

# SWISSQUOTE

FINANCE AND TECHNOLOGY UNPACKED

## INTERVIEW

Fabrice Billard,  
CEO of Burckhardt  
Compression

## SCAMS

Ponzi  
schemes  
never die

## HAPPY HOUR

British pubs  
are stumbling  
to their feet

## DOSSIER

ENERGY TRANSITION  
**BATTERIES  
POWERING  
THE WORLD**



ISSN 2296-3278

76

> CATL > QUANTUMSCAPE > BYD > UMICORE > SOLID POWER > LG > PANASONIC >

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COLLECTION

# *Fifty Fathoms*

The Fifty Fathoms collection embodies Blancpain's passion for the underwater universe that was originally expressed in 1953 with the creation of the first modern diver's watch.

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## DISCOVER NEW DEPTHS

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Ω  
OMEGA



# HUBLOT



  
**HUBLOT**

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In-house UNICO chronograph movement.

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## Time to wake up



By Marc Bürki,  
CEO of Swissquote

Something's not quite right. And this summer, the entire planet both saw and felt it. Like a bad omen, a lost beluga whale – a mammal that normally lives in the Arctic – wound up in France's River Seine in the middle of August. What was it doing there? Was it disoriented by changes in ocean currents linked to climate change? Experts have been trying to figure out what happened – to no avail. It's a serious possibility though, because meanwhile, Europe was experiencing an unprecedented heat wave, with temperatures bordering on 40°C in Switzerland and a drought the likes of which the continent had not seen in 500 years.

The consequences are terrifying. Over 730,000 hectares of land in Europe has been ravaged by forest fires since January this year. That's a record-breaking figure. For comparison, between 2006 and 2021, fires burned an average of 320,000 hectares a year. Of course, in Switzerland fires are less of a problem, but the situation isn't much better. Between 1 May and 14 August, the total rainfall recorded in western Switzerland was only half the 1991-2020 annual standard – the least rainfall in the past 140 years.

People around the world now seem to be waking up to the urgency of the situation. In June 2022, for instance, members of the European Parliament voted in favour of banning the sale of combustion-engine vehicles by

2035. California – which, along with the entire western United States, has been experiencing exceptional levels of drought since 2000 – adopted a similar measure in late August. As mentioned in our [feature story](#), those laws will drive up demand for lithium-ion batteries, especially since those batteries will also be used to store electricity generated from renewable energy sources. Global production capacity will likely increase by more than 600% by 2030.

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But Europe is lagging behind in the sector. Over 80% of batteries sold worldwide are produced by Asian companies, with China's CATL and BYD at the head of the pack. In recent months, however, the number of battery [gigafactory](#) projects in Europe has been on the rise. Competition between well-established [players](#) (CATL, LG, Panasonic) and newcomers (Volkswagen, ACC, Northvolt) looks set to be intense. Once again, the key to success will surely be innovation – an area where Europe excels.

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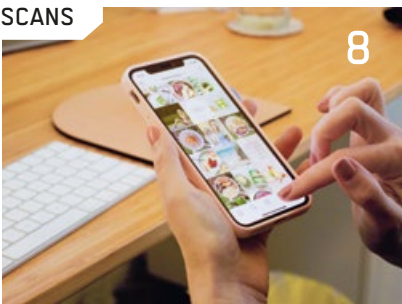
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In addition to our feature story, this issue also contains a fascinating interview with [Fabrice Billard](#), the new CEO of Swiss firm Burckhardt Compression. Little-known to the general public, Burckhardt produces huge machines that compress hydrogen – another energy source that could help reduce greenhouse gas emissions.

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Enjoy!





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## vintage alcohols SUZE UP YOUR BOOZE



A 1937 advertisement for Lillet, now owned by Pernod Ricard.

AFP / TRIPELON-JARRY

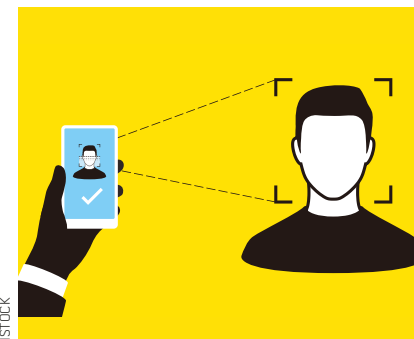
Celebrating its 150<sup>th</sup> anniversary this year, Lillet cleared the mark of 12 million bottles sold in 2021. That comes out to double-digit growth from the 9 million units sold in 2020 and 5 million in 2019. The white wine and citrus-based French apéritif has enjoyed global success, gaining popularity in Germany, Austria, the United Kingdom, the United States and even Brazil. The French wine and spirits giant Pernod Ricard bought Lillet in 2008, then jumped on the Spritz wave and cocktail boom to turn it into one of its star brands. But its other vintage spirits, such as Suze and Byrrh, have also benefited. Pernod Ricard has also forayed into non-alcoholic drinks – now that non-alcoholic beer has cleared the path – lining up ready-to-use cocktails such as Suze Tonic Zero and Cinzano Spritz Zero. — RI



**“Our trade with you (France) amounted to \$2 billion in 2000, as much as China. Now it’s \$7 billion with you and \$120 billion with China. You’re becoming insignificant for us”**

The Brazilian Economy Minister **Paulo Guedes** at a meeting with business leaders in Brasilia, talking about his conversation with a French minister.

## private sphere MICROSOFT LIMITS FACIAL RECOGNITION

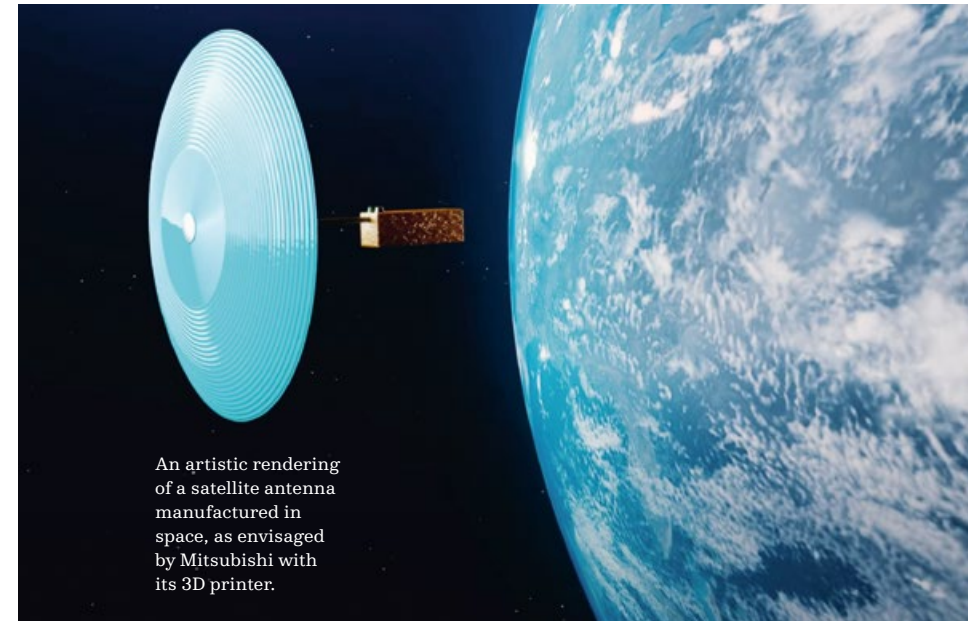


ISTOCK

To prevent misuse, the Redmond giant’s existing and future customers must now request special authorisation to use the firm’s three facial recognition software applications: Azure Face API,

Computer Vision and Video Indexer. In a more radical step, Microsoft is also discontinuing all facial analysis technology used to infer emotion from an individual’s facial expression. Its experts are quoted in *The Guardian* as asserting that there is no “linkage between facial expression and emotional state”. These decisions were partly made to contend with stricter regulations, especially in Europe, but also follow an underlying trend. For example, IBM withdrew from the market in 2020, Amazon indefinitely extended a moratorium on its Rekognition programme in August 2021, and Meta terminated Deepface, Facebook’s facial recognition tool, in November 2021. — MSFT

## telecommunications 3D PRINTING IN SPACE



An artistic rendering of a satellite antenna manufactured in space, as envisaged by Mitsubishi with its 3D printer.

MITSUBISHI

American researchers from Mitsubishi Electric have designed a 3D printer that can operate in the vacuum of outer space. The technology will be used to manufacture satellite antennas on orbit to avoid sending them from Earth. In addition to developing 3D printing capabilities in space, the researchers developed a photosensitive resin that hardens in the sun’s ultraviolet rays, even in a vacuum – an impossible feat

with traditional, low molecular-weight resins. So far, the new resin has only been tested on Earth. Once solidified, it resists heat of over 400°C, higher than the hottest temperature experienced on orbit. The Mitsubishi subsidiary states that the technology will reduce satellite weight by 80% on launch and can be used to produce larger antennas, thus increasing the bandwidth of communication satellites. — 6503



**+82%**

The increase in the number of planes flying the skies by 2041, according to Boeing projections.



**“One of my dreams is to do crash tests in the metaverse”**

**Luc Julia**, scientific director of Renault.

## RANKING

### TOP 5 UNICORNS WORLDWIDE

(based on market capitalisation in billions of dollars as of 3 August 2022)

1. BYTEDANCE (CHINA) | MUSIC  
180
2. ANT GROUP (CHINA) | FINANCE  
150
3. SPACEX (USA) | SATELLITES  
125
4. SHEIN (CHINA) | ONLINE APPAREL  
100
5. STRIPE (USA) | FINANCE  
95

Source: Crunchbase

### TOP 5 US UNIVERSITIES THAT HAVE PRODUCED THE MOST STARTUP FOUNDERS

(in number of funded founders, not including business schools)

1. STANFORD  
338
2. MIT  
246
3. HARVARD  
217
4. BERKELEY  
208
5. COLUMBIA  
94

Source: Crunchbase

### TOP 5 COUNTRIES THAT READ THE MOST

(number of hours spent reading per week and per person in 2021, out of 30 countries selected)

1. INDIA  
10.42
2. THAILAND  
9.24
3. CHINA  
8
4. PHILIPPINES  
7.36
5. EGYPT  
7.30

Source: NDP World Culture Score Index

**75%**

The percentage of Tesla’s bitcoins it sold in the second quarter of 2022, totalling \$963 million.



## SCANS



# +40%

The increase in the number of initial public offerings in China since the beginning of the year, totalling about \$59 billion. This comes at a time when IPOs in Europe and the United States have practically hit a standstill.



## “There’s no formula for making a country prosperous”

Esther Duflo, winner of the Nobel Prize in Economics, in an interview on NZZ.

## social networks

## TIKTOK AND INSTAGRAM FIND THEIR WAY

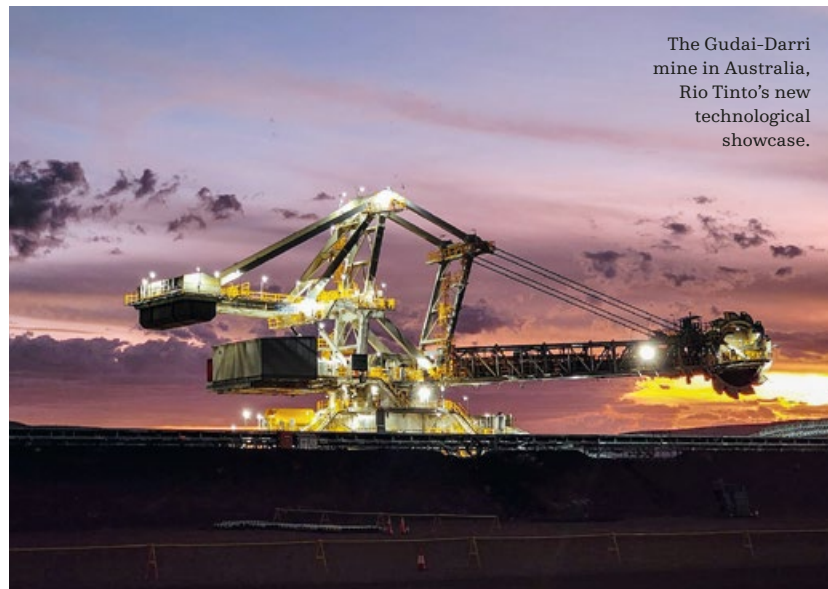


JAKOB DIVENS

New generations are bypassing Google Search and Maps, instead turning to social media to explore the world. A Google survey of US users aged 18 to 24 found that almost 40% check first with TikTok or Instagram when looking for a place to eat. Google explains the phenomenon as a paradigm shift in search methods. These new users no longer type in key words; they want to discover content via more immersive means. Meta is trying to seize this opportunity by gradually transforming its Instagram messaging service into an e-commerce platform. As of this summer, users can order, pay and track orders in direct messages with the merchant. — GOOGL — META

## autonomous vehicles

## MINING, WITH PRACTICALLY NO MINERS



The Gudai-Darri mine in Australia, Rio Tinto's new technological showcase.

RIO TINTO

About a decade ago, Anglo-Australian mining giant Rio Tinto commissioned an all-new mine. Located at Gudai-Darri in north-western Australia, the iron ore mine has become a showcase for the latest advances in autonomous technology from the world's largest iron producer. Rio Tinto estimates that it will only take 600 people to produce an annual capacity of 43 million tonnes. As a frame of reference, at the Serra Sul Project in Brazil, the world's second-largest iron mine, it took more than 4,300 people to

deliver 82.9 million tonnes in 2020. The enormous trucks, drills and, for the first time, water trucks will move around with no one on board. But the most impressive achievement is the region's rail network for autonomous trains built by Rio Tinto. The trains run 24 hours a day over the 1,700-kilometre line. A typical convoy includes a triple-headed diesel locomotive pulling 240 wagons carrying ore, for a total weight of 28,000 tonnes and a standard length of 2.5 km.

— RIO

## semiconductors

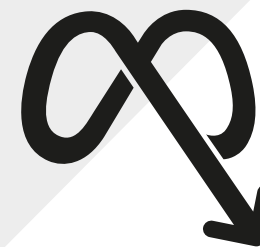
## 3 NM CHIPS HIT THE MARKET



SAMSUNG

In late July, Samsung made history as the first manufacturer to deliver 3-nanometre (nm) processors. In doing so, the Korean giant outpaced its direct competitor, the Taiwanese firm TSMC, which is currently only delivering 4 nm. This first batch is for non-consumer use only, namely for cryptocurrency miners, to power their energy-hungry data centres. Samsung states that, compared to 5 nm technology, its 3 nm process could reduce power consumption by up to 45%, enhance performance by 23% and reduce size by 16%. Meanwhile, TSMC is expected to launch production of 3 nm chips later in the year. This time, Apple will be the first served, for its own M2 Pro and M2 Max chipsets that will equip the upcoming 14-inch and 16-inch MacBook Pro family.

— 005930 — TSM



# -1%

For the first time since it went public in 2007, Meta (Facebook) reported a drop in quarterly year-on-year revenue. A steeper decline is expected for the third quarter.



## “We have to raise interest rates by 3% in a single hike”

Yanis Varoufakis, former Greek Finance Minister, on 9 June in an interview with the newspaper *Le Temps*.

## KICKSTARTER



FLEXTAILGEAR

## TINY PUMP

## “AND HE HUFFED, AND HE PUFFED”

Flextail, the small Chinese camping gear manufacturer, has developed a mini electric air pump for outdoor activities. It measures 4.6×4.3×5.8 cm – slightly larger than an AirPods Pro case (4.5×2.2×6.1 cm) – and weighs only 96 g, lighter than the typical 1 kg or so for low-range electric air pumps. Its 4 kilopascals (about 0.6 PSI) of power outshines these lower-end pumps (0.4-0.5 PSI), but its limited flow rate will take some patience, pumping 180 litres of air per minute compared to about 500-600 l/min. With this power, Tiny Pump can be used on large inflatable items (boat, canoe, mattress, etc.), and a full charge is enough to blow up 105 inflatable pillows. The Flextail device can also deflate objects and act as a lantern with its 8 LED bulbs that last up to 10 hours. Its built-in magnet adheres to metal surfaces, and it features a waterproof shield and a fast type-c charging port.

FUNDS RAISED  
CHF 633,129

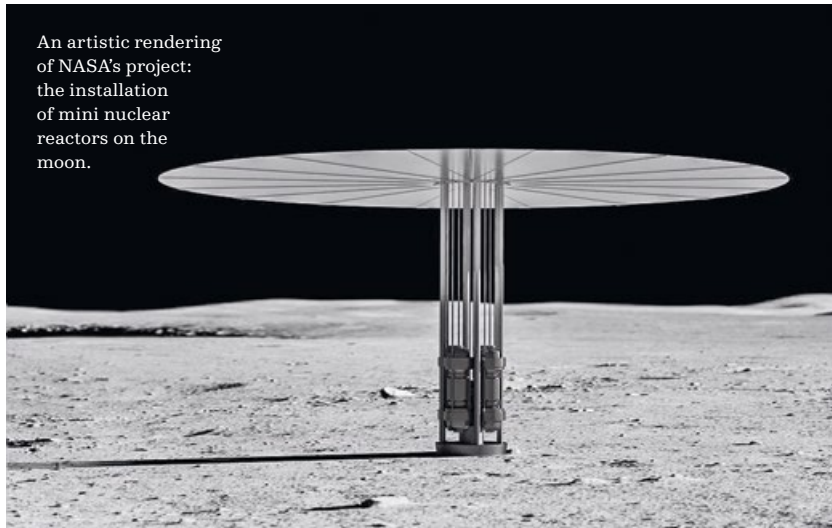
AVAILABILITY  
AVAILABLE



## SCANS

space exploration  
NUCLEAR POWER ON THE MOON

An artistic rendering of NASA's project: the installation of mini nuclear reactors on the moon.



NASA

NASA has selected three companies to develop concept designs for small modular reactors, or SMRs (see *Swissquote Magazine*, May 2022 issue), to be installed on the moon. With the Mir space station permanently shut down, NASA now wants to continuously occupy the moon's surface with hopes of achieving both scientific and economic benefits. To power a lunar base continuously, solar panels will not work through the two-week lunar night, leaving the agency

with nuclear power as a viable solution. The US companies Lockheed Martin, Westinghouse and IX (a joint venture between Intuitive Machines and X-Energy) will each receive \$5 million over a period of 12 months to design a prototype small reactor system that can produce 40 kilowatts of power, equivalent to the electricity generating capacity of Mir, which should be enough to support two to three astronauts living on the moon.

— LMT — WAB

**“There are now mitigation options available in all sectors that could together halve global greenhouse gas emissions”**

Céline Guivarch, co-author of the new report from the Intergovernmental Panel on Climate Change (IPCC).



39.9  
hectares

Boeing has the largest plant in the world located in Everett, near Seattle in the United States, spanning the surface area of nearly 55 football pitches.

## THE FLOP

### Trouble in the Tinderverse

Tinder is toning down its ambitions in the metaverse. In 2021, the Match Group subsidiary acquired AI and augmented reality company Hyperconnect to develop a dating experience in virtual spaces via avatars. However, Match Group's new CEO, Bernard Kim, has asked the company to scale back its activities in the metaverse due to the lack of clarity about the concept and its potential. On

another note, Tinder's in-app currency – called Tinder Coins, which were tested in a few countries earlier this year – has also been scrapped for now, this time due to mixed user feedback. The idea was that users would earn coins for being active and then use the currency to pay for Tinder's premium features, such as Super Likes. — MTCH



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THE MOST FABULOUS JEWELS IN THE WORLD



SCANS

stock market

BOBST TURNS ITS BACK ON SIX

JFB Finance, which owns a 53% stake in Bobst, has made a public tender offer for the remaining 47% of the share capital. The financial holding company owned by the Bobst founder's descendants plans to take a world leader in packaging equipment private, by delisting its shares from the Swiss stock exchange. To succeed in its fiercely competitive market, Bobst no longer wants

to have to share sensitive information with its competitors in order to focus on completing its digital transformation. This represents the end of an era for the Vaud-based company, which was founded in 1890 and listed on the stock exchange in 1978. But JFB Finance has promised that the company will remain in Switzerland and will continue to be run by the family. — BOBNN



A Bobst employee at the company's Lausanne headquarters.



**“There are a lot of things we can’t get done because we don’t have the people”**

Boeing CEO Dave Calhoun about labour shortages in the United States.

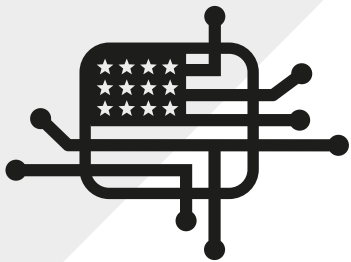
IPO

THE SUMMER STOCK MARKET SAGA

On 15 July, the Hong Kong company AMTD Digital began trading on the New York Stock Exchange without attracting much attention. However, by the end of the day the stock price had doubled from \$7.80 to \$16.21. The share price shot up to \$721.23 on 5 August, an increase of around 9,200% in 20 days. The company's market capitalisation hit over \$310 billion, outsizing Pfizer, Roche or Coca-Cola. Next, the

share price plunged as quickly as it had risen (to less than \$150 at the end of August). The reasons for the rise are still being debated, and no investigation has been opened for the time being. AMTD Digital provides digital services to the financial sector. Its NYSE-listed parent company, AMTD Idea, holds an 88.7% stake and is owned by AMTD Group, a financial services specialist.

— HKD — AMTD



52 BN

In dollars, the total amount of subsidies granted by the US Senate to jolt domestic semiconductor production.

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GRAFF

THE MOST FABULOUS JEWELS IN THE WORLD



## TRENDS



the figure  
OLIVER BLUME

## New boss for VW

Position  
CEO

Age  
54

Nationality  
German

Mid-summer, the Supervisory Board of the German auto giant Volkswagen ousted its CEO Herbert Diess, and the spot was filled by Oliver Blume. This inside man – with more than 20 years at the group – was until now Porsche's CEO. Under his leadership since 2015, the VW subsidiary has boosted its sales by around 50%.

Oliver Blume also served as head of production planning for the entire Volkswagen brand. As such, he had been named successor to Herbert Diess long ago, as his leadership and talent for innovation were highly appreciated. He holds a PhD in vehicle technology (from Tongji University in Shanghai) and co-led a pilot project in partnership with Siemens to implement an eFuel plant in Chile. Born in Braunschweig, near Wolfsburg in Lower Saxony, Blume is an accomplished sportsman and football fan who used to play sweeper. And he still clocks a half-marathon in 90 minutes. Ironically, his first car was a 2CV, and in private he prefers to travel by train or electric scooter.



the country

UGANDA

## The pearl of Africa is attracting investors

Famed for its national parks, Uganda is more pertinently one of the planet's poorest countries. Since January, it has held the unfortunate record worldwide of the longest school closure due to COVID-19, running almost two years. These woes notwithstanding, in 2021 several attention-worthy startups cropped up. For example, the "super app" SafeBoda became the first startup funded by Google's Africa Investment Fund. What started as a simple motorcycle taxi service has evolved into a multi-purpose platform offering food delivery and online payments and transactions. Safeboda's rapid growth shows what happens

when tech companies are driven to serve a young and connected population. A Ugandan government study conducted in 2021 estimated that e-commerce revenue (merchandise, but also finance and health) will double by 2025 to \$421 million. This growth is fuelled by other sectors, such as electric motorcycles and charging stations, e.g. those available in Uganda's capital Kampala from the startup Zembo. With 200,000 zipping through this city alone, motorcycle taxis are already a popular means of transport and the shift to electric versions is accelerating.

Population  
47,123,533  
(2021)

GDP per capita  
\$858.1 (2021)

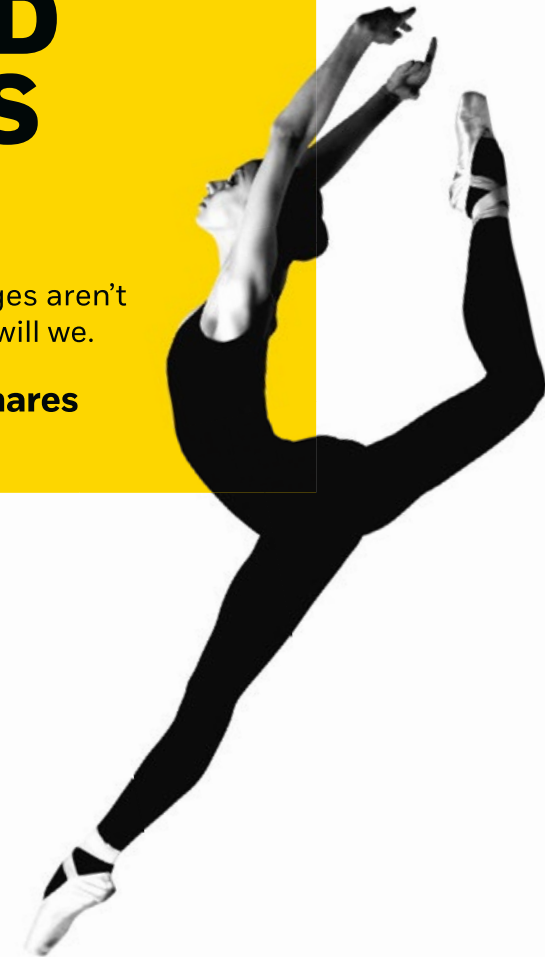
Growth  
3.4% (2021)

Main economic sectors  
Mostly agriculture (diversified: coffee, plantains, sweet potatoes, etc.), services (transport and communications), little industry (mining and oil)

## HIGH STANDARDS SHOULD ALWAYS GO UP

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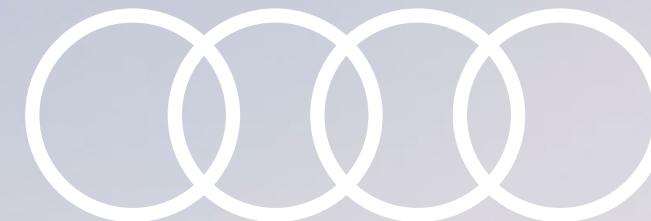


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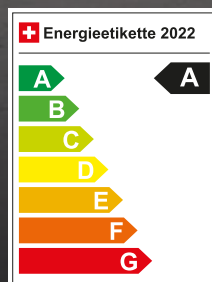
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# Upgrade to Audi's business class



Audi e-tron GT quattro, 476 HP, 21.6 kWh/100 km, 0 g CO<sub>2</sub>/km, category A.\* Leasing offer: down payment CHF 23 780.-, 48 months, 10 000 km per year. See table for price calculations. Displayed model: Audi e-tron GT quattro, 476 HP, 21.6 kWh/100 km, 0 g CO<sub>2</sub>/km, category A, Daytona Grey Pearl Effect, alloy wheels, 5-twin-spoke concave module with graphic print, black, 9.5 J x 21 | 11.5 J x 21 with 265/35 | 305/30 R21 tyres, Matrix LED headlights with dynamic indicators, black plus optical package, single frame in car colour, regular price CHF 121 970.-, compensation CHF 5 120.-, EnterprisePlus discount CHF 12 850.-, cash purchase price CHF 104 000.-, annual percentage rate for leasing 1.9%, term 48 months (10 000 km/year), down payment CHF 26 000.-. Leasing rate: CHF 619.-/month. All offers exclusive of compulsory comprehensive insurance. The granting of credit is prohibited if it leads to over-indebtedness on the part of the consumer. Financing provided by AMAG Leasing AG. Offer valid for contracts concluded by 31 December 2022 or until further notice. Subject to change. Applies to all vehicles imported by AMAG Import Ltd. Suggested list price of importer AMAG Import Ltd. EnterprisePlus: commercial offer, only available for vehicles registered to companies with an entry in the commercial register.

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Your special price	95 120.-
Your discount	16 430.-
Annual percentage rate for leasing	1.9%
Leasing rate per month	569.-*



# “In China, we’re considered the Rolls Royce of compressors”

Burckhardt Compression is the world’s leading manufacturer of gas reciprocating compressors. The Swiss firm’s order book jumped 44% last year. Interview with Burckhardt’s CEO, Fabrice Billard, at the Winterthur headquarters.

BY LUDOVIC CHAPPEX  
PHOTOS: NIELS ACKERMANN

With restrictions on Russian natural gas exports, liquefied natural gas (LNG) has become a scarce source of energy, especially in Europe. Liquefaction (which reduces gas volume by 600 times), its transport by sea, and regasification require extremely powerful compressors. That is where Burckhardt Compression comes in. The Swiss company, based in Winterthur, is the world leader in this complex process. Due to the current state of the world, the company has been in the spotlight in recent weeks. But its scope of action extends beyond LNG. The group’s main businesses also include hydrogen compression solutions and the production of solar panels, two fast-growing sectors. The company recorded an explosion in orders last year (see company feature on p. 24). Its CEO Fabrice Billard hosted us for an interview at the company’s headquarters, including a tour of the gargantuan factory where the compressors are manufactured.

**The general public cannot necessarily imagine the weight and enormous size of the equipment you produce. Your compressors are unlike any other on the market.**

The compressors that we install on LNG carriers (ed. note: tank ships used to transport liquefied natural gas) for example weigh about 150 tonnes. And the largest compressor we manufacture weighs 300 tonnes. Worldwide, only a few of them are sold per year. These “hyper compressors” are used by petrochemical plants that produce the polymer EVA (ethylene vinyl acetate), involved in manufacturing solar panels. The ethylene must be compressed at a pressure of 3,500 bar, meaning that the volume has to be compressed 3,500 times, hence these massive compressors.

**How do you transport these products from your Winterthur plant to your customers?**

We load each compressor onto a giant lorry. The trip to Basel takes

place over two nights as a special convoy. From Basel, the compressor is moved by barge to Rotterdam and then loaded onto a ship to its final destination, usually China.

**Manufacturing in Switzerland is expensive. Why do you continue to produce here?**

Machines that require a very high level of expertise to manufacture are designed in Switzerland, because all new technologies and compressors are developed here. The production of certain models is

then gradually transferred to other plants, particularly in India. We have also acquired our Chinese competitor Shenyang Yuanda Compressor, which has its own products and R&D geared towards serving the local market, as needs are different.

**What is your added value over your competitors?**

We position ourselves in very specific niches, covering about 30 applications in all, which require extremely high compression power and where reliability is a key factor. For example,

at petrochemical plants that produce solar panels, the compressor must operate continuously. For Chinese customers, Burckhardt Compression is considered the Rolls Royce of compressors. We’re definitely more expensive than our competitors, especially our compressors used to produce plastics for solar panels (ed. note: Burckhardt Compression is by far the world leader in this sector, with 80% of the market). More broadly, we also stand out for our services at the local level, due to our global presence.

**Your factory doesn’t look like a high-tech facility. It smells like oil and steel. How much of your business is dedicated to innovation?**

What’s fascinating is that the concept behind our piston compressors is the same as that of the very humble bicycle pump, and that this type of compressor has been manufactured for 150 years. But innovation, which has been picking up over the last 10 years, plays a central role in our business. The basic principle of a compressor hasn’t changed, but we’re constantly improving the ➤

**“What’s fascinating is that the concept behind our piston compressors is the same as that of the very humble bicycle pump”**

Fabrice Billard,  
CEO of Burckhardt  
Compression, in his  
office at the company  
headquarters in  
Winterthur.





composition and durability of the materials used. In fact, we're the only manufacturer with our own polymer R&D centre. We produce our own polymers and develop our own formulas.

**What kinds of technical challenges do you face?**

For hydrogen applications, you need a compressor that can handle a high capacity and discharge pressure (500 bar). Hydrogen molecules are extremely small and tend to escape from the sides of the piston, making the gas very difficult to compress. So, special materials that resist friction and high pressure are needed to seal the piston without a lubricant. It's really high-tech, even if the basic concept is old. We have a partnership with Shell to develop new solutions in this field.

**How will your businesses evolve over the next few years?**

The LNG market will continue to grow for at least five years and then start to decline gradually, following the course of governments' environmental ambitions. We consider it a transition energy. It has the advantages of being easier to transport than coal and emits less CO<sub>2</sub>, but it isn't a long-term energy source. The market for solar panels, however, should continue to grow. Hydrogen is a wild card. We're cautious about the fast development in this market, even though it has already shown very concrete growth.

**There's a lot of talk about hydrogen, but the market is in its infancy. What are the signs that the technology will take off?**

We have already signed on industrial projects, especially for hydrogen liquefaction in the United States. Our orders include lots of compressors. We also have orders for service stations for about a dozen compressors. Each molecule produced by an electrolyser must be compressed at least once before it reaches the consumption point, so

demand for compressors is considerable. Vehicle manufacturers are also communicating more and more about hydrogen's potential. Lorries are a prime market, but not the only one. For instance, BMW has several models in its pipeline. These announcements show that manufacturers believe in it and that hydrogen vehicles will hit the market, which should boost consumption.

**"We have already signed on industrial projects, especially for hydrogen liquefaction in the United States"**

**What if electric batteries show spectacular growth and stifle the hydrogen market? Does that type of scenario worry you?**

No. If only half of the forecasts from various studies came true, that would already be huge. Even if 20% materialised, that would already mean growth for us.

**What would prevent a major industry player from launching its own products to compete with yours?**

Expertise and references. In other words, credibility. These two factors are tremendous barriers to entry in this business. For customers, buying a machine as critical as an industrial compressor is a huge commitment. They need reliable references. In fact, no new competitors have emerged in the past 10 years.

**Focus is currently on liquefied natural gas (LNG) as an alternative to Russian natural gas. How much are you benefiting from this trend?**

The question surrounding LNG is

now coming into the public arena due to the current geopolitical situation, but the underlying trend is not new. The market has grown substantially and become a pillar in our business mix over the last five years (see chart on p. 25). Recent events are accelerating this shift, pushing our compressor sales up 20% in this sector. We hear a lot about plans to build three or four LNG import terminals in Germany, but don't forget that in China they've been installing one terminal per month for years! The main market is Asia. What's happening in Russia right now does not fundamentally change anything. On top of that, limitations due to environmental impact are stalling the construction of these facilities in Europe. And limitations also apply to the manufacture of new ships. The shipyards are already full for several years.

**Can you keep up the pace in terms of production capacity?**

For LNG compressors, we still have production capacity in Switzerland. We can also expand our assembly plant in Korea for LNG carriers. For other applications, we can increase the capacity of our plant in the United States. But production is not the limiting factor these days. The real challenge will soon be to recruit new experienced engineers and project managers. We need highly skilled people for specific tasks, and we can't train them overnight. It takes two to three years, especially in engineering for new product development. In addition to our Swiss base, we have three engineering centres, in Pune (India), Shanghai (China) and Milan (Italy).

**One of your main growth areas is service solutions. Can you provide a few examples?**

Service solutions are a key part of our business. The United States is a major market in this segment, especially in services to support our hydrogen compressors. They sell well in North America, which is

**THE GERMAN-SPEAKING FRENCHMAN**

Fabrice Billard, age 52, took over from Marcel Pawliczek at the helm of Burckhardt Compression last April. This Frenchman – who has also gained Swiss citizenship – had been chairman of the Swiss group's Systems division since 2016. Prior to that, he held various management positions over his 10 years spent at Sulzer, the company he joined after starting his career at Boston Consulting. During this first job experience, he was sent to work in Switzerland and never left. Today, he seems perfectly comfortable in German (if not Schwyzerdütsch), which has become his daily working language. Before the interview, he told us, "When I was at school, German was my favourite language. I went through a romantic period, Goethe, Schiller, and so on." Although trained as an engineer with a Master of Science in Aeronautics and Aerospace Engineering from École Centrale Paris, Fabrice Billard has spent his entire career in project management and optimisation. Very relaxed and approachable during our interview, he enjoys outdoor sports (road cycling, mountain biking, cross-country skiing, ski touring). He lives in Zurich and is married with two children.



currently our top market for these devices. The digital transformation of services is also a priority for growth. Lastly, we provide services to reduce our customers’ green-house gas emissions. Today, our compressors need a motor to operate, and that uses energy. There are also gas leaks in the chain. We can help our customers to optimise the use of our products. In countries like Switzerland, Sweden and Denmark, CO<sub>2</sub> prices are pushing our customers to reduce their emissions. This can become an important service for our business.

**Your service division is also more profitable than your product division...**

We gain from having a large installed base of compressors, because they then consume spare parts, maintenance, digital support,

etc. That’s why all manufacturers tend to make low margins on products. It’s also very difficult to copy a competitor’s spare parts.

**You also provide services for some of your competitors. Isn’t it counter-productive for them to give you this lucrative business?**

Only a quarter of our service business comes from competing compressors. We win this market for two reasons: first, we have a local presence throughout the world, which some competitors don’t have, and second, we can put our engineering expertise to use. That way, we can optimise other brands of compressors that are already installed, as end customers often contact us. It’s not just simple maintenance. We actually re-engineer competing models. Recently, >

A company technician taking care of a "hyper compressor", a 300,000-tonne behemoth that will soon leave the Winterthur plant by road (12 August 2022).

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You won’t find any Burckhardt compressors for domestic use online, as the Swiss company isn’t active in this product category. While the global compressor and vacuum pump market is worth a grand total of \$32.4 billion according to a MarketResearch report published in early July, Burckhardt Compression focuses on only a tenth of that market. In its 33,200 sq. m of hangars in Winterthur, the Zurich-based firm manufactures extremely heavy and powerful large-scale piston compressors that are used around the world in various industrial applications (see the graphic opposite) such as gas liquefaction, hydrogen compression and solar panel manufacturing, which are three booming markets.

This favourable atmosphere helped the group’s positive

2021/22 results, which were published in June 2022. Indeed, Burckhardt significantly increased its orders (+44%). Revenue over that period was slightly down by 1.2% to 650.7 million francs, primarily due to lockdowns in China, Burckhardt’s primary market. Net profits were up 6.8% reaching 50.4 million Swiss francs, and the EBIT margin was up 1.6 percentage points at 10.8%.

The Zurich-based group, which has almost 2800 employees, does have a few competitors, namely Dresser-Rand (owned by Siemens) and Baker Hughes, both US companies, as well as the German group Neuman & Esser. But in certain niche sectors, Burckhardt Compression enjoys near-total domination: it holds an approximately 80% market share in the hyper compressor sector,

devices whose uses include the production of EVA (ethylene vinyl acetate) polymer, which is used to manufacture solar panels. The only competitor in that sector, Nuovo Pignone, is now owned by Baker Hughes.

In recent weeks, piston compressors used on ships that transport liquefied natural gas (LNG) and at LNG import terminals have put Burckhardt Compression in the spotlight, given the gas supply issues in Europe due to the Ukraine war. That said, the Swiss company made a name for itself in these sectors, which it has dominated for several years now, long before the invasion of Ukraine. In 2021, it built 60 compressors for transport ships and loading terminals.

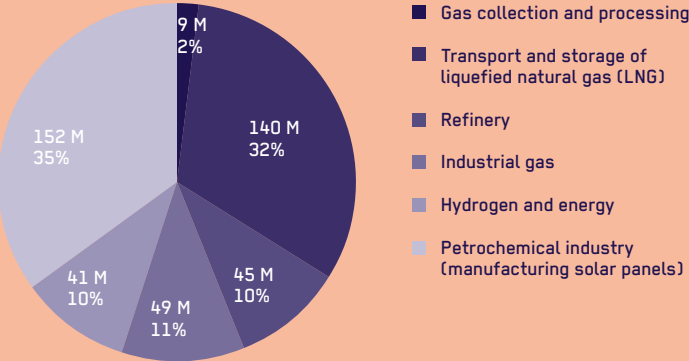
Most analysts consider Burckhardt Compression to be

a winning long-term investment, particularly due to the current energy transition. Arben Hasanaj from Vontobel is one of them, and he published a very detailed report on the company in June 2022. “Burckhardt has enormous opportunities in the hydrogen sector,” he says. “Demand from infrastructure will increase significantly. Moreover, this company is truly at the cutting edge of technology when very high pressure is needed and purity is important (compression without oil), which is exactly the case for hydrogen.” According to Hasanaj, the most relevant application will be mobility (liquefaction, filling tankers, refuelling stations), a sector in which business is expected to at least triple in the medium term, reaching 150 million Swiss francs. The Vontobel analyst also sees opportunities in the solar panel manufacturing sector.

However, he does not see the war in Ukraine as a “game changer” in the medium to long term for liquefied natural gas, an opinion shared

by the CEO of Burckhardt himself. Hasanaj recommends purchasing shares, with a price target of 560 Swiss francs.

2022/2023 sales estimate for the systems division  
(in millions of Swiss francs)



Source: Vontobel Equity Research





**“One tonne of CO<sub>2</sub> is getting expensive, so the market potential is colossal”**

we increased the durability of critical components in a competitor's compressor two-fold. By introducing our components, we transform the original compressor into a Burckhardt compressor. This model is attractive for any industry with a high service component, because the service division brings higher margins.

**Do you plan to make any further acquisitions?**

We're going to continue along the path we have been on for a few years, especially in service solutions. The goal is, first, to fill gaps in our geographical coverage, especially in Asia; and second to acquire companies with advanced technology. One example is the Dutch company Mark van Schaick, which we acquired last December. It is one of only two companies in Europe that can service and repair very large crankshafts.

**Will China remain your main market?**

Yes, because it is active in today's three major trends: LNG with import terminals, solar panels and now hydrogen with a proactive policy from Beijing. But we expect the share of business from Europe and the United States to grow over the next five years, to achieve a more balanced mix.

**You're also investing more in digital technology. Can you provide an example of an innovation that is already in use?**

In customer support for example, we can perform maintenance and repair work remotely. With a tablet, our customers can show our experts the problem in real time and be guided through the steps using augmented reality tools. This service is already operational. We're also testing preventive maintenance. This service is used to predict when a compressor

will break down using an artificial intelligence algorithm, for example based on the compressor's vibrations. We have filed patents for some innovative algorithms.

**Do you have any new markets to explore? Are there opportunities that you have not yet seized?**

Carbon capture and storage is an extremely attractive solution for us. One tonne of CO<sub>2</sub> is getting expensive, so the market potential is colossal. Applications we are interested in involve small volumes of gas that require high compression. We are currently in talks with the authorities of a Swiss city to equip an incineration facility. These facilities currently account for up to 20% of a city's CO<sub>2</sub> emissions, and some Swiss municipalities have pledged to achieve a net-zero emissions balance. This could become a real opportunity for us. ▴

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# BATTERIES POWERING THE WORLD

**An essential link in the energy transition, the battery industry is booming. The sector is expected to generate more than \$300 billion a year by 2030, three times more than today.**

BY BERTRAND BEAUTE

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High-power  
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to last

**T**he Seoul Stock Exchange has never seen such growth. Last January, 4.4 million South Koreans, almost 10% of the population, tried to buy shares in LG Energy Solution – the world's number-two battery manufacturer – when the company went public. This popularity resulted in demand for shares 70 times greater than the number reserved for the public at the time of the offering. While the IPO left many disappointed, the lucky few who managed to acquire LG Energy Solution shares did not regret their investment. Introduced at a price of 300,000 won per share, the stock jumped 68% on its first day of trading. Since then, of course, the stock has undergone a correction – like most technology stocks in 2022. However, it is still trading at more than 25% above its opening price. ▶



LG Energy Solution is not the only battery specialist to perform well on the stock market. China's CATL, the world leader in the sector, has seen its share price soar by almost 1,000% in four years since its IPO in June 2018. Another Chinese company, BYD, has experienced a similar share price rise – more than 600% over the last five years. What is behind such investor appetite? “The battery sector will experience massive growth over the next few years,” says Anna Väänänen, Global Environmental Equity Fund manager at Mirova. “These attractive outlooks are appealing to investors.”

Currently valued at around \$100 billion, the global rechargeable battery market is expected to reach \$284 billion in 2030, according to the Indo-Canadian firm Precedence Research. This is a very conservative assessment given that there are several types of batteries – lead, nickel and lithium in particular (see p. 36) – and demand for lithium-ion (Li-ion) models alone should drive the global market to much higher levels. In 2021, Li-ion technology generated between \$40 to \$60 billion. This figure is expected to rise to between \$180 billion and \$280 billion by 2030, according to estimates by various research firms with varying degrees of optimism.

### High value

For the past five years, the shares of companies active in future mobility, which includes battery players, have largely outperformed the rest of the market.

- MSCI ACWI IMI Future Mobility Index
- MSCI ACWI IMI Index



## LG Energy Solution is not the only battery specialist to perform well on the stock market. China's CATL, the world leader in the sector, has seen its share price soar by almost 1,000% in four years

This very wide range can be explained by the fact that the battery market, although 150 years old, is still in its infancy or, at least, in the midst of a revolution. The appearance of Li-ion models – first marketed in 1991 – has completely changed this century-old industry. Capable of storing much more energy than previous lead- or nickel-based technologies, lithium batteries have enabled the development of mobile electronics since the 2000s and electric mobility since 2010, and will play a key role in stationary energy storage in the future.

“People think the battery sector is already huge. But this is just the beginning,” enthuses Michael Pye, an investment manager at Baillie Gifford. “As a comparison, it's a bit like if we had just installed the first oil wells in Texas. The growth potential is enormous.”

“Rechargeable batteries are set to become an essential link in the energy transition,” confirms Väänänen. “They will enable the electrification of society, a process that is needed to reduce our consumption of fossil fuels.” The electric mobility sector is currently growing rapidly and will be the main driver of demand in the coming years. According to a report by the World Economic Forum, the demand for battery power for transport will increase tenfold, from 229 gigawatt hours (GWh) today to 2,333 GWh in 2030.

Giacomo Fumagalli, a stock market analyst at Robeco, confirms that demand will soar: “In 2021, 6.6 million electric vehicles were sold worldwide, accounting for over 8% of global sales. This means that there is a lot of room for growth,” says the analyst. “According to forecasts, sales of electric vehicles could exceed 10 million units in 2022. Despite inflation, the sector will thus continue to grow this year. Moreover, with the gradual banning of internal combustion vehicles (the European Union has voted to ban the sale of new models in Europe from 2035), we expect the penetration rate of electric cars to reach 50% worldwide by 2030.”

This transition has been made possible and has accelerated thanks to the steep drop in the price of lithium batteries, which fell to an average of \$132 per kilowatt hour (kWh) in 2021 from \$1,200 in 2010, a drop of almost 90%. “Prices will fall further in the next few years,” predicts Nicolas Jacob, thematic stock manager at Oddo BHF Asset Management.

“They should fall below the symbolic threshold of \$100 per kWh in 2025 – the rate at which electric vehicles become equivalent to petrol cars in terms of cost.”

But isn't there a risk that the emergence of other technologies, such as hydrogen-powered cars (see the September 2020 issue of *Swissquote Magazine*) will derail these positive forecasts? Absolutely not, according to Xavier Regnard, Utilities & Energy transition analyst for Bryan, Garnier & Co: “Hydrogen-powered cars are also equipped with batteries,” he points out. “Whatever type of mobility we choose in the future – battery, hybrid or hydrogen vehicles – we cannot do without batteries. They are essential for decarbonising transport.”

## “People think the battery sector is already huge. But this is just the beginning”

Michael Pye, investment manager at Baillie Gifford

The other driver of demand will be stationary energy storage. “The supply of renewable energy is intermittent,” says Väänänen. “We therefore need solutions to store energy when production is higher than demand, so we can then reinject it into the network during consumption peaks. Hydrogen and batteries are two technologies that can address this issue.” Large renewable energy producers require this type of storage, but so do individuals with small electricity generation capacities, such as solar panels installed on the roof of a house. According to the European Union, in 2020, the demand for batteries for stationary energy storage represented just 10 GWh, 20 times less than the demand for electric vehicles, and is expected to reach 221 GWh by 2030.

“Renewable energy storage is a nascent field and much smaller than electric mobility, but one in which all the major battery manufacturers are already positioning themselves, proving that they believe in its potential,” points out Nicolas Jacob at Oddo. The car manufacturer Tesla, for example, has been marketing Powerwall storage solutions for private individuals and Powerpack for industry since 2015.

The battery industry's last major market, consumer electronics, is expected to see its needs double between 2020 and 2030, from 60 GWh per year to 130 GWh. In this context, is now the right time to invest (see company profiles on p. 42 to 48)? “The battery industry remains expensive, because the markets expect the sector to grow strongly,” warns Jacob. “In 2021, valuations seemed excessive to me. The markets had over-anticipated the growth of the stationary energy sector. Now, after the correction of 2022, the share price of battery specialists seems a bit more reasonable.”

A view shared by Anna Väänänen: “Company valuations are more realistic now than a few months ago. I don't know if this makes for a good entry point for investors, but what is certain is that it is a market with strong growth,” emphasises the Global Environmental Equity Fund manager at Mirova. “However, investors should bear in mind that the battery sector is likely to become a cyclical industry, like that of semiconductors.”

In concrete terms, during the first phase of the cycle, companies invest heavily to increase their production capacity to meet growing demand. This is the golden era we are currently experiencing, with more and more gigafactories being built around the world, driven by attractive prospects. In July 2022, for example, Panasonic announced that it would invest \$4 billion in a new

factory in Kansas, while Volkswagen launched work on its first gigafactory, near Salzgitter in Germany, estimated to cost almost €3.5 billion.

The risk is that the cycle will move into a second phase, making it difficult to make these huge investments profitable. “With the opening of all these factories, the battery industry will find itself with excess production capacity within a few years,” warns Väänänen. “This will lead to market consolidation, with the smaller players disappearing. In a cyclical, capital-intensive industry, the advantage goes to the bigger, more established players that can dictate prices. Today's big names in batteries, such as CATL, LG and BYD, will probably remain the big names in the future.” ▲



# "Europe must form partnerships"

Specialising in energy issues, researcher Pierre Laboué breaks down Europe's strengths and weaknesses in the battery industry. Find out more in this interview.

BY BERTRAND BEAUTÉ

**T**railing behind Asia, Europe now seems determined to make up for lost time when it comes to battery manufacturing. Pierre Laboué, a researcher at the French Institute for International and Strategic Affairs (IRIS) and co-author of the study (in French) "European Battery Alliance: challenges and European perspectives", looks at the current situation.

## Why are batteries strategic for Europe?

Batteries are one of the pillars of the energy transition and are therefore of key economic importance. They are a solution for electrifying transport and incorporating renewable energy into the energy mix. These two objectives are integral to the European Union's strategy to be climate-neutral by 2050. Batteries are also a vital component for European car manufacturers, as they account for 30% to 40% of the price of an electric vehicle. The development of a European battery industry is a priority that will enable

the EU to achieve its energy transition and defend its economic interests.

## Can Europe catch up with Asian leaders despite their huge head start?

In December 2021, the Swedish company Northvolt launched battery production at its gigafactory in Skellefteå, Sweden, to manufacture the first truly European-made cells. Its success shows that it can be done. However, Europe still has challenges to overcome before it can become a global player. The continent lags behind in terms of research and development, but it can catch up with Asian players because Europe excels in R&D. The problem is production. We do not have the know-how necessary to mass-produce high-quality cells at low cost and within very short timeframes. Without this expertise, Western companies must currently rely on partnerships or buy from Asian manufacturers. Tesla, Mercedes-Benz, Volkswagen and Volvo have gone for the second option, all signing agreements with the Chinese company CATL.

Also, the notion of scale is important in the battery industry. The biggest manufacturer is more competitive than the others, and it becomes a winner-takes-all environment.

There are many gigafactory projects currently under way in Europe, which could make the EU self-sufficient in batteries by 2030. But the risk is that these factories will not be profitable against Asian giants. They could end up being bought out as the industry shifts towards concentration, or they could close down altogether. The competition will be intense.



**"Europe excels in R&D. The problem is production."**

## Is Europe's lack of mineral resources also a hurdle to developing a home-grown industry?

It's true that Europe has limited raw materials. Meanwhile, the International Energy Agency (IEA) estimates that by 2040, demand for lithium could increase by a factor of 42, for graphite by a factor of 25,

for cobalt by a factor of 21, and for nickel by a factor of 19. To handle this future explosion in demand, all European manufacturers are forming partnerships in an attempt to secure their supply. For example, in June, 2022 the car manufacturer Stellantis invested €50 million in the Australian lithium producer Vulcan Energy Resources.

So, in the short term, the situation is dicey. That's why the development of a recycling industry and "urban mines", where key metals could be recovered from end-of-life batteries, is a strategic imperative to secure Europe's economic and industrial security.

## So why is battery recycling not taking off?

Unfortunately, manufacturers are not interested enough in recycling and don't give much thought to eco-design. Their current priority is improving battery performance and reducing production costs. As a result, the chemical make-up of batteries is constantly changing, and that makes recycling difficult. Recyclers need stable products to develop the industry. I think recycling will grow when battery technology matures. It's an industry with a promising future. ▴

## KEY WORDS

### DISPOSABLE BATTERY

A disposable battery (or primary battery) is an electrochemical device in which a redox chemical reaction produces electricity. They are not rechargeable: once the chemical reagents introduced at the start are exhausted, they must be replaced with new ones.

### BATTERY PACK

A battery pack (also often shortened to "battery") is an assembly of several batteries (or cells), connected in series or parallel, in order to obtain the desired voltage. For example, the battery of the Tesla Model 3 (standard range version) consists of 2,976 cells.

### RECHARGEABLE BATTERY

A rechargeable battery (or secondary battery) is a system for storing electrical energy in chemical form. When discharged, rechargeable batteries work on the same principle as disposable batteries: a chemical reaction produces electricity. However, in rechargeable batteries, the reaction is reversible – hence "rechargeable". A rechargeable battery consists of two electrodes (the cathode and the anode), separated by a liquid substance (the electrolyte).

### CATHODE

In a battery, the cathode is the positive (+) electrode where chemical reduction reactions take place when the battery supplies power to an electrical device (discharge). In lithium-ion batteries, the cathode is made of metals such as cobalt, manganese, iron phosphate or aluminium (see infographic on p. 53).

### ANODE

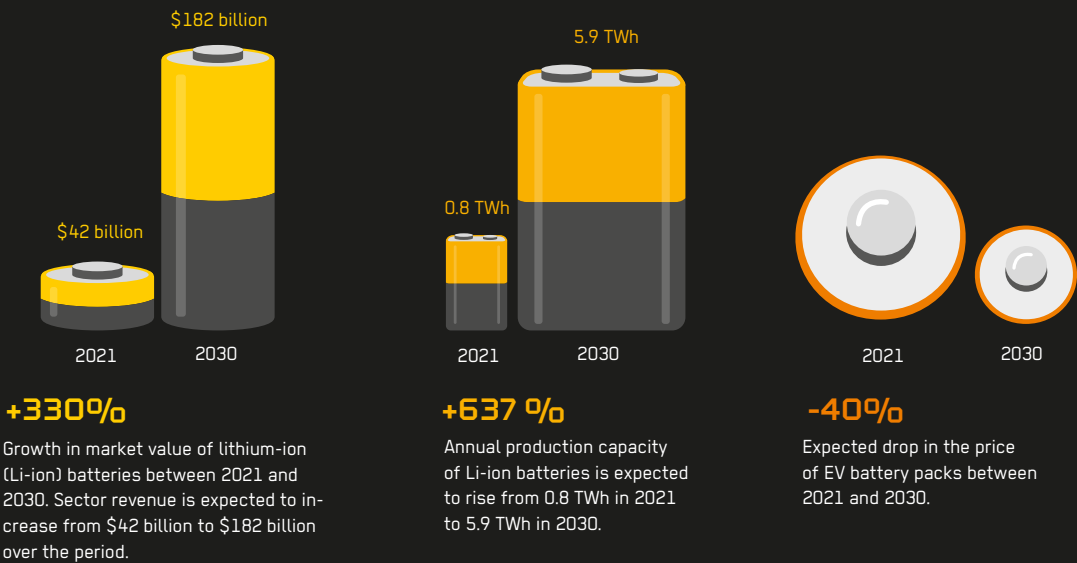
The anode is the negative (-) electrode of a battery. When the battery powers an electrical device (discharge), the anode supplies electrons through the external circuit to the receiving cathode. In lithium batteries, the anode is usually made of graphite.

### ELECTROLYTE

The electrolyte is the conductive solution that separates the anode from the cathode in a battery. In lithium batteries, the electrolyte consists of lithium salt.

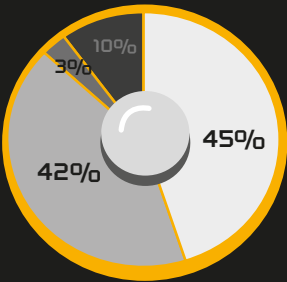


# High-power rise



## Lithium-ion, the king of batteries

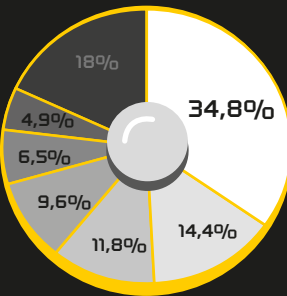
Sold for the first time in 1991 by Sony, lithium-ion batteries have become indispensable, knocking older lead and nickel batteries out of the lead.



- Lithium-ion**  
Consumer electronics and electric vehicles
- Lead-acid**  
Starter battery in internal combustion vehicles, industrial processes
- Nickel metal hydride (NiMH)**  
Rechargeable batteries (especially AA and AAA) and hybrid cars
- Other**

## Asia, the undisputed champion

Asian countries are home to all Li-ion battery market leaders.



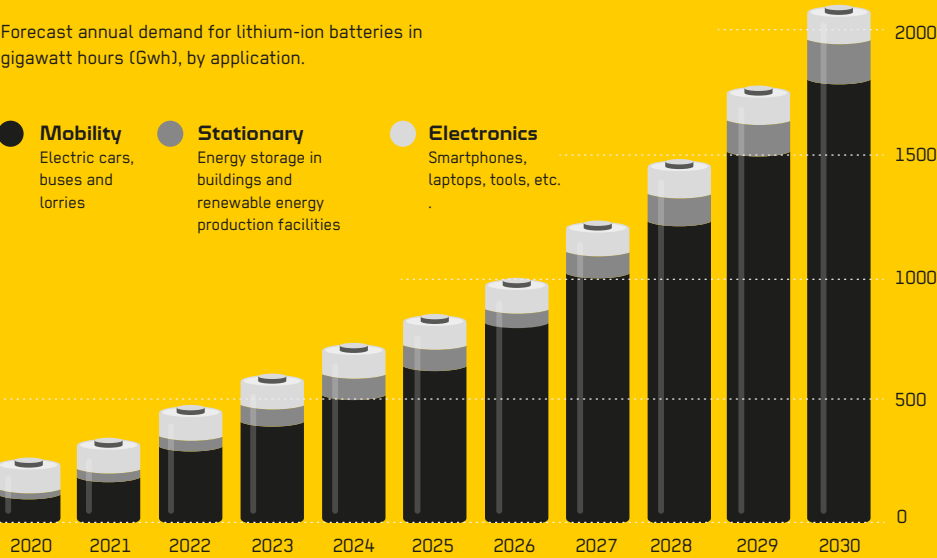
- CATL**  
China
- LG Energy Solution**  
South Korea
- BYD**  
China
- Panasonic**  
Japan
- SK Innovation**  
South Korea
- Samsung SDI**  
South Korea
- Other**

Since the development of mobile electronics in the 1990s, lithium-ion batteries have invaded our daily lives. But it's only the beginning – the boom in e-mobility is pushing them onto a whole new scale.

## Demand driven by electromobility

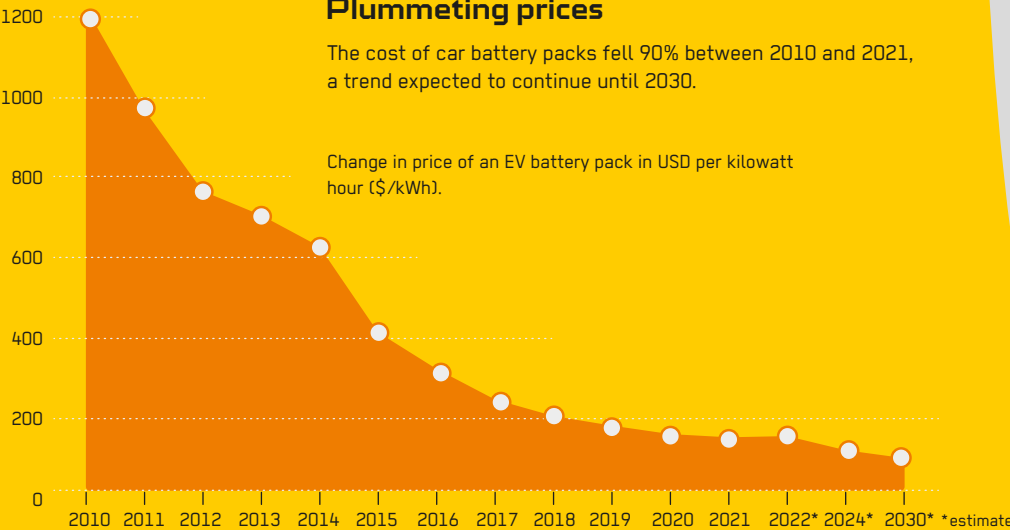
Lithium batteries are already highly prevalent in our everyday life, especially in our smartphones, but the mainstream adoption of electric vehicles will send demand soaring.

Forecast annual demand for lithium-ion batteries in gigawatt hours (GWh), by application.



## Plummeting prices

The cost of car battery packs fell 90% between 2010 and 2021, a trend expected to continue until 2030.



Sources: BloombergNEF, International Energy Agency, Precedence Research, S&P Global, SNE Research, Statista



# THE THREE MAIN TYPES OF BATTERIES

Thanks to their high energy density, lithium-ion batteries have become widespread. But older versions made from lead or nickel are still used in various applications. We review the advantages and disadvantages of the battery types available today.

BY STANISLAS CAVALIER

## LEAD

Invented in 1854 by German physicist Wilhelm Josef Sinstedden and improved by French inventor Gaston Planté, the lead-acid battery was the first rechargeable battery to be sold. More than 150 years later, this type of battery is still widely used today, most notably to start combustion-powered vehicles. The lead battery market, currently estimated to be worth less than \$60 billion per year, is expected to reach \$93 billion in 2027 according to US firm Grand View Research. This type of battery, made up of lead-based electrodes immersed in a sulphuric acid electrolyte, is essential for many applications such as storing renewable energy, electric generators and combustion vehicle starters, particularly due to their attractive price.

# Pb

### ADVANTAGES

- Competitive price
- Good level of safety
- High recycling rate

### DISADVANTAGES

- Low energy density
- Limited lifespan
- Long recharge time
- Lead pollution

# 1

# Ni

## NICKEL

Slightly more recent than their lead equivalents, nickel batteries were invented in 1899 by Swedish engineer Ernst Waldemar Jungner. Historically, this type of battery was made from a nickel (Ni) cathode and a Cadmium (Cd) anode, immersed in an aqueous electrolyte solution of potassium hydroxide – known as a NiCd battery. Since then, the technology has evolved to use other metals for the anodes, such as Nickel-Iron (NiFe) batteries and especially Nickel-Metal Hydride (NiMH) batteries, which now dominate the market. NiMH batteries are used in particular by regular consumers (they are often incorrectly dubbed rechargeable batteries) but are facing increased competition from lithium batteries. In addition, some of the Japanese automobile manufacturer Toyota's vehicles are fitted with NiMH batteries. The global market for NiMH batteries was estimated at \$2.74 billion in 2021 and is expected to reach \$6 billion in 2026, according to a study from The Business Research Company.

### ADVANTAGES

- Good level of safety
- Effective regardless of temperature

### DISADVANTAGES

- Average energy density
- Cadmium pollution

# 2

# 3

## LITHIUM

Developed in the 1970s by British chemist Michael Stanley Whittingham, the first lithium battery was sold in 1991 by Sony. For the Japanese company, this technology was, at the time, the solution to the main problem with its video cameras: battery life. Over the following decade, lithium batteries progressively replaced older batteries in portable and electronic consumer products. Today, the boom in electric vehicles ensures solid growth for lithium batteries over the next decade. According to US firm Grand View Research, the lithium battery market is expected to exceed \$180 billion in 2030, compared to about \$50 billion today. The term "lithium batteries" includes a wide variety of technologies which differ based on their cathode. The cathode can be made up of various metals such as cobalt, manganese, iron phosphate or aluminium.

# Li

### ADVANTAGES

- High energy density
- Extended lifespan
- No memory effect

### DISADVANTAGES

- Poor performance in extreme temperatures
- Risk of instability and fire



# THE RACE TO BUILD GIGAFACTORIES HAS BEGUN

The battery market is dominated by Asia, which accounts for more than 85% of global production, but Europe is hustling to make up for lost time.

BY BERTRAND BEAUTÉ



**W**ith the war in Ukraine raging and gas shortages looming in Europe, Olaf Scholz travelled to Salzgitter, in Lower Saxony, in early July to attend the construction kick-off for Volkswagen's first battery factory. The German chancellor wanted to mark the occasion.

For the automobile manufacturer, this event was the start of a major offensive in the industry. The German group plans to build six battery gigafactories in Europe by 2030, investing €20 billion.

"Today is a big day for the automobile industry in Germany and in Europe," said Olaf Scholz. And a major turning point for Europe.

Until now, the global market has been widely dominated by Asia, which accounts for more than 85% of global production of battery cells, leaving only crumbs for the United States (12% of production) and Europe (3%).

And yet: "Lithium-ion batteries were developed in Western laboratories several decades ago," says

Giacomo Fumagalli, an analyst at Robeco. "But at the time, the technology wasn't considered to be strategically important. So production was outsourced to Asia where consumer electronics were being made – and as a result, we saw the first prospective applications of lithium-ion batteries at that time." The companies that are currently industry leaders have primarily reached that status due to mass consumer electronics, such as Chinese company BYD, Korean groups LG and Samsung, and Japan's Panasonic.

Chinese company CATL benefited from significant support from Beijing to create the country's own automobile industry as part of the "Made in China 2025" strategy. "Very favourable government programmes in Asia and particularly China have led to a situation where the cost of investing in a battery factory is much lower than in Europe or the United States," says Fumagalli. And as a result, CATL – founded in 2011 – has become the global battery leader in less than a decade, with a market share of 32.5%, ahead of LG Energy Solutions (21.5%) and Panasonic

(14.7%), according to figures from Korean firm SNE Research.

The problem is that batteries have since become a critical component. They are at the heart of all of our daily devices, and they are the cornerstone of the energy transition. "The pandemic, the semi-conductor supply chain crisis and the war in Ukraine have demonstrated that it was risky for countries to depend on others for strategic supplies," says Michael Pye, an investment manager at Scottish firm Baillie Gifford. "Batteries are strategic. Given this context, Europe can, and in some ways should, respond by creating a local and diversified supply chain." Especially given that, in the automobile industry, batteries are also a vital economic component, because they make up between 20% and 40% of the price of an electric vehicle.

**"The quality of batteries produced, meaning the ability to ensure they don't explode, is one of the biggest barriers to entry in this market"**

Christina Woon, director of investments for Asian assets at Abrdn

In 2017, the European Union created the European Battery Alliance (EBA) which aims to encourage Europe to develop its industry and produce its own batteries in order to capture 25% of the global market by 2030, compared to 3% today. And the results are starting to show. Created in 2015 by Peter Carlsson and Paolo Cerruti, two former Tesla employees, the private Swedish company Northvolt produced its first battery cells in its Skellefteå factory in December 2021 and began shipments in May 2022, becoming the first

European company to supply the automobile industry with battery cells. Northvolt has big-name clients and partners, such as Swiss group ABB and German companies BMW, Scania and Volkswagen. The factory that the VW group is building in Salzgitter is also partnering with Northvolt.

And the Swedish startup isn't the only company throwing its hat into the ring: approximately 40 gigafactories are currently being planned in Europe. If all of these factories are completed, Europe will be home to a production capacity of 1000 to 1500 GWh in 2030 – enough to equip 15 to 20 million electric vehicles per year. This is sufficient to satisfy local demand: according to figures from the European Automobile Manufacturers' Association (ACEA), 14 million consumer cars were manufactured in European factories before COVID.

Besides Northvolt and Volkswagen, the most ambitious projects are being led by ACC (Automotive Cell Company), a co-enterprise that includes Total, Stellantis and Mercedes, and plans to build three factories in Europe in Douvrin (France), Kaiserslautern (Germany) and Termoli (Italy) for a total production capacity that is expected to reach 120 GWh in 2030. In another flagship project, the global leader in electric vehicles, Tesla, plans to produce 100 GWh per year in Germany (see map on p. 41).

It still remains to be seen whether this enthusiasm will be enough to catch up to Asia. "Producing batteries at an industrial level is not easy. It requires lots of expertise. CATL, LG, Panasonic and Samsung have been manufacturing batteries for a long time. They have many years of experience," says Christina Woon, director of investments for Asian assets at Abrdn. "For newcomers, entering this market is very complicated. It's not impossible, but it's a long journey. ▶



can't do it alone. In the short term, forming partnerships with battery experts is the way to go."

The giant Stellantis – which came from the merger of PSA Peugeot-Citroën and Fiat Chrysler Automobiles – entered into a partnership with LG Energy Solutions in May 2022, in order to build a factory in Canada. Toyota and Tesla did the same thing, both creating joint ventures with Panasonic. "Having decades of experience is an enormous advantage in the battery sector. European companies have a long way to go to catch up to their Asian counterparts," says Fumagalli. "We'll see if Europe can do it, but the race will be even more difficult as the current leaders continue to advance and invest heavily." But one aspect may be in Europe's favour: legislation. In March 2022, EU environment ministers adopted legislation encompassing the entire battery life cycle, including production, collection and recycling. And on this specific point, European companies have an advantage over their Chinese competitors: Northvolt, which began construction on its recycling facility Revolt Ett in early 2022, has already pledged that its batteries will be produced using at least 50% recycled material in 2030. ▲

**"European companies have a long way to go to catch up to their Asian counterparts"**

Giacomo Fumagalli, analyst at Robeco

The quality of batteries produced, meaning the ability to ensure they don't explode, is one of the biggest barriers to entry in this market."

Indeed, if a battery is poorly made, particularly as a result of the presence of impurities, clusters of lithium crystals can form on the anode during charging and discharging cycles, and can eventually reach the cathode. This causes a short circuit, which can lead to a fire. To avoid this possibility, battery design must be extremely rigorous. This challenge requires specific expertise, as battery chemistry continues to evolve and gigafactories must produce tremendous volumes. To see the difficulties that the manufacturing process can bring, take a look at the run of bad luck that occurred at the Tesla and Panasonic gigafactory in Nevada. According to an investiga-

tion published by Business Insider in 2019, the factory had to scrap 500,000 of the 3 million cells it produced daily due to imperfections. To solve the problem, Panasonic had to send Japanese specialists to the United States.

"Many automobile manufacturers hope to eventually have internal production capacities, because batteries are an essential component," says Woon. "But for the time being, given the difficulties of developing expertise starting from nothing and creating a large production volume quickly, they

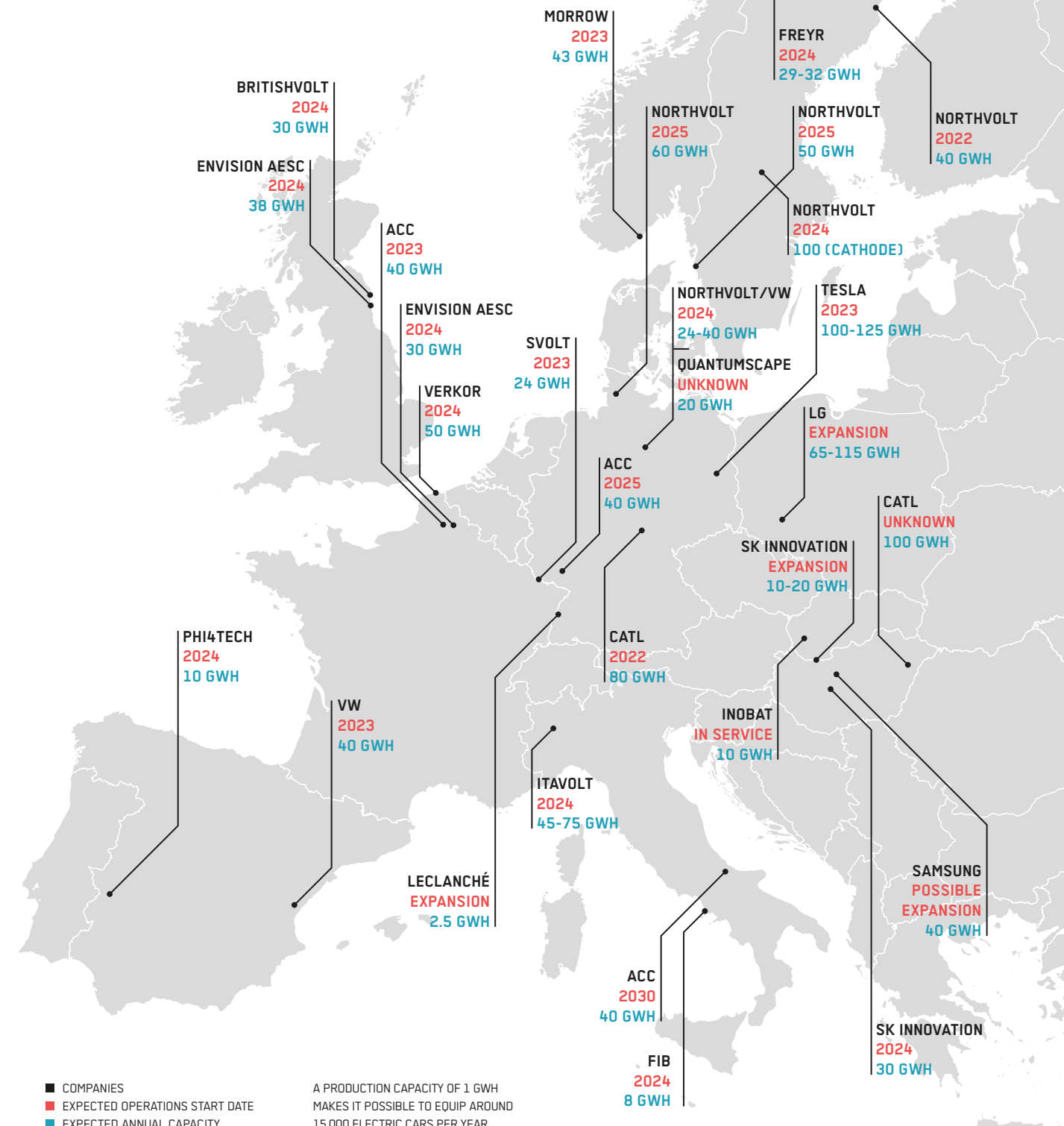
## THE WORLD IS GOING GIGA

It's the trendiest term in the industry right now. No one's talking about factories, production facilities, or manufacturing plants any more... just gigafactories. The term refers to gigantic factories that specialise in very high volume production. The expression was made popular in 2014 by Tesla, when the US automobile manufacturer began construction on Gigafactory Nevada (or Gigafactory 1), a battery manufacturing plant for its vehicles. Since then, the word has been adopted by the rest of the industry. But why is it

so important to have gigafactories in the battery sector? "It's a very difficult, very competitive industry, where some companies don't have significant margins," says Fumagalli, the Robeco analyst. "In this context, having gigafactories is important because it increases yields. With a higher production volume, companies are able to produce batteries at a lower cost." Yet another advantage for traditional industry players that already have large factories, whereas newcomers need to invest massively to catch up and become competitive.

## FUTURE EUROPEAN FACTORIES

Europe has plans to build more than 40 gigafactories. Here are the main ones.





# TODAY'S COMPANIES POWERED BY BATTERIES

The global battery business is dominated by Asian firms. But a handful of US and European companies are trying to carve out a spot for themselves by putting innovation first. Here is an overview...

BY BERTRAND BEAUTÉ

## CATL THE WORLD LEADER

The news came as a surprise. Though it has not yet completed construction of its first factory on the Old Continent (in Erfurt, Germany) the world leader in battery technology – Contemporary Amperex Technology, better known by its acronym CATL – announced in mid-August that it would be building a second gigafactory in Europe, in Debrecen, Hungary. This massive investment, tagged at €7.3 billion, is CATL's way of baring its teeth. The Chinese firm has no intention of leaving any market share to European newcomers, such as the Swedish Northvolt or Automotive Cells Company (ACC), a joint venture between Stellantis, Mercedes and Total, which are all launching plans to build enormous plants in Europe.

In barely 10 years of being in business, CATL has grown into a heavyweight with no cap on ambition. Since it was founded in 2011, the company has enjoyed massive support from the Chinese government. First came the "Made in China 2025" plan in 2015, which placed electric vehicles as a strategic area, followed by Beijing's exclusion in 2016 of Japanese and Korean producers from the Chinese battery market.

As a result, CATL took advantage of the strong growth in sales of local manufacturers such as Nio, XPeng and Li Auto. These Chinese challengers to Tesla are now all its customers. With 10 factories and five R&D centres, the company has also managed to list as a supplier to Western firms such as Tesla, Mercedes-Benz (Daimler), Volkswagen and Volvo. CATL now has more than 30% of the world market and half of the market in China, edging out significant economies of scale over its competitors. This break-neck growth has not gone unnoticed by investors: CATL's share price has increased tenfold since its listing on the Shenzhen Stock Exchange four years ago. Most analysts recommend buying shares as the company has a head start on all its competitors.

FOUNDED  
2011

HEADQUARTERS  
NINGDE (CN)

EMPLOYEES  
80,000

2021 REVENUE  
\$20.24 BN

300750

LIN SHANCHUAN / AFP



During the summer, CATL presented a new battery capable of ensuring a range of 1,000 km. Here, an aerial view of the company's headquarters in Ningde in the Chinese province of Fujian.

## AND ALSO...

### ALFEN NV

#### Energy storage

The Dutch company markets giant batteries that store electricity produced by solar and wind farms. They can also be used to supply electricity for events and work sites. For example, Alfen is currently building the third-largest storage solution in Finland for a wind farm. The company, which also manufactures electric vehicle charging stations, expects its revenue to increase by at least 30% in 2022.

FOUNDED: 1937

HEADQUARTERS: ALMERE (NL)

EMPLOYEES: 700

2021 REVENUE: €249.7 M

ALFEN

### SOLID POWER

#### The ambitious startup

The timeframe seems optimistic, to say the least. A specialist in solid batteries – a type of battery that is promising but still being developed – US startup SolidPower began its pilot production line in 2022 and plans to validate its concept with its partners (BMW and Ford) in 2023 before moving to mass production as early as 2024. The company must compete with other startups such as QuantumScape, as well as giants such as Toyota and CATL.

FOUNDED: 2011

HEADQUARTERS: LOUISEVILLE (US)

EMPLOYEES: 100

2021 REVENUE: \$2.7 M

SLDP





In its laboratories, QuantumScape is trying to develop a solid battery, the holy grail of the sector.

QUANTUMSCAPE

FOUNDED  
2010

HEADQUARTERS  
SAN JOSE (US)

EMPLOYEES  
600

2021 REVENUE  
0

— QS

“The future is solid,” writes QuantumScape on its website. The US company firmly believes that the battery of the future will be solid, whereas the current lithium-ion models contain a liquid electrolyte. The startup, founded in 2010, hopes to be the first on the market. That’s because on paper, the technology to create solid batteries would be a huge step forward. According to QuantumScape, their energy density could reach 400 Watt-hours per kilogram (Wh/kg), compared to 250 Wh/kg for the highest performing traditional lithium-ion counterparts. This would give nearly double the driving range, as well as provide a fast charging time, as 80% of the battery could be recharged in under 15 minutes. Another advantage is that unlike liquid models, solid batteries are safer due to not being flammable. A revolution for the electric vehicle market.

QuantumScape plans to produce solid battery cells for trial runs in vehicles by next year and hopes to move to large-scale commercialisation by 2024. This ambitious timeline has attracted both Bill Gates and Volkswagen. In 2020, the German manufacturer invested \$200 million in the California-based company, after an initial investment of \$100 million.

## QUANTUMSCAPE A SOLID BET

But there are still many obstacles to overcome before solid batteries become a reality, particularly the cost. According to several experts, a solid battery would be three to five times more expensive than a traditional model, restricting them to premium applications. Furthermore, QuantumScape has tough competition in the race for solid batteries, up against a multitude of startups including Solid Power from the US and ProLogium from Taiwan, as well as giants such as Toyota, CATL and LG Energy Solution. Analysts are cautious. Almost all recommend holding shares.

## BYD WARREN BUFFET’S CHOICE

BYD, for “Build Your Dreams”, is the story of the dizzying rise driven by the dream of a man of vision. Founded in 1995 by the no-fuss engineer Wang Chuanfu, the company initially specialised in manufacturing nickel-cadmium and lithium-ion batteries. The boom in mobile phones and laptops in the early 2000s quickly led the company to prosperous days. It offered batteries at rock-bottom prices, putting them in Nokia mobile phones, Dell computers and Black & Decker tools. Today, BYD batteries still power one in 10 phones sold worldwide, and the company’s customers include giants such as Samsung, the world’s largest smart-phone maker.

But that was not enough for Wang Chuanfu. Instead of resting on his laurels, the ambitious CEO sensed the future of automotive technology. In 2003, he bought Qinchuan Auto, a small, struggling manufacturer of petrol-powered cars. BYD’s experience gave it a critical advantage in the budding electric car industry.

FOUNDED  
1995

HEADQUARTERS  
SHENZHEN (CN)

EMPLOYEES  
288,000

2021 REVENUE  
\$34 BN

— 002594

In September 2008, as Wall Street was collapsing under the subprime crisis, Warren Buffet bought a 10% stake in BYD for \$232 million. The American investment icon never regretted that choice. Benefiting from Beijing’s EV subsidies, BYD has become the world’s third-largest electric car manufacturer, behind Tesla and SAIC, and the third-largest battery manufacturer behind its compatriot CATL and the Korean LG Energy.

However, Tesla and BYD have never really interacted with each other. While the US firm tackles the global market with premium vehicles, so far BYD has zeroed in on its domestic market with inexpensive models. But that could change. Since opening its Shanghai factory in 2019, Tesla has increasingly focused on the Asian market, while BYD is moving in the opposite direction. Active in Norway since 2021, the Chinese brand plans to tackle the European market as a whole starting at the end of 2022. This strategy has now been approved by investors. Over the last three years, BYD shares have risen by more than 500% and most analysts are still buying.

### POSCO CHEMICALS

#### The expert in cathodes

The Korean chemicals firm produces NCM (nickel, cobalt, manganese) and NCMA (aluminium) cathodes for electric vehicle battery manufacturers, as well as graphite anodes. The company, which accounts for approximately 20% of the global cathode market, plans to increase its cathode production capacities from 43,000 tonnes per year currently to 610,000 tonnes in 2030.

FOUNDED: 1963

HEADQUARTERS: POHANG (KR)

EMPLOYEES: 2,000

2021 REVENUE: \$1.71 BN

— 003670

### SGL CARBON

#### The understated anode

The German company specialises in developing and manufacturing carbon products. SGL’s activities include supplying graphite (a form of carbon), which allows lithium-ion battery manufacturers to produce their anodes. This is a booming market, which led SGL to increase its production capacities in 2021 for graphite used in anodes.

FOUNDED: 1992

HEADQUARTERS: WIESBADEN (DE)

EMPLOYEES: 4,700

2021 REVENUE: €1 BN

— SGL

### PANASONIC

#### Partners with Tesla

The traditional battery supplier to Tesla, the Japanese conglomerate announced on 14 July that it would invest \$4 billion to build a new factory in Texas. The goal is to increase production capacities in order to remain the primary supplier to Tesla, which is now also turning to LG Energy Solution and CATL.

FOUNDED: 1918

HEADQUARTERS: OSAKA (JP)

EMPLOYEES: 250,000

2021 REVENUE: \$62.969 BN

— 6752



A Varta employee holds button batteries at the factory in Noerdlingen, southern Germany.



CHRISTOF STACHE / AFP

**FOUNDED**  
1887

**HEADQUARTERS**  
ELLWANGEN (DE)

**EMPLOYEES**  
4,700

**2021 REVENUE**  
€ 902.931 M

— VAR1

Along with Duracell, Varta is undoubtedly one of the best known brands of microbatteries in the world. Operating in 75 countries, the century-old German firm is flooding the planet with rechargeable batteries, which can be found in numerous devices including car keys, DIY tools, torches and other consumer appliances. With five production sites in Germany, Romania and Indonesia, the company has no plans of depriving itself of the burgeoning large battery sector. Alongside its traditional business in rechargeable batteries, Varta has therefore launched into the building battery segment, used for example to store electricity produced by solar panels on a house. Tesla is also present in this sector with its Powerwall.

## VARTA THE GERMAN JOLT

Varta's fast-growing "Household Batteries" segment generated €388.6 million in 2021, gradually catching up with the "Microbatteries" segment, currently worth €514.4 million. This performance has made the group hungry for more. In 2021, it announced the development of the V4Drive battery cell for premium electric vehicles. This outlook has attracted investors: since its return to the Frankfurt Stock Exchange in 2017, Varta's share price has risen by more than 300%.

But the crisis in Ukraine could sap the energy out of Varta. Rising commodity prices and inflation have prompted the company to revise its forecasts downwards. In 2022, Varta's revenue is forecast at between €880 million and €920 million, down from its €1 billion target set at the beginning of the year. Most analysts recommend holding shares all the same.

## LG KOREAN AMBITION

The geopolitical crisis between Beijing and Washington might just find a lucky winner in the battery sector: LG Energy Solution. Currently number two in the sector behind the Chinese firm CATL, in recent months the Korean player has signed multiple contracts and partnerships with Western firms. Big names including Tesla, Hyundai, Volkswagen, General Motors, Stellantis are anxious to reduce their dependence on Chinese suppliers for components such as batteries or semi-conductors.

To finance its growth, LG Energy Solution, a subsidiary of the LG Chem conglomerate, pulled off a successful launch onto the Seoul Stock Exchange in January 2022, raising the equivalent of \$10.7 billion along the way in what was the country's largest ever IPO. Originally listed at 300,000 Korean won, the stock is now trading at around 445,000 won, jumping almost 50%.

While its primary competitor CATL relies mainly on its Chinese production sites and is currently completing its first plant outside the country in Germany, LG Energy already has gigafactories the world over, including in the United States, Europe, Australia, China and Korea. This distribution means its customers can be served at home and enjoy access to a local network. In addition, LG sets itself apart with its more advanced ESG (Environment, Social and Governance) approach than that of its Chinese competitors. For example, in July 2022 the company set up a joint venture in China with Huayou Cobalt to recycle its end-of-life batteries. In 2021, LG Energy generated revenue of \$15 billion, up 42% year over year. Most analysts have shown their support for the group's strategy with a buy recommendation.



View of LG's Chinese headquarters in Beijing

XIAO XIAO / AFP

## FORSEE POWER

### The niche market

Batteries are used in more than just electric cars. And as a result, French company Forsee Power manufactures batteries for buses, construction machinery, agricultural equipment and two-wheeled vehicles. In June, the company, which has production facilities in Poland, China and India, announced its plans to invest €13 million to build a factory in the United States.

**FOUNDED:** 2007

**HEADQUARTERS:** IVRY-SUR-SEINE (FR)

**EMPLOYEES:** 600

**2021 REVENUE:** €72 M

— FORSEE

## LEM

### The battery manager

The Geneva-based sensor manufacturer is benefiting from global electrification. Little known to the general public, LEM products can be found in electric vehicles, wind turbines and charging stations. For batteries, LEM Holding manufactures products including several sensors that allow Battery Management System software to function.

**FOUNDED:** 1972

**HEADQUARTERS:** MEYRIN (CH)

**EMPLOYEES:** 1,600

**2021 REVENUE:** CHF 373.4 M

— LEHN



## UMICORE THE BELGIAN RECYCLER

Umicore is an uncontested leader in green finance. Specialising in metal recycling, the Belgian firm is growing into a major player in end-of-life battery management – a nascent market with a promising future as electric vehicles become more mainstream.

In June 2022, Umicore announced plans to build the world's largest recycling plant in Europe. With capacity to treat 150,000 metric tonnes of battery material per year, this intended result of a \$525 million investment is scheduled to open in 2026. "It means moving up a gear," said Kurt Vandeputte, vice president of Battery Recycling Solutions at Umicore, during the presentation. "We're going to do it in Europe first, then in the United States."

But this seemingly bright future is overshadowed by the company's long history. In the early 20<sup>th</sup> century, the firm, at the time named Union Minière du Haut Katanga, directly operated copper mines in Katanga, in what is now the Democratic Republic of Congo. Independence, followed by nationalisation of the mines in 1966, pushed the company to redeploy elsewhere. Union Minière then operated a zinc mine in Saint-Félix-de-Paillières, France. The company has since moved out of the site, but it left behind highly polluting waste buried under the vegetation.

Cancer-causing arsenic, lead, zinc, cadmium, antimony and copper continue to haunt the soil and water. Umicore, forced by the public authorities, has been cleaning up the site since 2016 and is not done.

But that's not the only site, or problem. In Olen, Belgium, the company dumped behind it a 500,000-cubic metre mountain of radioactive waste. In a statement, Umicore said it "continues to work on environmental improvement projects and requests consultation with authorities on a robust methodology." This presents a dilemma for the Belgian government: forcing the company to clean up would cost billions, and Umicore would probably go bankrupt. But if the company doesn't pay, the taxpayer will foot the bill. In the meantime, analysts are very divided on the stock, with some issuing a buy recommendation and others a sell.

As the world leader in metal recycling, Umicore is tackling the end-of-life battery market. Here, the site in Hoboken, Belgium, where the company values 17 metals including gold and silver.



JACEK BAKUTIS / ALAMY

FOUNDED  
1989

HEADQUARTERS  
BRUSSELS (BE)

EMPLOYEES  
11,000

2021 REVENUE  
€ 4 BN

UMI

# Tesla and the 1001 batteries

Continuously optimising battery performance is part of the California brand's DNA. Here's the story.

BY STANISLAS CAVALIER

**W**hat type of battery is used in my Tesla? It's a question

that many customers ponder. In fact, it's difficult to know exactly which equipment successive models feature, as Tesla is not very transparent on the subject. Depending on the location where customers placed their online orders, cars may not have the same technological specifications. A Tesla Model Y from the Shanghai Gigafactory, for example, doesn't necessarily have the same battery as a Model Y made in Texas or Berlin. The lifespan, range and charging time can vary significantly depending on the battery model used. This creates a mystery for consumers. And yet Tesla doesn't plan to change its strategy: "We will continue to advance a diversified cathode strategy to address various market segments and provide flexibility based on raw materials availability and pricing," said the company in 2021.

This approach is one of the unique features of the brand, which tends to continuously modify its vehicles. In the early 2000s, there weren't a lot of batteries available on the market. To power its Roadster, Tesla chose the 1865 cylindrical cell from

Panasonic, using NCA (nickel, cobalt, aluminium) technology. This type of battery would also be used in the Model S and Model X. However, since it was designed for general use, not for use in electric vehicles, the 1865 didn't offer Tesla the desired performance. So the California company realised that it would be preferable to use larger battery cells, and therefore fewer cells per vehicle.

**In total, Tesla uses three battery technologies of which there are several variants**

That is how the 2170 cell entered the market via the Model 3 and Model Y vehicles, as well as in the company's energy storage products. The 2170 was initially produced by Panasonic at Tesla's Gigafactory 1 in Nevada with NCA technology. But in recent years, Tesla has found another supplier: LG Energy Solution, which produces another version of

the 2170 cell that uses NMC technology (nickel, manganese, cobalt). This year, Tesla is changing its batteries yet again, launching the 4680 (NMC), which is physically five times larger than the 2170 used in Model Y vehicles manufactured in Texas. For the time being, the 4680s are made by Tesla, but in the future, the manufacturer will share production with Panasonic, LG and Samsung.

Also this year, Elon Musk's company approached Chinese group CATL, which has been making LFP (lithium iron phosphate) cells since January for the Model 3 and entry-level Model Y. Compared to previous technologies, the LFP battery has the advantage of not containing cobalt or nickel, which makes it particularly inexpensive, but it does have a lower energy density than NCA or NMC batteries. In total, Tesla uses three battery technologies (NCA, NMC and LFP) of which there are several variants developed by each supplier (Tesla, CATL, LG and Panasonic). As a result, a Model 3 could be powered by a 2170C (Panasonic), 2170L (Panasonic), LG M48 (LG Energy Solution), LG M50 (LG Energy Solution) or LFP (CATL) battery – until the arrival of the 4680... ▴



# AT THE MERCY OF METALS

The large-scale use of batteries requires incredible quantities of metals such as lithium, nickel and cobalt. Fearing a shortage, industry players are doing everything they can to secure their supply.

BY BERTRAND BEAUTÉ

**T**he race for strategic metals is on. In August, Tesla signed a \$5 billion contract to secure its supply of Indonesian nickel from the Chinese company Zhejiang Huayou Cobalt, which owns mines in China. The US electric vehicle leader now has multiple partnerships of this type. In January 2022, Elon Musk's firm made an advance purchase of a portion of the production of the Talon Metals mining project in Minnesota

and in September 2021, it signed a contract with Prony Resources, which produces nickel in Goro, New Caledonia.

The "devil's metal" – named as such due to its very high volatility – is one of the key ingredients for making batteries, alongside lithium, graphite, cobalt and manganese. On average, an electric vehicle contains 50 kg of nickel, 45 kg of lithium and 7 kg of cobalt. With increased global

demand for batteries, the market for these metals is spiking, causing some to fear a global shortage. "Currently, extracting and refining lithium has become a fundamental limiting factor," said Musk in April 2022, when presenting Tesla's results.

"The production of certain metals is currently insufficient to keep up with the growth expected in the demand for batteries," says Nicolas Jacob,

Bags of nickel sulfate, photographed last April in South Korea, in a factory of the company SungEel, specialised in the recycling of lithium batteries.

thematic stock manager at Oddo BHF Asset Management. And the war in Ukraine has only complicated the situation (the Russian giant Nor Nickel was responsible for 10% of global nickel production before the conflict). As a result, for the first time since 2010, the cost of batteries is expected to increase this year due to the high cost of raw materials, reaching \$135 per kilowatt-hour, compared to \$132 last year, according to BloombergNEF (see infographic on p. 35).

## Accelerating the mining process

The good news is that this trend reversal is not likely to last. At least that's what Goldman Sachs is predicting in its report titled "Battery Metals Watch: The end of the beginning", published in May 2022. The US bank believes that "the battery metals bull market has peaked". One tonne of lithium, which is expected to cost an average of \$54,000 in 2022 compared to \$6,000 in 2020, could drop to \$16,400 in 2023, due to accelerated mining production provoked by the increased cost of metals. According to Goldman Sachs, lithium production, which was 11% below demand last year, will actually exceed demand by more than 15% in 2025, causing prices to fall automatically.

**The cost of batteries is expected to increase this year due to the high cost of raw materials**

But these outlooks do not account for geopolitical situations and social problems, such as the war in Ukraine and Chinese-US tensions. For example, more than 70% of cobalt is extracted from mines located in an unstable region in the eastern part of the Democratic Republic of Congo, where approximately 250,000 people, including many children, mine with their bare hands or with rudimentary tools. "Due to soaring prices and for ethical reasons, many companies have reduced the amount of cobalt they use in their battery production," said Giacomo Fumagalli, a stock market analyst at Robeco. "Ironically, they increased the share of nickel over that of cobalt and now they need to reduce the quantity of nickel because prices are up due to the war in Ukraine."

To address this issue, manufacturers are all trying to secure their supply of strategic metals. In March, Volkswagen created two co-enterprises with Chinese groups Huayou Cobalt and Tsingshan Group. The first will produce nickel and cobalt, whereas the second will specialise in refining these two metals. Automobile manufacturer Ford announced in July that it had signed an agreement to purchase the lithium production from the Rhyolite Ridge mining project in Nevada. Battery giant CATL acquired the operating rights for a lithium deposit in China.

Another strategy is to change the composition of batteries. "Every time a raw material becomes too expensive, companies find a way to reduce the amount they use," says Michael Pye, an investment manager at Baillie Gifford. "CATL, for example, recently announced that it had successfully manufactured a battery made of a blend of lithium and sodium ions." Nevertheless, lithium is still currently essential and even iron has become critical since the invasion of Ukraine.

## The promise of recycling

Europe, which has few resources, is poorly positioned in this war for metals, whereas China, which anticipated the energy transition, has helped itself to many extraction sites around the world and has multiplied its refinery factories. To compete, the European Commission is focused on recycling. But for the time being, the sector is struggling to take off. Why? "That's a question that I recently asked Tesla," says Pye. "The reason is in fact very simple: electric cars haven't existed for very long and have a long lifespan. So there are not enough used batteries yet to create a recycling sector." Another complication is that the constant change in the composition of metals present in batteries makes recycling complicated. "Recycling batteries remains difficult," says Nicolas Jacob. "It's a technology that needs to be developed, or even invented." ▲



# LITHIUM SET TO LAST

Batteries still underperform user expectations, especially in terms of charging time and range. Several emerging technologies promise to revolutionise the sector, but none of them is expected to topple lithium's reign before 2050. We take a closer look...

BY BERTRAND BEAUTÉ

The entire automotive industry dreams of a cheap, lightweight battery that has a range of more than 1,000 km and charges in minutes. As sales of electric cars take off, manufacturers and consumers want more from batteries than what lithium-ion models, the current market leader, can deliver for now. The media adds to that pressure with regular announcements that an emerging technology, such as vanadium, sodium or magnesium batteries, will revolutionise the industry.

But in the short term, the experts we consulted said these new technologies will not change anything. "I don't think there will be any technological breakthroughs in the

next few years, but rather a steady improvement in lithium-ion batteries to increase energy density and reduce manufacturing costs," says Christina Woon, investment director for Asian Equities at Abn.

**Energy density has more than doubled in the last 30 years**

That is because Li-ion technology – invented in the 1970s – can still be significantly improved. Their energy density – i.e. the amount of electricity contained per kilogram

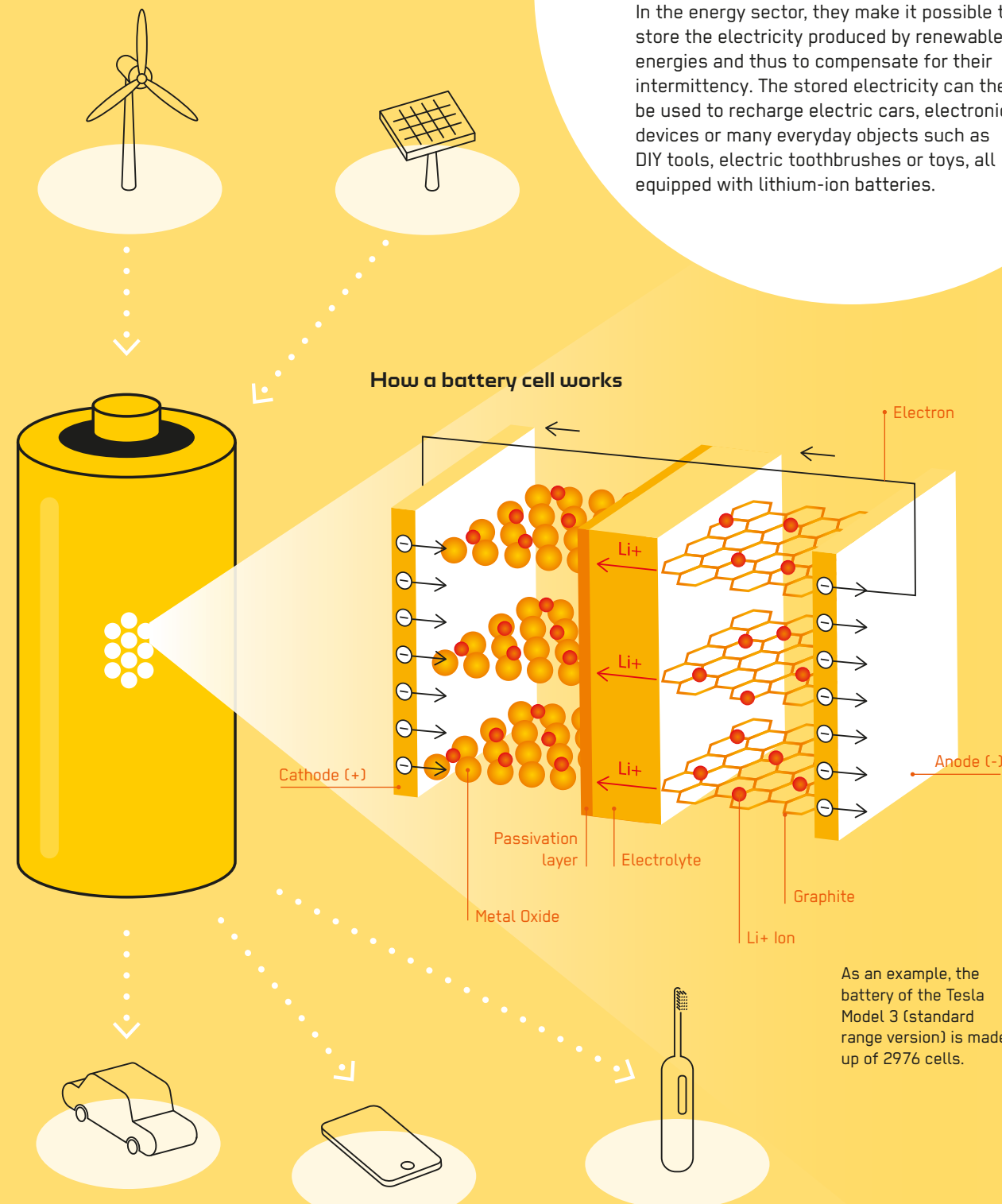
– has more than doubled in the last 30 years, from 100 watt-hours per kilogram (Wh/kg) to more than 200 Wh/kg today (e.g., compared with 40 Wh/kg to 50 Wh/kg for lead-acid batteries). And there is no sign of stopping there. For example, in June 2022 CATL, the industry's world leader, unveiled a new model with an energy density of 255 Wh/kg. The Chinese manufacturer says its Qilin battery should push electric cars over the symbolic range milestone of 1,000 km. The company expects the Qilin to hit the market in 2023.

## Optimisation at every level

To improve performance, battery manufacturers can play around with the three components contained in

## Batteries can do everything

Lithium-ion batteries will soon be everywhere. In the energy sector, they make it possible to store the electricity produced by renewable energies and thus to compensate for their intermittency. The stored electricity can then be used to recharge electric cars, electronic devices or many everyday objects such as DIY tools, electric toothbrushes or toys, all equipped with lithium-ion batteries.





cells: the cathode, the anode and the electrolyte (see the infographic on p. 53). In recent years, the metals that make up the cathode have undergone continuous development. The first Li-ion batteries developed in the 1970s used a cathode in titanium disulphide (TiS<sub>2</sub>). But today most electric car batteries contain cathodes in nickel, manganese and cobalt, which deliver better performance. And their composition continues to evolve. "Optimising cathode chemistry in the coming years will continue to improve battery performance (lifespan, range, safety), but also bring down their price," says Nicolas Jacob, thematic stock manager at Oddo BHF Asset Management.

**Solid state technology is where all hopes are now focused**

Innovation is also expected in anodes. These days, they are generally made of graphite (carbon). However, experts predict that switching to silicon can increase batteries' energy density in the next few years, thus improving their range by 20% to 50%, while augmenting their charging speed. Despite obstacles that remain, Porsche is interested in this area. In May 2022, the German car maker invested \$100 million in the US firm Group14 Technologies, which develops silicon-based anodes.

But the most important development in the lithium battery is likely to be in the electrolyte, the conductive material that connects the cathode to the anode. In current lithium-ion batteries, a solvent containing lithium salts – its exact composition remains an industry secret – transports the ions from

the anode to the cathode to power the engine (or from the cathode to the anode when charging). And the industry's Holy Grail would be to replace this liquid with a solid material. That is the so-called solid state technology, which is where all hopes are now focused.

A US firm specialising in this field, QuantumScape (see company profiles on p. 42 to 48), estimates that using solid state lithium-sulphur batteries could boost EV range by 50% to 80%, which is equivalent to an energy density of up to 500 Wh/kg. Industry giants are hopeful. Volkswagen has invested \$300 million in the Californian company QuantumScape; Ford and BMW have poured \$135 million into Solid Power, and Stellantis has placed its bets on the startup Factorial Energy. And traditional battery manufacturers (SK Innovation, LG, Panasonic, CATL) have not been left out. They all have solid state battery models in development. The Chinese are among the most innovative in the field, especially CATL, which has already unveiled its first solid state battery prototype.

"Solid state technology is not for straight away," Nicolas Jacob says. "Technological challenges must be overcome before these batteries can go to market." Toyota had announced that its cars would feature solid state batteries in time for the 2020 Tokyo Olympics, before having to renege on that promise. The Japanese giant now projects 2025, along with QuantumScape and ProLogium. But even world leader CATL admits that, while the first generation of solid state batteries is expected to emerge by 2025, the technology will only represent a 1% share of the market in 2030.

"Liquid Li-ion technology, which everyone is using today, will last for at least another decade," reckons Michael Pye, investment manager at Baillie Gifford. "That's because at

## MAIN TYPES OF LITHIUM BATTERIES

### LCO

(lithium cobalt oxyde)

This type of battery is mainly used in digital devices (smartphones, computers, tablets, cameras).

### NMC

(nickel manganese cobalt)

This is the most commonly used technology in electric vehicles because of its high energy density.

### LFP

(lithium iron phosphate)

Containing no cobalt or nickel, this battery has the advantage of being cheaper than NMC batteries, but delivers less energy per kilogram. That makes it an attractive choice for lower-range electric cars.

### NCA

(nickel cobalt aluminium)

An alternative to NMC technology, NCA batteries are used in electric cars such as the Tesla Model X and Model 3. NCA packs outperform NMC batteries in terms of being safer and causing fewer fires, but they also contain less energy per kilogram.

first solid state batteries will cost significantly more than liquid batteries, so they will initially be used for very specific applications such as aviation and high-performance vehicles."

And only much later could lithium eventually disappear and be replaced by other materials. In fact, leading battery expert Professor Jean-Marie Tarascon often tells the media that lithium-ion technology probably won't go anywhere before the end of the 21<sup>st</sup> century! ▲

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# BRITISH PUBS ARE BOUNCING BACK AFTER COVID



On 12 April, 2021, the British government lifted some of the coronavirus restrictions leading to a rush to the bars, like here in a pub in Soho, a district of London's West End.

With the pandemic over, UK pubs are back on their feet. But they still face a number of challenges, from inflation and remote working, to dwindling numbers of younger customers. Here's the latest.

BY JULIE ZAUGG, LONDON

**D**ecember 2021: all the lights are off at the Red Lion, a traditional-style, red-brick pub in one of London's quieter neighbourhoods. A sheet of paper hastily stuck on the door states that the pub has had to close for two weeks because the entire staff has COVID-19. Inside, the bar is all decorated for Christmas – a sad reminder that this is the holiday season, usually one of the busiest times of the year for publicans.

July 2022, and as London experiences an unprecedented heat wave, the Red Lion's beer garden is swarming with people. Inside, a packed crowd watches the women's Euro final. It's England vs Germany. The atmosphere is tense, and the roar each time a goal is scored can be heard outside in the streets. Sweaty bar staff swiftly pour pints of craft beer and large pitchers of Pimm's.

These contrasting images speak for themselves: British pubs are making an incredible comeback. The industry was decimated by the pandemic – when hospitality businesses had to remain closed almost continuously from March 2020 to July 2021

– and saw its revenue collapse. Publicans' beer sales fell 55% in 2020, according to the British Beer and Pub Association. They dropped another 38% in 2021, resulting in €5.7 billion in lost revenue.

**“The pandemic has revealed which pubs have an unhealthy business model”**

Robert Hayton, director of the real-estate consultancy Altus Group

“Most pubs were able to hold on for the first few months thanks to support from the government, which introduced measures allowing them to defer rent and tax payments and to place their employees on temporary leave,” says Robert Hayton, director of the real-estate consultancy Altus Group. “But as soon as that support ended, many of them closed down.” More than 1,000 pubs have closed since late 2019.

The pandemic also caused major staff shortages. According to UK Hospitality, an industry body, as >



the Omicron variant wreaked havoc in the UK in December 2021, a quarter of all pubs had to close for part of the week or reduce their opening hours because they didn't have enough staff. The industry, which employs roughly 2.5 million people, had 200,000 unfilled positions at the time.

"Many bar staff, kitchen staff and bouncers who were placed on leave during the pandemic found jobs elsewhere, particularly in delivery or at supermarkets," says Jesse Matheson, an economics professor at the University of Sheffield who has studied the sector. "When the pubs re-opened, those staff mem-

bers didn't come back." Brexit has further aggravated the phenomenon by preventing the recruitment of staff from the European Union. The situation has driven up wages in the sector by 8% to 12% in just one year. Since early 2022, pubs have also had to deal with record-high inflation, which reached 9.4% in June. "This has caused the price of their products to skyrocket, especially beer produced from grains, which have become a lot more expensive as a result of the war in Ukraine," says Matheson. Some pubs – such as those belonging to the Marston's chain – have had to scale down their menus, eliminating 35% to 50% of their menu options.

But the worst appears to be over. "Demand really started to bounce back in spring 2022," says Mark

Irvine-Fortescue, an analyst at Stifel who specialises in the sector. "In May and June, sales returned to pre-pandemic levels." Over Queen Elizabeth II's platinum jubilee week-end alone, in early June, pub sales jumped 20%.

Still, the recovery hasn't been equal across the board. "Pubs in the city centre that depend almost entirely on office workers are still suffering, because many employees are now working from home, at least for part of the week," says Matheson. Neighbourhood pubs near residential areas, on the other hand, have seen their sales increase.

Likewise, the premium segment has fared better, particularly gastropubs and pubs focusing more on cocktails and craft beer than on pints of lager.

"The people who frequent these types of pub tend to be higher earners and are therefore less affected by the cost-of-living crisis," says Irvine-Fortescue.

The sector's recovery seems to have more to do with pricier consumption – either because the price of certain drinks has increased, or because customers are choosing more expensive products – than higher volumes. "They are still 10% to 15% below pre-pandemic levels," says Joe Thomas, an analyst at HSBC who covers several pub chains. He says this means the recovery is weak, especially with high inflation.

A handful of operators are in a bad position. "The pandemic has revealed which pubs have an unhealthy business model," says

Robert Hayton. "Some are paying extremely high rent for a prime city-centre location, but it's eating away at their bottom line. Any decline in business, and they fail."

Others have a large volume of debt, such as Marston's, whose net debt is seven times greater than its EBITDA. "This situation makes it hard for the company to invest in its pubs, and it even had to part with its brewery, which it now manages with Carlsberg through a joint venture," says Irvine-Fortescue.

Over the medium term, pubs are also facing challenges that are more difficult to overcome. "More and more young people, particularly those under 25, either don't drink at all or drink less often," says Emily Nicholls, a sociologist at the Univer-

sity of York who has studied the phenomenon. This has given rise to a movement called "Nolo", which refers to drinks containing no or low alcohol. Some 26% of young people in the UK don't consume any alcohol, and a third drink only occasionally.

Some 26% of young people in the UK don't consume any alcohol, and a third drink only occasionally

"Those young people feel they need to constantly be at their best to survive in the modern world," says Nicholls. "They don't want to be slowed down by a hangover or risk having embarrassing photos published on social media." She adds that young people are also more health conscious – which they see as an individual responsibility – than previous generations.

These new behavioural trends have had an impact on pubs. "Their numbers had started to decline even before the pandemic," says Professor Matheson. There are now fewer than 40,000 pubs in the country – down 7,000 compared to a decade ago.

But the industry has started to adapt. "More and more pubs are offering a creative selection of non-alcoholic cocktails," says Nicholls. "Some even have non-alcoholic beer on tap." A handful have decided not to serve any alcoholic beverages at all. All of this is transforming the culture of the UK's iconic pubs. "They are becoming more inclusive and family-friendly places, where people can go just for a coffee or a bite to eat," says Nicholls. ▀

The resilience of Britain's best pubs

Many British pubs are owned by large listed companies. Some of those companies are well positioned to bounce back as the sector recovers in the wake of the pandemic, either because they own a large number of pubs outside city centres, or because they are in a high-end segment that is less affected by the cost-of-living crisis. Others are offering competitive prices to attract customers who are now more careful how they spend their money. For private investors, this may also be a good time to look at companies whose share price has taken a big hit, but whose business model is sound, such as Mitchells & Butlers.

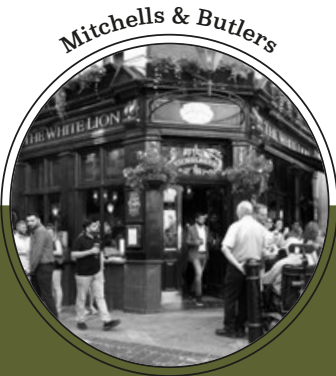


PREMIUM PLAYER

Founded in the mid-19<sup>th</sup> century, this company currently operates 380 pubs in London and southeast England. "Its balance sheet is solid, and it has the advantage of operating in the premium segment, which makes the company more resilient during periods of high

inflation," says Mark Irvine-Fortescue, an analyst at Stifel. In addition, it owns 80-90% of its pubs, which saves it from having to pay sky-high rents. Most analysts recommend buying shares

FOUNDED: 1845  
HEADQUARTERS: LONDON  
EMPLOYEES: 4,724  
REVENUE: £254 M  
— FSTA



THE BIGGEST OF THEM ALL

With a portfolio of over 1,700 pubs and restaurants, this Birmingham-based company is the largest pub operator in the UK. "Their majority shareholder is from the real-estate industry, and it shows: they have the best network of pubs in the country, all independently run by their managers,"

says Irvine-Fortescue. Their share price is much lower than the value of their net assets, which makes the company an attractive investment, according to the analyst, who – like most of his peers – has issued a Buy recommendation.

FOUNDED: 1898  
HEADQUARTERS: BIRMINGHAM  
EMPLOYEES: APPROX. 44,000  
REVENUE: £1.1 BN  
— MAB

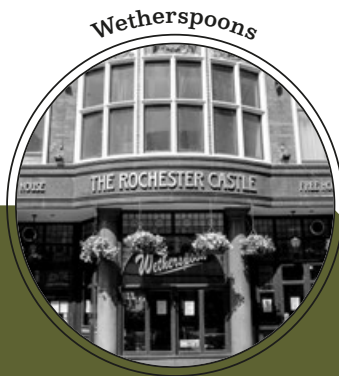


A PREMIUM PLAYER OUTSIDE CITY CENTRES

Originally founded to manage one of the UK's oldest breweries, the company now focuses on managing its 222 pubs. The company operates in the premium segment and owns many pubs outside city centres, so it should be in a good position to bounce back

as the sector recovers in the wake of the pandemic. "The company has little debt and is therefore in a position to invest in order to ensure healthy growth," says Irvine-Fortescue. Most analysts recommend buying shares.

FOUNDED: 1831  
HEADQUARTERS: WANDSWORTH  
EMPLOYEES: 5,275  
REVENUE: £309 M  
— YNGA



CHEAP AND CHEERFUL CHAIN

This chain of over 800 pubs is famous for its cheap beers, standard pub fare and unlimited coffee. "Some of its pubs tend to be frequented by older customers, who are still avoiding public places for fear of the virus," says Joe Thomas, an analyst at HSBC. But with the cost-of-living crisis, the chain's

low prices offer a competitive advantage – one that could help it attract customers who normally frequent more expensive pubs, says the analyst. He and most of his colleagues have issued a Buy recommendation.

FOUNDED: 1979  
HEADQUARTERS: WATFORD  
EMPLOYEES: 39,025  
REVENUE: £773 M  
— JDW



# PONZI SCHEMES IN THE SOCIAL MEDIA ERA

Fraudulent financial set-ups are becoming increasingly ambitious and spreading around the world. They also easily take advantage of the cryptocurrency boom. Here are a few recent scams.

BY JULIE ZAUGG

**T**he commission landed every Friday at 14.30 exactly. It fluctuated between 5% and 9.99%, no more, no less. The 62,000 investors on the platform EminiFX, who primarily were part of the Haitian diaspora in the United States, were thrilled with the performance of their online portfolios, comprised of investments in cryptocurrencies and foreign currencies. This godsend was the work of a robo-advisor called RA3, which was able to identify the most promising investments... At least, that's what was claimed by the founder of the platform, Eddy Alexandre, who investors affectionately called "our CEO".

But the institution collapsed on 12 May, when Eddy Alexandre was arrested by the FBI. He is accused of creating a Ponzi scheme worth \$250 million. "I haven't found the slightest bit of evidence that RA3 existed, in any files or in EminiFX's source code," said lawyer David Castleman, who was appointed by the government to try and locate the funds. The money collected by Eddy Alexandre was simply deposited into a bank account. When an EminiFX investor wanted to withdraw their earnings, the funds came from new clients of the platform.

And Ponzi schemes continue to victimise people. While the number

of formally identified frauds has decreased in recent years – there were 60 in 2019, dropping to 46 in 2020 and 34 in 2021 in the United States – the amounts in question have increased significantly. In 2021, the amount of fraud discovered in the United States was collectively worth \$3.8 billion, compared to \$1 billion in 2020 (according to Ponzitracker, the leading site on the issue in the United States, which independently tracks fraud cases of more than \$1 million within the country).

**Victims are pensioners with small savings accounts just as often as they are experienced financial experts**

Furthermore, the number of fraudsters caught to date is very likely to increase, according to economist Marie Springer, assistant professor at the City University of New York and author of the book *The Politics of Ponzi Schemes: History, Theory and Policy*. "When financial markets are down, Ponzi schemes

struggle to find new victims and their members try to withdraw their investments, which causes the system to fall," she explains. Charles Lundelius, an expert on this type of fraud at economic intelligence company Berkeley Research Group, agrees: "In the years that followed the 2008 financial crisis, there were approximately 100 Ponzi schemes per year."

Ponzi schemes have also become more ambitious. "The average number of victims has increased and the victims are more often located in several countries," says Springer. She gives the example of the OneCoin fraud, a cryptocurrency founded by Bulgarian Rouja Ignatova, which recruited 3 million people in 175 countries before falling in 2018.

This change in scope was made possible by the internet. "Social media is an essential tool for promoting Ponzi schemes," says Jordan Maglich, founder of Ponzitracker. "They can reach a much larger clientele than in the past, which relied on word-of-mouth exposure."

Lundelius also notes that many recent Ponzi schemes deviate from the historical definition of the term (see inset). "They begin as

legitimate funds, making real investments and generating returns," he says. "But one day, they no longer meet their objectives and become a Ponzi scheme." He gives the example of Aequitas Capital Management, founded in 1993 by Robert Jesenik in Oregon, that invested in education, health and transportation. Starting in June 2014, he began paying clients with funds invested by new recruits to hide his losses. >

## WHAT IS A PONZI SCHEME?

A Ponzi scheme is a fraudulent investment strategy. It uses funds from new clients to pay older clients. The money is generally not invested, but rather sent to a bank account and kept by the fraud creators for their own use. Investors are completely unaware of this, thinking that their money has been placed in stocks, cryptocurrencies, startups, precious metals and other securities. Some Ponzi schemes have a pyramid structure, in that the existing members make a commission when they recruit new members. Here too, the money is taken from funds brought in by new recruits.

1

### TEN HISTORIC PONZI SCHEMES

2

3

4

5

6

**CHARLES PONZI**  
**\$15 MILLION**

The Italian immigrant, who is the namesake for this type of fraud, sold mail-order coupons to American and Canadian investors in the early 1920s, promising returns of 50% to 100%.

**REED SLATKIN**  
**\$593 MILLION**

Between 1986 and 2001, this Scientist encouraged nearly 800 people – including many celebrities – to entrust him with their investments, claiming he would invest the money in promising startups.

**JEAN-PIERRE VAN ROSSEM**  
**\$860 MILLION**

The Belgian attracted investors by saying he had invented software called Moneytron, which could predict the financial markets.

**JOEL STEINGER**  
**\$1 BILLION**

Between 1994 and 2004, the American purchased life insurance policies for dying patients that he then sold to investors. The problem? The majority of these "dying patients" weren't actually dying.

**SCOTT ROTHSTEIN**  
**\$1.2 BILLION**

Lawyer Scott Rothstein attracted investors by promising them a cut of the out-of-court agreements that he was signing. But the majority of these agreements only existed on paper.

**IOAN STOICA**  
**\$1 TO \$5 BILLION**

In the early 1990s, this Romanian accountant convinced 3 million of his compatriots to send him their savings to invest in a game called Caritas, which he claimed would ensure returns of 800%.



Another trend is that a growing number of Ponzi schemes are founded on cryptocurrencies. “This new investment model is trendy and everyone knows someone who has made money from cryptocurrency,” says Maglich. “So it’s natural that the people behind these frauds use this to their advantage to attract new victims.” At OneCoin, Rouja Ignatova collected nearly \$4 billion by promising investors that the new virtual currency would ensure a profitability of 600% within just a few months. But OneCoin was never listed on any exchange platform. The cryptocurrency simply did not exist, a fact which was hidden by the complexity of the transactions identified solely anonymously via a Blockchain.

**“They use commonalities to temper any vigilance their victims might have”**

Marie Springer, economist and author of *The Politics of Ponzi Schemes: History, Theory and Policy*

BitConnect, another Ponzi scheme worth \$3.4 billion, promised its clients a return of 20% to 30% on their Bitcoin investments, thanks to a bot capable of anticipating large fluctuations in the virtual currency. Entrepreneur Alex Mashinsky used a cryptocurrency called Celsius, whose value was artificially inflated to pay people who made deposits in virtual currencies in its digital “bank”.

While anyone can fall victim to this type of fraud – whose victims are pensioners with small savings accounts just as often as they are experienced financial experts – the masterminds behind Ponzi schemes

do fit a certain profile. “They tend to cultivate an air of exclusivity, boasting that they invented a unique tool to generate profits, but the functioning of that tool must remain a secret,” says Lundelius. “Victims are invited to join the club of the lucky few who will benefit.”

Founders often recruit from the communities to which they belong. “They use commonalities to temper any vigilance their victims might have,” says Springer. The Texan William Neil “Doc” Gallagher took off with \$23 million from 192 pensioners by promising them returns of 5% to 8% on their savings. “To recruit them, he hosted a show about money on a Christian radio station,” said a person close to the case. Other communities that are particularly targeted by Ponzi schemes are the Amish, fans of English football, and Mormons.

Surprisingly, victims do not always rebuke the creators of these schemes. “Imagine that you receive regular returns on your investments for years, and then all of a sudden that stops overnight because the person in charge of your finances has been arrested,” says Maglich. “Who are you going to blame: your benefactor or the authorities?” Victims are also often in denial, preferring to believe that it was a misunderstanding rather than admitting that they lost everything.

More than 14,000 clients of EminiFX signed a petition on Change.org to free Eddy Alexandre. “Together we will fight this,” said Judith Ferdinand, a New York state resident. Reynald Horat, from Massachusetts, fights against a “system that is basically telling us (black people) to stick to basketball, football and rap music if we ever want to get out of poverty”. In early August, when Eddy Alexandre went before a court in Manhattan, hundreds of supporters came to cheer him on. ▀



7

TOM PETTERS

\$3.7 BILLION

This businessman recruited investors by promising them he would buy merchandise in bulk that would then be resold to retail stores. But the majority of orders never actually occurred.



8

ALLEN STANFORD

\$7 BILLION

The Texan used a bank in Antigua to scam 30,000 investors in 100 countries. He sold them false certificates of deposit.



9

SERGEI MAVRODI

\$10 BILLION

In 1994, the Russian sold shares of his company MMM, which specialised in importing electronic products, promising an annual return of 1,000%. The fraud claimed more than 10 million victims.



10

BERNIE MADOFF

\$65 BILLION

The man behind the biggest Ponzi scheme ever created needs no introduction. Between 1960 and 2008, he convinced 37,000 investors in 136 countries that he would make them rich by investing in the stock market.

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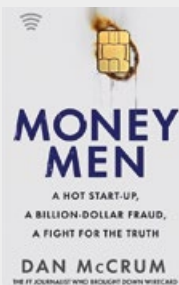


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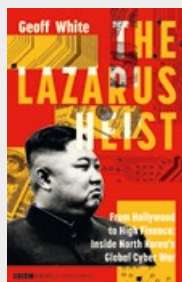
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## MONEY MEN

**A HOT STARTUP, A BILLION DOLLAR FRAUD, A FIGHT FOR THE TRUTH**

By Dan McCrum  
Bantam Press, 2022

This book tells the story behind the scandal surrounding Wirecard, the German company once considered an emblem of the European tech and financial industry. But in 2020, it filed for bankruptcy following evidence of fraud. The author is none other than the *Financial Times* investigative journalist who first exposed the murky goings-on. *Money Men* delves behind the scenes into the investigation from the *FT*'s point of view, while uncovering the underworld of the global economy, rampant with thugs and other eccentric characters. One of the book's highlights is an anecdote when a Wirecard critic, after dropping his daughter off at school, is confronted by two men in a supermarket car park and offered the choice between a pair of broken legs or €100,000 to reveal his contacts.



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## THE LAZARUS HEIST

**FROM HOLLYWOOD TO HIGH FINANCE: INSIDE NORTH KOREA'S GLOBAL CYBER WAR**

By Geoff White  
Penguin Business, 2022

Based on the successful BBC World podcast of the same name, *The Lazarus Heist* is the story of a group of North Korean cybercriminals who have so far gone unstoppable. Claimed by the US government to have ties to Kim Jong-un's regime, the Lazarus Group is believed to be one of the world's most dangerous criminal organisations, having allegedly stolen more than €1 billion over the past decade. But money is not its only motive. The Lazarus Group is also said to be used to silence detractors of North Korea and destabilise democracies.



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Inspired by the Spanish word *tertulia* – “gathering” in English – and equivalent to the French literary salons, this app produces a selection of five new books per day. Artificial intelligence combines the user's predefined tastes and more than 10,000 internet sources to generate targeted recommendations. The purchase and delivery features are currently only available in the United States.



Google Play,  
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purchases

## THE SKY BY REDSHIFT:

**ASTRONOMY**

**SECRETS OF THE SKY UNLOCKED**

This app uses your smartphone camera to show you celestial bodies in real time. With augmented reality, all you have to do is touch an object to observe it in greater detail and access a wealth of information. Stars, planets, comets, asteroids, satellites and other objects can be explored freely.



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Bundled subscriptions to digital magazines are booming. Ready is one of Europe's leaders in the segment, with more than 6,000 titles in its catalogue. All categories are available: cars, fashion, food, architecture, and more. The app offers users the welcome option of downloading articles to read them later, even offline.



Google Play,  
App Store  
Free

## SWISS BANKNOTES

**ALL ABOUT SWISS BANKNOTES**

This app from the Swiss National Bank showcases Switzerland's banknotes, a physical species on the verge of extinction. To use the app, scan the banknote of your choice – a smooth one if possible – with your smartphone camera. The banknote's design and security features are then displayed in small animations.

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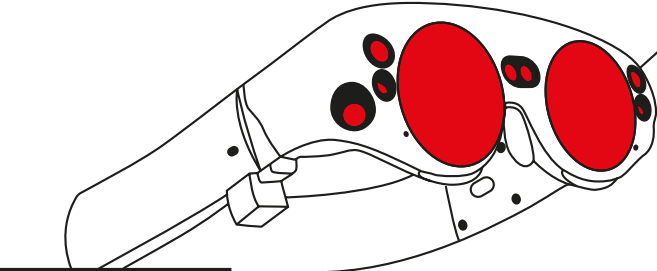
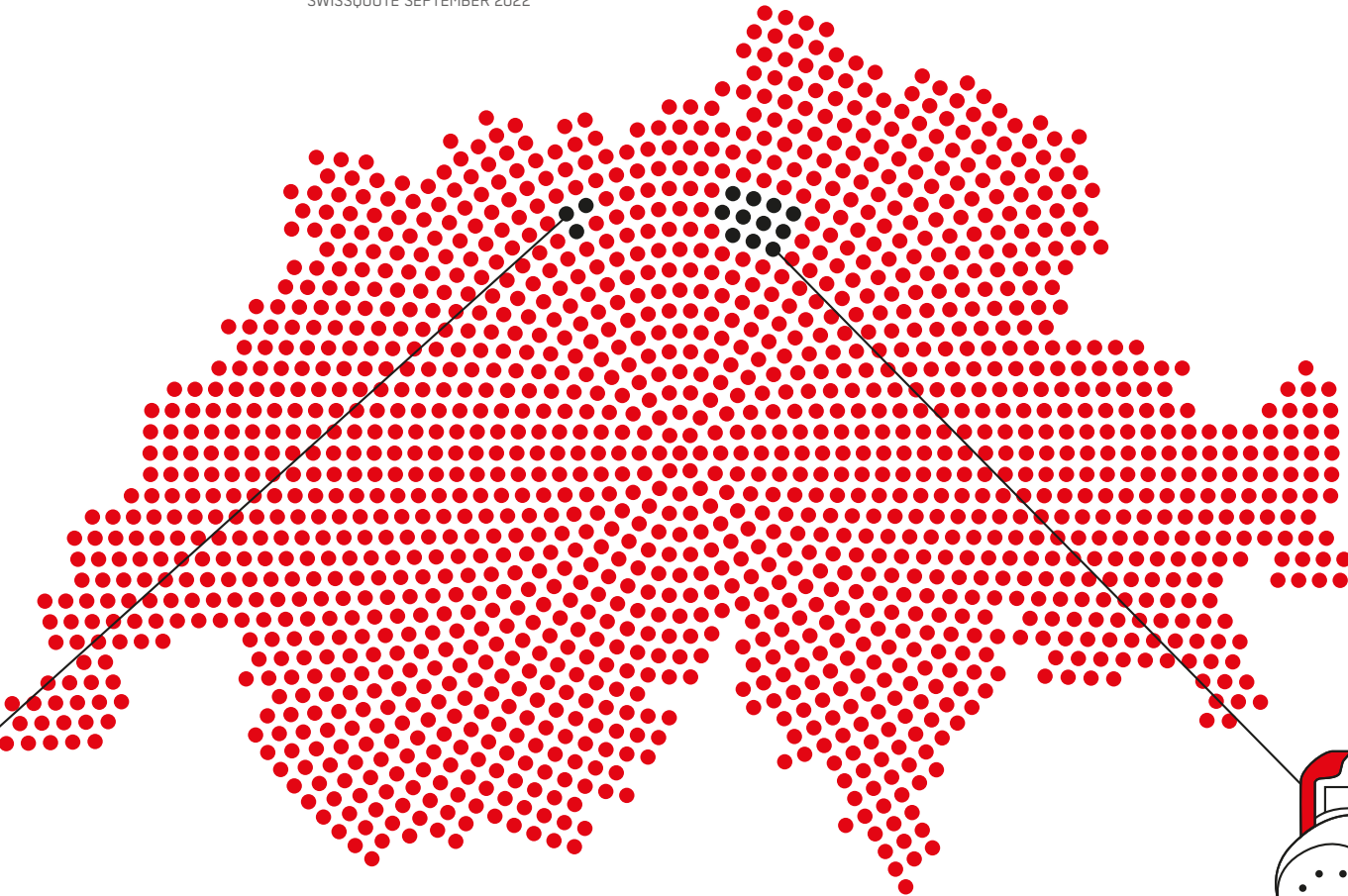


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# SWISS STARTUPS IN THIS EDITION

BY GRÉGOIRE NICOLET



## HOLO ONE

HOLOGRAMS FOR BUSINESSES .....

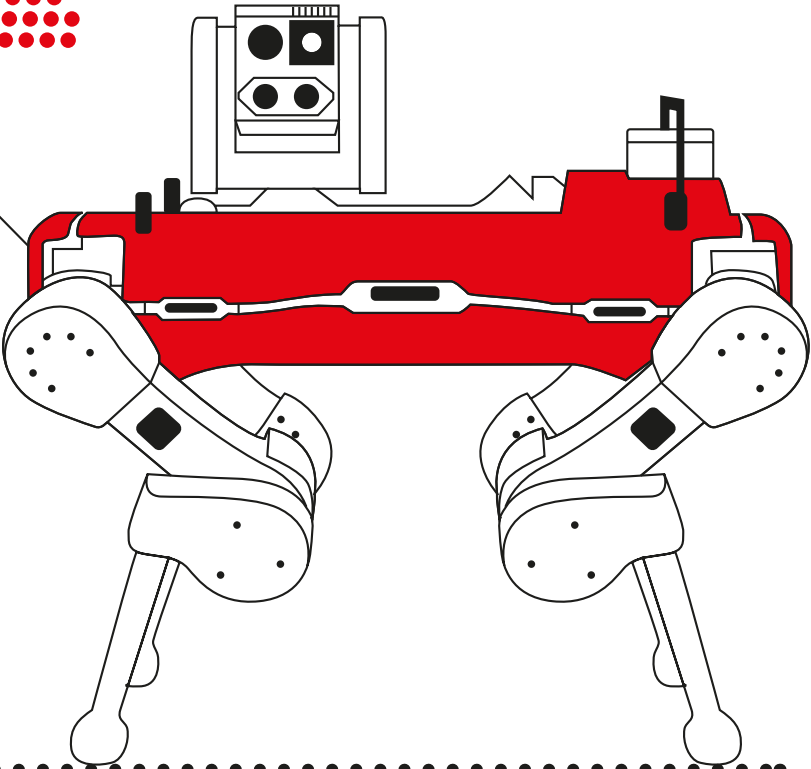
Number of employees	21
Founded	2016
Headquarters	Lenzburg

Holo One lets businesses experiment with mixed reality (MR), technology that combines virtual reality (VR) and augmented reality (AR). Users can visualise virtual 3D content overlaid on the real world by means of dedicated software and a headset equipped with sensors and cameras to map out the environment. For example, the different stages of a building under construction can be visualised in the form of life-size overlays from the site itself.

Holo One decided to focus on the software aspects of this technology. The Lenzburg-based company has developed Sphere, a turnkey solution for companies designed to be as flexible and universal as possible. This is the startup's central selling point. The product is compatible with most fixed and mobile operating systems and with the various mixed reality headsets on the market, such as ThinkReality A3 from Lenovo, HoloLens 2 by Microsoft, and Magic Leap 1.

Continuing its growth and expanding internationally, now with offices in China and the United States, Holo One has come out ahead as SME competitors have gradually left the sector. Currently, its main competitor is actually Microsoft. But Tobin Felder, Holo One's director of operations, does not seem particularly fazed. "Microsoft obviously has the advantages of a large company, such as a huge team and almost unlimited funds. However, their solution is far from being as complete and flexible as ours in terms of hardware and software. Their customers are limited to a single ecosystem."

Earlier this year, Holo One raised \$8 million in a Series A funding round that attracted well-known investors, such as the semiconductor manufacturer Micron Technology and the hardware manufacturer Lenovo, which has been working with the startup for several years.



## ANYBOTICS

SPOT'S SWISS COUSIN .....

Number of employees	100
Founded	2016
Headquarters	Zurich Oerlikon

First came the robot dog Spot from the US company Boston Dynamics. Now another quadruped robot has taken centre stage: ANYmal X, the latest inspection robot from EPFZ spin-off ANYbotics. It is the world's first explosion-proof autonomous robot certified to IECEx and ATEX standards. ANYmal X is designed to provide the oil and gas industry with a solution to automate monitoring of installations, such as checking gauges, lever positions and even gas leaks. It is not only equipped with the most advanced visual sensors (thermal, 20x optical zoom, etc.), but also with a gas detection sensor and a microphone to record noises.

The Malaysian company Petronas will be one of the first to integrate ANYmal X into its inspection operations, as it has already tested earlier versions on its offshore platforms. But Shell, Equinor and Petrobras are also showing interest. Péter Fankhauser, CEO of ANYbotics, agrees that his company has reached a milestone, "Over 10 years ago, some of our co-founders developed their first walking robots during their studies at EPFZ. Today, we are deploying our robots to the industry on a large scale."



## HEDGING SPECIAL

# Using options to weather market storms

Options are generally seen as speculative products, but investors also use them to protect against market turbulence. Stefano Gianti, Education Manager at Swissquote, explains.



## Sign up for our webinars

Register online at [swissquote.com/webinars](https://www.swissquote.com/webinars)

We are offering webinars on options in September and early October. The webinars are available in German, French, English and Italian. Here's what will be covered:

### FRENCH

#### Les options pour débutant

👤 Ergon Iseni and Marco Pereira Dos Santos – Swissquote  
📅 28.09.2022 - 11:00

#### Tout savoir sur les options couvertes

👤 Martial Diserens, wealth manager and Ergon Iseni – Swissquote  
📅 05.10.2022 - 11:00

### ENGLISH

#### Master in Options [1/2]

The Benefits of Options Trading  
👤 Stefano Gianti, Education Manager – Swissquote  
📅 12.09.2022 - 18:00

#### Master in Options [2/2]

Your Early Strategies  
👤 Stefano Gianti, Education Manager – Swissquote  
📅 26.09.2022 - 18:00

### GERMAN

#### Master in Option Trading [1/2]

Die Vorteile vom Optionshandel  
👤 Vincenzo Zinna – Eurex  
📅 06.09.2022 - 12:00 GMT+2

#### Master in Option Trading [2/2]

Einfache Strategien  
👤 Vincenzo Zinna – Eurex  
📅 14.09.2022 - 12:00

### ITALIAN

#### I vantaggi del trading con le Opzioni

👤 Stefano Gianti, Education Manager – Swissquote  
📅 19.09.2022 - 18:00

**Options are one of the more obscure financial products. They are often associated with speculation, but are used for other purposes too...**

Options are also used in hedging strategies. They allow investors to reduce their portfolio's exposure to the risk of a significant decrease in prices. They are an effective tool for protecting against a drop in equity prices. In other words, an option is like an insurance policy. Investors insure their investments against the risk of decline,

just like they would insure their car or their home. In practice, the investor is taking a position on the options market that is inversely correlated to the underlying market position. By analogy, a put option on Tesla shares is sort of like insuring your Tesla.

Anyone who wants to learn more about how to use these products can sign up for our webinars. The coming weeks will focus on options, with a number of different speakers [ed. note: see schedule opposite].

### In what ways can more experienced investors use options?

There are many different strategies, all based on the same concept. The most popular often have fantastic names, such as Iron Condor, Iron Butterfly and Jade Lizard... The idea is to take advantage of increases or decreases in volatility and the passage of time – not just rising or falling prices. When used effectively, options offer significant returns from relatively low fluctuations in the price of the underlying asset, particularly

with horizontal price movements. The market doesn't have to rise for investors to generate returns. Investors can also use leverage to take large positions with little initial capital.

### What is the most common strategy for Swissquote clients?

The "covered call" strategy, which takes a conservative approach. It allows investors to benefit from their long position while also selling call options. In practice, if the price of the underlying asset falls, stag-

nates or rises slightly, this strategy outperforms simply holding the asset. The potential gain, however, is limited if the asset price increases substantially. On the other hand, the covered call strategy allows investors to enjoy the rights associated with owning shares, such as receiving dividends. ▲



STEFANO GIANTI  
EDUCATION MANAGER  
AT SWISSQUOTE

## How options work

An option is a financial product that gives an investor the right to buy or sell a given quantity of an underlying asset – such as shares or commodities – at a predetermined price for a certain amount of time. An option to buy (right to buy the underlying asset) is a "call". An option to sell (right to sell the underlying asset) is a "put".



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SECONDS

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CHF 76,900.-

AUTO

## Taking it smooth

BY BLAISE DUVAL

Against the German giants, Lexus forges its own route with its NX hybrid SUV. Here's our test drive.

Comfort. Distinction. Reliability. These are the values on which Lexus has built its reputation as a premium brand. As the high-end division of the giant Toyota launched in 1989, the Japanese manufacturer is still perceived as "exotic" in its segment, but its cars nevertheless stand comparison with the top German brands. We had the opportunity to test drive its new NX 350h AWD SUV – positioned as an alternative to the BMW X3, Audi Q5 or Mercedes GLC – for 10 days. And for those who do not want a car capable of lightning-fast acceleration, its formula is quite attractive.

First of all, the configuration of this 350h version is unique on the market. The vehicle is not a plug-in hybrid, unlike almost all current models (including the NX 450h+ also in the line-up). Instead, it is a hybrid propulsion system. This technology is a favourite of Toyota. Basically, it means the car does not need to be plugged into

a power socket. The very small battery is tucked under the rear seats (its capacity is not specified by Lexus) and charges exclusively while driving, by recovering energy during deceleration and braking.

The system pairs a 2.5-litre petrol engine with a dual-motor electric powertrain (one on each axle). Together, the combo produces up to 244 hp. The EV drive mode is activated during low-speed city driving and in situations that do not require the internal combustion engine. The switch from electric to petrol is so smooth that the driver does not even notice. Fuel consumption does not exceed 5 l/100 km for city driving and just over 7 l/100 km on the motorway. Not bad for an all-wheel drive vehicle weighing over 1.9 tonnes. The only downside is that the Continuously Variable Transmission (CVT) on the NX 350h gets a bit loud at high throttle, to the point of disrupting the silence in the cabin for the rest of the ride.

Despite resembling its predecessor on the outside, Lexus announced that it started from scratch in designing the new and sharp-looking NX. At the wheel, the hybrid totally pulls off the compromise between smoothness and agility. It's comfortable but vigorous enough. Steering is precise and the suspension isn't thrown into imbalance through curves.

The "Excellence" finish of our test version, at a price tag of 78,650 Swiss francs stripped of options, offers the latest refinements in terms of comfort, driver assist features and multimedia interface. The 17-speaker Mark Levinson sound system makes it a pleasure to travel in this ergonomic cocoon. The fantastic (ventilated) seats are a bonus. Lexus also had the good taste to leave several high-quality physical buttons (namely air conditioning and volume), a choice that is more and more rare in the industry. ▴

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## TRAVEL

# Cycling through Transylvania

This region in the heart of Romania, where time seems to stand still, is best visited by bike. Beautiful bucolic routes connect the Saxon villages that are dotted around the countryside. Saddle up!

BY JULIE ZAUGG

On a hillside bathed in the glow of the setting sun, Florin is herding his sheep into a pen to shear them. He pushes his herd one by one under the wooden gate, where his colleague grabs them and holds them between his legs before shearing their long blonde wool with a sharp knife. The sheepdogs circle the flock, barking when one tries to escape. At nightfall, Florin returns to the simple wooden hut, which has no electricity or running water, where he spends the summer with the other shepherds.

Onlooking visitors rejoin the horse-drawn cart to leave this rural landscape at the foot of the Carpathians and return to Viscri, a Saxon village nestled in the heart of Transylvania. Back at the luxurious country inn, converted from an old barn, a hearty meal of succulent local ingredients awaits – fresh tomatoes, creamy white cheeses, tasty soups and home-made bread. The next morning, the adventure continues with a visit to the village's fortified Saxon church, a white structure with a brown tiled roof dating from the 13<sup>th</sup> century. Then it's back on the bike, cycling along quiet country roads. ▶



LUCAS SANDOR



Bran Castle, near Brasov, known for having inspired the writer Bram Stoker, author of the novel Dracula. ▶



Once part of the Kingdom of Hungary, this region of Transylvania was gradually colonised by Saxons who were invited by royal decree from the mid-12<sup>th</sup> century. Their main task was to defend the villages against Mongol invasions. This resulted in some 300 fortified churches, of which 150 are still standing and seven are listed as UNESCO World Heritage Sites.

The Saxons eventually left in the second half of the 20<sup>th</sup> century to escape the communist regime. Their former presence can still be felt in village names with Germanic overtones, such as Mesendorf and Saschiz, as well as culinary specialities such as răntaş soup, made with tarragon and sauerkraut, and henklesh, a dessert made from sour cream and grapes. The Saxons left behind them a string of traditional villages, each with its own fortified church as well as pastel-coloured houses that have been carefully renovated into trendy inns or restaurants serving local cuisine. Prince Charles fell in love with this region and its rural charm, and owns several restored farms locally.



For some years now, agencies have been offering cycling tours of the region, with routes ranging from four to eight days, starting from the medieval towns of Sibiu, Sighişoara or **Braşov**. The pace is leisurely, with 25 to 60 km covered each day, on flat terrain or with a slight gradient. The route can also be done by electric

bike. Stops include the remote village of Criţ, where many houses are still in ruins, and **Biertan**, with its huge fortified church with three sets of walls and eight watchtowers.

Cyclists frequently stop to visit local craftspeople whose practices have changed little since medieval

times. Among such artisans are makers of fish-scale tiles, organ restorers, charcoal producers, and weavers who create fabrics with colourful flower patterns. Lunch-time is often spent at a vineyard or farm, enjoying dishes inspired by the slow food ethic. Come evening, rest can be found in inns set in renovated historic houses surrounded by fragrant vegetable gardens and apple trees.

**Prince Charles fell in love with this region and its rural charm, and owns several restored farms locally**

The town of Braşov, nestled in the heart of the majestic Carpathian Mountains, often serves as the start or finish point for these two-wheeled adventures. It is an ideal base for visiting other key attractions in the

region. A 30-minute drive will take you to **Bran**, the location of the **castle** that served as Bram Stoker's inspiration for Count Dracula's home. Although Vlad III, also known as Vlad the Impaler, the prince behind the character of Dracula, probably never set foot in the castle, the sombre building perched on a rocky spur lends itself perfectly to the legend.

From Braşov, visitors can also explore the pristine forests of the Piatra Craiului National Park, deep in the Făgăraş Mountains. An expert on the local fauna and flora, guide Dan Marin leads expeditions on foot in search of wild bears. If you miss these big brown beasts in their natural environment, you can visit the Libearty sanctuary in Zarnesti, about 30 minutes from Braşov. This sanctuary is home to a hundred or so bears undergoing rehabilitation after being rescued from circuses or having developed problematic behaviour following contact with humans. Most of them will be released into the region's forests, which are among the best preserved in Europe. ▴



## GETTING THERE

Wizz Air operates direct flights between Switzerland and Bucharest several times a week. Braşov is then two-and-a-half hours by car.

## WHERE TO STAY

### Viscri 125

This inn is set in one of the historic houses in the heart of Viscri. The rooms are tastefully decorated with Saxon furniture and there is a large garden with a beautiful terrace. Meals are available, made using local produce. The friendly owners also organise a range of activities in the area.

### Bethlen Estates

This manor house run by the descendants of an 800-year-old dynasty, which helped shape the surrounding landscape and the charming village of Criţ, is an oasis of serenity in the middle of the Transylvanian countryside. With a swimming pool and spa, it offers four luxurious rooms and two detached houses in a bucolic setting.

## TOP SPOTS

### Transylvania Cycling

This agency offers bicycle tours of the Saxon villages in Transylvania, lasting from four to eight days, with multiple stops to visit local craftspeople and restaurants. Prices range between €790 and €1,820, all inclusive.

### Transybike

Launched by a former thespian with a passion for cycling, these six-day bike tours focus on a smaller number of sites, with daily distances of no more than 40 kilometres. The price is €1,200, all inclusive.

### Transylvanian Wolf

This agency, run by guide Dan Marin, offers walking tours from Zarnesti to explore the Piatra Craiului National Park. Some trips focus on the local flora, others on the fauna – including expeditions which allow you to observe bears near their dens from a concealed position in a hut.

### La Ceaun

This restaurant, housed in a typical cellar in the centre of Brasov, offers lovingly made traditional dishes, such as stuffed cabbage leaves, baked polenta with sour cream, lamb stew, and bean soup served in a bread bowl. There is also a fine collection of craft beers and local wines.

### D.O.R

After a visit to Dracula's castle, what could be better than a refined meal worthy of Prince Vlad himself? At D.O.R, an elegant restaurant with a green and woody décor, diners can enjoy fusion cuisine mixing local and foreign ingredients, all of which are organic. The deer entrecôte, trout fillet and chicken with prunes are particularly popular.



# BOUTIQUE

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With the first version out in 1962, the P50, billed as the world's smallest car, is now available as a customisable self-assembly kit. It comes in several colours, with either an electric or petrol-powered engine. Good to know: this three-wheeler has only one seat. Accessories and features are pared down to the bare minimum: a single door on the left side, one headlamp and one windscreen wiper. To top it off, the P50 does not have a reverse gear, just like the historic model.

[p50cars.com](https://p50cars.com)

From 9,965 Swiss francs



## SPICY JAMS

Gabriela Wurcel and Chiara Ciriminna make surprising homemade jams out of their workshop in Coppet, Switzerland. Their recipes are original in that they combine fruit and spices, and can be paired just as easily with toast as with grilled meats. Their unique creative recipes include peperoncino with bell peppers and chili peppers, blueberry with black pepper, and clementines with yellow chili peppers and limoncello.

[spicygirlskitchen.com](https://spicygirlskitchen.com)

8.90 Swiss francs per jar



## REAL COFFEE ANYWHERE, ANYTIME

Winner of the 2022 Red Dot Design Award, the Picopresso portable coffee maker by Wacaco is notable for being incredibly compact (10.6 cm high) and lightweight (350 g). You prepare the coffee manually, without electricity, so you have to press the pump yourself. All you need are hot water and fine ground coffee. A bit of a process, but the end result is surprisingly worth it.

[wacaco.com](https://wacaco.com)

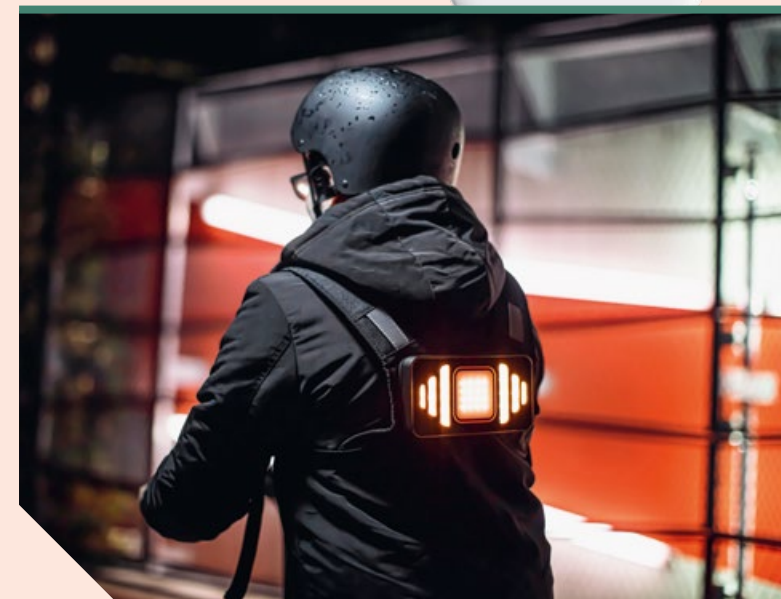
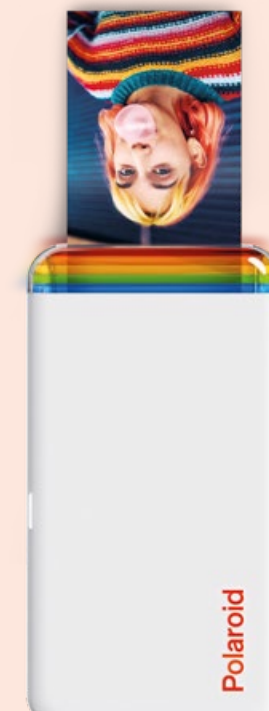
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[polaroid.com](https://polaroid.com)

105 Swiss francs



## INDICATORS FOR BIKES

Clic-Light is a device designed for urban bicycle and scooter riders. Worn on the user's back, the system displays signals like a car, including the essential right-left indicator, but also stop, position and hazard lights. The kit includes the signalling unit that can be attached to an adjustable harness to fit any size, along with a remote control and handlebar mounting bracket.

[clic-light.com](https://clic-light.com)

129 Swiss francs

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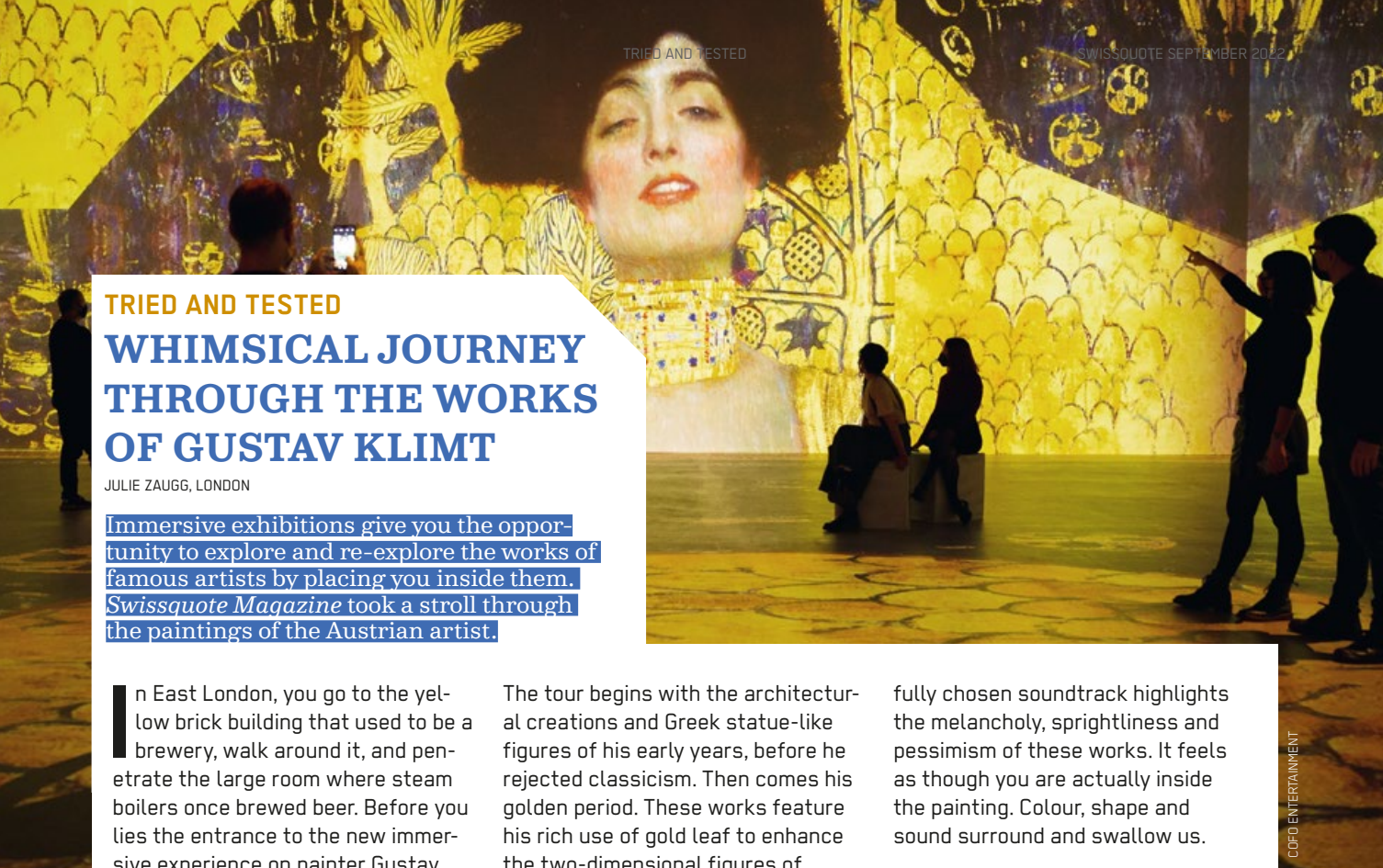
Recommerce, a startup operating out of Zug that repairs electronic devices, has released a sustainable mobile phone designed in Switzerland and manufactured in Germany with 100% green power. Delivered in compostable grass paper packaging, the rephone features a back case made of recycled plastic and a replaceable and recyclable battery. It runs on Android (version 11), without any additional software. While it doesn't try to compete with the latest smartphones on the market, the device covers the basics: 4G reception, Wi-Fi and Bluetooth capabilities, front and rear cameras, and memory of up to 512 GB.

[rephone.ch](https://rephone.ch)

399 Swiss francs







TRIED AND TESTED

SWISSQUOTE SEPTEMBER 2022

## TRIED AND TESTED

# WHIMSICAL JOURNEY THROUGH THE WORKS OF GUSTAV KLIMT

JULIE ZAUGG, LONDON

Immersive exhibitions give you the opportunity to explore and re-explore the works of famous artists by placing you inside them. *Swissquote Magazine* took a stroll through the paintings of the Austrian artist.

In East London, you go to the yellow brick building that used to be a brewery, walk around it, and penetrate the large room where steam boilers once brewed beer. Before you lies the entrance to the new immersive experience on painter Gustav Klimt. As soon as you step through the door, you experience a dramatically different atmosphere. Visitors are welcomed into a long corridor with panels that trace Klimt's life and influences, including Jugendstil, Fauvism and Japanese art.

Some works have been reconstructed in 3D, with panels hanging from the ceiling showing the detail of a painting. Classical music, playing Beethoven, Mozart and Haydn, evokes the Viennese turn-of-the-century atmosphere in which the artist lived.

After this deep dive into culture, we move on to serious matters. The next room is empty, except for deckchairs and benches set out along the walls. Projections cover the walls, floor and ceiling, and a large white cube stands in the middle of the room. That totals about 1,000 square metres lit up by some 50 video projectors. You take a seat and immerse yourself in this 360-degree reproduction of the artist's work.

The tour begins with the architectural creations and Greek statue-like figures of his early years, before he rejected classicism. Then comes his golden period. These works feature his rich use of gold leaf to enhance the two-dimensional figures of strong women, inspired by ladies from Vienna's high society, the style that makes his paintings so distinctive. The famous painting *The Kiss* covers the room, followed by the *Tree of Life* from the Stoclet Frieze. We then move on to the brightly coloured landscapes, nearly pointillist in style, painted by the artist during his stays in the Austrian Alps.

It feels as though you are actually inside the painting. Colour, shape and sound surround and swallow us

There is movement. Splashes of colour swirl around the walls like a swarm of bees. Almost neon-coloured lines twist along the floor. Geometric patterns from Klimt's paintings burst like fireworks against a starry night sky. A care-

fully chosen soundtrack highlights the melancholy, sprightliness and pessimism of these works. It feels as though you are actually inside the painting. Colour, shape and sound surround and swallow us.

To continue the experience, you go upstairs and slip on a virtual reality headset. The equipment enables you to explore seven of Klimt's works in detail. Projected in 3D, you can observe them all around you from every angle, from above, from below, from inside. From time to time, a bird flies through the sky, its beating wings almost brushing against you. A golden snake slithers towards us, its mouth wide open, eventually swallowing us. A little later, a cascade of flowers from the artist's landscapes showers over us.

It is time to leave the exhibition. Now that you have seen them in motion and examined them in minute detail, you feel as though you have discovered a whole new dimension to these world-famous works. This novel way of experiencing art has been replicated. Several immersive exhibitions are currently on in London, featuring the artists A.A. Murakami, Frida Kahlo and Vincent Van Gogh. And some of them have made or will make a stop in Switzerland. ▀

COCO ENTERTAINMENT

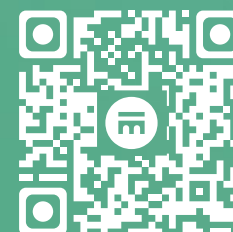
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