



Expleo **Innovation** **with Impact**

July 2021

(expleo)



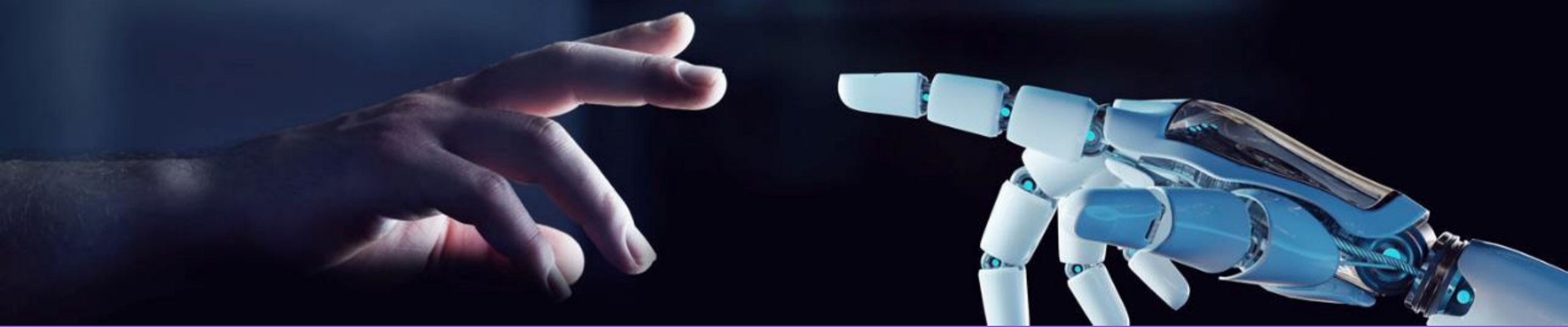
High-velocity change has become our default setting. Businesses are under pressure to respond to fast-evolving environments and to deliver breakthrough innovations that accelerate growth.

At the same time, the need to address the climate crisis and growing social inequality means that businesses must consider not just financial performance but also societal and ecological impact.

To address these enormous challenges, entire industries are completely rethinking and overhauling the way they operate. But transformation on this scale is not easy.

It requires the collective brainpower of the world's best and brightest problem-solvers.

This is where Expleo comes in.



Our bold, proactive innovators work hand-in-hand with our clients to optimise their performance and help unlock their potential, by building innovative solutions that anticipate the needs of tomorrow.

We're passionate about reinventing products, services and industries to help build a greener, safer world where each individual lives better. We put this principle at the heart of every decision we make and initiative we undertake.

Whether we're collaborating on a new kind of brain-controlled "exoskeleton" that allows tetraplegic people to walk again, using bamboo to reduce the environmental footprint of aircraft, or helping deploy a constellation of 900 satellites to deliver affordable internet access around the world, we are driven by a singular and powerful purpose every day: to transform technological expertise into concrete solutions for a greener, safer and better tomorrow.

That's the Expleo way.

**At Expleo, we are transforming
technological expertise
into concrete solutions
for a greener, safer
and better tomorrow.**

Together, we can reimagine...

#1 The way we move

Our lives are not static. Society and the economy are driven by mobility, keeping people and goods in constant circulation. But 95 per cent of the transport we rely on are prime contributors to air pollution and climate change. To protect the environment and guarantee our health and quality of life, we must rethink mobility. Through autonomous, sustainable electric vehicles or we can create safer, cleaner and more efficient transportation for our communities.

#2 How our cities operate

Today, 95 per cent of the world's population lives on just 1 per cent of its landmass. Concentration of people in towns and cities has created inefficiencies and inequalities in distribution of resources and services. With urban population growth showing no sign of slowing down, we must urgently address the way that our cities work, implementing intelligent systems that create a fairer environment with more abundant and sustainable resources for all.

#3 A transition towards a more circular economy

The world is suffering the consequences a “take-make-dispose” approach to production and consumption. Of all plastic produced worldwide, half is used once and thrown away. Today, 300 million tonnes of plastic waste is produced each year.

Having a circular economy, which promotes the elimination of waste and the responsible use/reuse of natural resources, could generate \$4.5 trillion of additional economic output by 2030.

#4 How we deliver healthcare

Growing and ageing populations have put healthcare systems under greater pressure than ever before. The pandemic has only increased the need of new models of healthcare provision. In parallel, rapid technological advances are creating breakthroughs in procedures and treatment, offering hope to millions around the world whose conditions were previously considered untreatable or incurable. These technologies will form the basis of new healthcare systems which will improve wellness outcomes for people the world over.

#5 The way we power our planet

Harnessing new fuel sources for energy has been the great driver of economic expansion and social progress throughout human history. However, the legacy systems on which we currently rely on damage the environment, doing more harm than good. They must be replaced before it is too late.

We must explore new ways of generating clean, safe energy and work to implement these at scale, with minimal disruption to daily lives. In doing so, we will transition towards a more sustainable energy ecosystem.

#6 The possibilities beyond our atmosphere

Human existence has been defined by a pursuit of understanding the world around us. But the challenges we face today are too complex to continue just looking around us. We need to look beyond our atmosphere. There's still much to learn about space but we know it offers untapped potential to broaden human knowledge, and look after our planet. Through a better understanding of the universe, we can open new frontiers on Earth and beyond.



**#1 Reimagining
the way we move**

Electric Air Taxi

What's the context?

Urbanisation has made our cities both wider and taller, cramming more people into smaller spaces. With more people driving every day, road networks have become congested to the point of failure. In fact, pre-pandemic, **traffic congestion rose in 57% of cities globally**. For the safe transport of people, we need to think vertically as well as horizontally. That means looking to the skies.

What did we do?

Silver Atena has helped a European pioneer of urban air mobility to develop a prototype autonomous electric air taxi prototype for use in towns and cities. Our experience working across automotive, aerospace and defence has been fundamental in **overcoming barriers to urban flight, including vertical take-off and landing**, while our deep knowledge of highly-regulated industries is key as the urban air taxi market navigates new and unique safety regulation.

What's the impact?

Silver Atena reduces both noise pollution and the environmental impact of urban mobility while breaking boundaries socially and economically. Safe urban flight almost exponentially increases the transport network in towns and cities making it easier for people to travel further, faster than before opening new opportunities for work and the economy. **Its electric propulsion engines are emissions-free and run more quietly than ambient noise in cities (c. 65-70dB), drastically reducing air and noise pollution.**

What's next?

The potential benefits to air quality and urban mobility have seen the industry attracting more and more interest with **many innovative players securing funding over and beyond USD 200m**. Recognising these benefits, the European Union Aviation Safety Association has also outlined a pathway to compliance for manufacturers marking a key milestone for fleets of air taxis to be deployed in major cities.



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Flying Whales

What's the context?

As towns and cities expand, we need resources to create new infrastructure. However, heavy raw materials such as timber are found far from where they are needed. This has created a logistical and environmental nightmare. It is believed up to **17% of deforestation in tropical and sub-tropical countries is caused by infrastructure** projects such as road building. In the Amazon alone, road projects over the next five years are forecast to lead to **5.9 million acres of deforestation**. We must urgently minimise the environmental impact of industries such as forestry and mining, with transport a key contributor to pollution and wildlife disruption.

What did we do?

Flying Whales is reshaping the transport of materials through flight. With Expleo's support, the company has designed a safe, quiet and green airship **capable of carrying 60 tonnes of heavy charge**. The electric propeller-powered airship requires no additional infrastructure such as roads or landing pads to operate, allowing it to serve remote locations without disrupting the local environment or wildlife. Expleo has led the stress testing of the project, proving its viability in real-world deployments.

What's the impact?

Expleo's experience in the aero field, as well as its mechanical engineering heritage, has been a key driver in the progression of this project beyond proof of concept with prototypes scheduled for launch in the next two years. The project has generated significant interest across the globe with investment from the French and Canadian governments, plus investors from across Europe and Asia.

What's next?

Originally designed to support logging in the Amazon rainforest, **the scope of the project is being widened to other sectors and environments**. Work is underway to optimise Flying Whales performance to reach and transport materials in harsh weather conditions. As the project progresses, Expleo's will support Flying Whales as it moves to the manufacturing phase of its project.





#2 Reimagining how our cities operate

Vertical Urban Agriculture

What's the context?

The UN predicts the population of the world will reach **almost 10 billion**. Meanwhile, **14% of all food produced is wasted before it even reaches consumers**. As we look to feed an ever-growing number of mouths, it is clear existing food supply chains aren't fit for purpose. Growing crops closer to the point of use will fight waste and limit environmental damage.

What did we do?

Green City Farming is making the way we grow crops greener, more efficient and more sustainable. Drawing on and applying Expleo engineering expertise relating to fluid water, plastic component modelling and electrical power systems it has been able to conceptualise and develop a method that allows crops to be grown in urban environments where they are needed, in large volumes. Using a combination of hydroponics and aeroponics – approaches that allow crops to be grown without soil, using mineral solutions in water or mists – the Urban Vertical Agriculture method will help communities produce and feed themselves using their own sustainable crops.

What's the impact?

Urban Vertical Agriculture has **the potential to help alleviate the food crisis that faces our growing population**. Farming is one of the greatest threats to freshwater supplies worldwide, but this new soil-less method has the potential to address that, **using 90% less water than traditional methods**. The use of low-energy LED lighting minimises both energy usage and heat generation. Moving production closer to the point of use will shorten supply chains, reducing carbon emissions and costs. Furthermore, protection from insects and bacteria means crops are non-GM and pesticide-free.

What's next?

The project has now moved past the conceptual level to real-world deployments with use across commercial kitchens looking to provide 'farm to table' experiences. While created for urban environments, **pilots are ongoing in South Africa as proof of space-effective farming**. Meanwhile, conversations with facilities management groups are ongoing as they look to develop green, multi-use spaces in cities and towns.



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Autonomous Valet Parking Project

What's the context?

While COVID-19 has caused a shift to remote working many still commute every day. Even while congestion is temporarily eased by lockdown restrictions, road traffic remains a problem: **the average commuter in Paris and London lost 88 and 69 hours respectively in traffic last year.** In many cities, finding somewhere to safely park is a challenge for many commuters, contributing to congestion and air pollution.

What did we do?

Expleo works with Valeo on its Autonomous Valet Parking (AVP) solution which makes driving in cities quicker, more convenient and safer. Using our deep experience across the automotive value chain, AVP harnesses the power of AI and computer vision, so that **virtually any car can enter, exit and park itself in an underground or multi-storey car park, improving driver safety and saving time.**

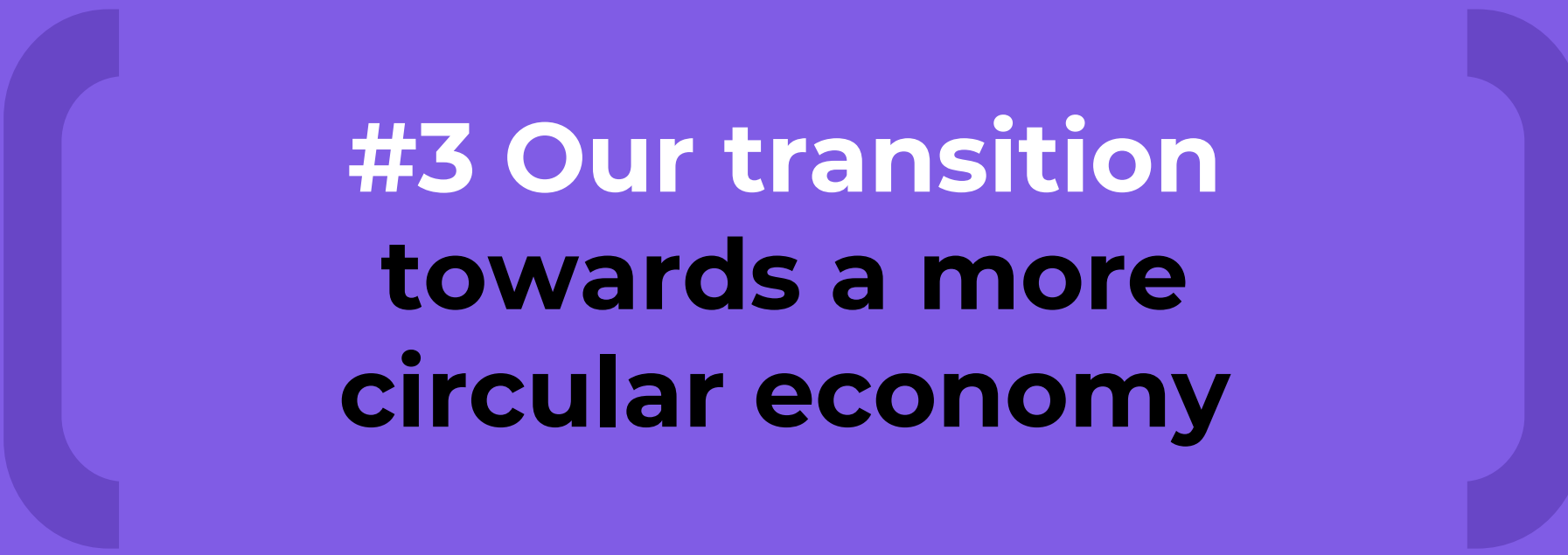
What's the impact?

The use of autonomous driving technology will address road congestion in cities by helping people park, getting cars off the road quicker than ever before. Drivers will no longer need to enter deeper levels of car parks, addressing concerns around safety and time-wastage that see only the spaces nearest entrances and exits used. Furthermore, by improving parking space efficiency – **75% of multi-storey parking spaces in Paris are empty despite being one of Europe's most congested cities** – the overall cost of parking can be reduced for consumers. In the future, cars with AVP technology will be able to be serviced, cleaned and more safely and easily when parked.

What's next?

The second version of AVP is already in production, addressing some of the shortfalls of the first-generation technology. AVP 2 makes use of sensors in parking infrastructure as opposed to just those in cars. This removes 'blind spots' and 'dead zones' in **computer vision mapping used in autonomous driving to make it even safer and more widely applicable.** Manufacturers hope to deploy this technology by 2022. AVP technology has also been earmarked to improve the jockeying process of cars on the factory floor.





#3 Our transition towards a more circular economy

BAMCO – Bamboo-based composites

What's the context?

Conversations around a green future emphasise energy and fuel emissions but the materials used in everyday products also have a huge impact too on the environment and human health. The EU's REACH regulation looks to combat this, removing certain chemicals from industrial processes, including the petrochemicals used to manufacture aircraft and other machinery that relies on a high strength-to-weight ratio.

What did we do?

Expleo is leading the BAMCO project, creating new green bio-composites for aircraft which **are lighter, equal in performance and greener** than composites currently used for cabin interiors. Made from bamboo fibres and bio-based resins, these new composites are being developed to replace the non-recyclable glass/phenolic composites used in cabin cladding. The project is currently at the pre-industrialisation phase and Expleo is working with six key partners: Arkema, CIRIMAT, Cobratex, Compositadour, Mécano ID and Specific Polymers.

What's the impact?

The bio-composites being **created reduce the weight of aircraft, lowering fuel consumption**. BAMCO materials can be implemented using standard composite processes to improve aircrafts' green credentials.. Case studies are ongoing with Airbus and bamboo has proven to provide the necessary strength and vibration absorption for use in these applications. Moreover, as a widespread natural crop, **the process can be easily industrialised instead of using finite natural resources**.

What's next?

After three years of research, the consortium has entered the pre-industrialisation phase with prototype aircraft parts to be manufactured in 2021. The next phase of the project, BAMCO II is being set up which will optimise the performance of bio composites developed in the initial project phase and is certified by Aerospace Valley.



Carbon Composite Recycling

What's the context?

Since Leo Baekeland first patented Bakelite in 1907, society has become reliant on plastic. So much so that **380 million tonnes are produced each year**. While plastics have proved to be endlessly useful, they are just as harmful to the environment. Recycling programmes have improved in recent years but fail to address highly durable thermoset plastics used in industrial settings such as the manufacture of aircraft which represent over **10% of all plastics produced**.

What did we do?

The Expleo Eco-Design Centre is pioneering an all-new process to make previously un-recyclable materials sustainable, reducing plastic waste. The PhD research project with Université Toulouse III – Paul Sabatier is targeting Carbon Fibre Reinforced Polymers (CFRP) used in aircraft. The experimental process has two key parts: **a new recycling process and the application of greener bio-based resins** to be used in the manufacture of composites.

What's the impact?

The new carbon composite recycling processes will make it possible to recycle CFRPs with **90% of the mechanical properties of virgin carbon fibres maintained**. This will eliminate a large amount of plastic waste and allow these fibres to be reused for a range of applications. Reducing the environmental impact of industry requires a holistic outlook across the entire supply chain, focusing on materials and processes as well as fuel emissions. For instance, a Boeing 787 Dreamliner is 50% CFRP by weight which currently would be destroyed at the end of its 15-20 year lifecycle. This process will allow much of that material to be **reused either in the manufacture of new aircraft or other products**.

What's next?

While developed and tested on CFRPs used in the manufacture of aircraft, the process applies to a wider range of products, with **CFRPs used in everything from cars to sports fields to solar panels**. Proven in a lab setting, refinements are being made to the time and energy it requires with plans to industrialise the process at the end of the PhD programme in 2023.





#4 Reimagining how we deliver healthcare

Brain Computer Interface Implant

What's the context?

Estimates suggest that as many as **500,000 people around the world are suffer new spinal cord injuries each year**. The overwhelming majority are faced with life-changing conditions such as paralysis and quadriplegia limiting their ability to live comfortable and independent lives.

What did we do?

Starting in 2015, Expleo began work with Clnatec on a project that would empower quadriplegics by giving them back their independence, allowing them to once again walk and directly interact with their environments. By placing **two implants directly on a patient's brain, patients can directly control neuro-prosthetics such as a wheelchair or an exoskeleton via the power of thought**. Expleo has provided the test bench for all the electronics and developed firmware for the implant, as well as training programmes to help patients learn to use the implant.

What's the impact?

Thanks to the dedicated exoskeleton, patients have been able to walk and use the arms of the exoskeleton to pick up objects for the first time since their injuries. This technology has **the power to give patients with severe motor function limitations greater autonomy to live independent, fulfilling lives**.

What's next?

Development of the implant is ongoing and soon enters a new phase of clinical trials with two new patients. Expleo continues to work with Clnatec to fine-tune the software to improve the fluidity of motion when working with the exoskeleton, enabling more complex actions. Plans are in place to enable **direct interaction with connected home devices such as TVs, heating systems and more**. A new interface is being developed to allow paraplegic patients to use the exoskeleton.



Covid-19 Contact-tracing App

What's the context?

The COVID-19 pandemic is arguably the single most transformative event for the global community in generations. With **over 136 million cases to-date and a death toll reaching nearly 3 million**, no corner of society has gone untouched. In March 2020, the containment and control of the disease through contract tracing became a global imperative to prevent infections and accelerate a return to normality.

What did we do?

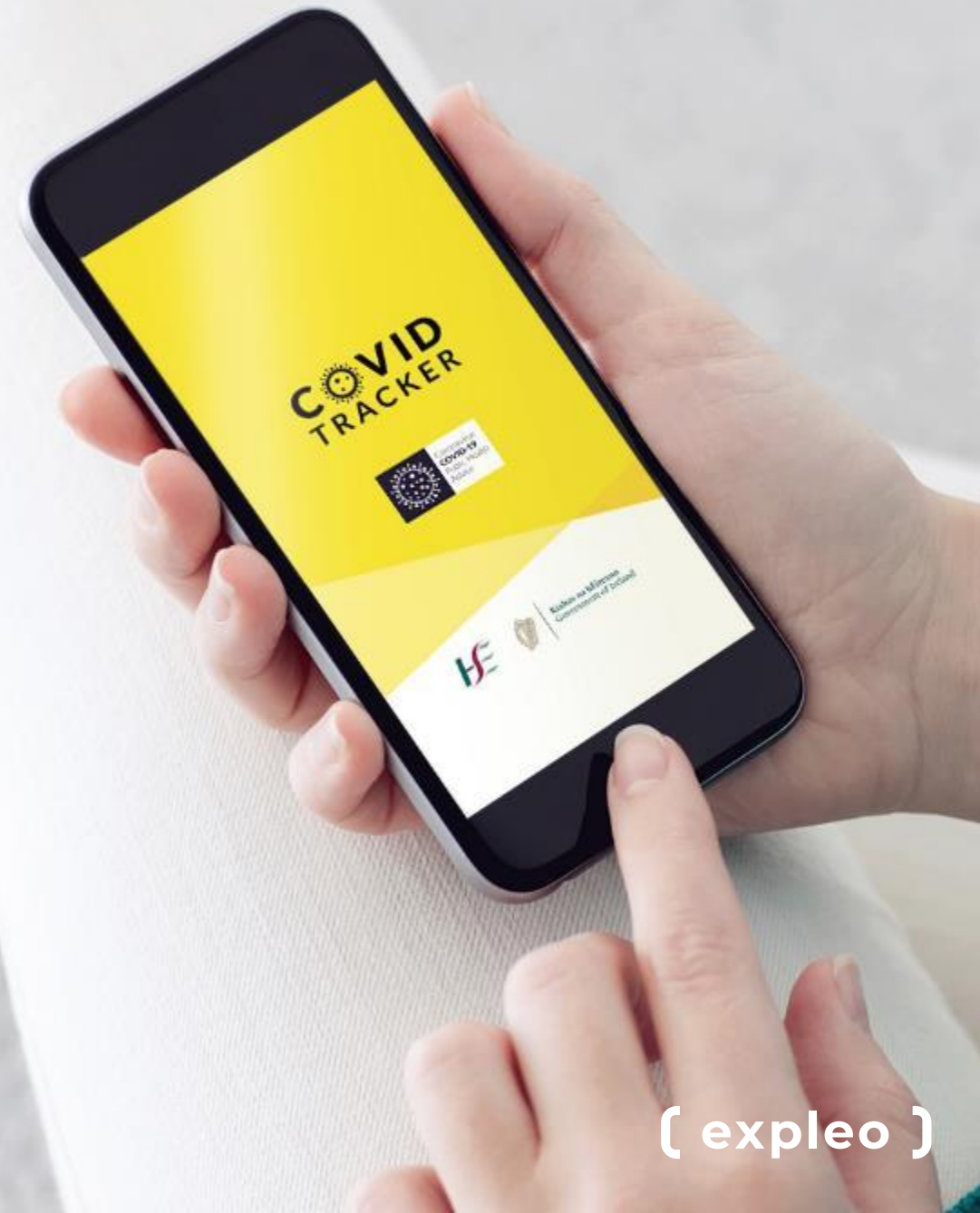
Working with Ireland's Health Services Executive (HSE), Expleo launched the HSE's most ambitious ever technology project: the COVID Tracker Ireland (CTI) app. The app notifies users who have been exposed to COVID-19 in the past 14 days and was launched to the public in July 2020 following a rigorous assurance process including **3,400 individual tests and 591 days' worth of working man hours**.

What's the impact?

The app was widely lauded as amongst the best-in-class and was **downloaded 1.44 million times in its first weeks, logging 300,000 check-ins each day**, helping control COVID-19 in Ireland. With the success of the project dependent on user trust, it was important that the application was robust and effective as well as deployed quickly to stem the spread of the disease. Expleo ensured that the CTI app met both quality standards and was delivered against constrained timelines.

What's next?

Expleo was also pivotal in the delivery of the Protect Scotland contact tracing application. An additional **1,500 hours of testing** were invested to augment the near **5,000 hours spent** on the Irish CTI app to support anticipated demand and activity from users.





#5 Reimagining the way we power our planet

ITER Nuclear Fusion Reactor

What's the context?

A world driven by connected technology requires a lot of energy to keep turning. Around **24,000 terawatt-hours of electricity globally each year**, in fact. Yet only 28% of that energy is generated sustainably and **60% comes from coal and gas**. With electricity consumption trebling since 1980 and set to grow further, our reliance on fossil fuels must be addressed to prevent further damage to environment. Thermonuclear fusion – the process which powers the sun – offers the potential of a truly clean energy future.

What did we do?

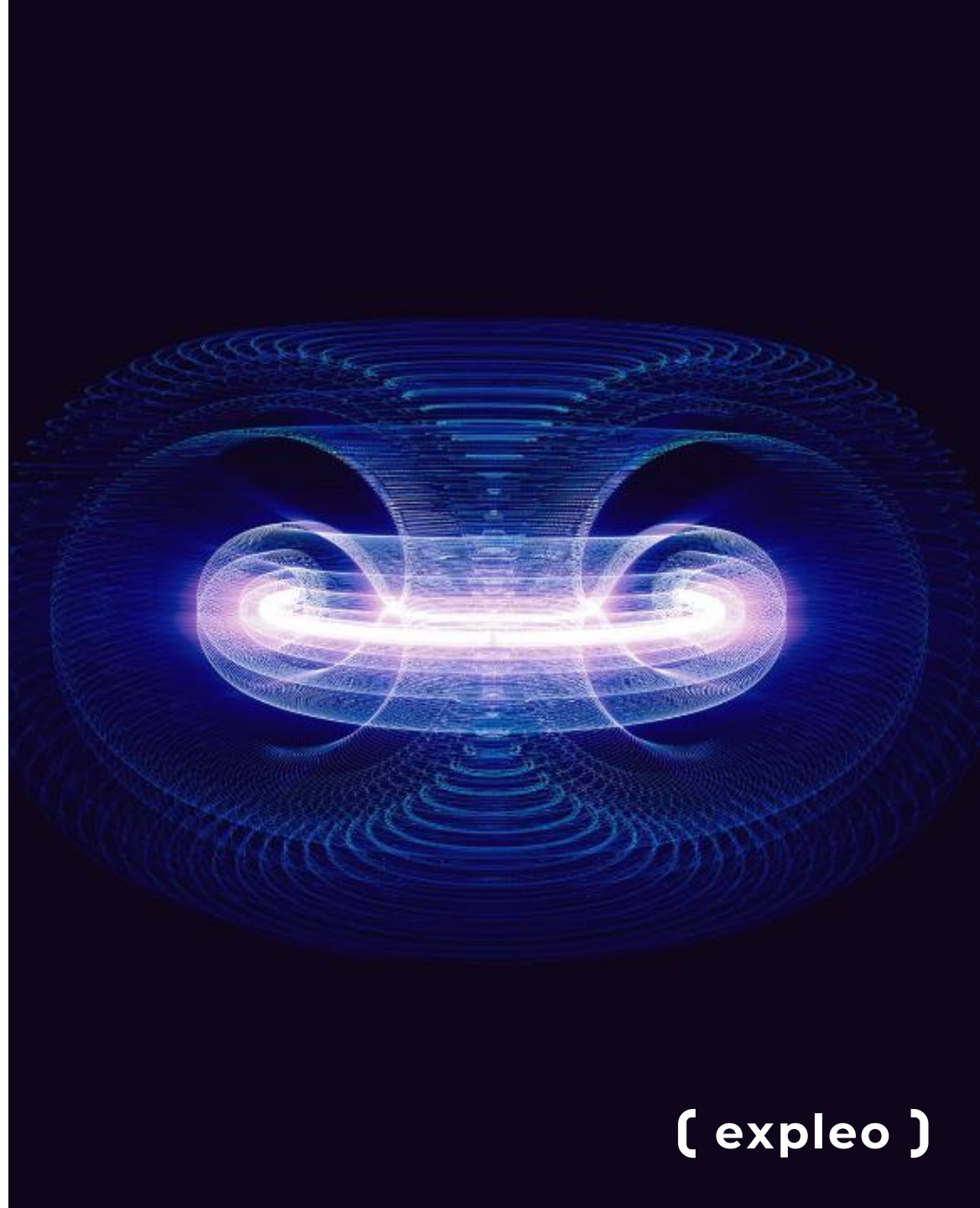
The International Thermonuclear Experimental Reactor (ITER) is a worldwide initiative looking to solve the challenge of **clean, cheap and plentiful energy through the same technology that powers the sun**. Working with Fusion For Energy– the European agency contributing to ITER – since 2018, Expleo is leading systems engineering efforts on the project, supporting design and documentation as well as interoperability and integration of all-new components manufactured for the reactor.

What's the impact?

Nuclear fusion has the potential to **completely transform energy production worldwide**, providing bountiful clean energy to meet the needs of today and tomorrow. It relies on fuels that are both readily available and almost infinite; enough lithium needed to fuel the process for millions of years can be found in the planet's seas and oceans. Similarly, it **produces no CO2 or long-lived radioactive waste** as by-products.

What's next?

The final phase of the project started in 2007 and progresses towards its goal of demonstrating the technical feasibility of Nuclear Fusion as an energy source. Expleo continues to support Fusion For Energy on key activities relating to regulation, safety and compliance as the programme aims to demo nuclear fusion for the first time towards the end of this decade.





#6 Reimagining the possibilities beyond our atmosphere

ENSO

(Expleo Nanosat for Solar-irradiance Observations)

What's the context?

Today around 2,000 satellites orbit Earth, supporting everything from weather forecasts to financial systems. However, **3,000 dead satellites and 34,000 pieces of space junk** pose a threat to their safe operation every day. If we are to continue to maximise the benefits of space technology on Earth, we need to look for new approaches.

What did we do?

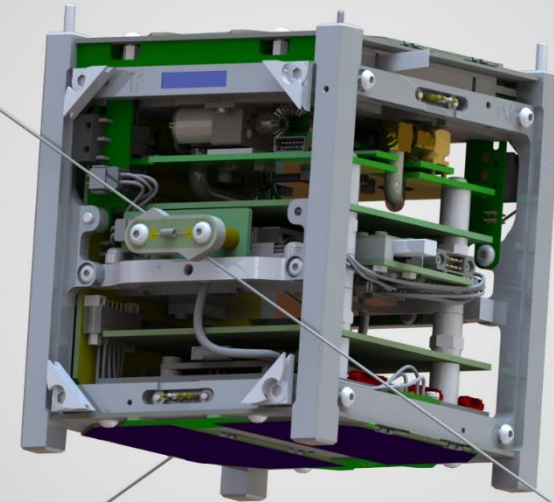
The Expleo-led ENSO CubeSAT programme has **successfully miniaturised satellites to just 10x10x10cm** – small enough to hold in your hands. The in-house project is in partnership with the University Space Centre of Montpellier, with Expleo creating a nanosatellite R&D platform that aims **to help characterise the ionosphere by providing a signal to SANSA ground stations that measure solar activity and its impact on Earth.**

What's the impact?

Nanosatellites have the potential to remove many of the barriers to entry for privatised and commercial space programmes, including space flight and environmental monitoring. ENSO will launch satellites to measure the impact of solar activity on Earth, furthering our knowledge of the world and space.

What's next?

With the cost of a nanosatellite dramatically lower compared to standard satellites, emphasis is now on reducing the cost of launch to support commercialisation. This will lower costs and accelerate deployment enough to make it possible for companies to launch their own satellite networks to support applications such as private telecoms networks, supporting economic growth.



OneWeb Airbus

What's the context?

A world without the internet is impossible to imagine. Its influence is felt everywhere, breaking social barriers and powering the modern economy. It has become so important, Tim Berners-Lee has added his voice to the calls to make internet access a human right alongside freedom, education and democracy. Yet today, **more than 40% of the world's population – especially in rural and developing areas – doesn't have access to the internet** and are excluded from its cultural and economic benefits.

What did we do?

Expleo, as one of Air, is **expanding internet access worldwide through a 900-strong constellation of satellites**. The use of compact yet powerful satellites mitigates against a lack of wired infrastructure in remote locations, providing high-speed, affordable internet to previously cut-off communities. Expleo's proven engineering expertise in space engineering and support services has been integral through the assembly, integration, tests and launch phases of the programme including some EGSE development.

What's the impact?

Expleo, as one of Airbus Oneweb's industry partners, is **expanding internet access worldwide through a 900-strong constellation of satellites**. The use of compact yet powerful satellites mitigates against a lack of wired infrastructure in remote locations, providing high-speed, affordable internet to previously cut-off communities. Expleo's proven engineering expertise in space engineering and support services has been integral through the assembly, integration, tests and launch phases of the programme including some EGSE development.

What's next?

Since Expleo supported the initial launch of 6 satellites from Kourou, Guyana further deployments have taken place. Satellite networks are a key component of the 5G age of mobile broadband and will support the huge demand for connected services worldwide.



