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Spacetech

The big business of
space on Earth



Spacetech

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Highly sophisticated space technologies are creating an explosion of business opportunities on Earth. And experts say we've only scratched the surface of what's possible. *Spacetech: The big business of space on Earth* is a Sifted Intelligence report that provides an extensive overview of the European spacetech ecosystem. It calls out the most active and promising disruptors and — following a surge of investment activity — weighs in on where the smart money is likely to go next. We also introduce the many European companies vying to develop products off Earth, and explain how breakthroughs in orbit can further transform life on the ground.

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Space is open for business

Emerging applications of spacetech are starting to influence our lives, and businesses, in ways that can't be ignored says Deloitte Space's Alex Bird and Deloitte Ventures' Mollie Martin



Space has always captured our curiosity and imagination. But it's becoming more and more relevant to our everyday lives, driving innovation and increasing productivity across almost every sector. Where the exploration of the late 20th century motivated a generation to be fascinated by life beyond Earth, we find ourselves again looking up for inspiration, this time to consider the many ways space technology can offer value for life on Earth.

“Spacetech doesn’t exist for the sole benefit of the space sector, it offers non-space organisations the opportunity to innovate.”

Falling costs of rocket build and launch — the very things needed to get data-collecting satellites into orbit — emerging technologies, and the ambition of

entrepreneurs and innovators is creating the dawn of a new era for space. Otherwise known as “new space”, it has relevance to everyone and is increasingly backed by private finance.

At Deloitte, we’re excited to sponsor Sifted’s inaugural spacetech report, as it speaks to the huge potential of the sector. This report sheds light on the growing momentum of investment in the space sector, uncovers the big bets of spacetech across Europe and showcases the startups leading the way. Importantly, it also puts into focus the role of space across different industries.

Spacetech doesn’t exist for the sole benefit of the space sector, it offers non-space organisations the opportunity to innovate. Emerging applications of space-enabled technology are starting to influence our lives, and businesses, in ways that can't be ignored. Through our spacetech accelerator alone, we've seen solutions to help organisations use satellite data to verify the value of carbon credits, enable near instant insurance pay-outs, monitor infrastructure and physical

assets at scale, and even track marine mammals from space — and that's just the start.

More urgently, spacetech is an important piece of the puzzle in helping us to deal with the critical issues of our time. From Voyager 1's 'pale blue dot' image of Earth, through to the ultra-high resolution sensing we have today, space has repeatedly allowed us to change the way we perceive and understand our home planet. It's for this reason that our climate teams have come to understand that it's impossible to separate space from sustainability.

“Spacetech should be on the radar of organisations across every industry.”

Looking beyond the horizon, we're excited by the possibilities of space-based solar power, in-orbit edge computing and a future where internet connection is readily available to everyone. We believe that spacetech

should be on the radar of organisations across every industry, from their innovation to data science teams. Unsurprisingly, this report finds that investors are increasingly focused on the sector, which is expected to more than double in size over the next 15 years.

Continued innovation and adoption of spacetech relies on collaboration with the ecosystem. The new space phenomenon will be driven by private enterprises, startups and public sector organisations working together. We're playing our part by connecting our clients to the ecosystem and championing the value of space for life on earth. It's why we've invested in our spacetech accelerator, built out our space practice, and are developing our spacetech innovation portfolio.

This report demonstrates the breadth of spacetech startups already operating in Europe. Some are building rockets, others are building satellites, and many are using the data to provide insights to businesses and end-users. However, what's clear is that no one company can do it alone. Collaboration is key.

Alex Bird, Deloitte Space

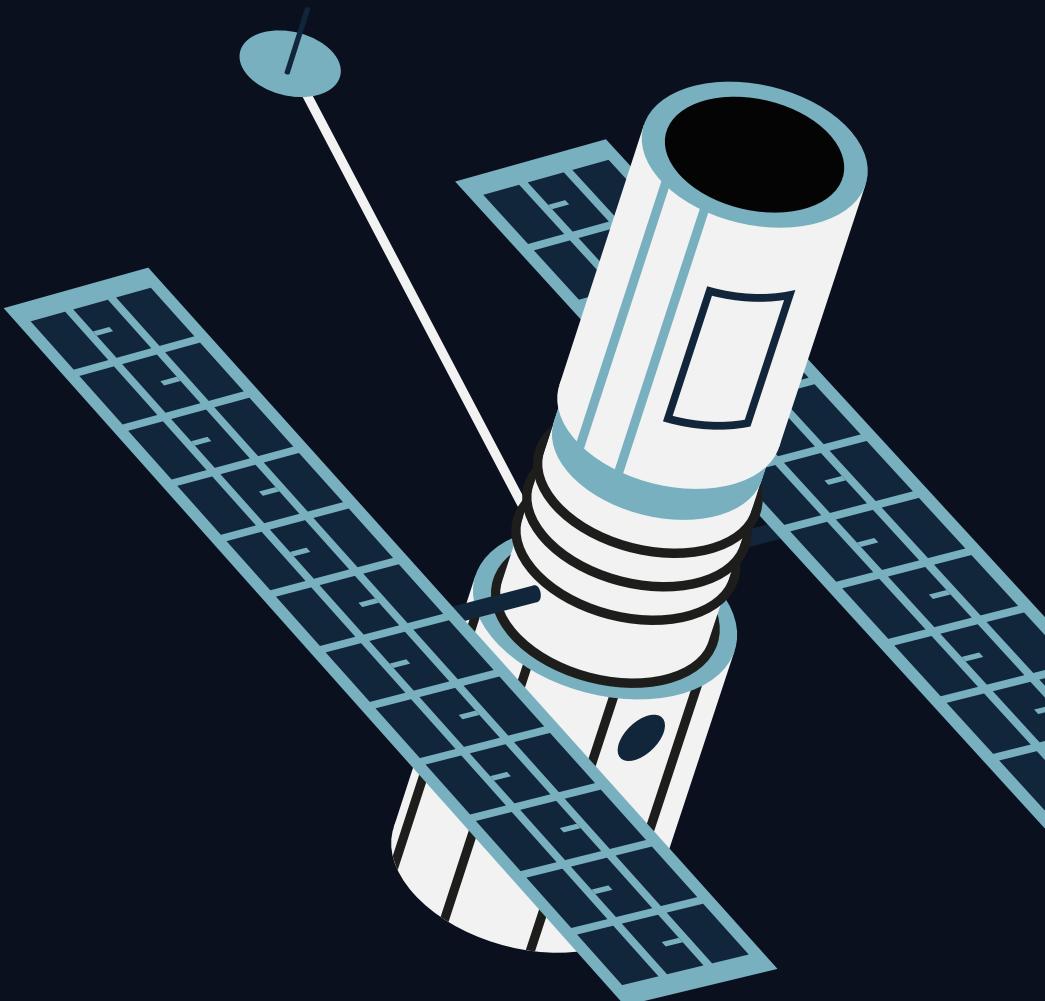
Mollie Martin, Deloitte Ventures



space
+
spacetech

3... 2... 1...
blastoff!

**European spacetech
goes into orbit**



What's space ever done for us? It's not immediately obvious how we benefit from rockets shooting out of Florida or French Guiana. But in the last few decades the drive to explore the universe has provided a lot of useful everyday items on Earth: cordless vacuum cleaners, Velcro, memory foam. It's given us ever-smaller electronics, freeze-dried food and wearable health monitors — which started off as tools to help keep tabs on astronaut health.

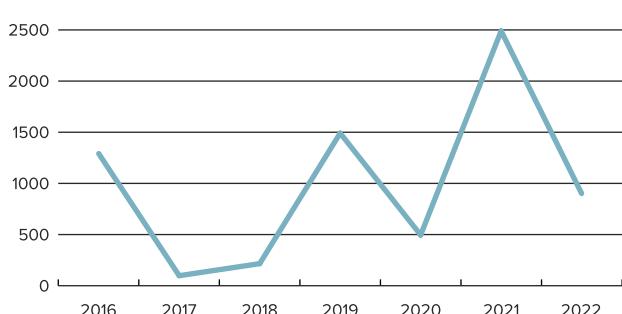
And few realise that spacetech is increasingly responsible for many invisible parts of life: Google Maps and Uber rely on a network of satellites that enable location pinpointing; weather satellites analyse hurricanes and heatwaves; the safety communications on planes and ships; pictures of troop movements in Ukraine; broadband services in hard-to-reach locations. Someday, space may be the place where we make new drugs and materials; maybe even food, wine and organs.

Space was, until fairly recently, an arena for governments to worry about and somewhere few private companies (or investors) would dare to go. Manufacturing satellites the size of a bus and sending them into space was about as expensive as you'd expect. But then came the invention of cubesats — nanosatellites no bigger than a toaster costing a relatively small \$1m or less, which circle the Earth in low orbit (around 800 miles up) — and these changed the equation entirely.

Mixed signals: spacetech funding has rocketed and crashed over the past seven years

VC funding into European spacetech, 2016-2022 (\$m)

Source: Dealroom



Suddenly space became cheaper and easier to access. Many started calling it the "new space" era.

Today the cost of launching a satellite using Elon Musk's SpaceX — the company that has arguably done the most to improve the affordability of space — is less than 8% of the cost of doing so before 2000, according to Harvard Business Review.

"When I started in space, way back in the day, it was all about big companies with space heritage, the tried and tested ones, a zero-risk approach. Now it's much more accommodating of innovative tech," says Tony McDonald, space consultant and Ireland's former delegate to the intergovernmental European Space Agency (ESA).

“Investors are betting on the startups whose capabilities could power the next several decades of earthly innovation.”

Defence ministries are still the number one buyers of space-related equipment, but the proliferation of smartphones and other satellite-connected devices, and the advent of truly reusable rockets, has driven significant demand for satellites. Within the last two decades, the number of commercial Earth observation satellites has increased from "11 in 2006 to more than 500 in 2022, about 350 of which belong to US companies," writes Mariel Borowitz, an associate professor at the School of International Affairs at the Georgia Institute of Technology.

Investors are flocking to the sector they once perceived as too capital intensive, with too limited a set of buyers. VC funding for spacetech companies saw a record amount raised in 2021, according to market research firm PitchBook (and then, like virtually every tech field, investment dipped in 2022). These investors are betting on the startups whose capabilities could power the next several decades of earthly innovation, from almost real-time pictures of climate change effects to the high-speed internet needs of autonomous cars.

SKYROCKET IN FLIGHT

Just count the number of European VC firms focused on space. "In the last two or three years, four or five vertical venture capital firms appeared, starting with Seraphim, then Primo Space, then the Luxembourg guys, then the German guys, and recently a Bulgarian fund that does private equity. I mean, five, six funds in two years, on a vertical, it's something new," says Matteo Cascinari, partner at Primo Ventures, a Milan-based VC firm focusing on space.

"Five, six funds in two years, on a vertical, it's something new."

Matteo Cascinari, partner at Primo Ventures

The majority of money for space projects has historically been funnelled to companies focused on tech with application on Earth, including satellite communications and imagery, Earth monitoring and geospatial analytics. "This is 95% of the market," Chad Anderson, founder and managing partner of VC firm Space Capital, has estimated.

Now investors are scouting the next big opportunities. "The private investment herd first went into launchers. Once that [segment] got oversaturated, it moved to constellations [networks of connected satellites] and that's where the weight of money is pouring right now — quite rightly too," says Mark Boggett, CEO of Seraphim Capital, which listed in 2021, raising £150m of fresh capital.

A few years ago NASA began preparations for this great private sector space transition by loosening restrictions on commercial activity in the International Space Station (ISS). ESA, too, has made a notable effort to embrace commercial access to space.

Just as significant has been the billionaire-led wave of space exploration, which spacetech startups have been able to ride.

The extremely rich are blasting into the upper atmosphere. Virgin Galactic's Richard Branson and



Amazon's Jeff Bezos both went some 60 miles into space in 2022 (the two companies are now licensed for passenger space travel, with single tickets likely to be around the \$450k mark).

SpaceX's upcoming Starship launch is considered by most space watchers as a pivotal one for the future of transporting goods off Earth. Elon Musk's company also says its goal is to one day make space travel more akin to air travel, with regular flights to orbit and beyond.

Other space-obsessed billionaires include Yuri Milner, the Russian-born Israeli tech investor who's putting hundreds of millions of dollars towards the search for alien life. American real estate mogul Donald Bren, meanwhile, is trying to seed an off-Earth solar energy revolution.

'NO MORE FREE MONEY': WILL STARBUCKS DRY UP?

If it's space-related, a lot of patience is required. "You may work two or three years to get your payload on the ISS, something could happen and you wouldn't know until it comes back down again," says Nicolas Gaume, cofounder and CEO of Space Cargo Unlimited, a company that wants to manufacture goods at scale in space. "So suddenly you've lost four years. It's never a sprint, it's always a marathon."

Bulgaria's Raycho Raychev expected to be beating investors away with a stick when he first started pitching his satellite company, EnduroSat. But after 32 meetings with VCs he only had one "maybe" and one "yes" to back his company. "Running a space company is like being a baby: you wake up at 5am and cry," he says.

We've just come off 15 years of a near-zero interest rate environment that encouraged risk taking. Now those conditions are gone and investment in space startups duly fell off towards the end of 2022, as stubborn, decades-high inflation and rapidly rising interest rates made it more difficult for space startups — and tech at large — to raise money.

"European spacetech is still super conservative and nascent right now," says Ksenia Moskalenko, cofounder and CEO of Mission Space, a startup that wants to



collect data on space weather. "Here you can get a €1m seed round; in the US, you can easily raise €5m plus at your seed stage." Over 70% of spacetech deals in 2022 were struck in the US.

Companies with high upfront capital needs and long lead times to revenue, including launch and emerging industries, are likely to be the most impacted over the next few years.

‘Running a space company is like being a baby: you wake up at 5am and cry.’

Raycho Raychev, founder and CEO of EnduroSat

"Clearly the investment party's over," says Damien Garot, founder of a French company called Stellar, which hopes to someday use internet-beaming satellites to empower self-driving cars. "There is no free money anymore. It's helping us come back to reality and making sure we're arriving at the table with something that's super relevant."

WE HAVE LIFT OFF

Estimates on the size of the industry vary, with investment bank Citi predicting a market for the whole space economy as big as \$1tn a year by 2040. In chapter I, we look at the key European startups poised to take a piece of this market.

Some of the best-known uses of space involve data. This usually falls into two categories: data gathered from space about what's happening on Earth, or data transmitted through space from one part of the world to another. The former is the subject of chapter II, where we look at how space companies are creating new business opportunities on Earth.

In chapter III, we look at the speculative projects, such as building factories and harnessing solar power in orbit, that entrepreneurs hope to one day make routine. Finally, we ask experts to give us their top spacetech predictions for the future.

Spacetech in Europe

A selection of up-and-coming stars

Launcher tech

The Exploration Company

HylImpulse

isar aerospace



PANGEA
AEROSPACE

RFA
Rocket Factory

SKYRORA

Satellite manufacturing & design

albaorbital

Alén
space

APOGEO
SPACE



emxys

ENDUROSAT

FOSSA

OneWeb

OPEN COSMOS



PICOSATS

SATREV

SPiN

Swissto12

u/SPACE

Satellite services

ALL.SPACE

ARQIT

astroc
cast

AURORA
PROPULSION TECHNOLOGIES

clearspace

ECSMATIC

exotrail



ION-X

kinéis

KINEXON

KRUCIAL

Lacuna
space

LEAF SPACE

Lumi

MAGORIVE

MORPHEUS
SPACE

OQ TECHNOLOGY

SATELIOT

SATLANTIS

SPACEIT

stellar

THRUSTME

wireless logic

In-space manufacturing, logistics & research

D-ORBIT



MAANA
ELECTRIC

METALYSIS

METASAT UK

SPACE CARGO UNLIMITED

SPACE FORCE

SPACE
SOLAR

YURI

Imagery, AI & data analytics

aerospacelab

AIKO

constellr

detektia

hiber

ICEYE

LATITUDO 40°

LiveE

MISSION SPACE

ORORA
TECHNOLOGIES

'overstory

Planet
Watchers

SATELLIGENCE

SATELLITEVU

share my space

Space
sense

Sylvera

TESSELO

UBOTICA

unseenlabs

VAKE

Note: startups were chosen on the basis of money raised to date and / or recommended to us by experts and investors

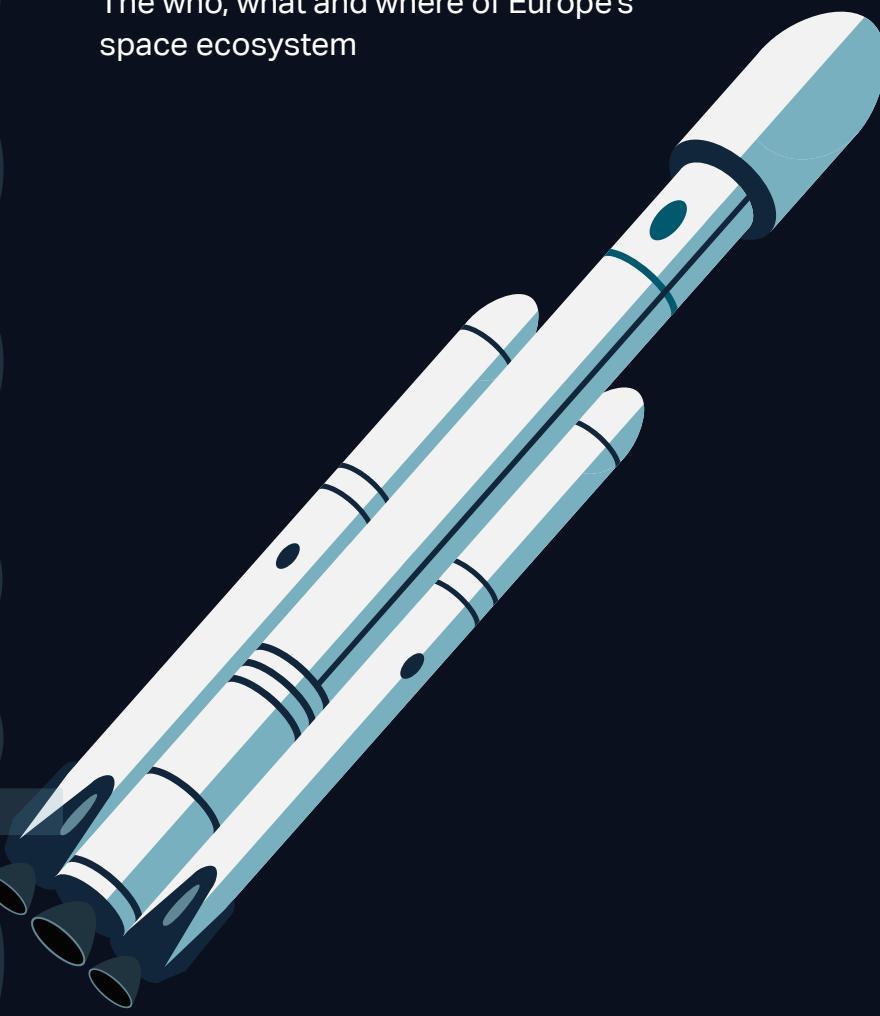
space
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Chapter I

Shooting for the moon

Finding Europe's spacetech niche

The who, what and where of Europe's
space ecosystem



There are space hotspots in Europe as well as smaller, unlikely places with no space history that are breaking into the commercial race.

Starting with the obvious: Toulouse is home to Airbus, the giant maker of commercial aircraft and a major manufacturer of satellites, and any number of space startups helmed by Airbus veterans. Munich is the home of two fledgling rocket makers, Isar Aerospace — which became the first private European company to win a contract from a national space agency, Germany, in 2021 — and The Exploration Company, which is prototyping reusable rockets. An hour's drive northwest gets you to Augsburg, home of yet another launcher, Rocket Factory.

The far north of Sweden may one day be the launchpad of choice for space tourists. Italy has rocketmaker Avio, one of the key companies securing the continent's access to the stars. UK companies based in Oxford, Cardiff and Glasgow, meanwhile, continue to make satellites of all sizes. And now the UK is going a step further with plans to turn its southern Cornish coast — an area better known for snug beaches and pasties — into a spaceport. It would be the first on the continent for orbital launches: currently, ESA launches its rockets from French Guiana.

“While major nations such as the US and China plough increasing sums of money into developing space programmes, European countries have to make a different bet.”

Smaller countries are also making their mark. On the face of it, Luxembourg is an unlikely home to space companies, including asteroid-mining Planetary Resources, until you learn the country's innovative laws have attracted a host of telecommunications companies, banks and consulting firms. And in southern Belgium, there are plans underway to build Europe's largest satellite manufacturing plant — a potential economic boon for Charleroi, the nation's former industrial heartland.

While major nations such as the US and China plough increasing sums of money into developing space programmes, European countries have to make a different bet, says Damien Garot, founder of Stellar, which wants to make satellite-beaming internet available to autonomous vehicles. "We don't have the luxury of their big budgets. We need to be smarter," he says.

For Ireland, a country with no big defence companies or satellite players, the space strategy has been to "spin in" components used in other industries. Its companies are developing lidar, antennae, radio systems, microelectronics, software, artificial intelligence (AI) and chip sets for space and other industries.

Ubotica is one of those companies, adding AI to satellites to make them far more efficient at processing pictures and sending them to Earth. Another Irish company carving out a niche in space is Lios, formerly known as Restored Hearing, which develops acoustic material to protect the interiors of rockets from vibrations on the journey into orbit.

"We have around 100 companies in contract with ESA. I'd say about 30% are developing tech for space and the rest are working on downstream applications," says Tony McDonald, a consultant and former delegate to ESA.



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TRAFFIC COPS IN SPACE

Startups in Europe are eyeing the many possibilities of Earth observation tech — the hottest area of the satellite industry — as well as internet terminals, launchers, commercial space factories and space debris removal services.

Concern over orbital junk — the villain in the Oscar-winning film *Gravity*, which showed a stray satellite taking out a shuttle to leave George Clooney and Sandra Bullock stranded — is growing among global space agencies and research institutions.

The space around Earth is littered with over 30k objects, including abandoned satellites and remains from disintegrating spacecraft.

Smaller satellites also have much shorter life expectancy than larger ones, implying a need for more of them. But the rise of satellite constellations risks a cascade of collisions. The UK's science minister George Freeman has warned that "a 'Wild West' space race without effective regulation risks a growing crisis of debris in space."

Gaia Roncalli, a university student and cofounder of Dutch startup Ecosmic, is trying to do something about all these potential orbital traffic accidents. She is developing software to help space assets stay in their lane with "optimised collision manoeuvres". A similar concept is already being deployed by Spain's GMV Aerospace, which runs 24-hour collision avoidance for 10 satellite operators.

Debris clearance is one of a number of "in-orbit services" space officials say will likely become big commercial opportunities. Other activities include satellite inspection and repair — of the kind offered by Toulouse-based Infinite Orbits — and refuelling options in space, which UK-based Metalysis is working on.

Space may someday also be a testing ground for a thorny legal question: could a company be held liable for its satellite bumping into something? Insurers including Swiss Re and Axa are looking into the possibilities. "Space debris collision risk could be a new type of policy in the future," says Roncalli. If it becomes a reality, it would mean a lot more demand for her invention.



It's getting crowded up there

Number of objects in the Earth's orbit, 2016 vs 2022

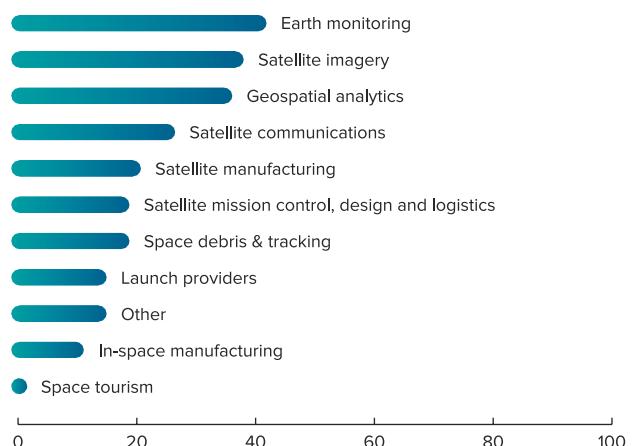
Source: McKinsey



Majority of startups believe Earth monitoring will be the #1 European spacetech niche

Question: What spacetech segment[s] do you feel European companies are best positioned to dominate in?

Source: Sifted survey of 52 European spacetech companies (% respondents)



CLOUDY WITH A CHANCE OF GEOMAGNETIC STORMS

It's not just flying objects you have to watch out for in near-Earth space. Magnetic waves, radiation, particles and matter — all ejected from the Sun — can interact with the Earth's upper atmosphere and surrounding magnetic field to produce a variety of effects.

Luxembourg-based Mission Space gathers data on these weather conditions, and is hoping to sell it to people in the energy, maritime, aviation, supply chain and oil and gas industries — basically anyone with big assets to protect in space and on Earth.

Take, for instance, geomagnetic storms. While rare, they can cause a lot of damage. As many as 40 SpaceX satellites were hit by one such storm in early 2022, potentially costing the company \$100m. It's possible that solar outbursts will knock more assets out of the sky soon: the sun has an 11 year cycle during which it swings between hyperactive and less active stages, and scientists expect solar activity will peak in 2025. And some predict it will be stronger than cycles-past. The effects are, of course, indirectly felt on Earth, with communications or connectivity disruptions.

"But we can't accurately predict space weather yet because we have legacy satellites," says Mission Space CEO Ksenia Moskalenko. "There's a data deficit right now. What data there is, it's delivered in the wrong format and the predictions are not that accurate," adds the company's other cofounder and COO, Artem Axelrod.

“We can’t accurately predict space weather yet because we have legacy satellites.”

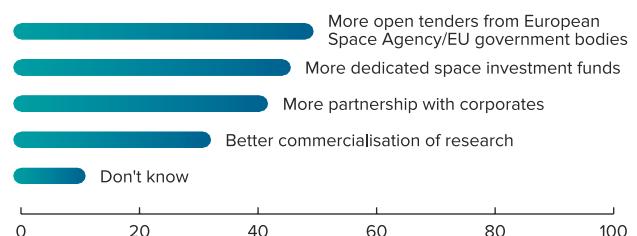
Ksenia Moskalenko, CEO of Mission Space

The company's plan is to launch satellites — which are being manufactured in Riga, Latvia — in 2023. The collected data will then be available back on Earth in a subscription format on an API-friendly platform, says Moskalenko. The founders did a bootcamp with Amazon Web Services in 2022 which "helped us significantly," she adds.

Startups see insufficient tenders from government/EU bodies as the biggest stumbling block to industry's success

Question: The 'new space' market is smaller in Europe than in the US. What would help close this gap?

Source: Sifted survey of 52 European spacetech companies (% respondents)



REVVING UP THE SELF-DRIVING MARKET

Another reason to put satellites in space is to get high-speed internet on Earth and bolster any industry involved in the internet of things.

SpaceX has said that its fleet of internet-beaming Starlink satellites, which number into the thousands, will be able to turn any spot on the globe into an internet hotspot — a capability that was demonstrated in 2022 when Starlink helped assure internet access for Ukrainian leaders fighting Russia. Jeff Bezos and Amazon are planning a similar system, called Project Kuiper.

Europe has its work cut out to compete with these American heavyweights. The EU plans to spend up to €6bn on internet satellites to catch up with Musk and Bezos. Another prominent effort is a combined plan from two satellite companies: Eutelsat, part owned by the French state, and OneWeb, part owned by the British government, which are expected to complete a merger this year. OneWeb now has 542 satellites in orbit, and "is two launches away from providing global broadband coverage," says the company's CTO, Massimiliano Ladovaz.

One entrepreneur ready to take advantage of new space internet providers is Garot, who wants to apply it to autonomous driving. His argument is that self-driving vehicles will never be a reality without good internet. Essentially, self-driving cars will be laptops on wheels.

Most will require an internet connection to send data to and from the car, to and from other vehicles and to and from surrounding infrastructure.

"But today, some 40% of our highways and trains suffer from poor connectivity," he says. "Try doing a video call on a train; it's frustrating. Humans spend 400bn hours per year on transport, feeling totally useless."

"And if we want [an autonomous] car to anticipate what's behind the hill, it needs to see beyond the hill. That's where creativity is essential, and we're here to fix this." His answer: satellites and AI software, coming sometime in 2024.

Carmakers see a hybrid internet system — one that switches between cellular and space networks — as a prerequisite, not only for autonomous tech, but for a whole new business line: in-car entertainment. For a glimpse of the future, you only have to look to China, where cars are being fitted with in-car payment and social media connectivity systems (in-car karaoke is another hot seller).

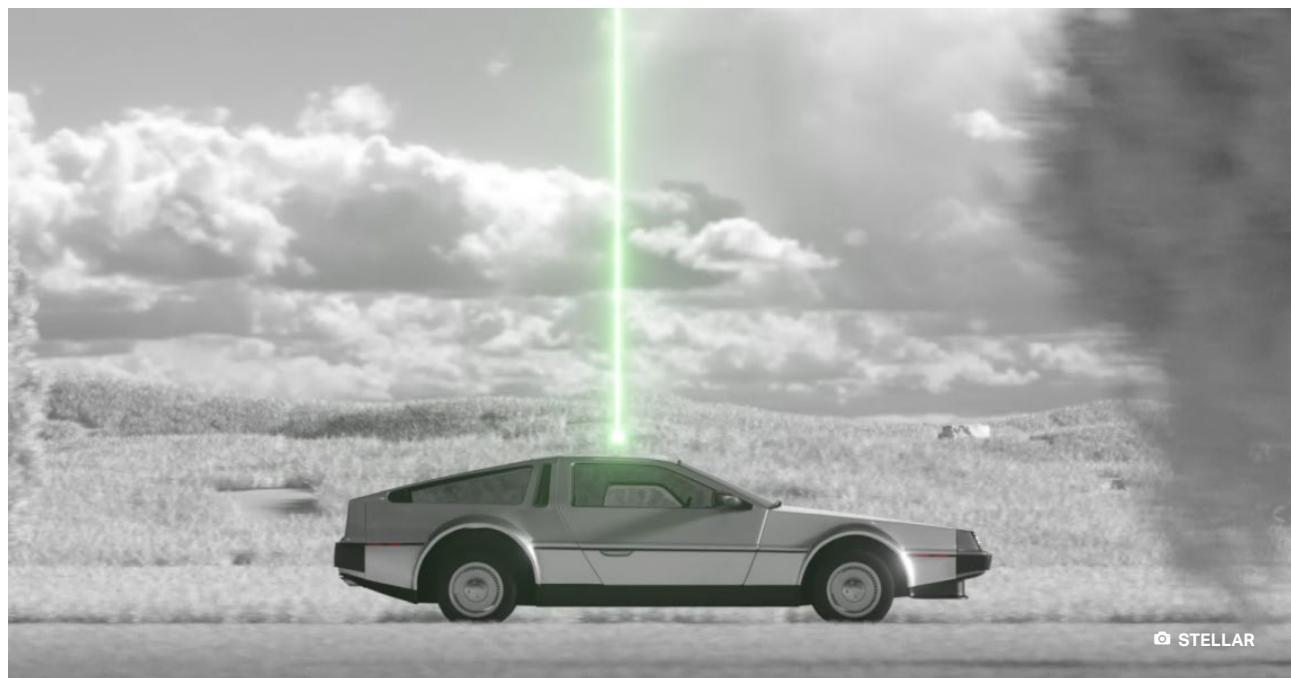
Speaking at an event in Luxembourg last year, Jonas Liske, head of new digital data and business models at the BMW Group, described the future car as "a managed

smart device on wheels where our customers can enjoy all the services they're used to at home or at work".

How much will this service add to the price of a car? "I think it has to be around the same amount that you pay for Spotify, Netflix [or] Amazon Prime," Liske says. BMW is not the only carmaker with an interest in space services: Porsche is an investor in German rocket startup Isar Aerospace, which has raised \$180m since 2018.

“Carmakers see a hybrid internet system — one that switches between cellular and space networks — as a prerequisite.”

But Stellar's plan — which involves fitting a terminal packed with antennae onto a car — is difficult. The technology needs to be small, cheap, able to cope with temperature fluctuations and not completely drain the energy needed to run the car. "Car companies are a refined piece of engineering. There's no way we can slap a terminal box on roof bars. You don't see Starlink terminals on Teslas," he says.



The terminal will likely work on big vehicles like buses or trucks to start. Farm machinery "is going to be [another] big market," says Garot. "There won't ever be 5G in the fields, this is where space will help."

The company is perfecting kit that's able to switch between cellular and space networks on a test vehicle, which Garot calls "the world's first space car". "It wasn't done in China or the US: it was done here in Europe," he adds.

“There won’t ever be 5G in the fields, this is where space will help.”

Damien Garot, founder and CEO of Stellar

READY TO LAUNCH

Another busy niche of spacetech are the companies offering to build satellites and arrange their launch.

The Exploration Company, based in Munich, is focused on reusable rockets and is pitching to become the European version of SpaceX. Alongside fellow Munich rocket maker, Isar Aerospace, it's challenging Europe's main launch company, Arianespace, on cost. Space officials count up to 10 companies in Europe that are working on launch capabilities. There's unlikely to be room for all of them, officials say: the number may eventually fall to two or three.

The Exploration Company wants to push launch costs down to around \$20k per kilogramme, compared with average European costs of \$40k+ per kilogramme for small satellites. This will still be more expensive than SpaceX which looks likely to remain, at least for the next few years, the preferred lift to space for most startups.

Cofounder and CEO Hélène Huby, a veteran of Airbus, says the company has big milestones this year. "We'll fly our prototype and focus on developing a second prototype."

Europe's soured relationship with Russia in the wake of Moscow's invasion of Ukraine is spurring governments



and companies to do more launch work of their own. Today many European countries don't possess their own ability to launch large payloads to orbit. "There will be an ongoing demand for launchers in Europe. The continent doesn't want to be dependent on Russia," says space expert and consultant Aravind Ravichandran.

Still, raising money for rocket companies in 2023 will be far trickier than in previous years. "I had more declines from investors than what I experienced in the seed round, that's clear," says Huby, referring to her fundraising efforts in 2022.

Spacetech startups in Europe

This map identifies cities that are home to multiple spacetech startups. Startups meet the following criteria in Dealroom: European headquarters, launched 2010 or later, tagged with "space" or cross-sectoral (eg space & telecom, space & robotics, space & energy), private and operational. The list was manually reviewed for relevance to spacetech.



space + tech

Chapter II

Back down to Earth

Applying cosmic knowledge at home

Here are some of the hottest applications
of space data and the Earthlings making the
most out of them



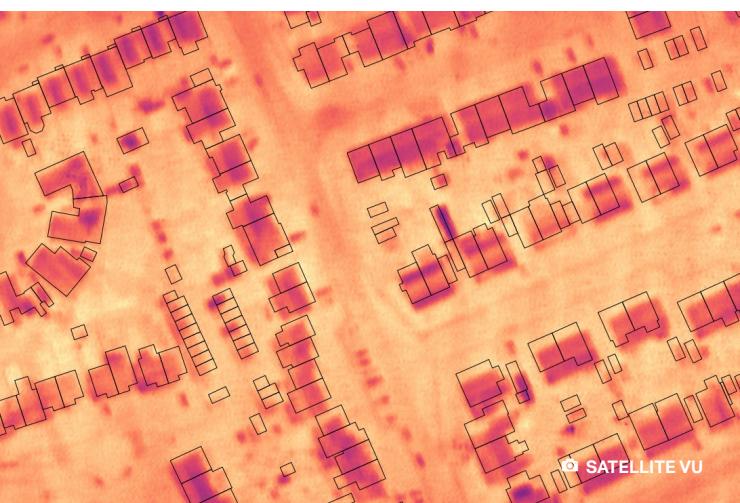
A big thrust of space investment: put more sensors in the cosmos to measure what's happening on Earth. "The opportunities here and now relate to spacetech looking down on the planet," confirms Mark Boggett, CEO of spacetech VC firm Seraphim Capital.

So whether it's detecting costly, environmentally damaging methane leaks from coal plants, assessing soil quality to maximise crop yields, or even just tracking the number of cattle in your fields or boats on the sea, creative uses for data gathered from space are starting to flourish.

THE CLIMATE EDGE

Commercial satellites generating almost real-time information about our planet's surface are helping us make sense of climate change. Time-lapse images from space help us understand glacial retreat, coral bleaching and deforestation. Governments, non-profits and researchers are keen to use satellite images to catalogue all manner of environmental misdeeds and catastrophes.

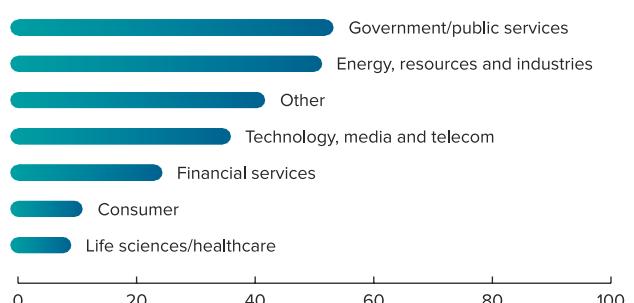
For decades, this sort of information was collected by government satellites and virtually impossible for the public to sift through. But the tools to interpret and analyse that data are becoming more readily available and advances in AI and machine learning, plus improvements in satellite technologies itself, have enhanced the impact of this data in recent years.



Despite greater commercialisation of spacetech, most startups still see the public sector as their end customer

Question: What industries do you see as your end customers?

Source: Sifted survey of 52 European spacetech companies (% respondents)



Now, demand for satellite pictures is growing in a number of sectors. "Earth observation is almost a horizontal industry: it's like software, it'll be used in every industry," says space expert and consultant Aravind Ravichandran.

London-based startup PlanetWatchers, for instance, uses satellites for monitoring crops and helping farmers make insurance claims if their fields are destroyed. Another London company, Satellite Vu, is aiming to be "the Earth's thermometer in space", using infrared and thermal imaging technology to monitor the temperature of areas and objects on the planet, down to individual buildings.

"Sometimes people don't get the point of space — but here's a great application," says cofounder and CEO, Anthony Baker. The idea for Satellite Vu was sparked when Baker read an article on plastic pollution in the ocean. "What was disturbing for me: that data was two years old. If only we could have better, faster data. That was my first foray into infrared imaging," he says.

The technology, he believes, could be used by regulators to monitor the energy efficiency of buildings — and then, in the midst of an energy cost crisis in Europe, decide where best to target insulation expenditure. Or it could be used to help discover whether farmers are polluting rivers (the sewage would be at a higher temperature and therefore visible). The company has so far raised some \$20m from investors including Seraphim Capital and Molten Ventures.

Governments aren't the only customer in mind. "How many times can we resell the same image of a city?" Baker asks. "Commercial landlords will want to know the temperature profiles of buildings, offices and factories. Banks will want these images to inform decisions on green mortgages. City planners and architects might be curious to find out why parts of the city are hotter than others and where best, therefore, to plant trees to cool the streets. The cost is the cost of an image: the value is where we'd try to drill down into."

Once seen as a minor topic for money managers, climate change has become a material part of investment decisions. Satellite pictures, to this end, are enabling a new blend of finance and climate science. Investors and commercial operators want this imagery — of the kind provided by London's Climate X — so they can understand and predict the potential damage to assets and infrastructure from a changing climate and extreme events.

“If we pay a company in, say, Brazil to plant some trees, are they actually doing what we asked them to do or are they scamming us?”

And this exposure and resilience of companies to climate change will only grow more important in the coming years, as weather becomes more unpredictable. "If you want to build a factory, you'll want to know if it's somewhere with a floodplain risk. Commodity traders need to know about wheat harvests for the year ahead. Again: satellites," says Ravichandran.

Big business is also increasingly keen to use satellites to help monitor and validate their environmental programmes. Planting or protecting trees is a typical corporate activity to offset emissions. "If we pay a company in, say, Brazil to plant some trees, are they actually doing what we asked them to do or are they scamming us?" says an employee at one large company, who spoke on condition of anonymity.

INSURERS <3 SATELLITES

Satellites deployed by Finland's Iceye are equipped with a technology called synthetic-aperture radar, which enables high-resolution image capture at night and in cloudy weather.

Iceye had Europe's biggest spacetech raise of 2022 — a \$136m round led by Seraphim Capital. One of the main Iceye customers is global insurance company Swiss Re, which wants help to quickly and accurately assess the extent of flooding — as one example — and calculate loss estimates. "[Iceye] can say how property X was flooded with a metre of rainwater," says Boggett. "So insurance people don't need to go to the field in question. They don't need to send someone on a plane to somewhere, where they have to rent a car, stay in a hotel, etc. Claims become a one or a zero."

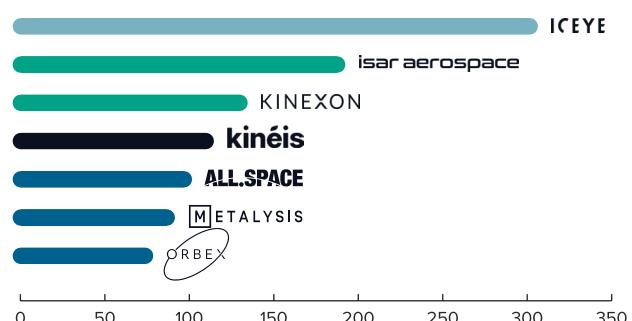
Satellite imagery delivered in fine detail will mean insurers can offer policies to businesses and farmers in previously uninsured parts of the world, Boggett adds. Other spacetech companies are seeing the opportunity here. OroraTech in Munich, for example, uses satellites to monitor over 161m hectares of forest the world over. Last year, it hired the former managing director of an insurance company to help it better target the industry.

More and more well-capitalised spacetech companies are emerging in Europe

Europe's best-funded spacetech startups by total funding (\$m) and HQ country

FINLAND GERMANY FRANCE UNITED KINGDOM

Source: Dealroom



Most startups see productivity increases on Earth as spacetech's biggest contribution

Question: Please complete the following sentence: Spacetech advances in Europe will eventually translate into _____ for companies on Earth

Source: Sifted survey of 52 European spacetech companies (% respondents)



Investors say there's much more to come; that few companies have really cracked how best to use space data. The industry can only develop further, says Adam Niewinski, cofounder and general partner at OTB Ventures, a VC firm in Warsaw. "We still see an issue with corporates when they hear satellite data and they think of Star Wars films," he says.

THE AGRICULTURAL SPACE

Satellites are not just monitoring or counting things on Earth: they're helping us analyse the health and productivity of animals, crops and plants in fine detail.

After insurers, agricultural companies are the next keenest bunch to get their hands on satellite data, says Niewinski. Farmers increasingly want data points — whether it's fertiliser use, crop rotation, rainfall or some other bit of information — to gain an edge and reduce the cost of their inputs. The world's biggest seed and agriculture chemical companies want high-resolution images that detect plant diseases and other issues. The UK's Lacuna Space, for example, plans to deploy satellites for tracking cattle on vast Latin American ranches.

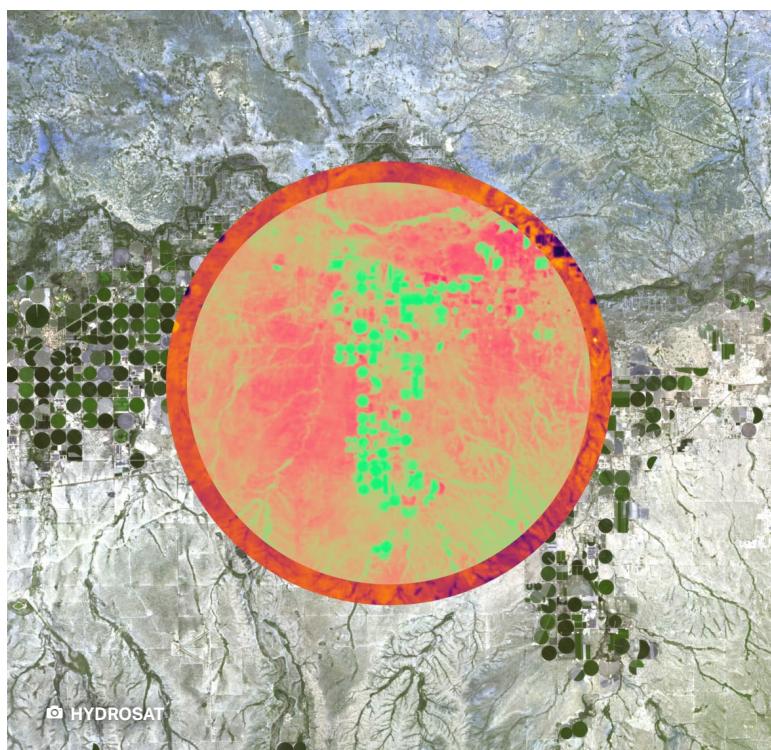
"If you want to deploy anything from automated watering systems to fertilisers, you need satellite data. Some understand it — the majority don't yet," Niewinski says. "Look at a company like Starbucks, which is some

distance from the fields: if they could only understand what their coffee crops would look like a few weeks earlier than anyone else, this could really influence their P&L [profit and loss]."

Niewinski talks about a US-Luxembourg company, Hydrosat, which uses satellites to see factors that the naked eye cannot. "They're capable of telling us which crops are too dry or overwatered. If you are overwatering your fields, you're not only wasting water, you're not only wasting energy, but crop yield can be 30% lower. The amount of inputs you use makes a big difference."

Satellite pictures, then, can help deliver so-called precision farming. "You can produce more crops if you use thermal imagery and [then use] water at just the right point," says Hydrosat's president, Royce Dalby.

The company, which is developing an app for farmers, also wants to develop a "yield forecast" system for packaging and food production companies so they can discover more information about where their produce comes from. With consumers demanding transparency in the food chain, information on how a crop was grown and its environmental impact will hold more value in the future.



in
space
+
tech

Chapter III

The next frontier

Will European startups boldly go?

Out-of-this-world ideas are moving closer to reality. Here we look at the contenders hoping to become the go-to platforms for space solar power, research, manufacturing and more



Today, spacetech is primarily useful for giving us accurate weather updates, communications, navigation and observation. Tomorrow's frontiers are in-space manufacturing and R&D, tourism and renewable energy.

The majority of these ideas — which will all be astronomically expensive — are still years, if not decades, away. Construction has not started on the first space hotel or the other permanent structures that will one day replace the ISS. Science and manufacturing experiments in space are promising but so far impractically expensive. Tapping the sun for space-based solar energy will take grand scale vision, bags of money and plenty of patience.

But somewhere down the line there are going to be opportunities for a host of industries: commercial real estate developers, lawyers, construction and logistics firms and other players who specialise in creating hospitable environments. There will also be rewards for scientists and pharma companies — and maybe even vintners, if anyone figures out how to grow enough new climate-resistant plants in space.

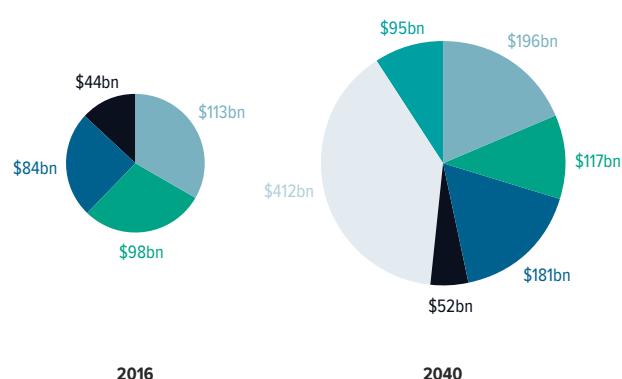
"We're not even at the foothills of Mount Everest when we're talking about opportunities," argues Seraphim Capital's CEO Mark Boggett.

The global space industry is estimated to surge to over \$1tn by 2040

Breakdown of the global spacetech industry by subsector in 2016 vs. 2040

GROUND EQUIPMENT CONSUMER TV GOVERNMENT
INTERNET CONSUMER BROADBAND OTHER

Source: Morgan Stanley



SPACE FACTORIES

With the ISS due to wind down its activities sometime after 2030, one of the big goals for the future involves the construction of permanent infrastructure in space. Companies including Bezos's Blue Origin, Sierra Space and Lockheed Martin have been motivated by a Nasa-funded competition to design privately owned replacements for the ISS.

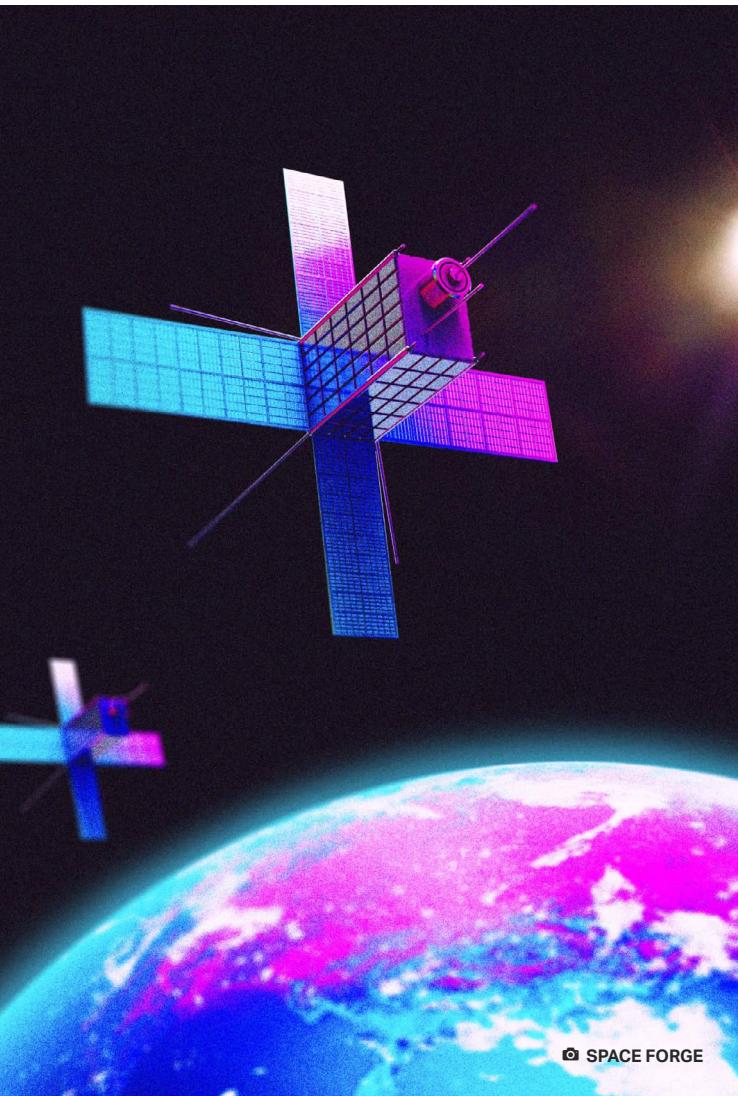
“One of the big goals for the future involves the construction of permanent infrastructure in space.”

One might ask, given how expensive and difficult this is likely to be: why?

The argument is that permanent bases in space would remove the need to design satellites and other space infrastructure to survive the violence of launching off the planet. The trouble with sending things on a rocket is that the dimensions and strength of the device are constrained, not to mention the need to survive the vibrations. This is why delicate things, like antennas, often are unfurled in space. Another compelling argument for building space factories is the ESA-estimated €100k per kilogram cost to take something up and back down again from space.

One European effort worth watching is the Airbus plan to send a metal-crafting 3D printer to the ISS this year as a first step to set up an orbital satellite factory. The company said it would like to be able to manufacture entire satellites in space in the "next three to four years". "The material for production can be sourced from the space debris floating around," Airbus said in a statement.

"The next industrial revolution isn't on Earth," declares Welsh startup Space Forge. Launched in a garage in 2020, the company aims to manufacture semiconductors, alloys and composites on mini-factories in space. The company's pitch — "microgravity as a service" — is to make unique materials outside of the constraints of gravity.



"Earth is not a very good place to make things," Andrew Bacon, CTO and cofounder of Space Forge, likes to say. "You have gravity which causes buoyancy so lighter elements like aluminium [when mixed] together with lead, the aluminium is going to go to the top, the lead's going to go to the bottom. Microgravity prevents that mixing problem." In the meantime, the company is attempting to make the world's first returnable and reusable satellite platform, for launch later this year.

The same microgravity conditions could also aid in the manufacturing of small components, like fibre optic cables, electronics and semiconductors, which could potentially all be built in space and brought back down to Earth.

BEAM ME DOWN, SCOTTY

The idea to tap space for renewable energy sounds enticing: remove solar technology's major drawback — that panels don't operate effectively in darkness — by placing them into orbit with an unrestricted view of the sun.

And without the obstruction by Earth's atmosphere, researchers say space-based solar power plants would generate energy more efficiently than Earth-based plants. Compared to a solar panel placed on Earth, an identical solar panel in space would harvest over 13x more energy, according to Martin Soltau, chairman of the UK's Space Energy Initiative, which was set up to investigate the effectiveness of space solar.

"This is an engineering challenge — not a physics challenge. It's a huge amount easier than achieving nuclear fusion energy on Earth, for instance," says Soltau, who is also co-CEO of Space Solar Limited, a company that plans to bring the concept to life.

"There's no breakthrough physics needed, it's just supply and demand. It's a lot more about logistics and costs," adds Andrew Ross Wilson, research associate at the University of Strathclyde. Wilson has his own concept, seven years in development, which he aims to realise through his company, Metasat UK. "We had the word Meta before Facebook," he points out.

How space solar could work: satellites, equipped with mirrors or reflectors, would convert sunlight into radio-frequency microwave energy and then transfer it wirelessly to a receiving site on Earth. The microwave beams would hit the receiving antennae and run into the energy grid.

Already, there are competing concepts in development around the world. The California Institute of Technology established the Space-based Solar Power Project as early as 2013. The programme has developed prototypes and plans to perform its first space test in early 2023. The US Air Force, meanwhile, plans to launch a power-beaming experiment to orbit in 2024.

China is planning in-orbit tests before the end of the decade as a stepping stone to a gigawatt-level system by 2050. China's Longi Green Energy Technology Co.,

the world's biggest solar technology manufacturer, will send panels into space as the first step in plans to test the feasibility of harnessing the sun's power in orbit. Japan is looking to demonstrate the viability of the tech by 2025 and ESA has asked its member governments to fund a three-year feasibility study for a solar power project called Solaris.

The UK appears to be the frontrunner in Europe. A 2021 report of the UK government, written by Frazer-Nash Consultancy, concluded: "Space solar power is technically feasible, affordable, and could both bring substantial economic benefits for the UK, and could support net zero pathways."

According to Wilson, "you'd be creating a new supply chain that doesn't exist and it could create thousands of jobs. The payback period is very good — it's just a lot of capital up front." Though it's impossible to say how much exactly: "north of £10bn anyway," says Soltau.

SPACE WINE, ANYONE?

The grand ambition doesn't end with solar power: a number of startups are pitching access for companies to the low-gravity vacuum of space, and the boost this could give their R&D. "Space offers a perfectly clean room, there's no contamination," says Nicolas Gaume, cofounder and CEO of Luxembourg-based Space Cargo Unlimited, which is offering round-trip science missions.

Space research is appealing for several reasons. Gravity and oxygen affects not just the behaviour of solids, liquids, gases but also living tissues. Removing these factors, then, allows scientists to exert greater control over many physical, chemical and biological processes, like the growth of crystals and cells and heat transfer. "There's no oxygen, so there's no oxidation and no impurities: it's a huge advantage," says Karine Courtin, board member of Space Cargo Unlimited.

This company, as an experiment, brought over 300 vine shoots to grow on the ISS for a little over a year, to see how they'd adapt to the physical stress of no gravity. Now, after completing their 300m-kilometre journey — the ISS orbits the Earth every 90 minutes — they're back on the ground, continuing their growth in a greenhouse in Bordeaux, and showing promise as a new variety of

plant that could prove more resilient to climate change (which is already wreaking havoc with the French winemaking season).

"These vines faced the most stress any living organism can experience — and that's when the magic happens. They completely freaked out and evolved. Life finds a way," Gaume says.

He explains how he tested the growth of "the space merlot" alongside the ordinary Earth merlot. "The difference was palpable: the space vines grew more." An extra year of growth is now needed to assess the merits of the wine, but it's showing promise, he adds. His ultimate wish: that the space-altered vines can generate up to €10m per year in licensing fees to winemakers.

It's not the only company experimenting with growing crops or plants in space. Also in France, there's Interstellar Labs, a company that wants to build mini greenhouses in low Earth orbit by 2025, the moon by 2027 and Mars by 2030.

"We're opening a bridge for terrestrial companies to grow [crops] in space," says the founder and CEO, Barbara Belvisi. Like the dream of creating climate-resilient plants, the concept has some way to travel. "It's going to be a step-by-step approach, first by sending small payloads to test the economic viability of growing new species in space," Belvisi adds.

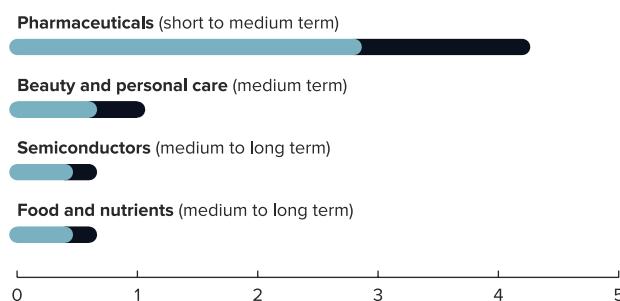


Space-sized profits?

Forecasts of annual revenue (\$bn) for selected industries if they partner with space companies

MINIMUM **MAXIMUM**

Source: McKinsey



SPACE-MADE DRUGS AND ORGANS?

Then there's the hope that the same microgravity conditions can help the development of new drugs — and organs.

Germany's Yuri aims to help pharmaceutical scientists carry out experiments in low orbit at a drastically reduced cost. "The future is to sit on your sofa and watch your cells grow in space," says the company's chief scientific officer, Daniela Bezdan.

Yuri describes itself as an end-to-end services provider for scientists. So it will help you define your research experiment, pick the right hardware to carry it out, test it on the ground, execute the mission to space and then help you analyse the results.

Flying these experiments up and down could cost as little as €59k, according to Bezdan, with Yuri's maiden flight expected in 2024. It wouldn't be the first time pharma companies carried out their research in space — Merck, Amgen, Novartis and Eli Lilly have all done it — but the Yuri way, if it succeeds, would be the cheapest. "We're working hard to get pharma on our side. We need just a couple of successes," Bezdan says.

Taking advantage of the lack of gravity to engineer new types of tissue or small pieces of liver or pancreas is another promising commercial activity, says Ken Savin, chief scientific officer with Redwire, which similarly aims to facilitate science in space.



The creation of small organs, or "organoids", in space could one day help reduce the need for animals in research experiments back on Earth, he explains. "The FDA [US Food and Drugs Administration] is trying to get away from using animals in clinical trials," says Savin. "Using organoids instead is a real money opportunity."

Today, there are issues with doing any of this at scale — who would bear the costs? It's also time consuming: right now it takes two years to run an experiment on the ISS, and a year more if you need to change anything. Culturing, preserving and returning organs to Earth is another not-so-small challenge.

Still, Savin says he's amazed at just how many space opportunities there are for people now. "I have a high school intern who has run her experiments on the ISS," he says.

And his main recommendation to help get these ideas off the ground: attend conferences full of people who have no idea about space and entice them to invest. "It's going to be a gold rush. Someone is going to find that one thing where you can make real money in space."

“It’s going to be a gold rush. Someone is going to find that one thing where you can make real money in space.”

Ken Savin, chief scientific officer with Redwire

Conclusion

Will investors boldly go too?

The smart money's on space cybersecurity — and six other predictions from experts and investors



In the near term, as the world grapples with the threat of recession, the commitment of VC and other funds to spacetech will certainly be challenged and maybe even reduced.

The space industry will surely go through periods of consolidation and retrenchment, as weaker players drop out or are acquired by rivals. Turbulence is guaranteed, says Laura Forczyk, executive director and founder of space consulting company Astralytical. "We will see a lot of companies fail or make arrangements to be acquired," she predicts.

This is a very difficult world to succeed in, observes The Exploration Company CEO Hélène Huby. "You need to be very resilient and someone who is ready to face massive problems [every day]."

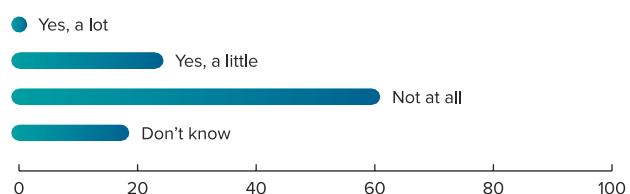
It's also, for now, a very male-dominated world: something Huby feels strongly about changing. "When you're a VP woman in an aerospace company, as I was, you receive monthly offers to work for other companies." At her company, "We'd never give a job to a female because she's a female; but with the same level of competence, we'd give the job to a woman," she says.

Tech, and the tech job market, will have a difficult 2023 but "I think space will get off more lightly given the backdrop," argues Boggett of Seraphim Capital.

Majority of spacetech startups believe rising interest rates won't affect their businesses

Question: Space is a high cost industry. Will growing interest rates force you to lower your company's growth forecast for 2023?

Source: Sifted survey of 52 European spacetech companies (% respondents)



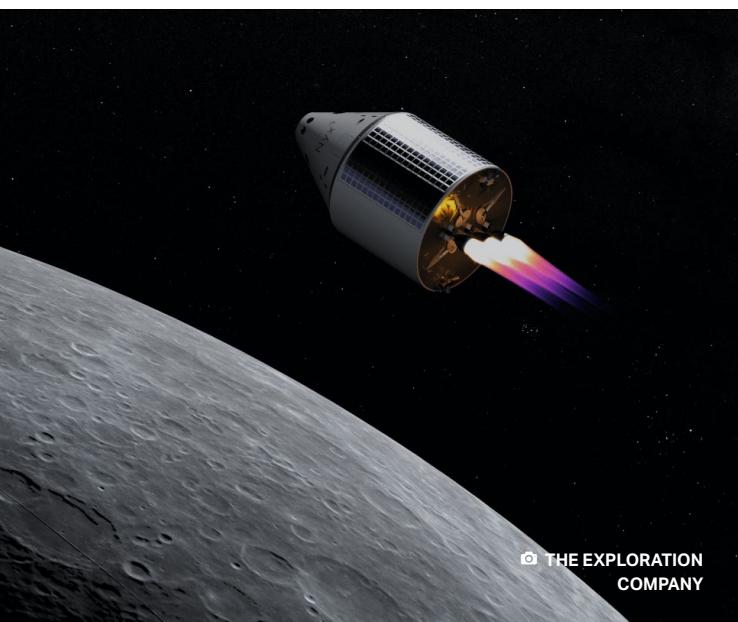
Defence and intelligence will remain space's first customers and "they have an insatiable appetite to understand the cutting edge", he argues. Moscow's invasion of Ukraine has only added an incentive for European countries to have their own space capabilities, he adds. "Ukraine has changed everyone's mindsets about defence budgets. This isn't just a one-off event. The world has changed for the worse and will continue this way for a decade."

Then there's extreme weather events, which scientists warn are getting worse. "Fires, hurricanes — we need to know more about the risks," says Boggett.

Regulatory compliance demands will push spacetech even further, many believe. "ESG standards are evolving around the world, driven by investors. Right now, a lot of the measures are self-reported. Space will be able to take measurements of virtually everything and apply them to a business that isn't self-reported," he says.

Space data will also help make insurance and farming more efficient. "There is government-sponsored insurance in the US for farmers that pays out after fields [get] ruined by weather. Guess what? This policy doesn't happen in Asia at all; there's no state-sponsored insurance."

"They are farming inefficiently; they're getting wiped out every few years by weather. Satellite data means insurers can offer insurance to a market that's never had insurance before," he adds.



Space factories to open their doors by 2030

"In the next few years, we'll begin to see the in-orbit assembly of infrastructure components. Then, by the end of the decade, we'll start to see the in-orbit manufacturing of novel materials. This will change the whole space industry. 10 years ago, all of this seemed fanciful. Now it's feasible, thanks mainly to huge advances in autonomous space robots."

Sir Martin Sweeting, executive chairman, Surrey Satellite Technology



Software — not humans — will decide when satellites should swerve

"With the rise of constellations, space traffic management will become a necessity. The amount of satellites in low Earth orbit is increasing too fast to continue to avoid potential collisions manually; there is going to be a shift in the way ground operators work, satellite operations will be autonomous and space-based, and human involvement is going to be minimised."

Gaia Roncalli, founder and COO, Ecosmic



Keep an eye on SpaceX

"SpaceX's Starship rocket — set to launch in 2023 — could really change the game for everyone. If they pull it off and prove that they can transport huge cargo to space, the possibilities are endless. It could change things for the whole industry."

Laura Forczyk, executive director and founder, Astralytical



Spacetechs may struggle to find enough customers

"Companies selling space data are still really struggling for traction in the market and it's hard to get sufficient customer volume to make their businesses profitable. But we are starting to see greater levels of collaboration, as companies seek to open up new customer opportunities through partnering."

Andy Grey, CEO, Exotopic



Here's one under-invested area

"Contrarian investing is often a good way to make money. If you look back over the last three-four years, the space area that's received the least amount of investment is what we call downlink (or how to get data to Earth in a cybersecure way). We believe there's huge opportunity here."

Mark Boggett, CEO, Seraphim Capital



All companies will have a satellite data strategy

"Satellite data will become mainstream: Satellites are already a major part of our economy, from weather forecasts to location-based services. The next big wave will be the integration of Earth observation data into organisations to power their digital transformation or their climate transformation initiatives. So, in a few years, I expect every company to have a satellite data adoption strategy."

Aravind Ravichandran, Earth observation strategist, TerraWatch Space



Fueling stations on the moon? It's doable

"Energy is a premium cost on Earth and in space. Our technology can extract oxygen from lunar rocks, which can then be used to create propellant for spacecraft and breathable air for astronauts. We have a proof of principle that our tech works on Earth; the next step for space-goers is to create an outpost on the moon."

Ian Mellor, managing director, Metalysis



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