and management practices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

THREE ACTIVITIES IN 2022 CONTRIBUTED TO SDGS:

Elyx, the UN and CNES digital ambassador for SDGs.

WATER ACCESS AND MANAGEMENT

The SWOT mission, launched late in 2022, is set to contribute to four of these 17 SDGs. Inventorying of surface waters, assessment of stocks and regular monitoring of water volumes will provide real-time data to guarantee clean water and sanitation for all **(SDG 6)**. SWOT will complement existing satellite data to support conservation of marine resources, monitor fisheries and more **(SDG 14)**. To a lesser extent, it will help ensure access for all to reliable energy services, as tight management of reservoirs and their capacity is required for production of more sustainable energies like hydroelectricity **(SDG 7)**. Lastly, by enabling scientists to study fine-scale ocean/atmosphere interactions, SWOT will support urgent climate action measures **(SDG 13).**



GENDER EQUALITY

Mindful of the need to maintain diversity within our teams, CNES has established a gender equality plan **(SDG 5)** with indicators measured at the end of 2021 and an action plan for 2022-2024 on the themes of gender equality and work-life balance. This plan is aimed at CNES employees and stakeholders outside the agency.

ENGAGING YOUTH

Through our efforts to promote education, CNES is demonstrating a commitment to sustainable development by helping young people to become socially responsible citizens **(SDG 4)**. Our educational policy is also geared towards achieving diversity and inclusiveness. These two priorities, pursued in partnership with the Ministry of Education and all youth and education stakeholders, underpin and guide the educational projects and initiatives conceived by CNES to show youngsters how vital space is to understand and adapt to a changing planet.
In addition to these strong commitments, our educational actions are designed and deployed with environmental and social responsibility in mind, as we aspire to be an example to youngsters and their families.

Effective management system

The audit of CNES's management system by certifying body AFNOR Certification in November 2022 delivered excellent results. For the sixth year running, no non-compliances were noted with respect to the ISO 9001 quality management and ISO 14001 environmental management standards.

AMONG THE STRONG POINTS HIGHLIGHTED BY THE AUDIT WERE:

The growing maturity of our environmental approach noted for several years now

The strong CSR ambitions of the agency's Objectives and Performance Contract (OPC), pursuing precise environmental and energy goals:

- Promotion of sustainable space
- Sustainable procurement
- Regulatory compliance and effective operational management at CNES facilities
- Energy-saving drive at the Toulouse Space Centre
- Avoidance, reduction and offset measures for Ariane 6's ELA-4 launch complex
- Project to green the Guiana Space Centre

How CNES Creates Value

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

RESOURCES

HUMAN RESOURCES

2,348 employees, **39%** women, working at **4** centres

5% of payroll devoted to training

84% engineers and executives

FINANCIAL, INTELLECTUAL AND TECHNICAL RESOURCES

€2,436m in subsidies and income

€294m for innovation

Dynamic subsidiaries and shareholdings policy

413 PhD and postdoc students

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 & Industrial and Digital Sovereignty, Higher Education & Research, Armed Forces)

Space user communities - Industry partners

Local and regional authorities

ESA, European Union, international space agencies, international organizations

SOCIAL AND ENVIRONMENTAL RESOURCES

Space missions for the environment, science and the military

Policies supporting the space industry and new space players, aiding the scientific community, nurturing the space ecosystem and fostering international cooperation

Structures to assure safety of space operations and aid military space strategy

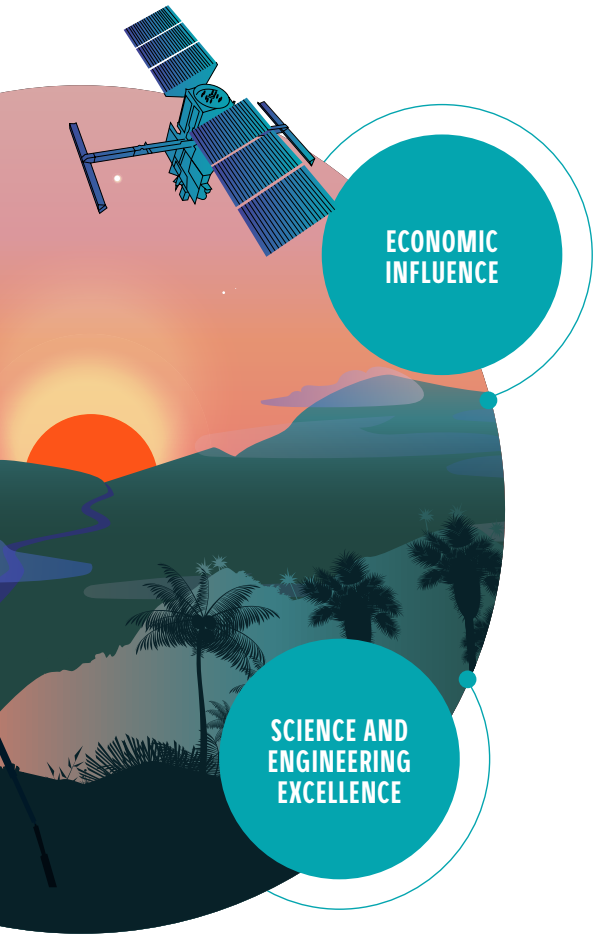
Commitments to surveying and preserving biodiversity at facilities

STRATEGIC OBJECTIVES

CNES aims to fully serve our sovereignty, competitiveness, climate and science.

CNES HAS 4 FIELD CENTRES:

Paris Les Halles **Paris Daumesnil** **Toulouse** **French Guiana**



RESULTS

FOR STAKEHOLDERS

2 data infrastructures/data hubs

6 launches from Kourou in 2022

39 future space missions under study

13 Priority Innovation Vectors in development

163 innovation proposals supported

895 scientific research proposals

163 New Entrants supported (start-ups, SMEs, mid-tier firms, large primes)

18 agreements with local and regional authorities or organizations outside the space ecosystem

129 international cooperation agreements

FOR SOCIETY & THE ENVIRONMENT

51 activations of the International Charter Space and Major Disasters

36 space agencies/organizations signed up to Space for Climate Observatory (SCO)

51 SCO France accredited projects

600,000 beneficiaries of educational actions

2,000 teachers trained

13 biodiversity goals (Act4Nature)

2,184 species of fauna and flora recorded at Guiana Space Centre

17 Sustainable Development Goals (Agenda 2030) to which CNES is contributing

FOR EMPLOYEES

Policy emphasizing work/life balance and well-being at work

95/100: Gender equality score

46,313 hours devoted to training

MAINTAINING

Space is today a crucial cog sustaining societies and our modern way of life. It has become so strategic that we have to keep track of orbital traffic to protect satellites from collisions, debris and sometimes malicious acts. Independent access to space is now, more than ever before, key to sovereignty. At the same time, the future of space is playing out before our eyes, with a profusion of services being driven by Newspace and renewed space exploration ambitions.

+ These activities meet CNES's commitments...

PROMOTING SUSTAINABLE AND PROTECTIVE SPACE

REDUCING OUR ENVIRONMENTAL FOOTPRINT

CREATING SHARED VALUE THROUGH SPACE

...and the UN Sustainable Development Goals (SDGs)

Ariane 5 lifts off from the Guiana Space Centre on 13 December 2022.

STRATEGIC independence

Q&A

CARINE LEVEAU
Director of Space Transportation

What is CNES doing to assure Europe's independent access to space?
C. L. Our chief priority is to get Ariane 6 flying as soon as possible and then to ramp up its launch rate. ESA's member states—France especially through CNES—are investing heavily in space transportation. With a shared vision of a reusable launcher and working from a sustainable space rationale, we're developing the Prometheus engine that will power the Themis reusable stage demonstrator. That said, the rise of Newspace is ushering in new families of launchers, for which we're stimulating the national ecosystem through the France 2030 plan. And we're transforming the Guiana Space Centre, the foundation of our launch capability, into a modern and green launch base.

What is driving the shift in emphasis from launchers to space transportation?
C. L. Space tranportation is an extension of a launcher's mission to orbit satellites and encompasses everything afterwards, because new in-orbit services are emerging that will require specific vehicles like satellite refuelling spacecraft or servicing vehicles to support operations on the Moon.

PHILIPPE STEININGER
CNES Military Adviser

What factors in space have led France to establish a military space strategy?
P. S. Ground-based anti-satellite weapons, jamming of satellite-to-ground links and cyberattacks on space systems, data hacking and uncoordinated in-orbit approach manoeuvres, deorbiting by other orbital platforms or high-velocity releases from satellites are the sort of things we're seeing in space for 15 or so years now, which warrant a military space strategy to defend our national interests.

How is CNES supporting the ramp-up of military space capabilities?
P. S. First of all by hosting Space Command (CDE) at its Toulouse field centre in the best possible conditions. Besides this organic aspect, CNES and CDE are already working closely together to hone the skills of the new command's personnel. And CNES is also providing support to prepare the armed forces' future space capabilities, especially for space surveillance and operations.

ELA-4 and Ariane 6 combined testing

FAST APPROACHING LAUNCH

In French Guiana, teams are introducing Ariane 6 to its launch pad and testing everything, including the Vulcain engine, before its maiden flight.

The ELA-4 launch pad was officially inaugurated in September 2021 and the first Ariane 6 arrived in French Guiana in January 2022. Both have been successfully tested separately and now it's time to verify that they work together as planned, in nominal and degraded situations, through what's called combined testing. As ELA-4's prime contractor, CNES is leading operations with ESA, the launch system architect, and ArianeGroup, the launcher prime contractor.
After mechanical testing in July to assemble the launcher, teams moved on to electrical testing, including that of the control station that "talks" to its flight program. Even more critical fluid tests in 2023 will fill and drain the cryogenic liquid oxygen and hydrogen propellant tanks. As Ariane 6's main stage is too big to be tested in Europe, ELA-4 will also serve as the stand for a 450-second hot-fire test to qualify the powerful Vulcain engine. For safety reasons, the P120C solid-rocket boosters—already qualified—will be mock-ups.

"Combined tests are in a sense Ariane 6's first flight campaign! For the teams, they provide an opportunity to drill and to optimize operations."

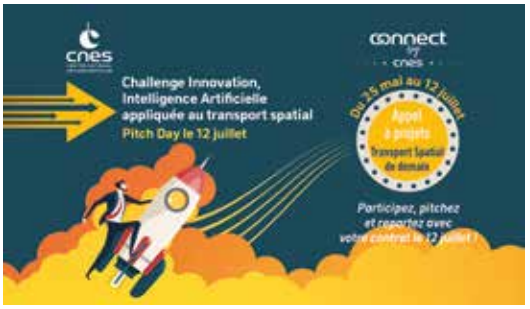
OLIVIER BUGNET
CNES's Ariane 6 project leader

UNDER THE GANTRY

Marking the first step of combined tests, the first assembly of Ariane 6 was a great success for the teams. Standing under its gantry, the launcher was mated with its upper composite, consisting of the fairing encapsulating a mock-up satellite. On this occasion, the Upper Composite Trailer (UCT), specially designed for Ariane 6, was operationally qualified to convey the upper composite from the assembly building—in the Ariane 5 zone—to ELA-4.

900

sensors are fitted to Ariane 6 during combined testing, in addition to generic instruments.



R&D Challenges

FLUIDIFYING THE NATIONAL ECOSYSTEM

In 2022, the third edition of CNES's R&D Challenges focused on artificial intelligence applied to space transportation for the 2030-2040 timeframe.

This rich seam spans the entire space industry base, from start-ups to primes, calling for development of a preferably reusable space transportation system, a manufacturing or inspection process, ground facilities, flight operations and more. After pitching their projects before a panel of experts in July, eight laureates showed real added value in terms of flexibility, agility, performance or recurring cost reductions, without compromising reliability.
To support their development efforts, CNES has signed a contract of €50 to €100k with each of them, for a total of €700k.

A GREENER SPACE LAUNCH BASE

Looking to meet 90% of its needs from renewable energies by 2030 and to significantly reduce its carbon footprint, the Guiana Space Centre is pursuing major projects to build tri-generation biomass plants and solar farms. Local production of green hydrogen and bio-methane are also under study.

Vega-C

POWER AND FLEXIBILITY

With larger stages and more powerful engines, the C variant of Europe's Vega launcher offers an additional 0.7 tonnes of lift capacity—taking it to 2.2 tonnes in total—and the ability to launch multiple microsatellites.

CNES has worked hard at the Guiana Space Centre to accommodate this new vehicle, notably to adapt ground support systems to handle telemetry. As the more powerful engines require the launch centre to be located further from the pad, the new Pandora building has also been constructed at the base. On 13 July 2022, Vega-C fully confirmed its potential. Unfortunately, its next launch on 21 December resulted in failure. As we all know, space is hard and certain kinds of anomalies only appear in real flight conditions. Ariane also experienced its own teething troubles before becoming the global gold standard. The close-knit teams are working flat out to return Vega-C to flight, but despite this failure it was nonetheless able to flight-qualify the P120C booster that is common to Ariane 6.

PERSEUS

INSPIRING CAREERS IN THE LAUNCHER INDUSTRY

With an eye on the future and technology emulation, students got to work on the first tests of two promising and complementary systems.

For more than 15 years, CNES has been inviting students to take part in our PERSEUS* challenges to develop launcher projects for which we are looking to acquire more mature technology building blocks. During the summer of 2022, students from Rennes-1 University succeeded in stabilizing a flight of the Mini-Apterros demonstrator for ten seconds. They will now be proceeding with horizontal flight and landing tests. To accommodate each demonstrator's independent launch capability and their bi-liquid fuelling requirements, another group is working on Astreos, a mobile launch ramp that can easily be set up and taken down. Since November 2022, they have been qualifying it in a test area provided by our partner ArianeGroup at their Vernon facility.

*European student space research project.

Gearing up for mini-launchers

NEW MARKETS IN SIGHT

A new family of mini-launchers is set to complement the current range of launch vehicles. Like their larger siblings, they will be operated from the Guiana Space Centre.

Standing some 20 metres tall and designed to orbit small satellites, mini-launchers offer an agile response to the needs of Newspace players and new remote-sensing and telecommunications markets.

To nurture a competitive French ecosystem in this domain to serve Europe, CNES is opening the Guiana Space Centre (CSG) to new operators. Seven laureates who responded to the agency's call for projects initiated in 2022 under the France 2030 plan were down-selected from all over Europe, two of them French. In 2024, the final four will be chosen to operate from the storied former Diamant* launch site that the CSG is currently refurbishing as the ELM micro- and mini-launcher complex. The finalists will be able to deploy their solutions in a shared environment with specific ground support facilities for their launcher.

*Diamant was the first actual launcher to lift off from the CSG in 1970.

2023 MILESTONES

May-June
PERSEUS launch campaign in Sweden.

June
Last flight of Ariane 5.

Second semester
Resumption of earthworks for ELM.

No earlier than year-end
Maiden flight of Ariane 6.

Ramping up at Space Command

AN ICONIC MILITARY SPACE BUILDING IN TOULOUSE

Signed on 24 October 2022, the 40-year construction lease for the future Space Command (CDE) building ties CNES, as the site's owner, to the Ministry of Armed Forces, as user.

A building occupying 15,000 m^2 on 3½ hectares of land at the Toulouse Space Centre (CST) will enable the CDE to accommodate 300 people from the autumn of 2025, and ultimately 500—one-third of the centre's headcount. In the meantime, CNES is providing modular buildings to host the more than 100 military personnel already present on site in 2022, in line with the military space strategy adopted in 2019, and we have started training some of them in the conduct of space operations.

CNES and the CDE's common goal is to share our cultures to implement the military space strategy effectively. Successfully integrating military personnel within the CST's environment is both a technical and human challenge to which we are paying particularly close attention.

AIMING HIGH

To serve partnerships and space applications, CNES is pursuing a strategy of major refurbishments at the CST to enhance performance and assure the centre's sustainable development. Through the lease signed in 2022, NATO's Centre of Excellence for space will soon be taking its place alongside the CDE. The military will be next to other European teams already on site from ESA and EUSPA, the agency tasked with operating the Galileo system (see page 40). Another building will also be getting a makeover in 2024 to host IGN Espace, whose spacemaps fulfil a vital role for land planning and defence.

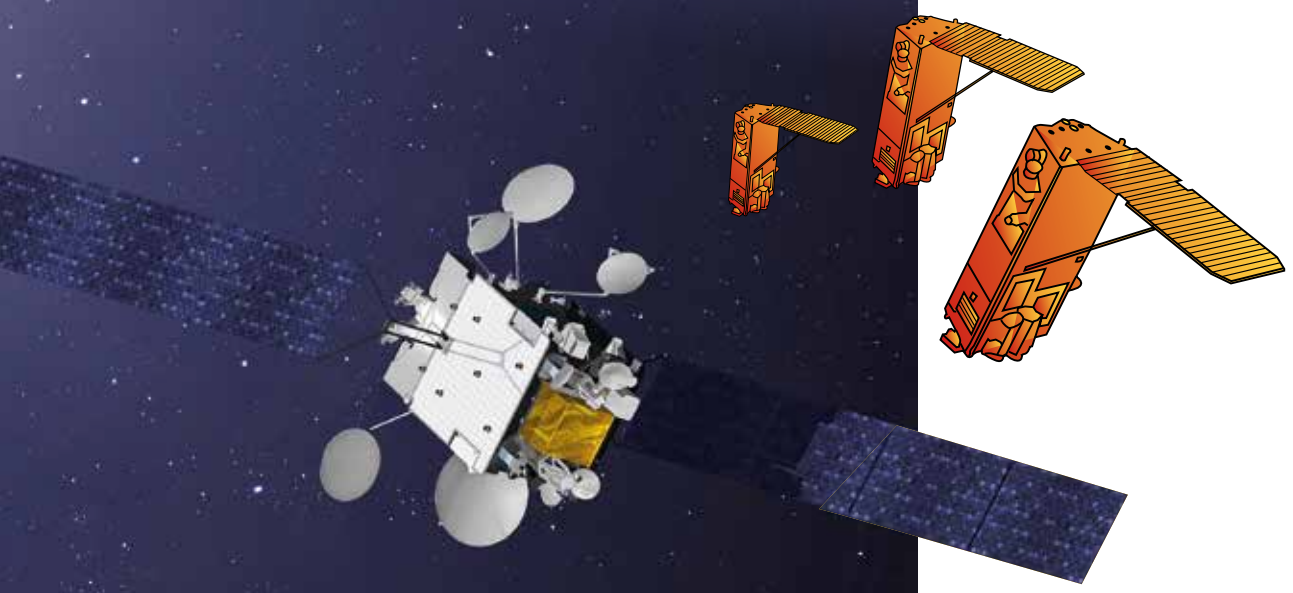
"Alongside the Toulouse space ecosystem, we're creating a world-class campus tailored to the missions of tomorrow."

VINCENT TOUMAZOU
CDE project leader at the CST

Structuring operational cooperation

IN THE SPACE ENVIRONMENT

In 2022, the main outlines of cooperation between CNES and the CDE to operate military satellites were validated by the highest authorities. Whether conducting space surveillance, uplinking work plans to satellites in low Earth orbit, keeping them on station or performing collision-avoidance manoeuvres, CNES and the CDE are now in a position to build a new partnership for military space operations together.



Syracuse 4A and CERES operational

FRANCE'S NEW MILITARY SPACE FLEET

After the "eyes" of the CSO optical space component launched in 2018, Syracuse 4A and CERES—orbited in late 2021—are now fully operational and providing communications and intelligence.

The first of a new generation of military telecommunications satellites, Syracuse 4A reached geostationary orbit with its electric thrusters in the spring of 2022. CNES was tasked with commissioning the satellite to check that it was performing as planned.
We also checked out the CERES signals intelligence constellation, after placing its three satellites in a formation to detect, characterize and precisely locate electromagnetic signals. We are now in charge of its sustainment for the armed forces.

2023 MILESTONES

20 February to 10 March
AsterX3 military exercise.

1st semester
Launch of Syracuse 4B by Ariane 5.

Launch of NESS, **depending on date for return to flight of Vega.**

There are two sides to space traffic management:
operational, to monitor and coordinate orbital activities, and regulatory, to lay down common "rules of the road".

Surveillance and protection

WITH CAESAR

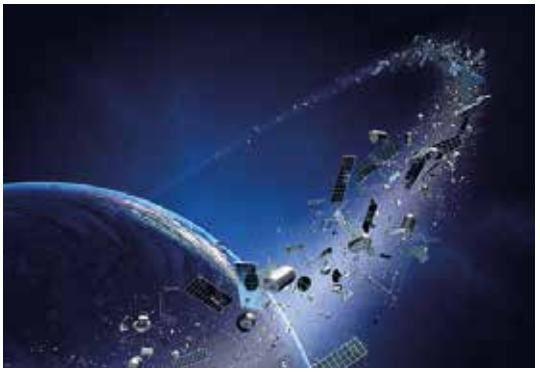
CNES and the CDE are keeping watch over space round the clock to guarantee the security of French and European satellite fleets.

Operated by CNES for the EU Space Surveillance and Tracking consortium (EU SST), the CAESAR[1] conjunction tracking service aggregates data from the civil and military assets of EU SST members—radars, telescopes and laser-ranging stations—to map space objects from all nations, including space debris. If it detects the risk of a conjunction (collision), it alerts the satellite's operator so that evasive action can be taken if required. The CDE uses the same assets to establish its own military space situational picture to protect satellites from any intentional act likely to compromise national security and defence. CNES and the CDE also jointly monitor atmospheric re-entries, watching out for any object that could fall to Earth.
In 2023, EU SST is moving up a gear, going from 7 to 15 European members. As a result, CAESAR will be stepping up its surveillance from 317 satellites currently to likely more than 1,000 over the next three years.

[1]Conjunction Analysis and Evaluation Service, Alerts and Recommendations.

180

conjunction alerts issued by CAESAR in 2022 gave rise to 19 orbital collision-avoidance manoeuvres.



Regulation

WITH THE FSOA

CNES is in charge of implementing the French Space Operations Act (FSOA), which took a big turn in 2022.

As a matter of security and ethics, since 2008 the FSOA obliges any French operator of a launcher or satellite to satisfy several requirements before it is cleared to fly. These notably include strict end-of-life provisions. In response to a burgeoning space sector, the FSOA convened a workshop in 2022 bringing together representatives from across the French space ecosystem to draft the first technical regulations compatible with Newspace orbital systems, including mega-constellations and future in-orbit services. In 2023, France will be inviting other legislators to take their cue from this corpus of regulations to improve international management of current and future space traffic.

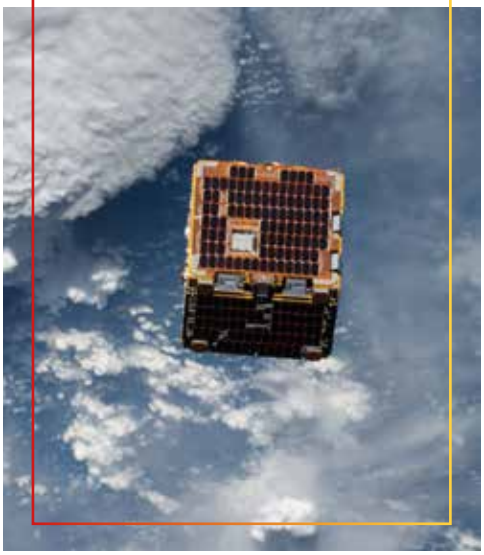
"What we're seeing is a step change. With space surveillance taking on a new European dimension to move towards coordination of space traffic, tailoring the FSOA to Newspace also marks a first in Europe and the world."

LAURENT FRANCILLOUT
Head of CNES's Security, Range Safety and Space Control Sub-Directorate

REDUCING SATELLITE FOOTPRINTS WITH TECH FOR SPACE CARE

On the trail of technologies for a more sustainable space environment, CNES is seeking to build zero-debris satellites.

Through the Tech for Space Care initiative, CNES is looking for innovative and sustainable technologies, like for example a system capable of bringing a satellite back to Earth at the end of its life using just atmospheric drag. To address the issue of space debris, in 2022 we fired a hypervelocity missile at a nanosatellite on the ground—a world first. By piecing together the dynamics of the explosion, we will be able to conceive more robust architectures and materials to withstand impacts or limit the amount of debris created.



6 LAUNCHES

FROM THE GUIANA SPACE CENTRE IN 2022

10 FEBRUARY

Launcher: Soyuz
Payload: OneWeb (34 satellites)
Application: Telecommunications
Orbit: Low Earth

22 JUNE

Launcher: Ariane 5
Payloads: MEASAT-3D and GSAT-24
Application: Telecommunications
Orbit: Geostationary

13 JULY

Launcher: Vega-C
Payloads: LARES-2 and six cubesats
Application: Science
Orbit: Medium Earth

7 SEPTEMBER

Launcher: Ariane 5
Payload: Eutelsat Konnect VHTS
Application: Telecommunications
Orbit: Geostationary

13 DECEMBER

Launcher: Ariane 5
Payloads: Galaxy 35, Galaxy 36 and MTG-I1
Application: Telecommunications and meteorology (MTG-I1)
Orbit: Geostationary

20 DECEMBER

Launcher: Vega-C
Payloads: Pleiades Neo 5 and Pleiades Neo 6
Application: Earth observation
Orbit: Sun-synchronous

A few minutes after lift-off, a drop in pressure in the launcher's Zefiro 40 second stage led to the loss of Vega-C's first commercial mission and its two payloads.

BOOSTING

Certain ultra-competitive domains of space, like telecommunications, call for agility and a forward-looking vision. France is a shining example in this respect, in no small measure due to CNES's efforts to give the nation's industry innovative, effective and competitive systems.
At the same time, Newspace is ushering in a new mindset that opens a whole new range of possibilities, also driven by the quest for increased economic competitiveness. CNES is gearing up and changing how the agency works to spur this transformation being fuelled by a shift towards services.

These activities meet CNES's commitments...

CREATING SHARED VALUE THROUGH SPACE

SUPPORTING REGIONAL RESILIENCE

...and the UN Sustainable Development Goals (SDGs).

Developed by CNES through the THDSat programme, the Oxford chip is connecting users worldwide to very-high-throughput satellite Internet.

THE NATIONAL ecosystem

Q&A

JEAN-PIERRE DIRIS
Head of Telecommunications and Navigation projects sub-directorate

What is CNES's role in the highly commercial telecommunications market?

J-P. D. CNES's mission is to support new solutions likely to consolidate or develop new markets and make our manufacturers world leaders. Two French primes in fact hold 60% of the geostationary satellite market. With increased backing from government, we're working in four main areas: all-electric satellites and satellites with digital core processors, both of which were in orbit in 2022; optical links, soon set to be demonstrated; and in the longer term, quantum satellites. We're making the move to mega-constellations and supporting the entire industry ecosystem, notably through the European Commission's IRIS^2 project.

What is CNES doing to stay in the vanguard of geolocation and navigation services?

J-P. D. We're working upstream of commercial, institutional and industrial applications to design highly innovative demonstrators and concepts, and we're helping our navigation systems to sell in export markets. Over the years, CNES has consolidated its high-level expertise and gained the recognition of the European Union, which has tasked us with Galileo Search & Rescue services and performance monitoring for GNSS and EGNOS.

FRANÇOIS ALTER
Newspace adviser

In today's shifting competitive industrial and commercial landscape, why is it so important for France to stay in step with Newspace?

F. A. Newspace offers an opportunity for the space sector to reach out to start-ups that weren't around a few years ago and to firms that hadn't previously shown an interest in space. It's thus encouraging new, dynamic and interesting ways of working.

How is CNES steering the ecosystem towards these new applications?

F. A. Our role is to provide the space component of emerging projects and services. For that, CNES is partnering specialist entities, for example to support the growth of start-ups and non-space sectors like the maritime industry and agriculture, as well as firms, large primes, ministries and all types of regional stakeholders. As a result, the space sector is seeing a new start-up appear every week, versus one every year five years ago!

Satellites holding their own against fibre

KONNECT VHTS BRIDGING THE DIGITAL DIVIDE IN EUROPE

Launched on 7 September 2022 by Ariane 5, Konnect VHTS embodies the advent of fast satellite broadband, made possible by a French sector spanning satellites to user terminals.

The most powerful geostationary telecommunications satellite ever built in Europe, Konnect VHTS is operated by Eutelsat to deliver broadband Internet services to millions of Europeans, including those in underserved areas or "notspots". For CNES, it marks the culmination of the THDSat programme pursued for several years under the government's PIA[1] future investment programme.

Thanks to its high-performance PNT5G processor developed through our R&D, Konnect VHTS can modulate capacity allocation and enables ground stations to be deployed in stages. It is also the first to use the high-capacity Q and V bands for feeder communications to connect to the Web. This payload is on the SpaceBus NEO electric spacecraft bus developed with Thales Alenia Space through the Neosat programme and the PIA. Ground user terminals incorporate the powerful Oxford-2 chip produced by a French ASIC component line. With the additional backing of the HIPE project funded by the government's stimulus plan to provide a terminal integral with the satellite dish, the system offers end-users a throughput and cost on a par with fibre.

[1] Programme d'Investissements d'Avenir.

500 GBPS

Internet bandwidth delivered by Konnect VHTS.

All-electric

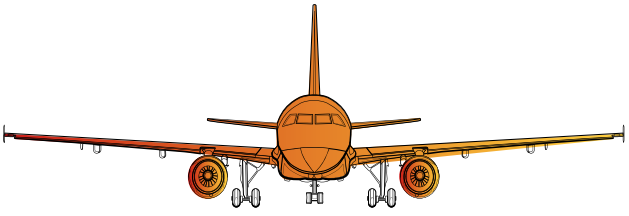
HOTBIRD 13 VALIDATES OPERATIONAL QUALIFICATION OF EUROSTAR NEO

As a result of CNES's R&D, big comsats are going all-electric to achieve cost and performance gains.

Launched on 15 October and 3 November 2022, the twin Hotbird 13F and 13G satellites are set to renew Eutelsat's geostationary fleet delivering television services to Europe. They are the first satellites built around the Eurostar NEO electric spacecraft bus developed with Airbus Defence & Space through the PIA future investment programme—up to the preliminary definition phase—and then the Neosat programme working in an integrated project team with ESA under the ARTES14 programme.
The two Hotbird 13 satellites feature PPS®5000 plasma thrusters developed in close cooperation with Safran. They are also carrying a radiation sensor designed in France with the ONERA national aerospace research centre. This sensor was activated to acquire measurements of the radiation environment as the satellites' orbit was being raised from 400 to 36,000 kilometres. These measurements will inform and optimize satellite design.

SHORT TAKE

In the near future, optical space communications will enable throughputs ten to a hundred times faster than current communications. With the backing of the government's stimulus plan, the 17 partners in the Optical Cooperation consortium are working to develop such links.



The development of a satellite-based augmentation system (SBAS) for the Augmentation NaviGation for Africa programme (ANGA) is firming up. On 17 June 2022, the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) signed an agreement with CNES concerning assistance with project oversight.

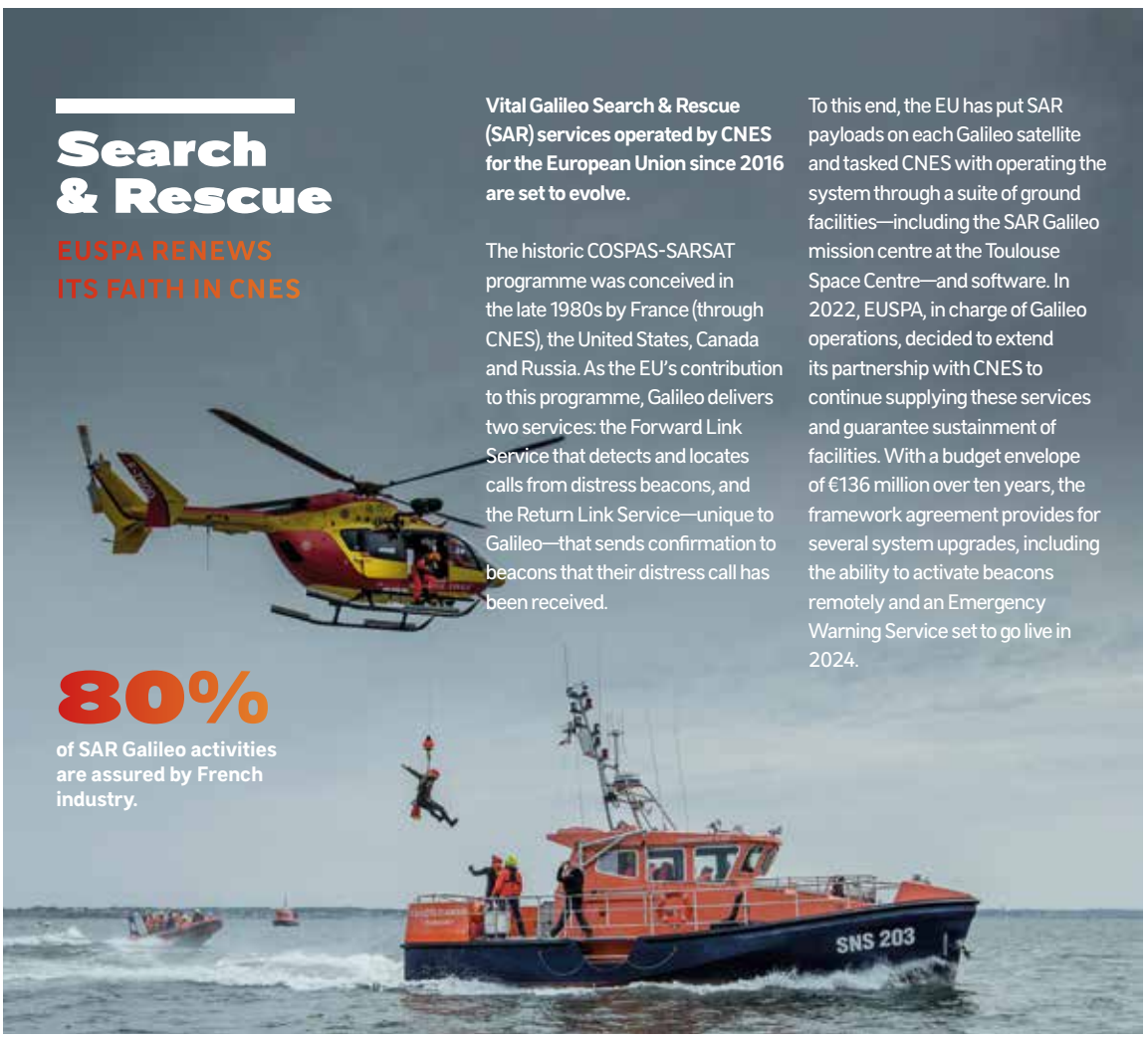
Search & Rescue

EUSPA RENEWS ITS FAITH IN CNES

Vital Galileo Search & Rescue (SAR) services operated by CNES for the European Union since 2016 are set to evolve.

The historic COSPAS-SARSAT programme was conceived in the late 1980s by France (through CNES), the United States, Canada and Russia. As the EU's contribution to this programme, Galileo delivers two services: the Forward Link Service that detects and locates calls from distress beacons, and the Return Link Service—unique to Galileo—that sends confirmation to beacons that their distress call has been received.

To this end, the EU has put SAR payloads on each Galileo satellite and tasked CNES with operating the system through a suite of ground facilities—including the SAR Galileo mission centre at the Toulouse Space Centre—and software. In 2022, EUSPA, in charge of Galileo operations, decided to extend its partnership with CNES to continue supplying these services and guarantee sustainment of facilities. With a budget envelope of €136 million over ten years, the framework agreement provides for several system upgrades, including the ability to activate beacons remotely and an Emergency Warning Service set to go live in 2024.

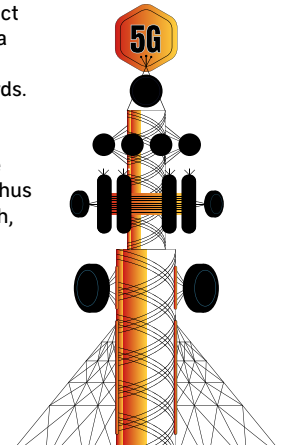


80%

of SAR Galileo activities are assured by French industry.

SATPHONE 5G CONSTELLATION IN SIGHT

Extending 5G smartphone connectivity beyond the reach of cellular networks thanks to a direct satellite link is the challenge that Thales Alenia Space is taking up with CNES, which has long worked to incorporate satellites in 5G standards. A constellation in low Earth orbit could cover more-isolated areas, including at sea. This kind of broad connectivity would enhance the roaming capabilities of 5G smartphones and thus their ability to access transport, energy, health, emergency and other services.



2023 MILESTONES

Mid-year
Demonstration of TELEO laser optical telecommunications on the Badr8 satellite.

Year-end
preparations for launch of Kineis, the first French and European constellation dedicated to the Internet of Things (IoT).

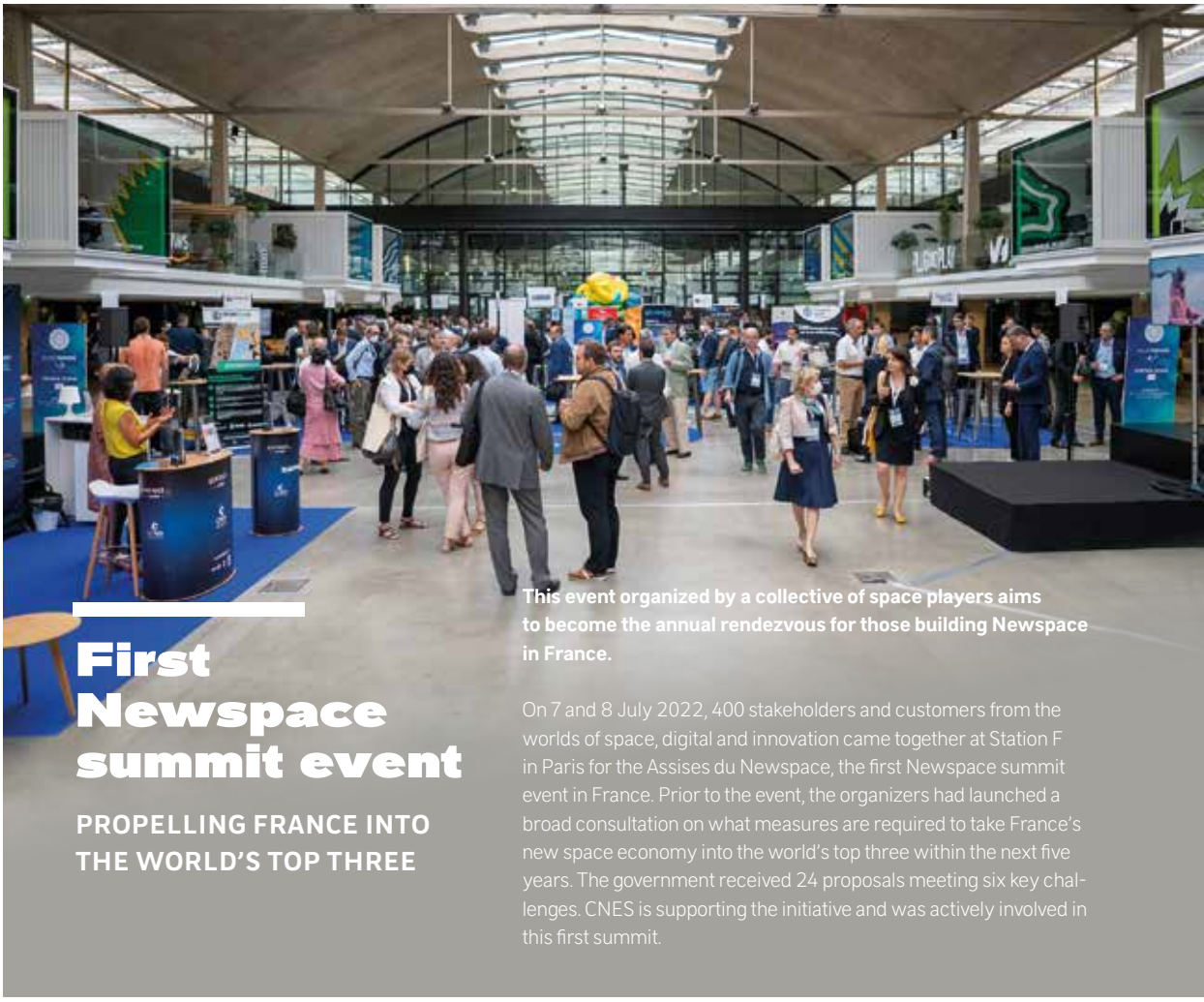
CNES in Newspace mode

FROM EARTH TO THE MOON BY WAY OF ORBIT

Connect by CNES is the gateway for non-space players coming to the world of space.

Fuelling new applications, leveraging disruptive technologies and attracting private funding, a wind of change is blowing with Newspace and the arrival of new non-space players. Looking to federate and support this emerging ecosystem, CNES created a Newspace sub-directorate within its Strategy Directorate in 2022. Connect by CNES, set in train in 2016 to encourage uptake of space solutions, is our agency's main tool for achieving this. The programme is today opening up to a wealth of futuristic real-world projects, including new orbital systems, a lunar economy and in-orbit services like those offered by a maritime logistics firm that is already gearing up to move into space. Through Connect by CNES, all of our experts are striving in their domain of excellence to provide the best of what the agency has to give.

www.connectbycnes.fr



First Newspace summit event

PROPELLING FRANCE INTO THE WORLD'S TOP THREE

This event organized by a collective of space players aims to become the annual rendezvous for those building Newspace in France.

On 7 and 8 July 2022, 400 stakeholders and customers from the worlds of space, digital and innovation came together at Station F in Paris for the Assises du Newspace, the first Newspace summit event in France. Prior to the event, the organizers had launched a broad consultation on what measures are required to take France's new space economy into the world's top three within the next five years. The government received 24 proposals meeting six key challenges. CNES is supporting the initiative and was actively involved in this first summit.

Emergence

UNLEASHING MARKET POTENTIAL

As precursors and innovators, we are keeping track of the latest trends in space to put France ahead in new markets.

Connect by CNES is structuring its efforts to support emerging markets through the NEXT[1] programme. The "emergence" strand of this programme is geared towards unleashing the potential of future markets and spawning tomorrow's champions. By anticipating possible evolutions and technology breakthroughs over the next five years, we are boosting the national ecosystem in promising areas, for example with the Sustainable Space Challenge (see page 19).

Looking further ahead to the 2040 timeframe, our Space'ibles observatory is bringing together a range of experts to envision what the future might hold for space and to inform decisions on how best to shape it.

Newspace events
#12 Emergence (podcast)

[1] Newspace, Emergence, eXperimentation & Technologies.

SPACE ECONOMY OBSERVATORY

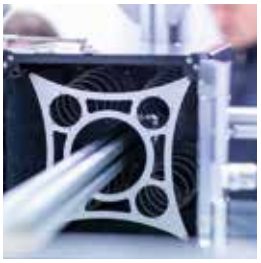
Founded in 2020 to survey the impacts of the COVID-19 pandemic on the French space ecosystem, the Space Economy Observatory (OES) is shaping up as a key asset to craft a shared vision.
The OES maps the French space sector to establish a status review of firms' health and how they are coping with the deep transformations it is undergoing. Combining the observatory's insights with the forward-looking perspective provided by Space'ibles, CNES is anticipating market business trends within different timeframes. Data and analysis are shared via a monthly bulletin to help firms plan for the future, as well as informing decisions and support policies for the government's stimulus and France 2030 plans.
The OES is now looking ahead and forging new partnerships, for example with the national statistics office INSEE, which on 6 September 2022 published its first statistical survey of the French space sector.

"With the OES, economic intelligence is serving our collective intelligence."

MURIELLE LAFAYE
OES Deputy Head

70,000
direct jobs supported by the French space sector.

BUDDING CHAMPIONS



SPACEFOUNDERS

The accelerator created by CNES and Bundeswehr University Munich (UniBw) to boost promising start-ups selected ten firms for its class of 2022. The laureates will be following a packed programme of conferences, meet-ups and other networking events, with support from the European Space Agency (ESA) and the German space agency DLR.

TECHTHEMOON

Created in 2021, *TechTheMoon* is the world's first incubator dedicated exclusively to the lunar economy. In 2022, it selected five new projects to be deployed here on Earth and on the Moon.
For 12 months, they will be coached by CNES and the Nubbo incubator to develop the terrestrial phase of their projects.

ACTINSPACE

On 18 and 19 November 2022, 1,915 participants—400 from France—registered for the fifth ActInSpace hackathon, where they were challenged to form their own space start-up in just 24 hours. Results in 2023...

2023 MILESTONES

Italian space agency ASI becomes a SpaceFounders partner.

14 February Final of ActInSpace in Cannes, France.

5 and 6 July Assises du New Space summit event at Station-F, Paris.

What can WE DO FOR

Climate change is fuelling warming temperatures and rising sea levels, flooding, drought and mega-fires. It is the result of complex interactions between the elements of our planet that are sometimes hard to fathom, but which require our urgent attention. At CNES, we are deeply attached to preserving our environment and working harder than ever to improve Earth-observation missions and develop applications to manage resources and help regions adapt to the impacts of a changing climate. In this respect, we stepped up our efforts in 2022 to strengthen resilience to natural disasters.

These activities meet CNES's commitments...

REDUCING OUR ENVIRONMENTAL FOOTPRINT

SUPPORTING REGIONAL RESILIENCE

...and the UN Sustainable Development Goals (SDGs).

OUR PLANET?

Q&A

SELMA CHERCHALI
Head of Earth Research and Observation (EOT) sub-directorate, EOT programme lead

How is space-based Earth observation (EO) addressing the challenges facing us?

S. C. Earth observation is getting ever more precise and gearing up to gain new insights into how the Earth system works and to understand climate change and its effects, as well as the impacts of humans on our environment. Satellite EO data and derived products are feeding into operational systems like Copernicus, weather forecasting and scientific models, thus helping to meet major societal needs for timely and qualified environmental information.

How can we build a long-term data record and ensure uptake?

S. C. Working with scientists, CNES is conceiving new space missions and infrastructures. We're also consolidating large-scale missions with our European and international partners, pushing towards integrated systems capable of meeting the challenges posed by Earth's three main cycles: the water, carbon and energy cycles. Observations must be continued over the long term and brought to a broad audience, through platforms like the Data Terra infrastructure and its data hubs, as well as Connect by CNES.

LAURENCE MONNOYER-SMITH
Director of CNES's Sustainable Development Office

What makes CNES a climate-focused space agency?

L. M-S. We're keenly aware of the changes now being seen through the "eyes" of our satellites and have been working alongside scientists for nearly 40 years to deploy Earth-observation missions. The data from these missions are documenting efforts to tackle climate change like those pursued by the IPCC. Since 2015, CNES has worked hard to foster international collaboration, creating the Space for Climate Observatory (SCO) in 2017 to give regions applications to help them adapt to its impacts.

What other environmental issues is CNES working on?

L. M-S. Preserving biodiversity is part of our agency's DNA, and we're especially attached to marine ecosystems, for which we conceived the Argos system operated today by CLS. Through our commitment to the Act4Nature initiative, we're responsible for managing an extensive natural heritage that needs to be preserved and restored. We're also looking to reverse land take by returning spaces to their natural state during the refurbishment of our field centres in Kourou and Toulouse.

A banner year for altimetry

LINKING PAST, PRESENT AND FUTURE

With its 30-year corpus of data essential to advancing science, altimetry illustrates the close cooperation and innovative mindset driving teams to keep improving observation performance.

In August 1992, CNES and NASA launched the TOPEX/Poseidon satellite carrying a French altimeter that would revolutionize ocean research and climatology as the only instrument in the world with the ability to measure sea level rise, a key indicator of climate change. It would be followed by the Jason series, working with the same partners backed by NOAA and the European operator Eumetsat. In 2016, they were joined by ESA to deliver the next generation with the Sentinel-6 family as part of the EU's Copernicus constellation. Building on all of this expertise and a data record spanning three decades, the Sentinel-6 Michael Freilich satellite was declared by CEOS (see page 47) on 7 April 2022 the new Reference Altimetry Mission for all other altimetry satellites.

Marking satellite altimetry's 30-year anniversary in 2022 was a great source of pride. A series of conferences gave the public a glimpse of the amazing advances that have been made, while also drawing their attention to the need for urgent action, particularly with regard to coastal erosion and submersion risks. French-U.S. cooperation is today continuing with the SWOT satellite, launched on 16 December 2022 and eagerly awaited by the scientific community. For SWOT, France has conceived a new revolutionary wide-swath radar altimeter in the shape of KaRIn, which with its 10-kilometre—and soon better—resolution versus 100 kilometres today is going to extend altimetric coverage to coastal currents and surface waters. By gauging river, lake and reservoir discharges and levels, SWOT will help us to manage Earth's freshwater stocks more sustainably. This wide-swath concept is very likely to be chosen by ESA to renew its Sentinel-3G series of satellites.

90%

of surface water stocks will be measured by SWOT, versus just 10% with current in-situ gauges.

CNES in the chair at CEOS

FROM DEMONSTRATORS TO TOOLS

During its term as chair of CEOS in 2022, CNES focused on the crucial importance of turning R&D demonstrators into operational services.

With 63 member agencies operating more than 200 satellites, CEOS (Committee on Earth Observation Satellites) coordinates civil Earth-observation programmes and fosters exchange of data. Great results were accomplished in 2022, with notable advances on post-crisis reconstruction observatories and closer integration of the Space for Climate Observatory (SCO) initiative in CEOS's work plan. France handed over the reins to Thailand at the plenary meeting in Biarritz on 30 November and 1 December 2022.

FORESTS TAKING UP CARBON

While a predominant factor in climate change when in the atmosphere, carbon can be stored in the oceans, soils and vegetation. Understanding its underlying mechanisms and surveying stocks is therefore vital, especially in tropical rainforests for which data are scarce. To this end, since 2013 CNES has been supporting development of ESA's Biomass mission, which will fly the first low-frequency space radar able to penetrate dense forest cover using an advanced tomographic imaging technique. The goal is to map forest strata in 3D to establish how biomass is distributed from the canopy to the floor, and to track its variations.

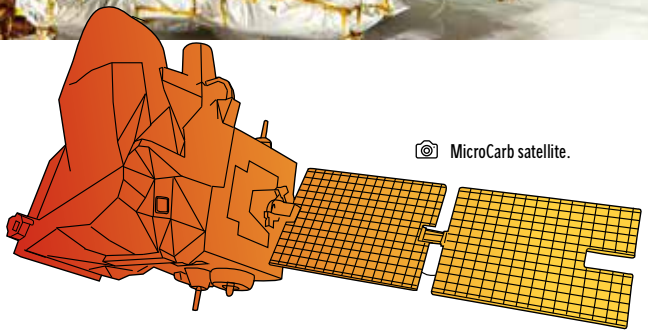
Alongside Biomass and with support from CNES, the dedicated Biomass Valo programme is enabling the French ecosystem to develop innovative multi-sensor products. Lastly, under the protocol validated in 2022 by CEOS to calibrate and validate measurements from space missions studying biomass, France is hosting the GEO-TREES international coordination office that will be collecting global in-situ biomass data, including from two sites in French Guiana, funded by France.

The IASI-NG instrument undergoes thermal testing on the MetOp-SG satellite at Airbus Defence & Space.

Eyes on the atmosphere

WITH IASI-NG AND MICROCARB

On 30 September 2022, CNES delivered the first flight model of the IASI-NG infrared atmospheric sounding instrument to the European Meteorological Satellite Organisation (Eumetsat) for integration on the new-generation MetOp-SG satellite set for launch in 2024. Observing more than 30 atmospheric components with twice the accuracy of the first-generation instrument, IASI-NG will provide data vital to gain new insights into climate change, air pollution and major wildfires.



MicroCarb satellite.

Designed to survey sources and sinks of carbon by precisely measuring global atmospheric concentrations of CO_2, the MicroCarb instrument was delivered to Thales Alenia Space UK on 8 December 2022 for launch in 2024.

Closer cooperation with Southern Nations

ACHIEVING SUSTAINABLE DEVELOPMENT TOGETHER

In regions lacking infrastructures and in-situ data, space technologies have great potential for addressing key challenges like food security and hydro-meteorological events.

These challenges are a prime focus for French development agency AFD, which is working with CNES to better integrate space technologies able to steer execution of its projects and assess their impacts more closely. Encompassing 13 domains from natural resource management to epidemiology, the agreement renewed in January 2022 enabled development of a demonstrator of space services for AFD and its beneficiaries.

In December 2022, CNES also signed a framework cooperation agreement with the African Union Commission (AUC) to support the GMES & Africa programme (with funding from the European Commission), as well as to create a Space for Climate Observatory (SCO) in Africa.

CNES is also coordinating since 2020 the Working Group Africa of the Copernicus User Uptake programme, providing training to African instructors in three languages from several European partners for 17 African nations.

The Aswan High Dam in Egypt, seen by Pleiades

SHORT TAKE

The ANVOLE convention signed by CNES, national scientific research centre CNRS and national weather service Meteo-France validates the principle of renewing the jet aircraft in the SAFIRE airborne fleet, whose instruments serve to calibrate and validate new space missions.

800

activations of the International Charter Space and Major Disasters since it was founded in 2000. Aiding emergency responders during major disasters, the charter has 17 member space agencies who provide free and timely maps and satellite imagery of disaster zones.

2023 MILESTONES

Mid-year
SWOT data come on stream.

Go-ahead decision for Atmosphere Observing System (AOS) programme in partnership with NASA (USA) and JAXA (Japan).

Space SCOlutions

WITH THE SPACE FOR CLIMATE OBSERVATORY

For the Space for Climate Observatory (SCO), now a fixture of the fight against climate change, 2022 was a pivotal year in which it structured and expanded its activities.

Driven by France, the SCO is mobilizing the international community to promote the use of satellite data in combating and adapting to the impacts of climate change. Deploying a use-case approach, it is boosting and transforming scientific projects into regional decision-support tools that can be replicated elsewhere. By inviting end-users to join the project consortium, tools are developed in line with their needs, combining all available space, in-situ and socio-economic data. Led by CNES, SCO France is playing a driving role. In 2022, 12 SCO France projects delivered promising operational services and demonstrators seeking to improve resilience to flooding in the Aude department of Southwest France, track cyclone floods in the Bengal Delta, predict drought in New Caledonia or prevent epidemics—what we call space SCOlutions.

57

SCO-accredited projects in three years in 28 countries, of which 51 by SCO France.

The Brahmaputra estuary in Bangladesh seen by the Sentinel-2 satellite.

www.spaceclimateobservatory.org

FOUNDING CHARTER

Presented on 27 June 2022 at the Cité de l'Espace space theme park in Toulouse, France, and effective from 1 September, the founding charter of the SCO was co-drafted by the signatories of its 2019 Declaration of Interest. Setting out the SCO's scope of action, activities and governance, this charter opens it to any entity committed to climate action. The 35—and soon more—space agency, international body, development agency and research institute members can now look forward to issuing national and regional calls for projects.

COP27

PROVIDING DATA AND TOOLS

From 6 to 18 November 2022, CNES was at the COP27 conference in Sharm-el-Sheikh, Egypt.

Alongside the world's leaders convening to combat climate change, CNES showcased its many Earth-observation programmes and SCOlutions at COP27. In the Mediterranean Pavilion we presented SCO projects geared to protecting the Mediterranean region. In the France Pavilion, the Rainforest Alliance was given a demonstration of the www.tropisco.org platform, which uses Sentinel-1 radar imagery to allow people to visualize tropical deforestation in near-real time. The United Nations Environment Programme (UNEP) also signed the SCO Charter at the conference.

Deforestation in Asia.

National Science Week

ENGAGING THE PUBLIC

France's National Science Week 2022 focused on climate change, a theme close to CNES's heart. On 9 October, live from the National Natural History Museum in Paris, representatives from our agency and the LEGOS space geophysics and oceanography research laboratory took questions during the popular TV science programme L'Esprit Sorcier. With visuals and real-life examples from the SCO, they showed the potential of satellites to help us understand the phenomena we are seeing and to protect Earth.

2023 MILESTONES

23-25 May
11th SCO international steering committee meeting on the sidelines of the first Global Space Conference on Climate Change.

30 May
Second SCO France congress.

December
CNES and SCO at COP28.

Delving DEEPER INTO

The universe is our cradle and environment. By observing it in different ways, we are gradually piecing together the history of our galaxy and how it is likely to evolve in the future.
Most missions are underpinned by remarkable international cooperation, deploying kaleidoscopes of instruments. CNES and French research laboratories have designed several, some of them of prime importance. The data they acquire are advancing our knowledge in the fields of observation, chemistry, fundamental physics, life science, material science and more, paving the way for human exploration of space while seeding solutions here on Earth.

+ These activities meet CNES's commitment...

CREATING SHARED VALUE THROUGH SPACE

...and the UN Sustainable Development Goals (SDGs).

Galaxy M82, site of supernova explosions, captured by the Hubble Space Telescope.

THE UNIVERSE

Q&A

THIERRY BRET-DIBAT
Head of CNES's Universe Science and Exploration sub-directorate

What do we stand to gain from space exploration and universe science?
T. B-D. First of all, they're advancing our knowledge by answering the big questions regarding the laws of the universe, stars, planets and the search for lifeforms. They're driving new technologies and innovation, industrial development and economic spin-offs, so they also have significant impacts on our lives. With their long history of cooperation, they're essential tools supporting policymaking and diplomacy. And because they're inherently hard to do, they signal that a nation is at the cutting edge and capable of inspiring new vocations.

What is CNES's role in sustaining French space science excellence?
T. B-D. From a macroscopic perspective, CNES is providing the scientific community with space systems required to conduct research. Laboratories are usually involved in building instruments and ground segments, and exploiting data. We work with them upstream and during the R&T phases, as well as during project phases as prime contractor or providing oversight, and we supply specific domain expertise. CNES supports research through funding and via PhD and postdoctoral grants. We also have a programmatic role, in line with the science priorities set by the CERES space research and exploration committee.

Crewed spaceflight missions are once again a focus of attention. What is their purpose?
T. B-D. Human spaceflight is emblematic of social stakes, technological progress and scientific opportunities, as well as the stuff of dreams. CNES advocates greater independence for Europe in this field, and in the short term is pushing to secure a place for its astronauts in international initiatives. We now have three French astronauts in ESA's Astronaut Corps: Thomas Pesquet and Sophie Adenot, who are career astronauts, and Arnaud Prost, a reserve astronaut. They will be well placed to set foot on the Moon and to work on the ISS.

The ECLAIRs and MXT instruments for the SVOM satellite in integration at the Toulouse Space Centre.

SVOM's lightning-fast camera

SPACE VARIABLE OBJECTS MONITOR

French instruments designed to observe the highest-energy phenomena in the universe have been shipped for integration in China.

The French-Chinese SVOM mission is set to probe gamma-ray bursts (GRBs), the most distant star explosions in the universe releasing all their energy in the space of a few tenths of seconds. Working alongside ten French research laboratories, CNES has designed two instruments for the mission that were cleared to fly by the acceptance review in the spring of 2022. When the ECLAIRs camera scans the skies in search of flashes of gamma rays, the French MXT telescope and its Chinese counterpart VT will observe the secondary radiation produced by such violent ejections of matter. Two robotic telescopes on the ground, one of them French, will then receive a priority alert from the satellite to confirm the location and nature of the event and cue larger ground telescopes.

6,400

detectors inside the ECLAIRs camera.

MICROSCOPE DOESN'T DISPROVE EINSTEIN

In 2022, the latest findings from the French Microscope mission confirmed the equivalence principle postulated by Albert Einstein, establishing with the unprecedented precision of 10^{-15} that bodies in a vacuum fall at the same velocity, no matter their composition or mass.

Gaia DR3, the Big Data catalogue of the universe

UNDERSTANDING WHERE WE CAME FROM AND WHERE WE'RE GOING

The European Gaia satellite has been mapping the skies since 2013. CNES is a key player behind the catalogue making its wealth of data available to scientists.

Released on 13 June 2022, the numbers involved in the Gaia DR3 catalogue are enough to make our heads spin: 1.8 billion stars, 4.8 million galaxies, 6.6 million quasars, 160,000 asteroids... the list goes on. However, with 500 million daily measurements, this release only aggregates 34 months of data up to December 2017. In 2030, the final DR5 release will recompile all 120 months of Gaia data, a feat made possible by the Data Processing and Analysis Consortium (DPAC) of 450 engineers and astronomers from 25 countries—100 from France—working to acquire, process and calibrate the raw data to make them intelligible to the wider number. CNES's data processing centre (DPCC) plays a key role in this endeavour, generating results for three of Gaia's nine thematic areas: complex objects, radial velocities and astrophysical parameters of stars (temperature, colour, mass, brightness, etc.). With its cluster of 250 servers and more than 6,000 processing cores, the DPCC has processed in three years what a single computer would have taken 460 years to do.

Thanks to Gaia, we know our Milky Way was born from a collision with another galaxy 0.8 billion years after the Big Bang, itself estimated to have occurred 13.8 billion years ago.

Gaia catalogue - How it was made

DECLIC offers molecular solutions

DEVICE FOR THE STUDY OF CRITICAL LIQUIDS AND CRYSTALLIZATION

Material sciences in microgravity are opening up promising paths with stakes here on Earth. In 2022, France and the United States decided to extend their cooperation on the DECLIC device.

In the absence of gravity, atoms arrange themselves naturally. In the Kibo module on the International Space Station (ISS) since 2009, DECLIC is operating like a microscope inside an oven to observe how materials react to very precise temperatures. Samples are simply inserted and everything else is controlled remotely from the CADMOS* centre at CNES, working with NASA and the scientific community. After spending a few months being overhauled back on Earth, DECLIC resumed its experiments on the ISS in 2022.
With DECLIC we are studying crystallization, how atoms arrange themselves when alloys solidify, with implications for the semi-conductor industry seeking to replace increasingly scarce natural minerals. We are also analysing supercritical liquids, which behave like a liquid and a gas, like saltwater under very high pressure at the base of deep ocean volcanoes. And what if we could recycle organic matter without emitting CO_2 by keeping it in a liquid state?

*Centre for the development of microgravity applications and space operations.

"DECLIC is set to accommodate a new experiment on aerosols, which we emit in huge quantities and are key elements driving the formation of clouds and therefore climate change."

CÉCILE FIACHETTI
DECLIC project leader, CADMOS

PREPARING TO LIVE IN SPACE ON EARTH

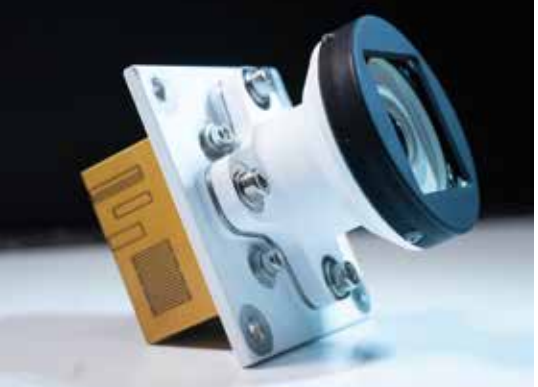
Human exploration of space implies that crews will need to be self-sufficient. To preserve astronauts' health, the MEDES space medicine and physiology institute is conducting a range of experiments like extended bedrest campaigns to simulate the impacts of weightless conditions on the body's main physiological functions and to devise counter-measures. To alleviate muscle loss in microgravity, a team based in Strasbourg is working to isolate a molecule that appears to enable bears to limit muscle loss during hibernation. They have successfully done this with mice. First-aid techniques are also being tested on parabolic flights.

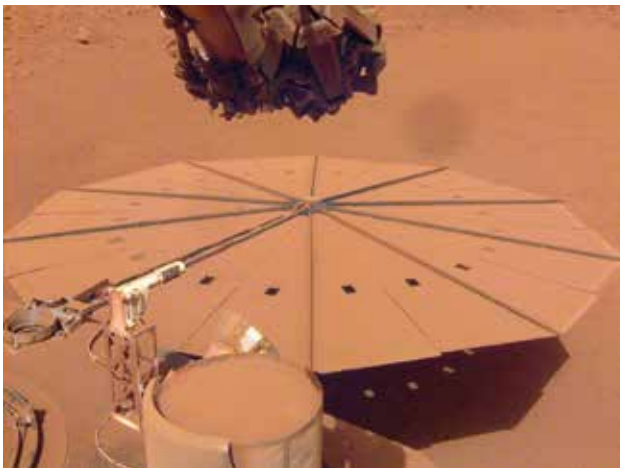
Destination Moon

ROBOTIC AND CREWED EXPLORATION

As a pioneer of space exploration, CNES is aboard the international adventure to return to the Moon.

On 7 June 2022, France signed the Artemis Accords governing the U.S. programme to send a crew to the Moon by 2025. On 21 July, NASA selected the lunar lander for its Farside Seismic Suite (FSS) mission that will be carrying the seismometer developed in partnership with CNES and the IPGP Earth physics institute in Paris. And on 11 December 2022, three CASPEX cameras conceived by CNES and 3DPlus departed on the Emirati Rashid rover. Despite the failed lunar landing, the cameras have already proved their reliability for SuperCam on the Perseverance Mars rover and the OneWeb satellites, and will be operating on the MMX and Rashid 2 rovers.





Listening to Mars

HONING PLANETARY EXPLORATION TECHNIQUES

As a longstanding partner of the United States, France has supplied several instruments for major missions to Mars, three of which were active in 2022.

Whereas the Curiosity rover marked its tenth anniversary on Mars on 6 August 2022, its cousin Perseverance has already trekked 14 kilometres since its arrival in February 2021 to collect samples for return to Earth. During this time, its French-designed microphone has been capturing the sounds of the red planet. According to a research paper published in April 2022, recordings reveal that the Martian atmosphere attenuates and slows sounds, and that high-pitched and low-pitched sounds in fact travel at different speeds there. Meanwhile, on 4 May 2022, seven months before it finally ran out of energy, the InSight mission's French seismometer SEIS detected a 4.7-magnitude 'marsquake', the largest ever recorded. Analysis of this temblor on Mars will further refine our understanding of Mars's interior structure, on which SEIS has already shed so much light.

Listen to the largest 'marsquake' ever recorded

2023 MILESTONES

14 April
Launch of the European JUICE mission to Jupiter and its icy moons.

Third quarter
Launch of the European Euclid mission to detect dark energy.

A SOCIALLY RESPONSIBLE EMPLOYER

Corporate social responsibility (CSR) is integral to CNES's Human Resources policy, underpinned by constructive labour relations that seek to encourage diversity, gender equality and well-being at work, thus ensuring good performance. In 2022, our HR teams continued to roll out systems that embody the agency's values and commitment in this area, and the desire to promote our employees' individual and collective sense of fulfilment at work.

ROUNDING UP PAY DELIVERS FIRST PROMISING RESULTS

Solidarity often relies on small gestures that together add up to bigger numbers. One year after initiating the system of rounding up pay (the first donations were deducted in January 2022), it's time to look at the results:

10%

of employees had signed up to the scheme as of end December 2022.

€6,852

in donations have been collected in one year.

65%

of employees make an extra donation on top of rounding up their pay.

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 2022 index, CNES scored

95/100

MOBILITY KEY TO HR POLICY

Effective since 1 January 2022, the new agreement on career development and support at CNES offers a broader framework for employees with respect to internal and external mobility, on individual career paths and talent management. The agency strongly encourages mobility, which contributes to tailoring individual career paths, favours acquisition of new skills and consolidates a dual approach to career development, while ensuring employees' commitment and motivation.

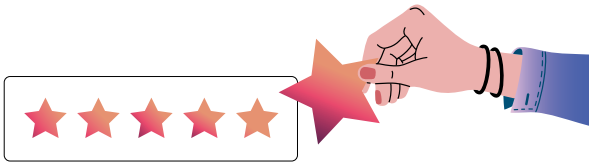
AGREEMENTS SIGNED IN 2022

- Agreement on career development and support at CNES
- Agreement on extending the terms of employee representatives on the Central Economic and Employee Relations Committee (CCSE) and Economic and Employee Relations Committees (CSEs)
- 2022 labour relations agreement
- Amendment n°1 to the agreement on union rights and labour relations
- Amendment n°2 to the agreement on end-of-career management and transitioning to retirement
- Amendment n°3 to the 2020/2022 profit-sharing agreement
- Amendment n°3 to the pension plan (PERCO) agreement of 19/02/2010
- Amendment n°4 to the PERCO agreement
- Amendment n°5 to the agreement of 14 November 2018 on the establishment of CNES's Economic and Employee Relations Committees (CSEs).
- Amendment n°6 to the agreement on the corporate savings plan (PEE) of 5 November 1990

Mid-2022, new elections to employee representative bodies registered an overall turnout of 65%. A quorum was reached at all of the agency's field centres, so all seats were allocated.

CSR TRAINING

CNES has identified a need to provide CSR training for its personnel and to deploy it across the agency. Three modules will thus be offered from 2023, starting with regulatory aspects before moving on to the day-to-day application of CSR principles in the way the agency works and conducts its space activities.



97.6%

percentage of new hires who feel they made the right choice in joining CNES (versus 84.6% in 2020), according to the Happy Index® At Work for Starters survey conducted in early 2022 in partnership with ChooseMyCompany.

Employer brand: consolidating our strategy

In addition to a record number of new hires on permanent contracts, 2022 marked a turning point for CNES's employer brand. Our teams worked hard to restructure the HR function, consolidate our strategy and raise our profile.

SHARING THE MISSION

Our employer brand strategy is geared towards luring future talents to develop and secure the space sector's technical skills base, making the agency more attractive, being a socially responsible employer and fostering employees' sense of belonging through a dynamic HR policy. To accomplish this mission, CNES's Human Resources team is working hand in hand with internal stakeholders like the Communication Directorate, the Sustainable Development Office, managers and employees.

TARGETED ACTIONS

Employer brand actions were restructured in 2021 in line with the agency's Objectives and Performance Contract (OPC) and pursued throughout 2022.
To inspire vocations and promote careers, CNES's HR teams reached out at student shows and forums where its employees were able to share their passion for space, talk about their jobs and career paths, and answer youngsters' questions.
Committed to getting more women into science careers while encouraging diversity and accommodating disabilities, we partnered with associations like Elles bougent, Airemploi and Article 1 to show these audiences the agency's organization, challenges and career profiles, and to give youngsters tours of our field centres. This was backed by communication actions on social media, including broadcasts on Twitch.

CNES took part in

11 student forums

across France in 2022.

"When I was offered the chance to join the employer brand team, I had no hesitation because I'm attached to the idea of promoting the agency and boosting its employees' loyalty and sense of belonging.
I subsequently discovered other equally important aspects of the job, such as promoting diversity, hiring more women, gender equality and disability awareness. In this respect, making CNES more attractive implies a lot of discussion during our actions. When we organize events with associations like Elles bougent or Article 1, or when we meet students or do a live broadcast on Twitch, we give all of these people from different horizons a taste of space. This shows them working at CNES is possible and we encourage them to pursue careers in science and engineering. We're aiming to reach everyone and leave nobody by the wayside, while showcasing our fine agency.
In a few years' time, maybe we'll be seeing profiles that we weren't previously used to hiring at CNES.
When I think about all the actions we're pursuing, I get a great deal of satisfaction because they're aligned with my values."

SANDRINE ELLERO
Employer Brand Assistant

LOOKING AHEAD

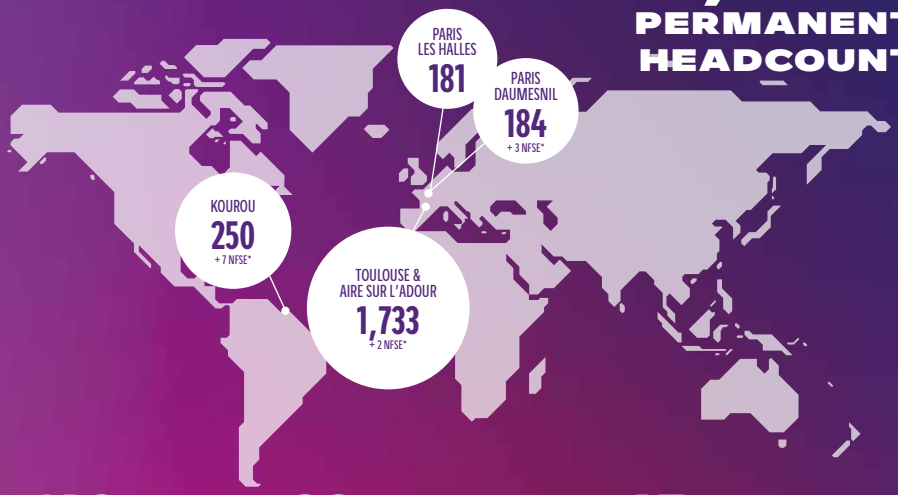
CNES is pursuing this path in 2023 and planning new actions to attract more and more young men and women to space careers. At the start of this year we welcomed for the first time 90 ninth-grade interns at our four field centres for a programme of fun events and educational presentations about what we do. In the same vein, we are going to take a fresh look at the idea of appointing employee ambassadors.

DATA AT 31/12/2022

HUMAN RESOURCES IN FIGURES

HEADCOUNT PER FIELD CENTRE

2,348
PERMANENT HEADCOUNT

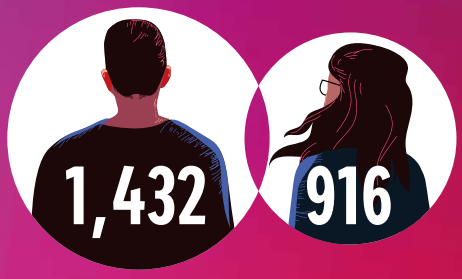


142
Permanent hires in 2022

33 years
Mean age of permanent hires in 2022

47 years
Mean age of CNES employees

TOTAL HEADCOUNT (MEN AND WOMEN)



MEN HEADCOUNT
+ 8 men NFSE*

WOMEN HEADCOUNT
+ 4 women NFSE*

INTERNS AND WORK/STUDY PLACEMENTS

207 INTERNS

168 in mainland France

39 in French Guiana

75 WORK/STUDY PLACEMENTS

68 in mainland France

7 in French Guiana

INTERNAL MOBILITY

10 Moves outside agency
0.4%

62 Relocations
2.6%

246 Functional moves**
10.5%

* Non-French-speaking Europeans ** Not including end-of-career leave

FROM THE CENTRES

After a lull due to the COVID-19 pandemic over the last two years, events are making a comeback at our four field centres. Once again, our people are getting together for cultural, environmental, celebratory and sporting events, sharing moments of friendship to build team spirit and pride in what we do.

HEAD OFFICE
PARIS LES HALLES

PARIS DAUMESNIL

TOULOUSE
SPACE CENTRE

GUIANA
SPACE CENTRE


Toulouse


Head Office and Paris Daumesnil.

60-YEAR FESTIVITIES

Head Office, Paris Daumesnil, Toulouse Space Centre and Guiana Space Centre.

2022 was marked by 60th anniversary celebrations at CNES's four centres.

The festivities began in mainland France on 21 and 22 June 2022. In Toulouse, the event was held at the Halle de La Machine, with a cocktail dinner, rides on the Minotaur, a poetic encounter with Long-Ma the horse-dragon and other mechanical discoveries.
Our people in Paris got together at the Atelier des Lumières for a screening of Destination Cosmos, an original CNES creation to mark our 60th anniversary, exhibitions and a cocktail dinner. The evening concluded in style with a live broadcast of the lift-off of flight VA257, the first Ariane 5 launch of the year.
At the Guiana Space Centre, employees were invited to a garden party at Kays'ly Garden on 21 October. The event began with a cocktail reception followed by performances from acrobats and theatre companies, musical interludes and a virtual reality experience. And to cap it all, an anniversary cake!


Guiana Space Centre.

PATROUILLE DE FRANCE FLIES OVER TOULOUSE

Toulouse Space Centre. Late morning 22 September 2022, all eyes at the Toulouse Space Centre were turned skywards, not to gaze at the stars but rather to see the Patrouille de France aerobatics team fly over CNES and Space Command (CDE), now operating at the centre since 2020. The flyover was on the way from the squadron's base in Salon-de-Provence to the air display organized by the Des étoiles et des ailes (Stars and wings) association on 24 and 25 September at the Toulouse Francazal airfield—a proud and exhilarating moment for everyone at CNES and the CDE.

ENVIRONMENT DAYS CALL TO ACTION

Paris Daumesnil. For the 2022 Environment Days, the Paris Daumesnil centre invited employees to take part in several eco-friendly actions, including creating a vegetable garden, collecting waste and used pens, clearance sales, encouraging 'soft' mobility solutions and other awareness-raising actions. All of these activities brought our employees together in pursuit of the common goal of reducing our environmental footprint.

SPACE TEAM EUROPE PUT BEST FOOT FORWARD

Paris Daumesnil. Our agency's athletes were at the foot of the Eiffel Tower on Sunday 9 October for the start of the Paris 20-kilometre road race. The 17,872 finishers for this 44th edition included Space Team Europe, composed of employees from CNES, ESA, Arianespace and ArianeGroup. With clear blue skies and a team of runners with a decidedly "space" flavour, all the ingredients were there for a successful event. Mission accomplished and congratulations to all who took part!

POSING IN FRONT OF ARIANE 6

Guiana Space Centre. From July to December, employees from all of the firms working at the Guiana Space Centre (CSG) were invited to visit the new ELA-4 launch complex with their families. They were thus able to see Ariane 6 fully assembled under its mobile gantry, go inside the assembly building, learn all about combined testing and of course take a souvenir photo.

NEW MUSEUM EXPERIENCE COMING

Guiana Space Centre. The Space Museum at the entrance to the CSG closed its doors for refurbishment in August 2022, aiming to re-open at the start of 2024 for an all-new digital and interactive experience. At the end of the year, objects that will no longer be on display were removed and some of them donated to the Aviation & Space Careers Campus. The refurbishment involves creating a new museum experience covering space in Europe and French Guiana, work to redesign the building's layout and bring it up to the latest standards, as well as a bigger shop and a new look for its entrance. The refurbishment is being funded by the European Union, CNES and ESA.

BIODIVERSITY MANAGEMENT PLAN

Toulouse Space Centre. In 2022, a biodiversity status survey was conducted at CNES's three facilities (Toulouse, Aire-sur-l'Adour and Aussaguel), detailing strong points and areas for improvement with regard to habitats. This initial survey served as a basis for addressing medium- and long-term biodiversity issues and identifying threats. We are now studying actions to be put in place in the years ahead to preserve and improve existing habitats and create new ones wherever possible.

COMEBACK FOR CNES-BUSINESS MORNINGS

Head Office. After a hiatus due to the COVID-19 pandemic, CNES-Business mornings resumed in April 2022. These get-togethers are held at CNES Head Office two to three times a year, inviting our ecosystem's players to discuss a given topic. Three events took place during the year: Connect by CNES, a Newspace player in April, Space Observatory in October and Operational space solutions for sustainable cities in December. The large number of participants and positive feedback received from them and from speakers confirms the value of these meet-ups, which will be continuing in 2023.

CONTEMPORARY ART SPACE

Head Office. Under the responsibility of the Observatoire de l'Espace, CNES's art and science laboratory, this space opened in October 2022 exhibits artworks produced under the agency's cultural policy. It offers a new way to promote space, its materials and narratives through the eyes of contemporary artists. The first exhibition was devoted to Kouroupolis, a series of water colours by plastic artist Erwan Venn inspired by archive visuals of the creation of the Guiana Space Centre. The exhibition ran from 27 October 2022 to 2 January 2023. Open to all outside the Head Office building, this space will be hosting new exhibitions every three months or so.

A CHANCE TO MEET THOMAS PESQUET

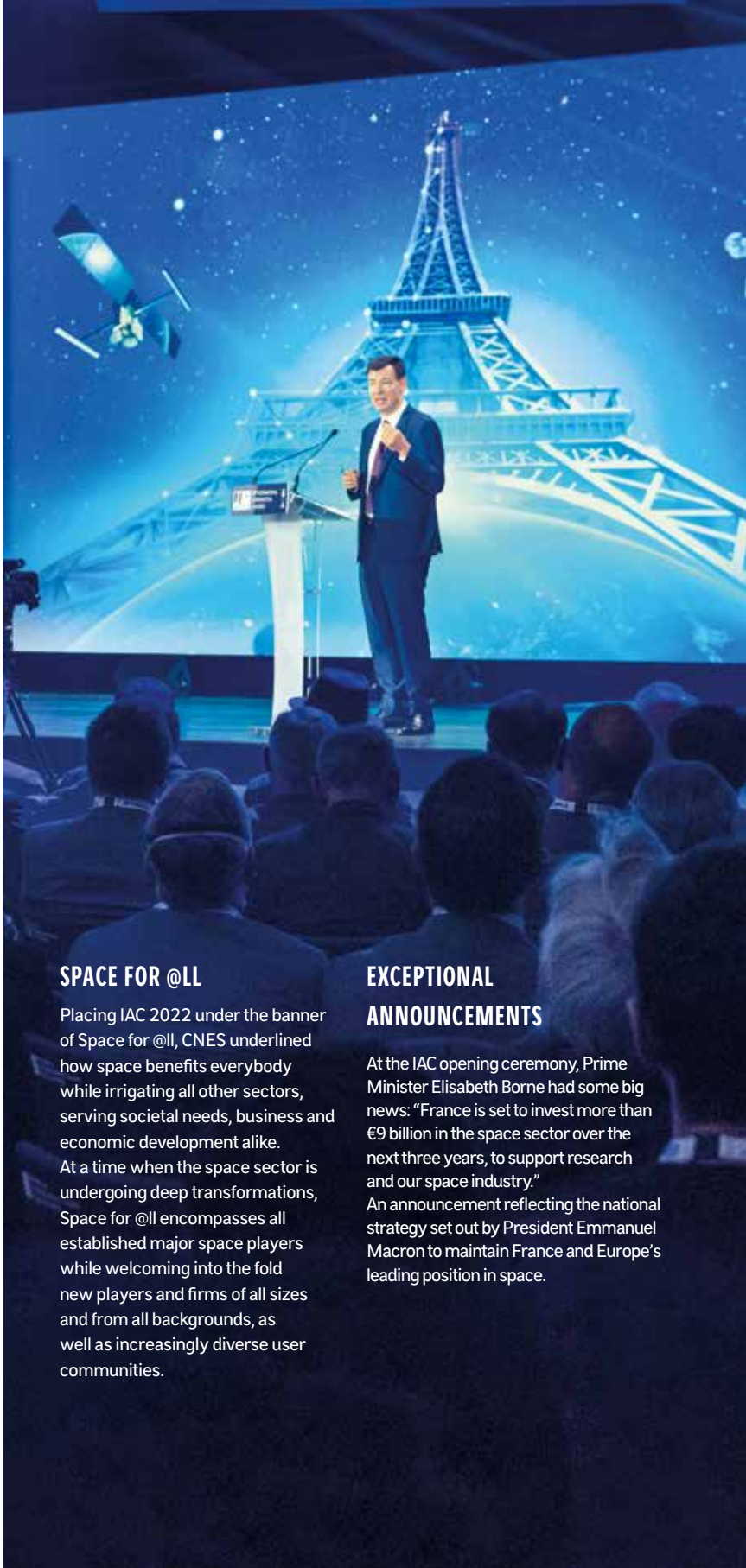
Toulouse Space Centre and Guiana Space Centre.
3 June 2022, a warm welcome was extended to Thomas Pesquet at the Toulouse Space Centre, where an audience of 700 and 300 others on livestream were able to ask questions about his Alpha mission.

He then visited French Guiana on 15 and 16 June to meet employees from all of the firms working at the Guiana Space Centre. In the Jupiter building, he talked about his second mission on the ISS before taking this group selfie. He also met classes taking part in the Raise your Blob operation and the people of Kourou and Cayenne.

CNES HOSTS

73rd IAC

The most important space event of the year, the International Astronautical Congress (IAC) was held in Paris from 18 to 22 September 2022, bringing together several thousand top-level dignitaries, experts and students from space agencies, the space industry and the space science community. CNES was chosen by the International Astronautical Federation (IAF) to host the event.



SPACE FOR @LL

Placing IAC 2022 under the banner of Space for @ll, CNES underlined how space benefits everybody while irrigating all other sectors, serving societal needs, business and economic development alike.
At a time when the space sector is undergoing deep transformations, Space for @ll encompasses all established major space players while welcoming into the fold new players and firms of all sizes and from all backgrounds, as well as increasingly diverse user communities.

EXCEPTIONAL ANNOUNCEMENTS

At the IAC opening ceremony, Prime Minister Elisabeth Borne had some big news: "France is set to invest more than €9 billion in the space sector over the next three years, to support research and our space industry."
An announcement reflecting the national strategy set out by President Emmanuel Macron to maintain France and Europe's leading position in space.

CNES AS ORGANIZER AND ACTOR

Alongside the other exhibitors at the event, CNES welcomed visitors on two booths. One highlighted the agency's institutional activities while the other trained its focus on Connect by CNES, with the launch of the 2022 edition of ActInSpace, the world's largest international space hackathon.

AMBITIOUS PROGRAMME

Aside from organizing IAC, CNES also contributed to its scientific programme, chairing 15 sessions. Over five days, more than 3,000 mini-conferences—including 800 interactive presentations—were held at the event. Attendees were also invited to plenary sessions on key stakes for society, like for example the conference on France and CNES's expertise in the field of satellite altimetry acquired over the last 30 years (see page 46).

FULLY SUSTAINABLE CONGRESS

IAC was not only the most ambitious ever, but also the most virtuous thanks to the efforts of CNES and its PCO KIT. All CSR bases were covered, from the event's carbon footprint, offsetting and drastic reductions in printing to local suppliers, selective sorting of waste and accommodating people with disabilities, and many original solutions were devised. These efforts were rewarded with ISO 20121 sustainable event management certification.

SCO TAKES FLIGHT

Initiated by CNES and France in 2019, the Space for Climate Observatory (SCO) held its 10th international steering committee meeting at IAC 2022, hailing the adoption of its founding charter. It also organized a plenary on how Earth observation—which is spearheading its actions—is helping societies adapt to the impacts of climate change (see page 50).

RECORD-BREAKING IAC

9,300 space representatives

110 nations represented

250 exhibitors

Over 10,000 visitors, 30% more than the previously best-attended IAC in Washington D.C. in 2019

8,000 m² of exhibition space

EDUCATION FOR ENGINEERS

CNES, the European Space Education Resource Office (ESERO France) and the International Space Education Board (ISEB) put on two day-long sessions for teachers and the younger generations.
On 17 September, a training session for secondary school teachers focused on space exploration and climate science.
On 21 September, young visitors took part in a range of educational workshops on space training, going inside the heart of a satellite, how it's orbited, learning about solar storms and more—everything to fire the enthusiasm of budding engineers.

NEXT MAJOR EVENT FOR CNES

54th Paris International Air Show at Le Bourget in June 2023. CNES will be welcoming trade visitors and the general public in its exhibition pavilion coordinated with ESA's through a shared exhibition zone.

2022 highlights

SWOT IN THE NEWS

A comprehensive SWOT press plan obtained more than 274 mentions for the mission. To arrive at this result, our press office provided journalists with a complete press kit, press releases at each key mission milestone, a tour of the manufacturer's facility to see the satellite in the clean room, a remote press briefing and a trip to watch the launch. Mission scientists and engineers were on hand throughout the campaign and also made themselves available for the many interview requests.

SPACE PODCAST FOR 6-10-YEAR-OLDS

"How are rockets built?" or *"What colour are stars?"* To feed youngsters' curiosity and get them interested in science and technology, CNES collected questions from six-to-ten-year-olds about space. The agency's experts answer them in a simple, fun and educational way in the form of short podcasts. We aired 20 weekly episodes in all on our podcast site and streaming platforms. A project aligned with CNES's youth outreach actions that ties in with our strategy to boost our digital presence, particularly on social media like TikTok.

Listen to the podcasts (FR)

JDR X CNES: MISSION LUNE SCORES SUCCESS

9 March 2022, CNES organized a livestream event on Twitch, consisting of a role-playing game designed to showcase Europe's lunar exploration efforts. The project led by the agency's Directorate of Communication took numerous employees—subject matter experts or gaming enthusiasts—along for the ride, who helped to craft the scenario and took part in the game. French astronaut Jean-François Clervoy and several influential streamers, including top French role-playing gamer Fibre Tigre as game master, Ultia, MisterMV and Hugo Lisoir, were there too. The livestream attracted 86,000 viewers, putting it in the Twitch France top five on the evening it went out, and a total of 330,000 views on replay.

FRANCE-PORTUGAL IN THE SPOTLIGHT

Focused on compelling themes like the oceans and environmental conservation, the France-Portugal 2022 season provided the French and Portuguese space agencies the opportunity to strengthen their ties through joint projects that gave rise to fruitful exchanges and strong synergies, backed by the Institut français and the Portuguese Comisario.
The exhibition of Pleiades and GeoSat images of the French and Portuguese coastlines organized in Bordeaux and Guimaraes, the parabolic flight campaign and the Spatiobus tour through several regions of Portugal sought to bring space to a wide audience of schoolchildren and students.

FIRST SCIENCE DAY

This new yearly CNES event devoted to space science aims to share results, visions and discussions between research communities studying the Earth system, universe science, materials science and life science. The first edition took place on 18 October 2022 in Paris.

YGGDRASIL FESTIVAL IMMERSES VISITORS IN SPACE SCIENCE

On 12 and 13 February 2022, CNES took part in the Demain mais en mieux (A Better Tomorrow) exhibition at the Yggdrasil festival in Lyon. This festival devoted to imaginary and imaginable worlds offered visitors an immersive scientific voyage aboard a spacecraft. Inside a 3.000m2 exhibition space, they were able to meet scientists and engineers, attend conferences, take part in workshops, talk about exoplanets and more. Alongside a panel of research organizations, we notably addressed the themes of Mars exploration and space innovation to satisfy the curiosity of a public eager to learn.

24,000
visitors attended the Yggdrasil festival in 2022.

CNES EDUCATION BEARS STANDARD FOR EUROPE

In 2020, CNES joined ESA's European Space Education Resource Office programme (ESERO) with the aid of its partners—the La main à la pâte foundation, the Cité de l'espace space theme park and Planète Sciences—and support from the Ministry of Education and Youth.
Over the last three years, ESERO France has made available more than 150 education resources and brought together 70,300 pupils and 6,550 teachers on six education projects. Training has been dispensed to 900 teachers all over France, and space events and classroom visits organized for 90,000 youngsters and their parents. At the end of 2022, ESA decided to renew this partnership with CNES for the 2023-2025 period and solicited it for a pilot phase of Space Camp in the summer of 2023—a great opportunity to show our young French learners what Europe's space programme is all about.

Listen to the talks (FR)

TUESDAY SPACE TALKS IN TOULOUSE

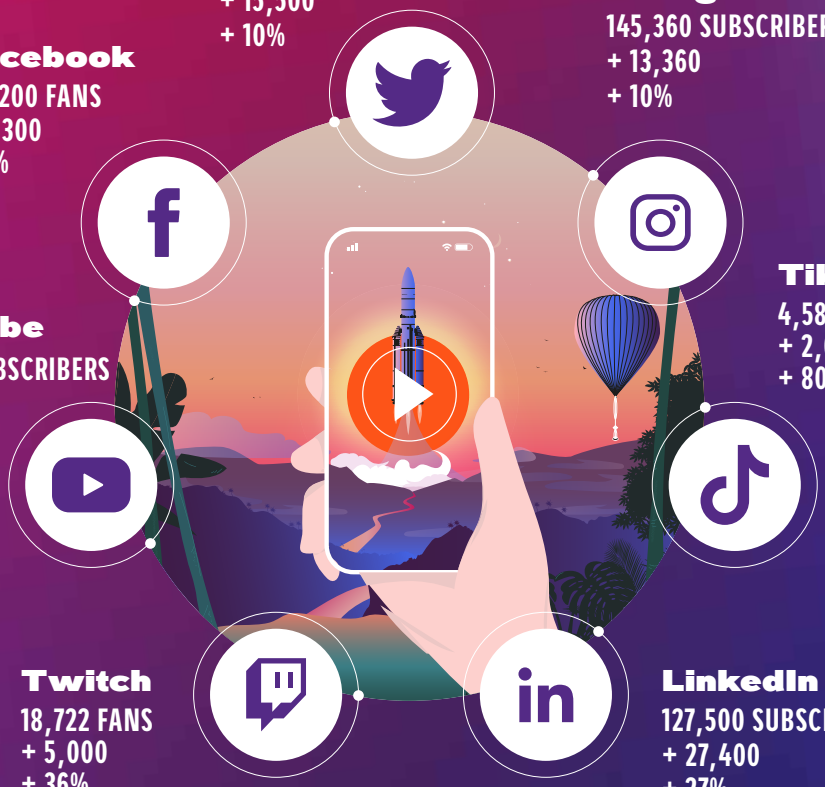
For the 2022-2023 season of Tuesday space talks, CNES and partner association the Science Bar set up stall in Toulouse for three exceptional evenings, the first of which was in October 2022.

These evenings, which are free and open to all, look at a space-related theme with talks by experts from CNES and other scientific bodies and institutions, interspersed with musical interludes. The Toulouse public were thus able to learn more about a range of topics such as the James Webb Space Telescope and the SWOT satellite and get all their questions answered.

C'SPACE ANNUAL GATHERING FOR STUDENT SPACE PROJECTS

This event for youngsters and professionals from 18 to 22 July 2022 at the Camp de Ger military base saw launches of experimental rockets, balloons and cansats developed by student clubs during the school year. The area open to the public featured booths showcasing student activities organized by CNES and its partner Planète Sciences, both celebrating their 60th anniversary. C'Space 2023 will also be the 60th edition of this initiative where students get the chance to present high-tech space projects.

2022 SOCIAL MEDIA REVIEW



Twitter
176,400 SUBSCRIBERS
+ 15,500
+ 10%

Instagram
145,360 SUBSCRIBERS
+ 13,360
+ 10%

Facebook
141,200 FANS
+ 4,300
+ 3%

TikTok
4,580 FANS
+ 2,040
+ 80%

YouTube
97,800 SUBSCRIBERS
+ 1,500
+ 2%

Twitch
18,722 FANS
+ 5,000
+ 36%

LinkedIn
127,500 SUBSCRIBERS
+ 27,400
+ 27%

2022 was marked by a large number of events on CNES's Twitch channel, with livestreams, theme-based programmes, quizzes, career focuses and gaming evenings to name a few.

Our LinkedIn account also continued to grow, with a first livestream on the national military space strategy and a now monthly newsletter.

Also, the year saw our big return to TikTok, one of the social media channels preferred by the 16-25 age group.

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