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SWISSQUOTE

FINANCE AND TECHNOLOGY UNPACKED

COVID-19
Mutant mice to the rescue

E-COMMERCE
The rise of giant warehouses

CLOUD COMPUTING
Europe fights back

DOSSIER

GREEN HYDROGEN
THE FUEL OF THE FUTURE

Is now finally the right time?

▶ NIKOLA ▶ NEL ▶ MCPHY ▶ TOYOTA ▶ HYUNDAI ▶ POWERCELL ▶ BALLARD

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It's time for green hydrogen

By Marc Bürki,
CEO of Swissquote

In the mid-1970s, a famous French advert proclaimed: "On n'a pas de pétrole, mais on a des idées!" [*We don't have oil, but we do have ideas!*]. The oil crisis hit and an alternative to black gold was urgently needed. The solution was primarily nuclear. Fifty years later, the advert stands the test of time. The threat of climate change requires us to move away from fossil fuels in order to ensure a sustainable future. In Japan, Switzerland and Germany, nuclear is no longer the answer, considering the effects of the Fukushima disaster. Hydrogen could be the solution. According to a study by the firm McKinsey, hydrogen could be used for 20% of global energy consumption by 2050, compared to less than 1% currently.

p. 28

On paper, hydrogen is very promising. If the gas is produced from renewable energy via electrolysis, hydrogen would be carbon neutral, renewable and storable. It can also be used as fuel in applications that cannot easily convert to electric, such as industry or heavy transportation. But in practice, producing green hydrogen is too expensive for it to truly be competitive. To overcome this obstacle, many countries such as Germany, Australia, Japan and China have launched programmes to support the industry. These strategies should result in green hydrogen becoming competitive by 2030, or even 2025.

p. 38

Is it just a pipe dream? It's true that in the past, this technology – which is over a century old – has generated both hope and disillusion in equal measure. And investors that bet on hydrogen in the early 2000s lost big. But this time, things could be different. If you need a bit of convincing, just look at some of the big names that are working on hydrogen: BP, Total, Shell, Engie... all the major oil players are investing heavily, and there's an ever-increasing amount of practical applications for hydrogen power. On the other end of the spectrum, start-ups such as US-based Nikola dream of being the new Tesla. From start-ups to giants, the ecosystem is ready: it's finally time for hydrogen!

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Good reading!

PORTRAIT

BIG BROTHER

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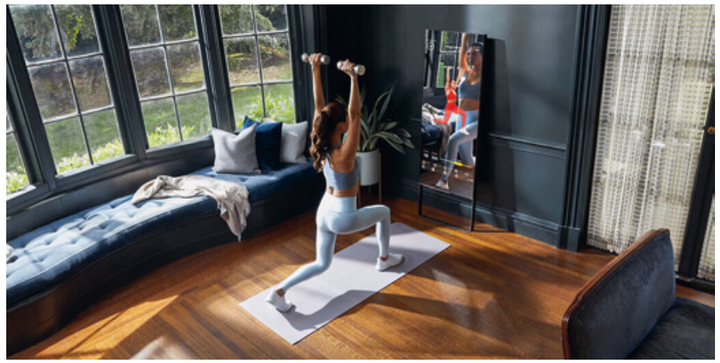
SCANS

fitness

LULULEMON TAKES UP SMART MIRRORS



LULULEMON

Lululemon, the Canadian king of athletic and yoga apparel, is now resolutely focused on digital fitness. With the pandemic, demand in this industry has skyrocketed. For example, the share price of Peloton, the US smart indoor bicycle company, has doubled in six months. In response, Lululemon decided to acquire New York start-up Mirror for $500 million. The company sells a smart mirror, costing $1,495, that can be used as an interactive home gym. The device, which is linked to a smartphone app, can also act as a large screen to display all kinds of information. The mirrors are sold at a high price with a subscription for training sessions – a lucrative model that also ensures long-term customer loyalty. LULU PTON

"The crisis will sort out the car manufacturers"

Carlos Tavares, CEO of PSA in an interview with *Les Echos* on 28 July.

3

The number of Swiss companies (Nestlé, ABB and Novartis) in the Top 50 most innovative companies in the world, according to a ranking by Boston Consulting Group.

autonomous vehicles

AMAZON BETS ON ROBOT TAXIS

The start-up Zoox, now owned by Amazon, is continuing its road tests.

ZOOX

Amazon has acquired an autonomous driving expert – and it's not just any company. California start-up Zoox, whose equipment and software can convert vehicles into robot taxis, has already raised more than $1 billion and has 1,000 employees. The amount of the acquisition was not disclosed, but the *Financial Times* estimates the figure at $1.2 billion, making it Amazon's most expensive acquisition to date. Like Twitch, Zoox will be an independent subsidiary of Amazon. For now, the acquisition aims to help the start-up make its vision of autonomous taxis a reality. Zoox isn't going to immediately focus on package deliveries, but its base technology could easily be used to serve Amazon's interests in that sector. AMZN

delivery services

UBER EATS GOBBLES UP POSTMATES

Postmates delivery robot delivers food to Los Angeles residents.

ISTOCKPHOTO

Uber had to react after the European food delivery giant Just Eat Takeaway beat it to acquire US-based Grubhub (for $7.3 billion). This merger-acquisition still needs to be approved by the regulatory authorities, but once the agreement is signed, it will create the world's largest food delivery service outside of China, with 600 million orders and 70 million customers each year. And so Uber turned to another Uber Eats competitor, Postmates, which it acquired for $2.65 billion. Uber described Postmates as complementing Uber Eats very well, highlighting the differences between the two companies in terms of geographic coverage and demographic targeting. DoorDash, the leader in the US market – valued at $15 billion – is preparing for its IPO this autumn.

JET TKWY UBER GRUB

RANKING

TOP 5 BEST UNIVERSITIES
(of 1,400 universities in 92 countries)

1. UNIVERSITY OF OXFORD
2. CALIFORNIA INSTITUTE OF TECHNOLOGY
3. UNIVERSTY OF CAMBRIDGE
4. STANFORD UNIVERSITY
5. MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Source: Times Higher Education World University Rankings 2020

TOP 5 MOST VISITED WEBSITES
(number of monthly visits)

1. WIKIPEDIA.ORG
17.70 BN

2. GOOGLE.COM
8.62 BN

3. YOUTUBE.COM
7.15 BN

4. TWITTER.COM
6.20 BN

5. FACEBOOK.COM
4.74 BN

Source: Rankranger

TOP 5 MOST FAVOURABLE ECOSYSTEMS FOR START-UPS

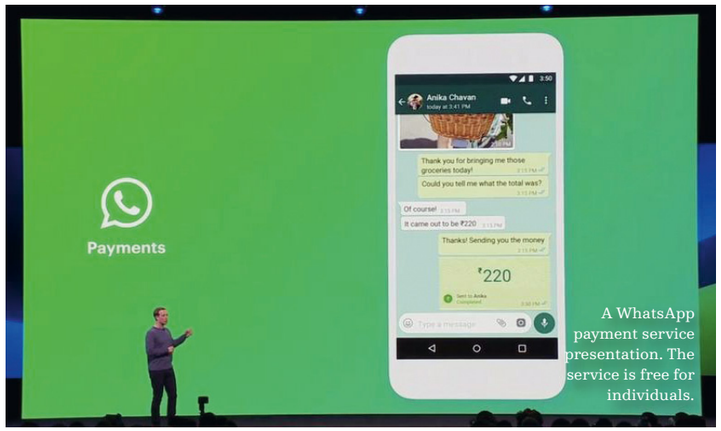
1. SILICON VALLEY
2. NEW YORK CITY (JOINT)
2. LONDON (JOINT)
4. BEIJING
5. BOSTON

Source: The Global Startup Ecosystem Report 2020 from Startup Genome

SCANS

finance

BRAZIL STARTS USING WHATSAPP PAYMENTS



A WhatsApp payment service presentation. The service is free for individuals.

DR

Everyone was expecting it to be India. But it's Brazil that's leading the way with WhatsApp payment solutions. Brazilian users are the first in the world to be able to send and receive money via the messaging service owned by Facebook, by using Facebook Pay, a payment service launched last year. WhatsApp says that the service is currently free for consumers, but companies pay 3.99% in fees to receive payments. Transactions are made using a six-digit PIN code or a fingerprint, and users must also link their WhatsApp account to a credit card (Visa or Mastercard), debit card (Banco do Brasil, Nubank and Sicredi), or a payment processing company like Cielo. The WhatsApp model aims to be very open in the hopes of attracting as many partners as possible. FB

"Switzerland is significantly behind when it comes to digitalising the healthcare system – some doctors are still using fax machines to share information"

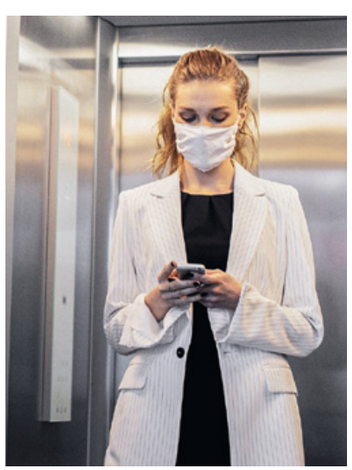
Heinz Brand, president of the professional association Santésuisse, in the newspaper *Le Temps*.

$50.1 BN

An estimate of the global revenue from apps (Apple Store and Google Play) in H1 2020 – a 23.4% increase compared to 2019 – according to the firm Sensor Tower.

digital

LIFTS CONTROLLED BY A SMARTPHONE



SCHINDLER

In a sign of the times, lift manufacturer Schindler is fighting infections and viruses in its own way by launching new contactless lift models. Using a smartphone app called ElevateMe, riders can call a lift without having to touch any buttons. Once inside the lift, riders can choose their desired floor using a QR code that appears on a screen. For this technology to work, the lift must be compatible with the new Schindler ecosystem and be linked to a mobile network. SCHP

health

STRAUMANN IS SMILING

Straumann Group's premises in Basel.

KEYSTONE / GEORGIOS KEFALAS

Basel-based group Straumann, one of the global leaders in producing instruments and components for dental surgery, has acquired a majority stake in DrSmile, the German specialist in clear aligners. This market has seen average growth of more than 20% over the last three years, a trend that is set to continue, according to the two companies. The exact terms of the agreement were not disclosed, but DrSmile will remain independent and this partnership will allow for significant synergies in the aesthetic dentistry segment. Straumann will also benefit from DrSmile's expertise in consumer marketing. STMN

36.4%

The percentage of global electricity produced from coal in 2019, according to the "Statistical Review of World Energy 2020" report conducted by BP, making coal the main source of electrical energy in the world.

"Time to break up Amazon. Monopolies are wrong!"

Elon Musk, in a tweet posted on 4 June.

KICKSTARTER

LUMOS

LUMOS ULTRA

THE NEW STANDARD FOR BICYCLE HELMETS

Lumos, the pioneer of smart bike helmets, is no novice at this. Its first model, which raised more than $800,000 on Kickstarter, was named one of the top 50 inventions of 2018 by *Time* and won many awards, including the Dyson innovation award. Its new helmet model, called the Lumos Ultra, was financed in less than five minutes (the goal was $60,000) and, with more than $2 million pledged, it has now become the best-funded product in the history of Kickstarter in the 'bikes' category. The first model was equipped with several LEDs on the front, back and sides of the helmet, and riders used a wireless device on the handlebars to make the LEDs blink on the sides to indicate a turn. The Lumos Ultra will be lighter (3.7 kg vs. 4.9 kg) and better ventilated. It will be equipped with a retractable visor and will have fewer LEDs, but they will be more powerful. Apple Watch users will no longer even need the wireless device on their handlebars; all they need to do is raise their arm to control the indicators.

FUNDS RAISED	AVAILABLE
$2,313,923	NOVEMBER 2020

SCANS

$10.9 BN

The amount that German group Bayer, which owns Monsanto, will pay in the United States to end lawsuits with 125,000 plaintiffs regarding glyphosate – a carcinogenic weedkiller sold under the brand name Roundup.

"IBM no longer offers general purpose IBM facial recognition or analysis software"

Arvin Krishna, CEO of IBM, in a letter addressed to the US Congress regarding racial justice reform.

automobile

TESLA REACHES THE TOP SPOT

A Tesla factory in San Francisco.

ISTOCKPHOTO

In 10 years, Tesla has gone from a start-up to the car manufacturer with the largest stock valuation in the world. The California firm has long surpassed the capitalisation of Ford or GM. In January, when its market capitalisation reached $81.39 billion, Tesla already had the largest valuation ever for a US automobile manufacturer. But there were still a few manufacturers ahead of it until 1 July, when Tesla reached nearly $208 billion surpassing the previous leader, Toyota, at $202.74 billion. This new status obviously does not coincide with its global sales volume, but that hasn't scared away investors at all. In fact, Tesla has accelerated production and deliveries, and was able to deliver 367,500 electric vehicles in 2019, which is 50% more than the previous year – a record largely supported by sales of the less expensive Model 3 and Model Y. TSLA

THE FLOP

Medtronic and insulin pumps

Is Medtronic, the creator of the first Pacemaker in 1954, trying to get people to hate it? In 2015, it transferred its legal registration from the United States to Ireland, even though the majority of its profits are generated in the United States. After the US tax authorities, people with diabetes are next in line to pay the price for the pharma giant's attempts at profitability. Medtronic secretly decided to stop selling implantable insulin pumps in 2017, but the patients who use the pumps were only told in June. Unfortunately for the 350 patients affected, this pump is the only one of its kind available on the market. Now, these patients must go to the hospital to receive their insulin injection intravenously, or consider a pancreas transplant and all the risks that come with it. MDT

gaming

ZYNGA: BUOYED BY CORONA

Toon Blast has been in the top 10 mobile games for over two years.

DR

In 2011, California company Zynga, a specialist in social smartphone games, completed the largest IPO for an internet company since Google's IPO in 2004. Afterwards, Zynga experienced economic difficulties, but targeted acquisitions made it possible for it to get things back on track from 2019. That is, until global quarantine gave the share price a big boost from April. Driven by its success, Zynga acquired Peak Games, an Istanbul start-up that created *Toon Blast* and *Toy Blast*, games similar to the blockbuster *Candy Crush*. These two games have ranked respectively in the top 10 and top 20 most profitable iPhone games for more than two years. At $1.8 billion (half in cash, half in shares), this is the first acquisition of a Turkish start-up for more than $1 billion. ZNGA

$1,500 BN

The cost of the United States' new infrastructure plan (The Moving Forward Act), which calls for significant investments in the green economy and aims to drastically reduce carbon emissions in the United States to reach a "net zero emissions" economy by 2050.

food

BELL FOLLOWING IN THE FOOTSTEPS OF BEYOND MEAT

Butcher and meat wholesaler Bell, located in Basel, doesn't want to miss out on the synthetic meat trend. It will invest an additional 5 million Swiss francs in Dutch company Mosa Meat, following on from the 2 million francs already invested in 2018. The Dutch start-up presented its first lab-grown burger in 2013, to which the co-founder of Google, Sergey Brin, contributed funding of $330,000. This new funding round will allow Mosa Meat to build a production location and continue developing its technology. It is expected to begin industrial production in 2022, followed by large-scale production in 2025. BELL

Synthetic meat from Dutch company, Mosa Meat, in which Bell has invested.

MOSA MEAT

SCANS

“My message is: spend, spend, spend. Please, spend as much as you can.”

Kristalina Georgieva, International Monetary Fund (IMF) managing director.

telecoms

GAFAM TARGETS INDIAN TELECOMS

NASIR KACHROO / AFP

A Jio mobile stand, India’s largest telephone operator, on a New Delhi street.

India has become one of the biggest economic battlegrounds between Silicon Valley and Chinese companies. Each is eyeing India’s 1.3 billion residents, the majority of which still do not have smartphones or an internet connection. And Indian operators are the first to take advantage. Jio Platforms, which owns Jio, the largest mobile operator in the country, has raised more than $16 billion since April. With $5.7 billion, Facebook is currently in the lead, but Microsoft is considering investing $2 billion. Amazon and Google aren’t sitting idly by either: Amazon is currently in negotiations to acquire a 5% share in Bharti Airtel, the third-largest Indian telecoms company, for $2 billion, while Google is aiming for a 5% share in Vodafone Idea, the second-largest Indian operator.

FB MSFT AMZN GOOG
BHARTIARTL IDEA 532822

677,000

On Wednesday 6 June 2020, Twitter’s app reached a new one-day record for global downloads. This boom is associated with the death of George Floyd and the protests that followed, according to firm Apptopia.

IPO

THE REMARKABLE IPO FROM NESPRESSO’S COMPETITOR

With €2.25 billion raised, Dutch company JDE Peet’s (owned by JAB Holding) is the biggest European IPO since 2018. Plus, it only took 72 hours for the world’s second-largest coffee company – which owns the brands Jacobs, Douwe Egberts and Peet’s Coffee – to sell its shares to investors. It has to be said that investors have been moping around thanks to the shortage of IPOs caused by the pandemic. But that only partially explains the success of JDE Peet’s: Nestlé’s competitor also generated €6.9 billion in revenue in 2019. The funds raised by JDE Peet’s will first be used to pay off debt. JAB Holding will continue to manage the group via Acorn Holdings, which holds a 62% stake, and Mondelez will maintain a stake of between 22.9% and 23.4%.

JDEP NESN MDLZ

The figure

LUCA DE MEO

A marketing ace to save Renault

Position
CEO

Age
53

Nationality
Italian

Luca de Meo, Renault's first non-French CEO, is going back to his roots – he began his career at Renault in 1992 after completing his studies at Bocconi University in Milan. After some time at Toyota, he joined Fiat, where he enjoyed one of his most successful moments with the triumphant launch of the new generation Fiat 500 in 2007. Two years later, he was recruited by Volkswagen and became the group's marketing director. He was named CEO of Seat in 2015 and brought the Spanish company out of the red. At all of these companies, Luca de Meo was well known as a leader with a reputation for being close to his employees. At Seat, for example, he established "Moments with Luca", where he would meet the company's workers. A speaker of several languages (Italian, French, German, English and Spanish), he has a passion for football (he is a Juve fan) and techno music.

The country

EGYPT

A country led by the military

After its economy was modernised in the mid-2000s, Egypt experienced record growth rates (+7% from 2005 to 2008). However, the 2008 financial crisis and the political instability that arose after the fall of Mubarak have weakened the economy. With el-Sisi as president since 2014, the country has enjoyed relative stability, but the army has become a large-scale employer. Its empire now includes 93 companies, a third of which have emerged since the start of the new presidency. The military institution isn't just active in the food and healthcare industries – it also breeds fish, produces cement and even organises exhibitions.

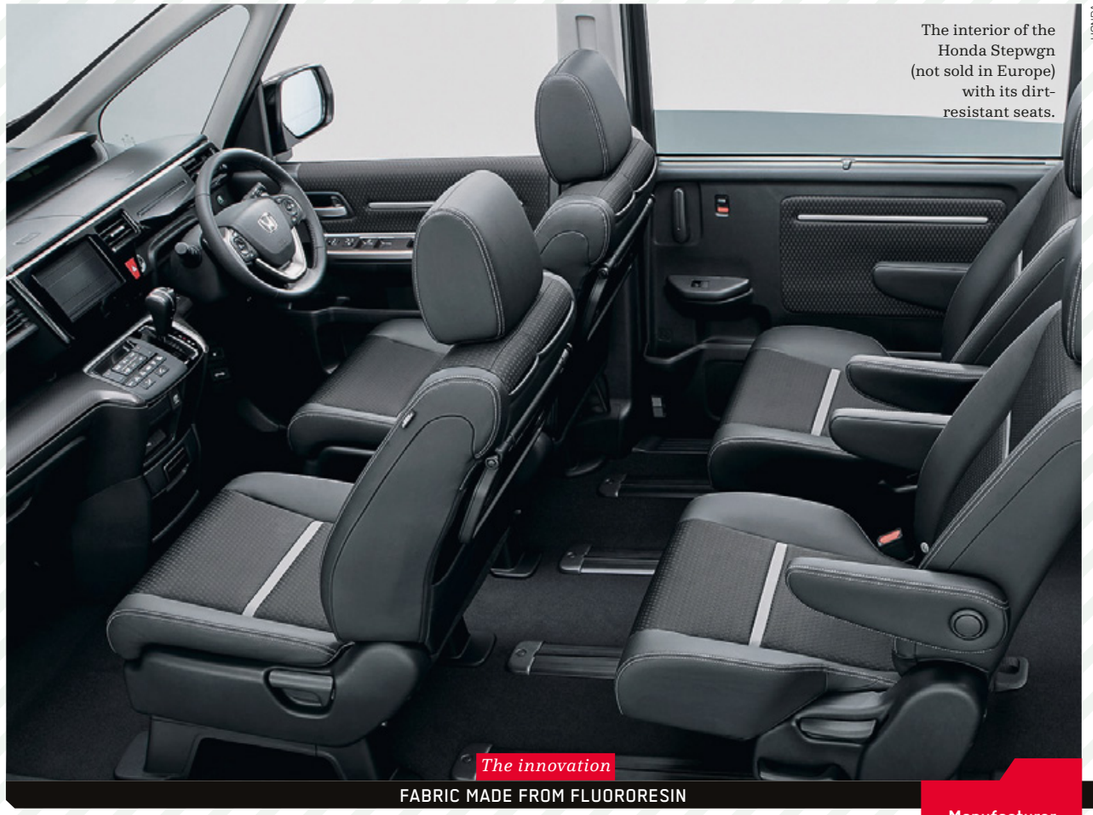
Population
100,388,073 (2019)

GDP per capita
$11,014 (2019)

Growth
+5.6% (est. 2019/2020)

Main sectors of the economy
manufacturing, property and construction, wholesale and retail commerce, agriculture and fishing, mining

Yet, this frenetic business activity doesn't seem to be benefiting Egypt. While boosting growth, the rise in construction and public works also raises borrowing – Egypt's IMF debt reached 100% of its GDP before the pandemic. Additionally, the growth has created very few jobs, while the percentage of informal jobs has doubled since 2006.



The interior of the Honda Stepwgn (not sold in Europe) with its dirt-resistant seats.

HONDA

The innovation

FABRIC MADE FROM FLUORORESIN

Manufacturer
Honda

Available from
2020

Price
not disclosed

Honda creates seats that will never get dirty

Honda has equipped its new MPV utility model, "Stepwgn" (not sold in Europe), with a fabric that never gets dirty. The Japanese auto manufacturer decided to tackle this project after a market study showed that vehicle owners wanted the seat fabric to be easier to clean, with no stains from food and drink spills, and not to retain any odours. And so Honda had the idea of developing a new material that was resistant to all types of stains. The solution was found by analysing the properties of fluororesin, a plastic blend commonly used to produce electrical cables and pipes. A series of tests allowed researchers to perfect the structure of the fabric, which is made up of three different resins (each with its own characteristics) that, when woven together, stop many liquids and oils from soaking into the seat.

ANALYSIS

SPECIALISTS' VIEWPOINT

FOCUS

Europe takes on the cloud

Trying to restrain the domination that the GAFAM companies have on data storage, Germany and France have joined forces to create the GAIA-X project. At the same time, a "Swiss Cloud" is on the horizon. The digital sovereignty of Europe is at stake.

BY LUDOVIC CHAPPEX

Maintaining control over digital data: this is the goal that France and Germany agreed upon during a virtual event on 4 June. For ministers of the economy Peter Altmaier and Bruno Le Maire, who took turns championing the concept of digital sovereignty, the conference was a chance to present a new communal cloud platform dubbed "GAIA-X". The objective is to provide an alternative to the excessive dependence on American industry giants.

The consortium includes 22 founding members, equally split between France and Germany (see inset opposite). These companies include direct cloud players, such as SAP, Orange, OVH and Deutsche Telekom, as well as industry heavyweights such as Siemens and BMW. These companies will cooperate through a non-profit structure located in Belgium, starting in September.

Currently, European companies rely most often on US giants to host their data. An estimated 80% of companies on the DAX and CAC 40, the primary stock exchanges in Germany and France, use Amazon's cloud offering Amazon Web Services to varying degrees. Amazon and Microsoft alone hold more market share globally than all other cloud companies combined (see infographic on p. 18).

GAIA-X: THE FOUNDING MEMBERS

France
Orange, OVHcloud, Scaleway (Iliad), Atos, Docaposte, Outscale, Institut Mines-Télécom, CISPE association, EDF, Amadeus, Safran

Germany
Deutsche Telekom, SAP, German Edge Cloud, DE-CIX, PlusServer, Siemens, Bosch, Beckhoff, BMW, Fraunhofer Institute, IDSA, PlusServer

French Minister of the Economy Bruno Le Maire and his German counterpart Peter Altmaier at Gaia-X's launch via videoconference (4 June, 2020).

KEYSTONE

But there is a risk concerning the confidentiality of this data. By virtue of the CLOUD Act signed in 2018, the US government can already request the data of US citizens via a warrant, even if that data is stored outside the United States.

> **"A company like Amazon is very far ahead of its competitors, particularly due to its long-term relationship with clients"**
>
> **Guillaume Plouin**, cloud expert and author

So what should we expect from GAIA-X? Could this platform become the "Airbus for the cloud" as we've heard here and there, and compete with American heavyweights? "This project is still just a statement of intent," said Guillaume Plouin, cloud expert and author of many books on the subject. "Among the digital companies involved in this platform, some are happy to manage GAFAM storage services for their customers."

It is true that the French-German project doesn't scare the American giants. In practice, GAIA-X will serve as a marketplace to connect data storage providers with European companies. French and German companies taking part in the initiative plan to spend €75,000 each, which will add up to slightly more than €1.5 million as an upfront investment. But this amount is laughable compared to the €28 billion that Chinese company Alibaba will invest to strengthen its market position. It's worth noting that Alibaba is already well positioned in the industry.

LIMITING THE DAMAGE

Perhaps surprisingly, US and Chinese companies are also invited to participate in the GAIA-X project... But in order to do so, they must comply with the founding principles, such as transparency regarding the localisation of data, and reversibility, or the ability of a client company to change from one cloud offer to another. ▷

This is because currently US giants are doing all they can to hold their clients captive, particularly through their pricing policy.

> **"We're going to propose a solution to the Swiss government. The goal is to offer a 100% free email and storage service based in Switzerland that is available to all citizens."**
>
> **Boris Siegenthaler**, CEO of Infomaniak

It seems that the primary purpose of GAIA-X is to establish standards and obtain transparency guarantees from the companies involved. This is a way for Europe to limit the damage. "A company like Amazon is very far ahead of its competitors, particularly due to its long-term relationship with clients," said Plouin. "And in terms of artificial intelligence, Google is completely untouchable for European companies."

There are plenty of examples of Google's AI prowess in the news, with no shortage of irony: on 7 July, only one month after GAIA-X was announced, Deutsche Bank, Germany's largest bank, announced that it had signed an agreement with Google for the US giant to manage its data in the cloud and develop innovative financial products. "With this partnership, Deutsche Bank will gain direct access to world-class data science, artificial intelligence and machine learning," said the group in a press release. Two days later, Renault also partnered with Google for cloud services. The French automobile manufacturer signed an agreement aiming to "use Google's strengths in storage efficiency, real-time data sharing, and artificial intelligence," in order to accelerate the digital transformation of the group's 22 factories around the world.

THE FEDERAL COUNCIL GETS INVOLVED

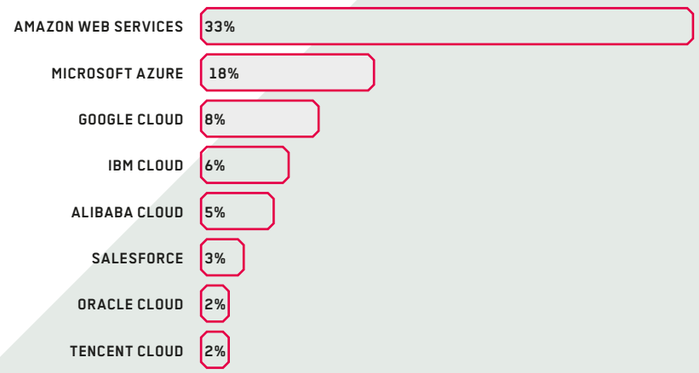
In Switzerland as well, a stronger political commitment to data sovereignty has emerged in recent months, with the pandemic. Digital sovereignty is now being addressed by the Swiss Federal Council, which ordered a feasibility study on 16 April for a "Swiss Cloud". The results will be presented by the end of June 2021. "There is increased awareness of the risks of dependence due to international networking," said Peter Fischer, delegate for Switzerland's Federal IT Steering Unit. "This study is very timely."

The work has just begun, and is currently focused on identifying actual needs and requirements in collaboration with the cantons, the economy, science and other interested parties. Swiss companies in the cloud market, such as Swisscom, ProtonMail and Infomaniak, will get to have their say later: "Discussions with potential solution partners will be the focus of the second phase. During this phase, design variations for a Swiss Cloud will be evaluated," said Fischer.

Boris Siegenthaler, CEO of Infomaniak, who is aware of the project, has more to say: "On our side, for the past two years we've been actively working on developing an alternative to Gmail and Google Drive. We're going to propose a solution to the Swiss government. The goal is to offer a 100% free email and storage service based in Switzerland that is available to all citizens." The CEO of Infomaniak, whose data centres are located in Geneva and Wintertour, is surprised that its competitors, including the international players, are not more active in this domain: "We believe there's a truly strategic shift here: now, companies need to move away from a storage solution and towards turn-key cloud solutions. The trend is to no longer have a webmaster, even internally within companies. In the same vein, next year we're going to offer storage of objects compatible with Amazon's offer, in order to facilitate the migration for companies that wish to use us to store their data." The battle is far from won when competing with US giants, but Infomaniak, which hosts institutions such as the CHUV, EPFL and RTBF, has an advantage in that all of its servers are located in Switzerland. Could Switzerland take the lead in Europe? ◢

THE OVERWHELMING DOMINATION OF US GIANTS

Market share of the primary cloud infrastructure providers around the world (as of Q4 2019)



SOURCE: STATISTA

INTERVIEW

The soaring rise of COVID bonds

After green bonds, responsible finance has found a new avenue for growth.

BY ANGÉLIQUE MOUNIER-KUHN

COVID bonds have been a topic of conversation for several weeks. They are the response to an explosion of financing needs associated with the COVID-19 crisis. Joséphine Chevallier, Head of ESG Integration (environmental, social and governance criteria) in credit research at Ostrum Asset Management, analyses the excitement for this newcomer in the world of finance.

COVID bond issues are often lumped together with social bonds. What are the main characteristics of these bonds?

Social bonds are bonds that appeared a few years ago. These assets only finance projects that generate a positive social impact, such as green bonds, which are designed for projects that are beneficial to the environment. These two types of bonds are in the impact bond category, which in 2019 made up approximately 5% of the total bond market. Until now, impact bonds were essentially dominated by green bonds. But since the end of Q1 2020, social bonds have become a new lever of growth, particularly thanks to the ripple effect from COVID bonds.

What are these COVID bonds worth?

With the health crisis, COVID bonds are booming. The volume has already reached $100 billion in June. These bonds are designed for either financing emergency aid to alleviate the social impact of the crisis, or to support the healthcare sector (purchasing medical equipment, researching treatments and vaccines).

To regulate social bonds, the ICMA (International Capital Market Association), based in Zurich, designed principles and a process that are benchmarks in the industry, and the issuers must comply with the process and principles. The objectives of the new COVID bonds are similar to social bonds, but not every entity that issues bonds adopts the ICMA framework. Sometimes issuers simply say that they do. Therefore, we can't completely exclude the risk of "COVID bond washing" from some issuers who may be controversial.

Who is issuing COVID bonds?

For the time being, the issuing volume is very heavily dominated by supranational agencies, such as the World Bank, which plans to raise $160 billion to combat the pandemic, and a good portion of that amount will be in COVID bonds. The European Investment Bank, the African Development Bank and several countries have also issued bonds of this type. Currently, there are only a few private issuers that are issuing their own COVID bonds: examples include Pfizer and Getinge, two companies active in the healthcare sector, as well as banks such as BBVA and Bank of America.

Can these bonds become a new standard in the world of sustainable finance?

The global economic crisis and its social impact, with problems in sectors such as health, food and infrastructure, creates a favourable context for this market to grow. The boom is just as present among issuers as it is among investors. The first issues were a big success, and order books were oversubscribed four to seven times more than the actual amount available.

These bonds could attract investors who are sensitive to the social quality of their portfolios, such as insurers, for example. But COVID bonds are still a bond like any other, in which the yield is linked to the quality of the issuer. The majority of the COVID bonds issued so far have been by entities ing good signatures (AA/AAA ratings), but they have low absolute returns, which limits their appeal. The market will grow if more private issuers take part, which would diversify the field and expand the investor base. ◢

JOSÉPHINE CHEVALLIER
HEAD OF ESG INTEGRATION
OSTRUM ASSET MANAGEMENT

INTERVIEW

Are autonomous vehicles finally ready for the road?

In June, the UN adopted an international standard that is an important milestone for the industry.

BY LUDOVIC CHAPPEX

A few years ago, we were promised that 100% autonomous vehicles would be on the road soon. Our expectations have since been gradually replaced with realism and even a certain disillusion. While technical difficulties still remain, the real issue is the lack of a clear legal framework that has halted the launch of the latest innovations. Until now.

An important milestone was reached on 25 June, as detailed directives were adopted by the World Forum for Harmonization of Vehicle Regulations, which is a working party of the United Nations Economic Commission for Europe (UNECE). This regulation will apply starting in 2021. However, the content of said regulation is so restrictive that some wonder if it will lead to the end of autonomous vehicles for good. Among other limitations, assisted driving is limited to 60 km/h (approximately 35 mph) and reserved solely for roads with a physical separation between the two directions of traffic, i.e. on motorways or expressways. Notably, the UNECE regulation makes it illegal for drivers to activate the automated system on roads that are shared with pedestrians or cyclists. Is this the end of the utopia? Or is it the start of a long-awaited regulatory approval? Markus Deublein, an expert in the automated driving sector at the Swiss Accident Prevention Bureau (BPA) and author of a recent report on the subject, shares his perspective.

As we've heard many times before, autonomous vehicles aren't on our roads just yet. When do you think that we'll be able to travel in these vehicles?

If we're talking about cars that will drive themselves from point A to point B, with no human intervention, we're probably a few years away still. But entirely autonomous driving isn't the same thing as automated driving, which is already happening. The international Society of Automotive Engineers (SAE) defines five levels of driving assistance, which range from adaptive speed regulation (level 1) up to 100% autonomous driving (level 5). The standard that was adopted by the UNECE pertains to level 3 autonomous driving. At this level, drivers can turn their attention away from driving to read a message or watch a video, for example. Using sensors and control algorithms, the vehicle is capable of reacting automatically in situations that require immediate action. But the driver needs to be ready to intervene quickly if the vehicle reaches the limits of the system. For a few years now, Tesla claims to meet the requirements for level 3 automated driving. Audi is expecting its new A8 to be approved at this level as well.

Under this regulation, the only places where automated driving is allowed are sections of a motorway with no cyclists or pedestrians present. Is this United Nations framework too restrictive?

No. The idea is to make progress by gradually introducing this technology into road traffic in such a way that safety is an absolute priority. This regulatory framework is a first step, but it is a very important one. As sensors and safety standards become more advanced, the scope of application will be quickly expanded, for example by authorising automated driving at higher speeds and on other types of roads. Currently, the biggest challenge remains the interaction with pedestrians and cyclists. Autonomous vehicles still have trouble correctly interpreting non-verbal human communication, such as a hand signal. Yet currently 90%–95% of road accidents are due to human error (excessive speed, fatigue or distraction while behind the wheel, etc.). Increased automation and cooperative driving between humans and machines should make road traffic a lot safer in the future.

How are manufacturers reacting to this UN regulation?

For manufacturers, a clear framework is very good news. The scope of level 3 automated driving is now well defined. And the big brands are already actively preparing for the transition to 100% autonomous vehicles. For example, BMW has an Autonomous Driving Campus in the Munich suburbs. Daimler is also doing advanced research on this topic. Their pilot project "Automated Valet Parking" is already testing level 5 autonomous driving in car parks. ◢

Bosch and Daimler have obtained approval from the authorities in Baden-Wuerttemberg, Germany, for their automated parking system in the Mercedes-Benz Museum car park in Stuttgart.

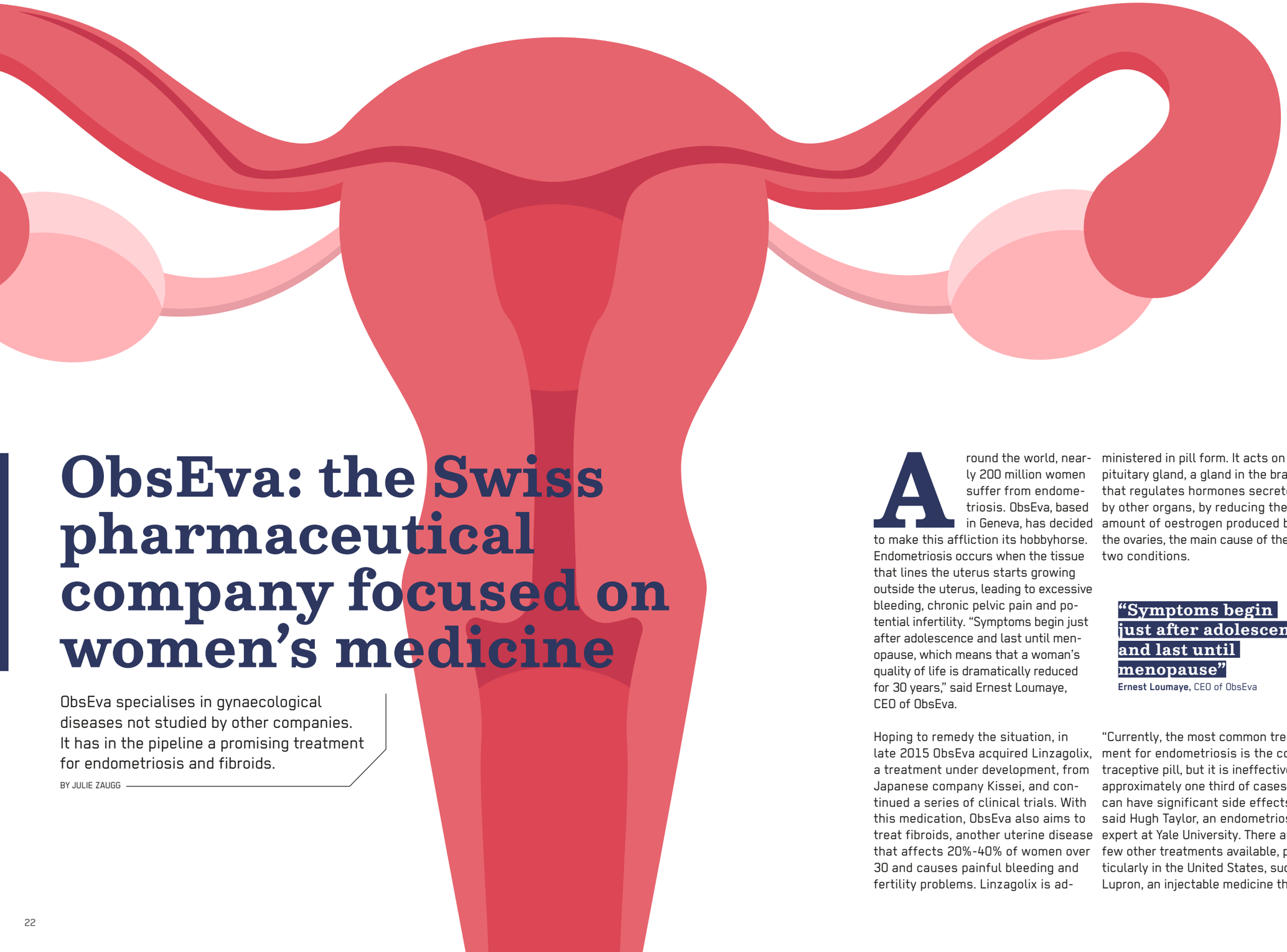
BOSCH-MERCEDES-BENZ

Regulations in place starting in 2021

The UNECE regulation will be applicable as of January 2021 in Japan, as the country actively participated in drafting the regulation alongside Germany. But the European Commission hasn't yet set a date for the law to come into force in the European Union. While the United States did not participate in this global forum, US manufacturers must comply with the UN standards if they want to be able to sell their vehicles in the 53 signatory countries.

MARKUS DEUBLEIN
AUTOMATED DRIVING SECTOR EXPERT
SWISS ACCIDENT PREVENTION BUREAU (BPA)

PORTRAIT SWISSQUOTE SEPTEMBER 2020



ObsEva: the Swiss pharmaceutical company focused on women's medicine

ObsEva specialises in gynaecological diseases not studied by other companies. It has in the pipeline a promising treatment for endometriosis and fibroids.

BY JULIE ZAUGG

Around the world, nearly 200 million women suffer from endometriosis. ObsEva, based in Geneva, has decided to make this affliction its hobbyhorse. Endometriosis occurs when the tissue that lines the uterus starts growing outside the uterus, leading to excessive bleeding, chronic pelvic pain and potential infertility. "Symptoms begin just after adolescence and last until menopause, which means that a woman's quality of life is dramatically reduced for 30 years," said Ernest Loumaye, CEO of ObsEva.

Hoping to remedy the situation, in late 2015 ObsEva acquired Linzagolix, a treatment under development, from Japanese company Kissei, and continued a series of clinical trials. With this medication, ObsEva also aims to treat fibroids, another uterine disease that affects 20%-40% of women over 30 and causes painful bleeding and fertility problems. Linzagolix is administered in pill form. It acts on the pituitary gland, a gland in the brain that regulates hormones secreted by other organs, by reducing the amount of oestrogen produced by the ovaries, the main cause of these two conditions.

> **"Symptoms begin just after adolescence and last until menopause"**
> **Ernest Loumaye,** CEO of ObsEva

"Currently, the most common treatment for endometriosis is the contraceptive pill, but it is ineffective in approximately one third of cases and can have significant side effects," said Hugh Taylor, an endometriosis expert at Yale University. There are a few other treatments available, particularly in the United States, such as Lupron, an injectable medicine that ▷

IN NUMBERS

19 M
The number of women suffering from fibroids in the United States

$34 billion
The annual cost of working days lost and complications caused by fibroids in the United States

300,000
The number of hysterectomies performed each year in the United States because of fibroids

53
The number of employees at ObsEva

KEYSTONE / SALVATORE DI NOLFI

Ernest Loumaye, CEO of ObsEva, at the company's Geneva headquarters (2018).

induces a sort of early menopause, and Danazol, a male hormone that can cause excessive hair growth or acne, according to Taylor.

For fibroids, the situation is even worse: "Currently there is no treatment on the market for fibroids," said Loumaye. "The only treatment is either the contraceptive pill, which is not very effective, or an operation to remove the uterus." The major advantage of Linzagolix is that it reduces the size of fibroids without the need for invasive surgery. In early July, ObsEva shared promising results from a phase 3 clinical trial – the last step before approval – for fibroids. The study showed that 85% of women who received a 200 mg dose and 57% of women who received a 100 mg dose reported that their fibroid symptoms improved. ObsEva expects to file for a request for approval late this year in Europe and in early 2021 in the United States, with the drug expected to be on the market by 2022.

The Swiss start-up is also conducting phase 3 clinical trials for Linzagolix on women suffering from endometriosis. However, it is not the only endometriosis treatment on the market. There are already a handful of treatments that function the same way, sold by US group AbbVie and British company Myovant. But ObsEva has an advantage over its competitors, explained Liana Moussatos, analyst at Wedbush Securities: "Rather than systematically accompanying this medicine with hormonal supplements, as its competitors do (ed. note: this is done to avoid the loss of bone density resulting from the suppression of oestrogen), ObsEva will offer a lighter version that can be taken without these supplements."

CONDITIONS IGNORED BY OTHER PHARMACEUTICAL COMPANIES

Gynaecological conditions are largely neglected by the big pharmaceutical groups. "Some of these afflictions are treated with drugs developed over 40 years ago," said Ernest Loumaye, CEO of ObsEva. "For others, like fibroids, there is no cure." Similarly, despite considerable progress made in the infertility field, the success rate is barely over 30%. There are several reasons for this lack of innovation. "For a long time, women were excluded from clinical trials, because researchers couldn't take the risk of harming the foetus if a woman was pregnant and didn't know it yet," said Jacques Balayla, a Canadian gynaecologist who has researched the issue.

Furthermore, most gynaecological issues are caused by hormonal problems, and therefore need to be treated with hormonal drugs. "These conditions aren't really ideal in terms of innovation and discovering new revolutionary molecules, which explains the disinterest from pharma companies," said Balayla. Another issue is the complexity of these conditions. "Some conditions, such as endometriosis, cause a vast range of symptoms, including painful periods, fatigue and infertility," said Balayla. As a result, it's not easy to conduct clinical trials. "How can you tell if a drug is effective if the condition manifests itself differently in each patient?"

> **"There has been barely any innovation in this field in the past 20 years in Europe, and in the past 40 years in the United States"**
> **Ernest Loumaye**, CEO of ObsEva

ObsEva will be the only company that offers this "light" version, which will allow it to gain an entire segment of the market that is unable to take heavier medications. "Many women cannot take hormonal supplements because they have contraindications such as obesity or blood clots," said Taylor. He also notes that 15% of women aged 35 and over smoke in the United States, another contraindication. "Current treatments only treat about half of all patients suffering from endometriosis," said Loumaye. "Our solution is an option for the remaining 50%."

Two other test molecules

In addition to Linzagolix, ObsEva has two other treatments in the pipeline. One of them, OBE022, can stop contractions in the event of premature labour. "Premature births are the primary cause of mortality in children under the age of 5," said Loumaye. The majority of medications on the market for this purpose have serious side effects, both for the mother (cardiovascular issues) and the foetus (kidney problems, premature closure of the blood vessel connecting the pulmonary artery and the aorta, and abdominal thrombosis). "There has been barely any innovation in this field in the past 20 years in Europe, and in the past 40 years in the United States," Loumaye continued. The results of phase 2 clinical trials, designed to test the efficacy of a drug on a limited number of patients, are expected later this year.

The third treatment that ObsEva hopes to advance is Nolasiban, which improves the chances of an embryo implantation following in vitro fertilisation by blocking the secretion of oxytocin, a hormone that stimulates contractions in the uterus. "Despite promising results in phase 2 and 3 clinical trials, a second round of phase 3 trials did not produce the desired effects," said Loumaye. "We were very disappointed." After reviewing the data generated by these trials, ObsEva decided to test a higher dosage over a longer period. In early 2020, it delegated this task to Chinese company Yuyuan. If the results of the trials are positive, Yuyuan will be able to obtain a patent in China and ObsEva will be able to sell the medicine in the rest of the world. There are already two similar drugs on the market, sold by Swiss company Ferring. "The advantage of Nolasiban is that it can be administered orally, rather than via injection," said Laurentiu Craciunas, a Romanian gynaecologist who recently participated in a meta-analysis on oxytocin blockers. "That means patients can take this medication at home without having to go to the hospital, which is a real plus in the current situation with COVID-19."

ANALYST OPINIONS

SUCCESS IN SIGHT

Founded in 2012 in Geneva, ObsEva is the second Swiss start-up created by Belgian gynaecologist Ernest Loumaye. In 2006, he started PregLem, a company specialised in treating uterine fibroids, which he sold in 2010 for 445 million Swiss francs to Hungarian pharmaceutical company Gedeon Richter. Loumaye then began ObsEva, choosing to focus on acquiring molecules in the final stages of clinical trials. "This approach allows the company to save on research and development costs," said Liana Moussatos, analyst at Wedbush Securities.

As of yet, the company, which has 53 employees and is listed on the Nasdaq, does not have a product to sell and recorded a loss of $108.8 million in 2019. But most analysts believe it has a promising future, in particular thanks to the size of the endometriosis and fibroids market and the lack of drugs available on the market to treat these two conditions. Moussatos estimates that by 2026, sales of Linzagolix will reach a peak of $1.1 billion for fibroids and $653 million for endometriosis in the US alone. Most analysts recommend purchasing or holding shares.

OBSN

Under the watchful eye of office cameras

Facial recognition software is now being used in Chinese offices. Employees are under surveillance at all times.

BY JULIE ZAUGG, IN HONG KONG

In China, it is now impossible to walk down the street without being filmed by a surveillance camera. The country has more than 350 million cameras, or one camera for every four residents. "The cameras are used to catch fugitives, to identify pedestrians who cross the street at a red light, or even to stop people from stealing toilet paper," says Jake Laperruque, a facial recognition expert for the US NGO Project on Government Oversight.

But this massive system, reminiscent of a panopticon, isn't limited to just public space. An increasing number of companies are now using these cameras as well. "In many Chinese companies, it has now become normal to have your face scanned when you get off the lift in order to be able to enter your office," says Martin Chorzempa, an expert in new Chinese technologies at the Peterson Institute for International Economics. "This scanning procedure replaces traditional clocking-in systems and allows companies to closely monitor the comings and goings of their employees."

On Chinese e-commerce site Alibaba, there are dozens of facial recognition devices available that can be installed at the entrance of a building, which also allow users' faces to act like a key. The least expensive versions cost $50 each.

Facial recognition is used to identify employees who are slacking off

Yitu, a company that develops facial recognition software, has expanded the concept even further: as employees walk around, they are tracked by a network of surveillance cameras installed all over the office, and their movements – along with their names – are displayed on a screen in real time. Each person appears as a small blue dot that can be monitored as they move about the office.

Insurance company Ping An has deployed a facial recognition system at the entrance of its offices to ensure that its 1.4 million insurance agents all attend the daily morning meeting. "Before we introduced facial recognition, some agents who didn't attend the morning briefing would ask their friends to sign them in using their staff card," said Jessica Tan, co-CEO of the group, in the Chinese press.

At some companies, facial recognition is used to identify employees who are slacking off. Most of the oil and gas fields owned by China National Petroleum are equipped with surveillance cameras that use algorithms to determine whether any workers are chatting, smoking or looking at their mobile phones instead of working – and identify them.

IMPROVING PRODUCTIVITY

Facial recognition can also help companies manage their teams more effectively, according to Steffi Noël, an expert on the Chinese manufacturing sector at Daxue Consulting. For example, electricity producer State Grid Zhejiang Electric Power has equipped its plants with facial recognition cameras that use algorithms to analyse the micro-expressions on employees' faces and calculate their body temperature. "This type of system can detect peaks in stress, fatigue or confusion," says Noël. "The management can use this data to resolve the underlying problems causing these emotional states and in turn improve workers' productivity."

GETTY IMAGES

Huawei's Shenzhen campus. Over 30,000 employees of the company work there.

Another company, Ningbo Shenyang Logistics, has its new employees experience simulated work scenes using augmented reality headsets. "These headsets are equipped with facial recognition cameras that analyse employees' facial expressions to determine which scenarios cause the most difficulty, which can be used to improve the training programme accordingly," says Noël.

Cameras can also be installed to meet safety requirements. "Surveillance cameras can be used to detect if someone's hand is too close to a hazard on an assembly line or to spot a tired employee who may fall asleep at the wheel of a construction vehicle," says Noël. "This can prevent many accidents." Since the COVID-19 pandemic, some Chinese factories have also been using cameras to verify that workers are complying with social distancing measures.

Surprisingly, these surveillance measures are met with little resistance from employees. "In China, facial recognition is already part of everyone's daily lives," says Noël. "This technology allows people to make payments and monitors even their smallest actions and movements in public." They are more worried about being replaced by a machine: "Many jobs that involve checking compliance with safety measures or monitoring the efficiency of company procedures could disappear," Noël adds.

What's more, beyond a company's own use, questions have emerged regarding other uses of the data employers gather on their employees. "If the state requests it, companies must hand over this information," says Laperruque. He fears that in time, this data will be fed into the social credit system that China is currently developing on a national level.

CAMERAS IN SCHOOL AS WELL...

A university campus in Nanjing and a secondary school in Hangzhou have also installed surveillance cameras at the entrance to classrooms in order to determine whether students are actually attending class or if they are paying someone to attend in their place – a common practice in China. Equipped with smart software that analyses students' facial expressions and movements, the cameras can also spot if students are not following along in class or if they fall asleep.

The Hangzhou school produces daily reports on all of its students that indicate how many times they raised their hands, the number of minutes they spent distracted, and whether or not they experienced stress or confusion during the day. This information is then sent to their parents.

HYDROGEN SWISSQUOTE SEPTEMBER 2020

DOSSIER

GREEN HYDROGEN: THE FUEL OF THE FUTURE

With the technology on its way to becoming mature, clean hydrogen investment projects are booming. And share prices of companies active in this industry are skyrocketing.

BY BERTRAND BEAUTÉ

34. Infographic: The many uses of green hydrogen

36. Hydrogen forges its path

38. Hydrogen lorries hit the road

42. Forklifts move up with hydrogen

44. A hydrogen town emerges from fukushima

46. On board an air-purifying SUV

48. Interview with Oliver Bishop, CEO of Shell Hydrogen

50. These companies are gassed up and ready to go

Will this time finally be it? Since the 1970s, hydrogen – or more accurately hydrogen gas (H_2) – has been presented time and again as the solution to move away from oil and other fossil fuels. Now may finally be its time to shine. In early June, Germany approved an expansive €9 billion investment strategy to develop the industry. One month later, the European Commission unveiled its own hydrogen plan, estimated to cost between €180 billion and €470 billion by 2050.

"The announcement of Germany's plan has revived excitement about the sector," says Xavier Regnard, an analyst for investment bank Bryan Garnier & Co. As a result, the share prices of companies in this indus- ▷

Dossier prepared by: Bertrand Beauté and Stanislas Cavalier

JOHN THYS / AFP

German Chancellor Angela Merkel has put the development of the hydrogen sector at the centre of her post-COVID recovery plan.

try have skyrocketed. Since early 2020, the share price of US company Nikola has increased by more than 270%. In Europe, companies such as Ceres Power, ITM Power and McPhy Energy have seen their shares rise 100%, 265% and 540% respectively (read features on p. 50 to 56). None of these companies are currently profitable, but they all focus on hydrogen-related technologies that are now of increasing interest to governments, energy companies, industry players, and of course investors.

This isn't the first time that the markets have spiked because of hydrogen, as investment bank UBS pointed out in a report published on 22 June. As early as 2000, the index covering companies in the industry saw its value increase sixfold before dropping sharply. "For decades, hydrogen was full of promise but was unable to deliver sufficient results," said UBS analysts. Is a new hydrogen bubble forming now? "I don't think so," says Xavier Regnard, an analyst at Bryan, Garnier & Co. "Yes, the sector has seen excellent market performance since the beginning of the year. But it's not immune to the reality of the situation. There is a real demand, real projects, and real opportunities. These technologies are starting to reach maturity, and given the climate crisis, it will be necessary to move to green hydrogen. During the first market spikes, the industry didn't keep its promises and investors were disappointed. But this time seems to be it."

> **"Hydrogen has long been relegated to automobile use, but there are indeed opportunities in all industries"**
>
> **Thierry Lepercq**, author of the book *Hydrogène, le nouveau pétrole [Hydrogen: the new oil]*

On paper, this colourless, odourless gas is very promising, a perfect fit for our current environmental needs. Water electrolysis is a process that can split a water molecule into hydrogen and oxygen via a simple electric current: "If the electricity used in the electrolysis is renewable and if the process takes place close to a water source, it is possible to produce hydrogen anywhere in the world, on demand, and in a completely clean way," says Daniel Hissel, a 2020 CNRS Innovation medallist. In Switzerland, the Alpiq power plant, located along a river in Gösgen, has produced 100% clean hydrogen since February 2020.

Once created, the gas can be stored in large quantities and transported in gas form via a pipeline, or in liquid form by boat or lorry. It can also be used for electricity or transformed into methane to supply houses and industry, or into fuel for cars, lorries, ships and aeroplanes. "Like oil, hydrogen is easy to store and transport," said Thierry Lepercq, author of the book *Hydrogène, le nouveau pétrole* [*Hydrogen: the new oil*] and founder of the company Solaire-Direct. "As a result, it can be a profitable replacement for fossil fuels in all applications (transportation, industry, energy). Hydrogen has long been relegated to automobile use, but there are indeed opportunities in all industries. It's a phenomenal market." By 2050, it could be worth $1,000 billion, according to HSBC, and potentially even $2,500 billion according to McKinsey – though these estimates came before the recent German and European investment strategies.

FROM BLACK HYDROGEN TO GREEN HYDROGEN

In 2018 – the most recent figures available – the hydrogen market was worth $130 billion, with an annual ▷

Hydrogen, the friend of renewable energy

By their very nature, wind and solar energy are intermittent and uncontrollable: the sun doesn't shine 24 hours a day and the wind doesn't always blow. As a result, when there is no wind and no sun, no electricity can be generated. Conversely, when demand for electricity is low and generation is high, for example during a summer day, many renewable energy farms are forced to shut down in order to avoid overloading the grid.

This is one of the reasons you often come across turbines that aren't turning when the wind is blowing. "Hydrogen is very promising in that you can store the surplus renewable energy, and then use that energy at a later time in the form of electricity, hydrogen or another fuel," says Christian Bach, director of the Empa Automotive Powertrain Technologies laboratory in Dübendorf. Solar energy accumulated in summer can be stored for several months in the form of hydrogen, and then used in winter – something that batteries are not capable of due to volume and self-discharge.

A century of false starts

1766
British chemist Henry Cavendish isolates hydrogen gas for the first time, calling it inflammable air. In 1783, French chemist Antoine Lavoisier renames this gas "hydrogen", from the Greek for "water creator", as hydrogen combustion produces water.

1800
"Coal gas", composed of approximately 50% hydrogen gas, is used to light street lamps in cities, and then to heat buildings. But from 1880, it is gradually replaced by electricity for lighting, and by natural gas for domestic heating from the 1930s.

1804
Swiss inventor François Isaac de Rivaz designs the first internal combustion engine. The engine is powered by a combination of hydrogen and oxygen. As we see today, this type of engine would later meet with great success using fossil fuels.

1899
Count Ferdinand von Zeppelin begins building the first hydrogen airship. But the LZ 129 Hindenburg explosion in 1937 in the United States put a stop to transatlantic transportation via airship.

1969
The spacecraft used in the Apollo 11 space mission is powered by hydrogen-oxygen motors, allowing humans to land on the moon for the first time. This fuel is still used by the space industry, including in the Ariane rocket.

1970
After the first oil crisis, hydrogen is considered to be the energy source of the future. But many countries choose to focus on nuclear energy instead.

production of 74 million tonnes. This energy source was primarily used to produce fertilisers and refine oil products. But more than 95% of hydrogen currently produced is made from hydrocarbons (oil, natural gas or coal). This highly polluting process produces as much CO_2 as the UK and Indonesia combined, according to the International Energy Agency (IEA). This type of hydrogen, called grey or black hydrogen, is not a solution to climate change (see inset on p. 33).

To become the promised energy of the future, hydrogen must go green. "There are technologies that produce clean hydrogen. But they are more expensive than producing hydrogen with hydrocarbons," says author Lepercq. "The challenge now is how to produce green hydrogen at a competitive price." In 2018, it cost between $3 and $7.50 to produce 1 kilo of green hydrogen with an electrolyser, which is two to three times more expensive than production methods that use natural gas (grey hydrogen), according to the IEA.

"Sudden profitability is not a good indicator," says Hissel. "If you only look at the price at the pump, you lose sight of the overall societal benefit of moving beyond fossil fuels." But Lepercq disagrees: "When it comes to raw materials, everything needs to be at the right price. If you need to be subsidised, you're not in the market and you'll get nothing but crumbs. For hydrogen, a good price is $1 per kilo. Beyond that, it's not competitive enough compared to oil."

> **"Hydrogen is not a passing trend"**
>
> **Hubert Girault**, professor of physical and analytical electrochemistry at the École polytechnique fédérale de Lausanne (EPFL)

Even just a few years ago, that goal would have been completely unattainable. But the tides have turned. In June 2019, for the first time, the International Energy Agency (IEA) supported the use of hydrogen in a crucial report named simply "The Future of Hydrogen". "Hydrogen is currently enjoying unprecedented momentum. The world should not miss this unique chance to make hydrogen an important part of our clean and secure energy future," said Fatih Birol, executive director of IEA, in the report's foreword. Why the sudden boom? The cost of hydrogen produced from renewable energy is falling faster than expected and the IEA estimates that clean hydrogen will become competitive by 2030.

"In fact, it will actually be much sooner," says Lepercq. "In five years, we're expecting a price of $1 per kilo. Some manufacturers are announcing a price of $1.50 starting in late 2020." There are two reasons for this price drop. First, in order to produce green hydrogen, you need access to completely clean electricity from renewable and cheap sources. From 2009 to 2019, the cost of electricity produced in solar power plants decreased ninefold to reach $40 per megawatt-hour, and wind energy dropped from $135 to $41 per megawatt-hour, according to a study by Lazard Bank published in late 2019. "And prices will continue to fall in coming years, reaching $10 per megawatt-hour in 2025 with solar, which will automatically reduce the price of green hydrogen," predicts Lepercq. The second reason is electrolysers – the machines that can transform water into hydrogen using electricity. "In recent years, the sector has gone from small pilot units – demonstrators with less than one megawatt of power – to industrial-scale projects that can reach 10, 20, and even several hundred megawatts," says Xavier Regnard, an analyst at investment bank Bryan Garnier & Co. "This change in scale will lead to an industrialisation of the industry and a drop in prices."

At the port of Rotterdam, for example, companies BP and Nouryon are planning to build a 250 MW electrolyser, which will be ready in 2025. Obviously, the sector's industrialisation will be facilitated by government investment programmes. Germany is planning to produce 5 gigawatts (5,000 MW) of green hydrogen by 2030, and 10 gigawatts by 2040. "We're laying the groundwork to become the global leader in hydrogen technologies," said Peter Altmeier, minister for Economic Affairs and Energy. "Germany will be a pioneer, as we were 20 years ago with the promotion of renewable energies." The European Commission is aiming for 6 gigawatts by 2024 and 40 gigawatts by 2030.

"Hydrogen is not a passing trend," says Hubert Girault, professor of physical and analytical electrochemistry at the École polytechnique fédérale de Lausanne (EPFL). "Look at what happened in China: two or three years ago, the government began supporting this energy carrier. And when Beijing began supporting the industry, the country became the global leader, as we've seen with lithium-ion batteries and solar panels." In 2017, Japan also implemented a hydrogen plan, followed by South Korea in 2019. Conglomerates such as Hyundai, Kawasaki and Toyota have invested in the industry for years and offer solutions that are already on the market.

Faced with the prospect of green hydrogen becoming the norm, traditional players – that run on grey hydrogen – are reacting accordingly. In 2019, Air Liquide acquired an 18.6% stake in Canadian company Hydrogenics Corporation, a specialist in fuel cells and electrolysis equipment to produce hydrogen. Also in 2019, German group Linde purchased a stake in UK electrolyser manufacturer ITM Power. Even oil giants such as BP, Total and Shell (read the interview on p. 48) are getting heavily involved, creating dedicated hydrogen power subsidiaries. "The fact that giants such as Linde and Air Liquide are taking positions in the industry is a good sign," says Regnard. "It shows that these companies also believe in the potential of green hydrogen." ◢

2000

Climate change concerns bring hydrogen gas back into focus. But the technology is too expensive and not mature enough. It fails to live up to its promises and the hydrogen bubble bursts.

2014

Toyota launches the "Mirai", the first hydrogen-powered car designed for and sold to the general public. Sales are low. In late 2018, according to the International Energy Agency, only 11,200 hydrogen-powered cars were used around the world across all brands.

2020

The European Commission adopts a vast programme to support the hydrogen industry. But what will be the outcome?

THE DIFFERENT SOURCES OF HYDROGEN

Except at the very depths of the oceans in interplate areas, hydrogen gas does not exist in a natural form on Earth. Unlike fossil fuels such as oil, hydrogen has to be made – as harnessing hydrogen a long way from the coast is not economically viable. There are several techniques to produce hydrogen, but not all of them are clean.

BLACK HYDROGEN
Hydrogen is produced using coal or lignite through a process called gasification. This method creates the most pollution, but fortunately it is no longer very common. The hydrogen produced costs between $1 and $2 per kilo.

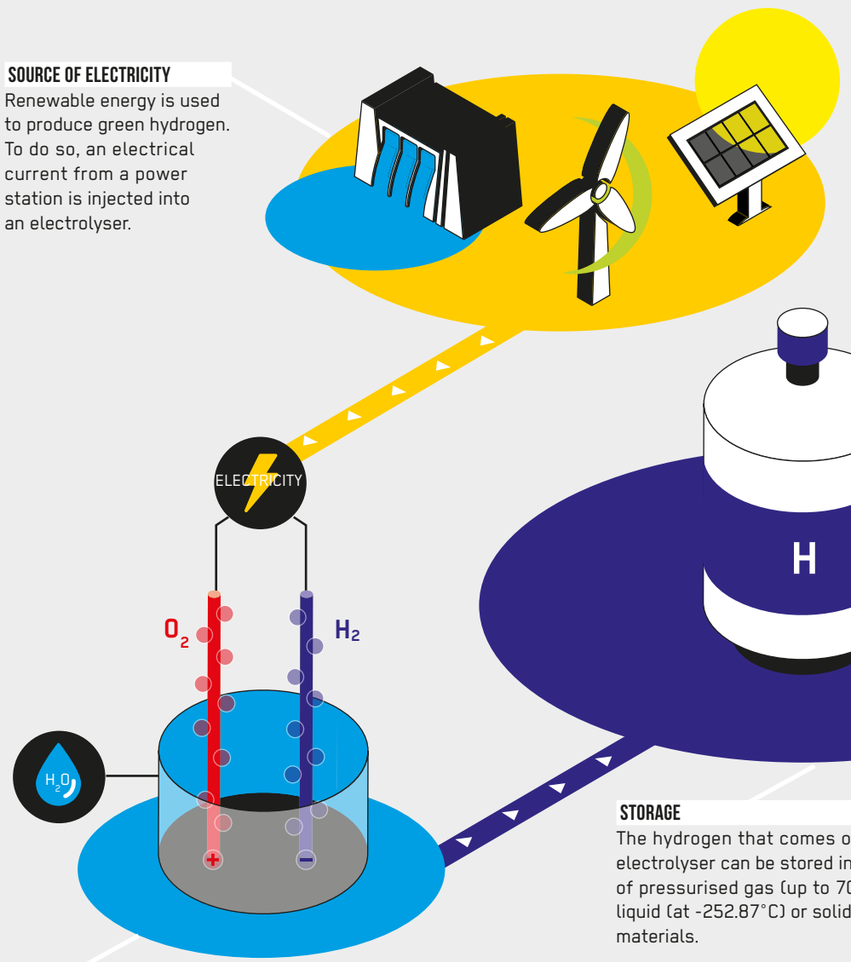
GREY HYDROGEN
Hydrogen gas is produced from natural gas via a chemical reaction called steam methane reformation. This method is the most widely used today because it is inexpensive ($1 to $3 per kilo), but it produces a lot of CO_2.

BLUE HYDROGEN
Hydrogen is produced via natural gas reformation in a similar way to grey hydrogen, but the CO_2 produced is captured by filters, and then either reused or stored and not released back into the atmosphere. Blue hydrogen costs between $1.50 and $3 per kilo.

GREEN HYDROGEN
Hydrogen is produced by water electrolysis, i.e. splitting water molecules (H_2O) into hydrogen gas (H_2) and oxygen (O) using an electric current supplied by renewable energy (solar, wind, hydroelectric dam). This method has the advantage of not releasing any greenhouse gases, but it is expensive ($3 to $7.50 per kilo).

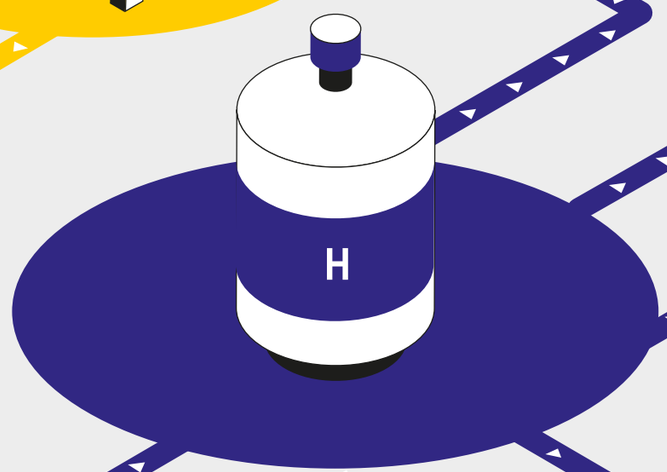
THE MANY USES OF GREEN HYDROGEN

By 2050, hydrogen could cover 18%–20% of the world's energy consumption. This could be possible because the gas can be used in a wide variety of domains, all without any CO_2 emissions.

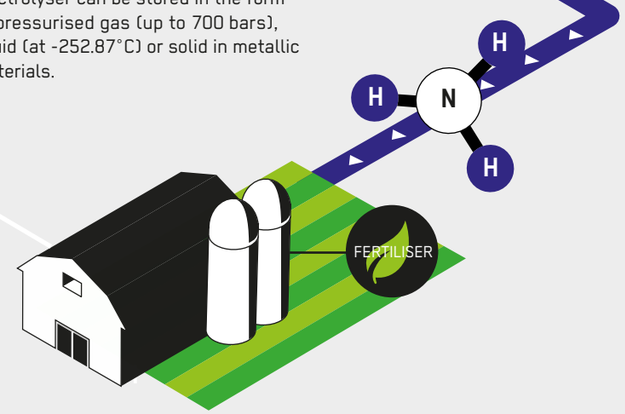


SOURCE OF ELECTRICITY
Renewable energy is used to produce green hydrogen. To do so, an electrical current from a power station is injected into an electrolyser.

WATER ELECTROLYSIS
Inside the electrolyser, the electricity will split water molecules (H_2O) to produce dihydrogen (H_2) and oxygen (O_2) according to this chemical reaction: $2H_2O \rightarrow O_2 + 2H_2$.



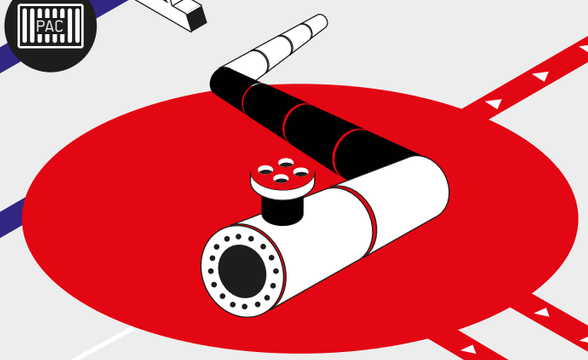
STORAGE
The hydrogen that comes out of the electrolyser can be stored in the form of pressurised gas (up to 700 bars), liquid (at -252.87°C) or solid in metallic materials.



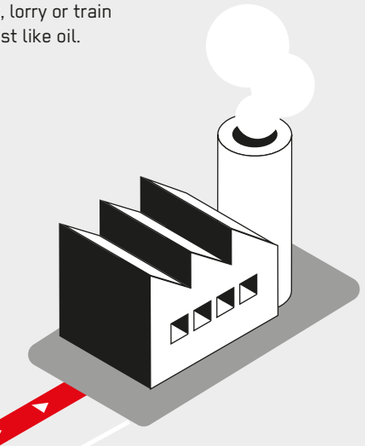
AGRICULTURE
Hydrogen is used to make ammonia (NH_3), a chemical mole-cule that is the base of many nitrogen fertilisers.

EXPORTS
In liquid form, hydrogen can be transported by boat, lorry or train across the world, just like oil.

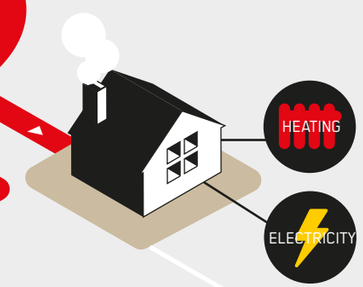
CONVERSION TO ELECTRICITY
A fuel cell produces the opposite reaction of electrolysis, i.e. it uses hydrogen to produce electricity. The current can be fed into the electrical network, particularly to meet energy needs during consumption peaks.



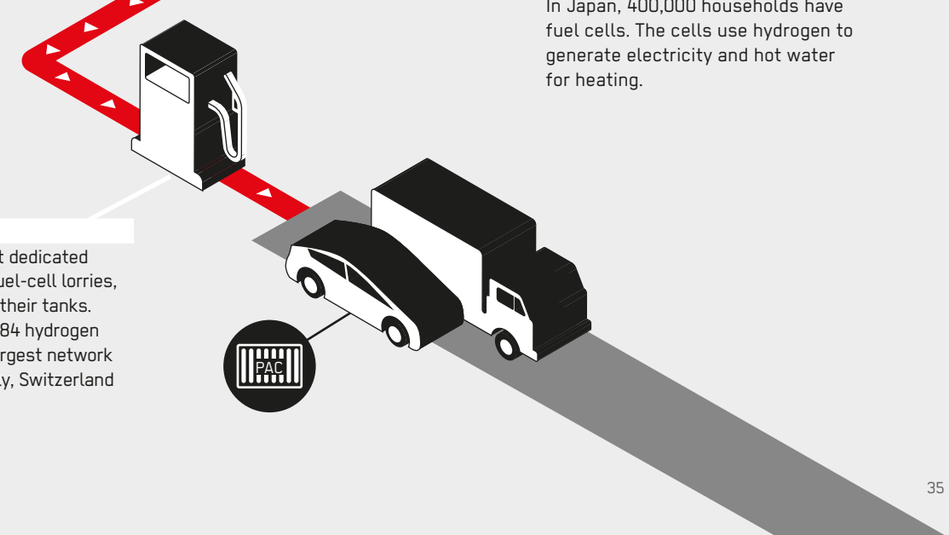
TRANSPORT
In gas form, hydrogen is transported in pipelines.



INDUSTRY
Hydrogen can replace fossil fuels in industrial applications. Since 2019, for example, Thyssenkrupp has used hydrogen to partially replace coal in the blast furnaces at its factory in Duisburg, Germany.



BUILDINGS
In Japan, 400,000 households have fuel cells. The cells use hydrogen to generate electricity and hot water for heating.



SUPPLY
Hydrogen is available at dedicated filling stations where fuel-cell lorries, buses and cars can fill their tanks. Germany currently has 84 hydrogen pumps, making it the largest network in Europe. Comparatively, Switzerland has two.

HYDROGEN FORGES ITS PATH

Transporting hydrogen from production sites to consumption locations requires a vast infrastructure. 23,000 km of gas pipelines are planned for European soil by 2040.

BY BERTRAND BEAUTÉ

In order to reduce costs, green hydrogen power plants will have to be built on the very sites of renewable electricity generation, i.e. in Europe, mainly near Dutch, Danish or Norwegian offshore wind farms and solar power plants in Spain and even North Africa.

The problem is that these generation sites are far away from where the energy is actually being consumed, particularly for German industry – so the hydrogen needs to be transported over long distances. Currently, Europe has only 1,600 km of dedicated hydrogen pipelines. That's not enough for hydrogen to fully grow as an alternative energy source. So what is the solution?

> **"All the major gas groups are getting on board. This is proof that hydrogen is no longer a pipe dream."**
> **Hubert Girault**, professor at École polytechnique fédérale de Lausanne (EPFL)

In July 2020, eleven European gas infrastructure companies presented their "European Hydrogen Backbone" plan, which aims to develop a 23,000 km network of hydrogen pipelines across Europe by 2040. The estimated cost is between €27 and €64 billion. The report claims this amount is actually fairly low, due in particular to the fact that 75% of the network will be built upon pre-existing pipelines that are currently used to transport natural gas. The project is based on the hypothesis that demand for natural gas will decline between 2020 and 2030 as societies go electric and as a result of the need to fight climate change.

"Hydrogen will be transported via existing gas infrastructure," says Lepercq. "For the companies that manage that infrastructure, this is a godsend. Assets that are currently not in use could even come back to life." In reality, the development of this European hydrogen road will be gradual. Between now and 2030, the first 6,800 km of the pipeline (on which construction is expected to begin in 2020) will connect the first movers of Hydrogen Valleys, i.e. the primary hydrogen production and consumption sites in the Netherlands, Belgium and northern Germany. In 2035, a longer network will connect the south of France to Germany. Finally, in 2040, ten European countries will be connected, including Switzerland, which will be linked to France via Oltingue, to Germany via Wallbach and to Italy via Gries Pass (see infographic). Beyond that, other possibilities are in the works, such as import routes from the North Sea (Norway and the United Kingdom), Ukraine, Greece, North Africa and Russia. Building such infrastructure will "increase the production and use of hydrogen", according to the report.

Hubert Girault, professor of physical and analytical electrochemistry at École polytechnique fédérale de Lausanne (EPFL), notes, "We are living through a revolution. All the major gas groups are getting on board. This is proof that hydrogen is no longer a pipe dream." And Girault adds that the pipelines aren't the only way to transport hydrogen: "The gas also exists in liquid form. As a liquid, it can be transported via existing rail networks or motorways in tankers, which can access places pipelines cannot. It can also be transported by ship." The latter was the solution chosen by Japan: in 2020, Kawasaki Heavy Industries announced it was building a hydrogen liquefaction plant and a loading terminal in the Australian state of Victoria to export hydrogen to Japan by ship.

The "European Hydrogen Backbone" project was developed by 11 European companies: Enagás, Energinet, Fluxys Belgium, Gasunie, GRTgaz, NET4GAS, OGE, ONTRAS, Snam, Swedegas and Teréga, with additional support from consultancy firm Guidehouse.

HYDROGEN SWISSQUOTE SEPTEMBER 2020

HYDROGEN LORRIES HIT THE ROAD

HYUNDAI

Several models of heavy goods vehicles equipped with fuel cells have been driving across Switzerland since July. If the tests are successful, there will be several thousand of these lorries on our roads by 2025.

BY BERTRAND BEAUTÉ

It is Monday 20 July in Hunzenschwil (AG), in the middle of the afternoon. A lorry with its radiator grille covered enters the Coop fuel station. An everyday scene. Except that the heavy goods vehicle (HGV) in question is exceptional. It runs without making any noise and only emits water vapour, rather than exhaust gas. It's also not at the petrol station to fill up on petrol. It's ready to fill its seven hydrogen tanks.

Despite the tape over the cab, you can still see the H logo of the Hyundai brand underneath. The lorry is one of the 10 units of the XCient Fuel Cell model, the very first mass-production hydrogen cell HGV in the world, which arrived in Switzerland in early July. "It's incredible to drive," said the driver. "Compared to a traditional diesel HGV, the acceleration is much better. I feel like I'm driving the lorry of the future."

Weighing 35 tonnes, equipped with a refrigerated body and able to tow a trailer, the XCient Fuel Cell is powered by two 95 kW fuel cell stacks. Its seven tanks can hold 32.09 kg of hydrogen at a pressure of 350 bar, which gives it a range of 400 km, according to the manufacturer. The system was designed for short-distance deliveries between logistics centres and supermarkets. The 10 units that arrived in Switzerland are currently being tested and are expected to begin commercial use in September. This is just the start for the Korean company, which plans to export 50 hydrogen-powered lorries to Switzerland by the end of the year, and 1,600 by 2025.

> "It's incredible to drive. I feel like I'm driving the lorry of the future."

It's not by chance that Hyundai chose our country as a starting point for its hydrogen journey. "In Switzerland, at least for the time being, the LSVA HGV charge – a tax on lorry traffic – doesn't apply to vehicles that don't emit pollution," explains Christian Bach, director of the EMPA Automotive Powertrain Technologies laboratory. "As a result, the cost per kilometre of a hydrogen-powered lorry – while much more expensive to purchase – becomes comparable to that of a traditional diesel lorry."

While Hyundai has been investing in hydrogen for years (read about our test drive of the Nexo SUV on p. 46) and is the first manufacturer to send its Fuel Cell lorries to Switzerland, it's not the only manufacturer in this segment. GreenGT, a small Vaud-based company which made a name for itself with race cars (see inset on p. 40), is following closely behind the Korean group. Associated with the St. Gallen group LARAG, which specialises in lorry imports, GreenGT is in the process of installing its electric-hydrogen propulsion system in a 40-tonne HGV as part of the Generation of Hydrogen (GOH!) project. The lorry will be delivered to Migros by the end of 2020, before beginning a testing and approval period in Geneva. The hydrogen used to power the lorry will be produced by Services industriels de Genève (SIG), using electricity generated from solar or hydraulic energy – green hydrogen, then. If the trials are successful, further lorries will be ordered, and not just by Migros.

In France, GreenGT has already signed a contract with retail giant Carrefour to convert another 44-tonne lorry into a hydrogen-powered vehicle. Tests for this will also begin at the end of this year, in partnership with Air Liquide. "There is already very high demand for hydrogen-powered lorries," says Jean-François Weber, general manager and founder of GreenGT. "Currently, we're drowning in requests from companies that want these lorries."

This is because compared to battery-powered electric lorries, hydrogen models have many advantages. "The heavier a vehicle becomes, the more clearly traditional lithium-ion batter- ▷

15 to 20 million

The number of lorries that are expected to be powered by hydrogen around the world by 2050, according to the Hydrogen Council. The Council also estimates there will be five million hydrogen-powered buses.

ies show their limits," explains Bach. "In order to drive a 40-tonne lorry for a few hundred kilometres, you need several tonnes of batteries that take up valuable space on-board that could be used to transport goods."

For example, we estimate that the Volvo FE Electric lorry, sold since 2020, carries nearly two tonnes of batteries, and has a maximum range of 200 km and a maximum permitted driving weight of 27 tonnes. As a comparison, the XCient Fuel Cell has a 400 km range and a permitted weight of 35 tonnes. Another advantage is recharging time. At the Coop station in Hunzenschwil, it takes less than 10 minutes for a Hyundai lorry to fill up with 30 kg of hydrogen, compared to an hour for the Volvo FE Electric with a fast charger, and 6.5 hours with a normal charger.

"Switzerland will have about 100 pumps in the next 3 to 5 years"

Jean-François Weber, founder of GreenGT

"Hydrogen can be a real player in heavy mobility," says Xavier Regnard, an analyst at Bryan, Garnier & Co. The only downside is the lack of infrastructure. In Switzerland, there are currently only two "pumps" open to the public that provide hydrogen: the Coop fuel station in Hunzenschwil and Avia in St. Gallen, compared to more than 3,300 stations with petrol pumps. "The network will grow quickly," says Weber. "Switzerland will have about 100 pumps in the next 3 to 5 years." By the end of 2020, six hydrogen fuel stations are expected to open on the Lake Constance–Lake Geneva route.

It won't be enough for hydrogen-powered vehicles to be used by individuals, but it will probably be sufficient for HGVs and captive fleets. "Generally, lorries leave the warehouse in the morning and return in the evening," says Bach. "If you have sufficient range to make it through the day and there's a fuel station near the depot, then hydrogen power is no problem at all."

This situation could also apply to public transport. Belgian constructor Van Hool, for example, markets a hydrogen-powered bus that is experiencing growing success. They are used in Cologne and Wuppertal in Germany and Pau in France. Somewhat behind, Volvo and Daimler announced in April 2020 that they were creating an equal joint-venture to produce high-powered fuel cell batteries, designed to be used in both brands' HGVs. Each has invested the equivalent of €600 million.

But without a doubt, the most talked-about company at the moment in the hydrogen lorry field is Nikola. Founded five years ago in Salt Lake City (Utah) and based in Phoenix (Arizona), Nikola is already considered to be the Tesla of hydrogen (read the company feature on p. 50). But the competition doesn't worry Jean-François Weber: "There's room for everyone," smiles the GreenGT GM. It's a gigantic market."

Sport as a means of communication

From 0 to 100 km/h in 3.4 seconds, a top speed of over 300 km/h, and a design by none other than the famous Italian firm Pininfarina. No, we're not talking about the latest stylish Ferrari – we're talking about another racing car, the LMPH2G. This is the ugly name of the hydrogen-powered racing car developed by Swiss company GreenGT, in partnership with Total and Symbio (a joint venture between Michelin and Faurecia). The vehicle made headlines in June 2019 when it took part in the opening proceedings of the 87th edition of the 24 Hours of Le Mans race. It made quite the impression across hundreds of televisions.

"We're using sport as a means of communication, to showcase the idea that hydrogen technology is a reliable solution that also offers performance," says Jean-François Weber, general manager and founder of GreenGT. While the cars that usually participate in the Sarthe race guzzle between 35 and 40 litres of petrol per 100 km and emit significant amounts of greenhouse gases, the LMPH2G prototype runs on hydrogen. Its secret? A fuel cell battery coupled with four electric motors that can deliver the equivalent of 653 hp. "We're not yet at the level of the petrol models that participate in the 24 Hours of Le Mans, but we're heading in the right direction," adds Weber. "We're working on showing people that it's possible, and the goal is to compete in the 24 Hours of Le Mans in the hydrogen category in 2024."

BLUE TRAINS HAVE A ROSY FUTURE

After 18 months of successful testing in Germany, hydrogen locomotives are generating interest from other countries around the world.

BY BERTRAND BEAUTÉ

On its sky-blue paint, the train proudly displays "HO", short for "hydrogen zero-emission". It could also add a pretentious "PS" for "planned success". The Coradia iLint regional train from Alstom — the first hydrogen train in the world — would indeed seem to have a bright future. After 530 days and more than 180,000 kilometres travelled in Germany, its testing phase under real commercial conditions was declared successful in May 2020, opening the way to more widespread deployment.

Starting in 2022, Alstom will begin delivering the 14 trains ordered by LNVG, the rail operator for Lower Saxony, as well as 27 trains to Hesse (in the Frankfurt region). More trains have been purchased in the Netherlands, where hydrogen trains were tested on the Groningen-Leeuwarden line, as well as in Italy, France, Spain and the UK.

The reason hydrogen is so in-demand is because the technology has several advantages that can help the rail industry move away from carbon. Indeed, the Coradia iLint, which emits only water vapour, hopes to replace polluting diesel locomotives. In Switzerland, where more than 90% of rail lines are electrified, the market for hydrogen trains is non-existent, but it is enormous in the rest of the world. In Germany, where 38% of the rail network, or more than 25,000 km, is not electrified, nearly 1,600 diesel trains are still in service. The UK has slightly fewer diesel trains, at just under 900, and Italy has more than 600.

"This technology means countries don't need to change their rail networks to go electric"

Xavier Regnard, analyst at Bryan, Garnier & Co

"When looking to replace diesel trains, hydrogen is very competitive," said Xavier Regnard, analyst at Bryan, Garnier & Co. "This technology means countries don't need to change their rail networks to go electric. They would simply need a hydrogen charging station along the route, which is much cheaper." According to figures from Alstom, electrifying a railway costs €1 million per kilometre, which is cost-prohibitive for underused regional lines.

With its first contracts, Alstom is moving ahead of its competitors. Siemens is working on a hydrogen-powered train, but it isn't expected to be ready until 2021. Canadian firm Bombardier, whose acquisition by Alstom is awaiting approval from the European Commission, is focused on a battery-powered model. But its prototype, dubbed the "Talent 3", only has a range of 40 km, whereas the Coradia iLint can travel up to 1,000 km on a full tank of hydrogen.

At present, only Swiss group Stadler seems capable of competing with the French giant. In November 2019, right under the nose of Alstom, Stadler signed a contract to deliver a hydrogen train to the United States. Named "Flirt H2", this train is expected to enter service in 2024 in Southern California.

20%

The percentage of diesel trains around the world that will be replaced by hydrogen models by 2050, or approximately 28,000 locomotives, according to the Hydrogen Council.

STILL

A forklift driver fills up with hydrogen in a Carrefour warehouse located in Vendin-le-Vieil (Pas de Calais). The forklift in question, manufactured by German company STILL, is equipped with a fuel cell designed by the American company Plug Power.

FORKLIFTS MOVE UP WITH HYDROGEN

In warehouses, hydrogen-powered forklifts perform better than their battery-powered counterparts. Here's why.

BY BERTRAND BEAUTÉ

This certainly isn't the most attention-grabbing use of hydrogen. But unlike the auto industry (in which sales of fuel cell vehicles remain low), the hydrogen-powered forklift sector is already highly industrialised: more than 25,000 forklifts are powered by hydrogen and carry goods throughout US warehouses, compared to approximately 300 in Europe.

Most companies that have stocks of goods, such as Amazon, Ikea, Walmart and Coca-Cola, are in the process of adopting hydrogen-powered forklifts. In Europe, retail giant Carrefour deployed 137 fuel-cell forklifts in 2018 at its Vendin-le-Vieil (Pas-de-Calais) location, the largest fleet in use in Europe. Hydrogen technology is becoming more popular because it has significant advantages over fuel-powered forklifts and electric battery forklifts.

"With hydrogen, charging time is only a few minutes"

Daniel Hissel, a professor specialising in hydrogen at the Belfort FEMTO-ST Institute

"In places like warehouses, it is becoming increasingly difficult to use petrol-powered pallet forklifts," said Daniel Hissel, a professor specialising in hydrogen at the Belfort FEMTO-ST Institute and co-founder of the start-up H2SYS. "In fact, due to health concerns, it is no longer acceptable for employees to breathe in fine particles from petrol all day long."

As a result, companies are gradually converting to electric battery-powered forklifts, which currently make up nearly 50% of the global market. But battery-powered technology is not ideal for the intense usage required in warehouses. "These forklifts have an approximately eight-hour charging time, which requires companies to maintain twice as many machines," said Hissel. "While half of the machines are charging, the other half are in use. With hydrogen, charging time is only a few minutes."

Despite a higher purchase price, hydrogen-powered forklifts are therefore competitive compared to their battery-powered counterparts, because hydrogen power allows companies to get rid of their charging room and avoid short-term machine rentals during high levels of activity (sales, holidays, Black Friday). Another advantage is that companies that install a hydrogen recharging station in a warehouse to charge forklifts can also use it to charge delivery lorries. Carrefour, which will receive its first fuel-cell lorry, hopes to take advantage of this ecosystem.

Most forklift manufacturers, such as Japanese group Toyota, US company Crown and German brand STILL (a subsidiary of Kion group), now offer hydrogen models. Toyota Industries, the primary manufacturer of forklifts, has even implemented a complete solution called "SimpleFuel". In service since April 2019 at its Motomachi location in Japan, the SimpleFuel system consists of solar panels installed on the roof, which supply a compact electrolyser that converts water into hydrogen and compresses it at 350 bar. This system, developed by companies Ivys Energy Solutions, McPhy and PDC Machines, can supply enough hydrogen for a fleet of seven to eight forklifts.

$45 BN

The value of the global forklift market in 2019. This number is expected to reach $81.39 billion by 2027.

A HYDROGEN TOWN EMERGES FROM FUKUSHIMA

The largest green hydrogen plant in the world was opened in March 2020 in a place that experienced the most serious nuclear accident in history. This is not a coincidence.

BY STANISLAS CAVALIER

7 March 2020. In a highly symbolic move, the Japanese government opened the Fukushima Hydrogen Energy Research Field (FH2R) — the largest green hydrogen plant in the world — almost nine years to the day after the Fukushima nuclear disaster. The FH2R is located in Namie, just a few kilometres away from the Fukushima Daiichi power plant. Once home to more than 20,000 people, Namie became a ghost town, with residents fleeing in 2011 due to radioactive fallout. Access restrictions to the town were lifted in 2017 and residents are starting to return. The opening of the FH2R is one of the signs of this renewal.

Japanese Prime Minister Shinzo Abe at the inauguration of the Hydrogen Energy Research Field (FH2R) in Namie on 7 March.

KYODO / NEWSCOM

"Namie has suffered due to nuclear energy," said Naka Shimiyu, the town's head of industry promotion in a *Wall Street Journal* article. "Today, Namie is using renewable energy to get back on its feet." And so the atom is replaced by solar and wind energy. The prefecture of Fukushima expects to meet 65% of its energy needs via renewable energy in 2030 and 100% by 2040. The problem, particularly with solar panels, is that they are not reliable, as it is impossible to produce enough electricity on sunless days.

This is where the Fukushima Hydrogen Energy Research Field comes in. Comprising a 180,000 m² solar plant linked to a 10 megawatt electrolyser, the research centre will be able to test the mass production of green hydrogen under real conditions. The plant can generate 1,200 m³ of hydrogen per hour, or approximately 100 kg, making it the largest facility of this type in the world according to Toshiba, which is participating in the project.

Some of the gas produced will be stored on site to meet electrical demand during consumption peaks, thus resolving the problem of unpredictable solar panels. The rest of the gas will be transported by truck to the Tokyo area to supply filling stations for hydrogen-powered buses, trucks and cars, as well as industries. With the FH2R, Japan is pursuing its 2017 plan of making the archipelago a "hydrogen society". ◢

x 56

The increase in Japan's hydrogen market by 2030, reaching 3.7 billion Swiss francs, according to a study conducted in 2019 by Fuji Keizai, an information services firm.

HOUSES POWERED BY HYDROGEN

The Col du Palet mountain refuge in the French Alps has become energy self-sufficient thanks to hydrogen. The solution is ideal for generating energy in isolated regions, as well as in more populous locations.

BY BERTRAND BEAUTÉ

Connecting to the energy grid is no easy task at an altitude of 2,587 metres. The Col du Palet mountain refuge, located in the Vanoise National Park, uses solar panels for its energy needs. But while creating plenty of energy in the summer, when demand is low, the panels generate less energy in the winter, when demand is higher. To supplement its resources, the refuge, like many high-altitude mountain lodges, used a diesel-powered electric generator. But all that changed in 2015, when, in a revolutionary move, a hydrogen production station was installed.

Concretely, when the building has low demand for electricity, photovoltaic panels supply energy to an electrolyser that produces hydrogen from water. The gas is then stored in tanks. During certain times of the year when solar energy is low, a fuel-cell battery converts the stored hydrogen into the electricity needed. The entire process is automatic. With the installation of the system, the Col du Palet hut has become completely energy self-sufficient and no longer needs the polluting generator. Before the hydrogen battery was installed, the electric energy produced by solar panels could only be stored for three days. As a result, more than 50% of the electricity produced annually by the solar panels could not be used by Col du Palet. Now, the energy can be stored for several months.

Refuge du Col du Palet

"Hydrogen technology is a very appealing solution for truly isolated areas, such as high-altitude cabins and islands," explained Daniel Hissel, a professor specialising in hydrogen. "Many locations that lacked electricity because they were unable to connect to the grid can now become energy self-sufficient." Building on the Col du Palet experience, the same solution was implemented to supply electricity to an isolated hamlet in the Cirque de Mafate area of Réunion Island. In Switzerland, the Dix Hut, located 2,928 metres above sea level in the depths of Dix Valley, was hoping to switch to hydrogen in 2017. But the project never materialised.

In addition to mountains and isolated locations, hydrogen technology can be installed in many buildings, including in densely populated cities. One such city is Tokyo, where an increasing number of new homes are equipped with the ENE-FARM hydrogen system. This system dispenses with the need for photovoltaic panels. Instead, hydrogen is supplied to the building via the city's gas network. The fuel-cell batteries used in the ENE-FARM system, developed by Panasonic, then convert this gas into electricity and hot water for dwellings. This is a way for Japan to reduce its imports of gas, oil and coal, while simultaneously avoiding the use of nuclear energy. ◢

305,000

The number of Japanese houses equipped with the ENE-FARM system, which produces electricity and heat from hydrogen, as of May 2019.

ON BOARD AN AIR-PURIFYING SUV

HYUNDAI

MOTOR:
FRONT ELECTRIC, POWERED BY A HYDROGEN FUEL CELL
POWER:
120 KW (163 HP), 395 NM
ACCELERATION:
FROM 0 TO 100 KM/H IN 9.2 S
PRICE:
FROM CHF 89,900.-

With the Nexo, Hyundai sets its sights on using hydrogen to power cars designed for the general public. Is that a wise choice? Here are our thoughts after a week of test driving the Nexo on Swiss roads.

BY BERTRAND BEAUTÉ

Which information should we trust: the on-board computer or the technical specs written by the manufacturer? As we started our test drive of the Hyundai Nexo, this was the big question. On a full tank, the instrument panel said we had a range of 570 km. The tech specs said 666 km. The difference may seem trivial, but it's actually not. We had planned a drive from Dietlikon to Geneva and back, which is a 600 km trip. With a petrol car, this would be no problem. We would just stop at any petrol station. But the Nexo, on the market since 2018, is not just any car. Equipped with a fuel-cell battery, it runs on hydrogen – a fuel that is available at only two public filling stations in Switzerland: one in St. Gallen and the other in Hunzenschwil. As we set off on our journey, we were very uncertain: would we make it back to Dietlikon? Who knows?

From the outside, the Nexo's exterior looks like any other car. At 4.67 m long and weighing almost two tonnes, or the equivalent of an Audi Q5, this crossover has the style of a modern SUV. But of course, the most interesting part is what is under the bonnet. Like Teslas, the main component is an electric motor. But instead of batteries powering the motor, the power comes from a fuel cell: the electric current is produced by a chemical reaction between the hydrogen in the tanks and oxygen from the air. The car emits zero emissions and the exhaust pipe expels only water.

But let's get back to our test drive. We press the start button and… nothing. The only way to know that the car is ready to drive is through an LED, because the engine is so silent. We lightly press the accelerator and the two-tonne vehicle rolls along the tarmac. Inside the car, we can hear a low noise. Designed for pedestrians, this signature noise disappears when the Nexo reaches speeds of over 30 km/h. Once on the motorway, we pick up speed. The permanent-magnet motor, which has the equivalent of 163 hp, is immediately able to handle our quick accelerations. Settled into our comfortable "vegan leather" seats – as the Nexo is environmentally-friendly in all aspects – we get the impression that we're driving the car of the future.

400 M

The number of hydrogen-powered cars on the road by 2050, according to the Hydrogen Council. In 2019, there were approximately 7,500 hydrogen cars sold globally, including 4,818 Hyundai Nexos, 2,407 Toyota Mirais, and 349 Honda Claritys, according to figures from EV Sales.

Three hundred kilometres later, we reach Geneva and are pleasantly surprised: the gauge indicates that we still have a range of 350 km left. Now that we know we can make it back to Dietlikon, we relax and test the Nexo on smaller roads. Unsurprisingly, the consumption increases rapidly with a bit of sporty driving and we can feel the extreme flexibility of the shock absorbers. The Nexo is not a sports car and you can tell. You need to drive casually in eco mode.

If you want to flatter yourself, you can consult the data available on the dashboard: during the trip, we purified more than 150,000 litres of air rather than polluted them, thanks to the fuel cell filter that eliminates 99.9% of microparticles, according to the manufacturer. The return to Dietlikon was quite pleasant. Driving green does wonders for your soul. As we arrive in Solothurn, the dashboard tells us that a hydrogen filling station is nearby and that we should fill up.

So we go to the Coop service station in Hunzenschwil. After quickly reading the instructions, we take the pump and plug it into the car. Hydrogen is a voluminous gas: you need 11 m^3, or the size of the boot of a utility vehicle, to store 1 kg of hydrogen at atmospheric pressure. To resolve this problem, hydrogen manufacturers have adopted a standard: high-pressure storage (700 bars in cars, 350 for lorries). But even at that pressure, hydrogen still takes up a lot of room. The Nexo has three reservoirs for a total capacity of 156.6 litres, capable of storing 6.33 kg of H_2. Comparatively, the tank of an Audi Q5 can only hold 75 litres. Luckily, the Nexo was designed from the very start to be a hydrogen-powered vehicle and Hyundai placed the tanks under the car so that they don't take up too much room in the passenger compartment.

Filling up with hydrogen requires a special touch that we do not have

But let's get back to the pump. The display, which indicates the volume of hydrogen supplied in kg, ticks up for a few seconds and then stops. Inside the car, the dashboard gives us more information: the tanks are still empty. We tried again and still nothing… Despite multiple attempts and a half-hour of annoyance, we are unable to fill the vehicle. But right at the moment where we feel like smashing the Nexo with the pump, a Hyundai Xcient Fuel Cell lorry arrives at the filling station. It was extraordinarily lucky timing: there are only about 10 of these lorries currently driving in Switzerland (see also p. 38). The sympathetic driver gives us a hand. And like magic, he succeeds on the first try. The tank fills up in just a few minutes, compared to the minimum 15 minutes it takes to recharge only 270 km of a Tesla Model Y using a supercharger.

The price was 10 Swiss francs per kilo of hydrogen – and one kilo equals 100 km. Comparatively, an Audi Q5 uses between 6.3 and 6.9 litres of petrol to travel 100 km according to the manufacturer, which would come out at about 10 francs as well.

To be honest, we still don't know what we were doing wrong with the hydrogen pump. But it seems that filling up a hydrogen-powered car requires a special touch that we do not have. That said, we were rather won over by the Nexo. Enough to spend 89,900 Swiss francs? No. The lack of hydrogen fuel stations makes this vehicle unusable for the general public. At least for the time being. To develop the network, Hyundai is using a cluster strategy. That means that every time a company converts to hydrogen, it will open a pump that can also be used by the public. In Geneva, for example, a station will open in late 2020 to supply the fuel-cell lorry used by the Migros chain.

In the meantime, the Nexo is primarily used in captive fleets (companies, taxis, government) that never travel far from the few available stations. In Zurich, for example, the cantonal police have been using two Nexos since May. And the company Airport Taxi Zurich has 10. In short, Nexo is a bit too far ahead of its time. But what a pleasure to drive!

"2020 IS A TURNING POINT FOR HYDROGEN"

Oil and gas giants are now investing in the growing hydrogen market. We interview Oliver Bishop, general manager of Shell Hydrogen, a subsidiary of the Anglo-Dutch group.

BY BERTRAND BEAUTÉ

Oil giants are breaking into the hydrogen industry. Total and Shell, in particular, are opening charging stations at their respective petrol stations, and the heavyweights are also planning to produce hydrogen themselves. Oliver Bishop, general manager of Shell Hydrogen, a subsidiary of the Anglo-Dutch group, answered questions from *Swissquote Magazine*.

Why are oil giants increasingly interested in hydrogen?

At Shell, we think that this type of energy has enormous potential and that it will play an increasingly important role over the next decade in markets such as Germany, the UK, Benelux, the United States, Japan and Switzerland.

Why do you think that?

The world is in a situation where demand for energy is increasing, but at the same time, greenhouse gas emissions need to be reduced in order to comply with the objectives of the Paris Agreement. That means that we need low-carbon fuel sources. Given that, I think that hydrogen will play a major role, whether in the form of green hydrogen, produced using renewable energy, or in the form of blue hydrogen, produced from methane with the carbon emissions captured and stored underground (see inset on p. 33).

This isn't the first time that hydrogen has been heralded as the clean energy of the future. Why do you think this time is different?

There's finally a real sense of enthusiasm about the industry. Thanks to political support, scale up and substantial cost reduction, hydrogen is becoming a viable alternative to fossil fuels. In recent weeks, we saw the European Union adopt an enormous bill in favour of hydrogen, and many countries, including Germany, China and Australia, have done the same. These investment plans will help hydrogen overcome the initial hurdle, in exactly the same way that solar and wind energy were supported for several decades before reaching the point they are at today. I am convinced that 2020 is a turning point for hydrogen.

SHELL

"The technology to produce green hydrogen is operational but costs need to continue to fall"

Oliver Bishop, general manager of Shell Hydrogen

Battery-powered electric cars are a growing success. What can hydrogen bring to the mobility sector?

Battery-powered vehicles have a big role to play, but when you need high energy density, the size of the batteries become a major obstacle due to their heavy weight. I think that we'll see hydrogen play an increasingly significant role in heavy duty transport such as buses, trucks, trains, ships and ferries, and in the longer term possibly even aviation. I would also not rule out hydrogen in larger passenger vehicles such as SUVs or specific fleet applications where you need short recharge times or long ranges. Hydrogen refuelling for passenger cars can be done in 3 minutes, similar to gasoline or diesel refuelling. Today, you can buy a hydrogen fuel cell electric car and drive the length and breadth of Germany – there are almost 90 stations there. You can see that also in Switzerland the industry has opened hydrogen stations and more are in the works.

And what about in industry?

Hydrogen is relevant to a wide range of industries. It could, for example, replace coal in the blast furnaces used to produce steel, or replace the fossil fuels used to make cement. The chemicals sector, which already uses grey hydrogen produced from gas, would also benefit from converting to a carbon-free hydrogen. Fertiliser production is one of the largest consumers of fossil-based hydrogen today, so a logical step will be to use renewable hydrogen.

What is Shell's strategy with regards to hydrogen?

We're aiming to supply both blue and green hydrogen products in line with market demand. We see opportunities across the entire hydrogen supply chain, including production, storage, and shipping of hydrogen, as well as sales to end clients.

Blue hydrogen is controversial because it is produced from fossil fuels... Why not focus solely on green hydrogen?

That's the long-term goal, but transitioning to green hydrogen via blue hydrogen will allow the industry to lower its production costs and ensure green hydrogen can compete with other energies more quickly.

When will green hydrogen become competitive?

Hydrogen as an industry is still in its early stages, and even though production costs have dropped significantly over the last decade, the production of green hydrogen is still relatively expensive compared to existing alternatives (ed. note: two to three times more expensive than the grey hydrogen usually used by industry). The technology to produce green hydrogen is operational but costs need to continue to fall. According to the latest estimates, green hydrogen will be able to compete with methane by the end of this decade.

Do you have landmark projects in the works for green hydrogen?

In February, we announced the launch of a feasibility study for the NorthH2 project, located in northern Netherlands, alongside our partners Gasunie and Groningen Seaports. It's a very large wind farm in the North Sea that is able to reach a capacity of approximately 10 gigawatts. The first turbines are expected in 2027 and will be used to produce green hydrogen. If this project comes to fruition, the hydrogen produced by NorthH2 will be used primarily to supply the industrial sector. This sector already consumes large quantities of hydrogen, but the hydrogen is currently produced from natural gas. NorthH2 could produce approximately 800,000 tonnes per year by 2040, which would avoid the release of approximately seven megatonnes of CO_2 per year.

OIL COMPANIES ON THE LOOKOUT

Will hydrogen be the perfect wild card for oil groups? If you need a little convincing to believe it, just look at the list of member companies that are part of the Hydrogen Council, the global industrial alliance to promote hydrogen technology. BP, Royal Dutch Shell, Total and even Saudi Aramco: all the big names in black gold are taking part. Why? The official word is that they want to promote a gas that can reduce greenhouse gas emissions. Unofficially, hydrogen has some serious advantages – enough to win over the oil and gas industry. Firstly, these companies are well acquainted with hydrogen, which is already used in oil refining. Secondly, unlike battery solutions, hydrogen would allow these giants to ensure the continued existence of their pipeline networks, which could supply hydrogen in gaseous form to fuel stations. Finally, oil companies support a transition period during which blue hydrogen, produced from gas, will develop before making way for green hydrogen. This is a way to preserve their business against all odds.

THESE COMPANIES ARE GASSED UP AND READY TO GO

Hydrogen producers, electrolyser and fuel-cell manufacturers, energy utilities, automotive and rail manufacturers... The hydrogen market is attracting quite a range of companies. Overview.

BY BERTRAND BEAUTÉ

NIKOLA

A prototype of the Nikola Two hydrogen lorry made its first commercial delivery of Budweiser beer in St. Louis in November 2019. Mass production of this HGV is not expected to begin until 2023.

FOUNDED	2014
HEADQUARTERS	PHOENIX (US)
EMPLOYEES	300
2019 REVENUE	$0
	NKLA

NIKOLA
THE TESLA OF LORRIES

American engineer Nikola Tesla, who invented the alternating current and died in 1943, certainly could never have imagined that he would become a market favourite more than 70 years after his death. But now his name describes a famous brand of battery-powered electric cars. His first name, Nikola, is also quite popular on Wall Street these days.

Created only six years ago, US start-up Nikola Corporation develops hydrogen-powered electric lorries. It went public on 4 June via its merger with VectoIQ, which has been on the NASDAQ since 2018. It was a stunning debut. Five days after the IPO, on 9 June Nikola's capitalisation exceeded 34 billion, which was more than Ford's capitalisation (30 billion), before falling to 13 billion currently.

Nikola already has 14,000 pre-orders for its hydrogen lorries

This valuation is even more impressive considering that the company has never sold a single lorry. Nikola is garnering keen interest because it produces hydrogen-powered vehicles and many observers think it will be the future Tesla. However, the Phoenix-based start-up has adopted a strategy that is very different from its prestigious competitor.

Whereas Tesla and its ebullient CEO Elon Musk have always taken pride in doing everything themselves, Nikola works with many partnerships. For the fuel cells that will power its vehicles, Nikola's supplier is German group Bosch, which has been a stakeholder in Nikola since 2019. For electrolysers, which produce the hydrogen that will be supplied to filling stations, the start-up announced on 3 June that it had placed an order with Norwegian group NEL (see also p. 52). And for the body of its lorries, Nikola has partnered with Italian holding company CNH, which is both a stakeholder in Nikola and the owner of the brand Iveco.

Another notable difference is that Nikola isn't exclusive. While the start-up is primarily focused on hydrogen, it also develops battery-powered electric models. The Nikola Tre, which is actually a re-branded Iveco lorry, will run on batteries, while the company's two other articulated lorries (Nikola One and Nikola Two) will be hydrogen-powered.

The start-up confirmed that it already has 14,000 pre-orders for its hydrogen lorries – equating to approximately $10 billion in revenue. US beer giant Anheuser-Busch has ordered 800 of them. But these models won't be available until 2023. Nikola's catalogue also includes the Badger, a hydrogen-powered pickup. This could irritate Elon Musk, who also has a pickup in the works – the Cybertruck with a futuristic design – and an articulated lorry named "Semi", and both are battery-powered vehicles. In June, the Tesla CEO told his teams to accelerate the development of the Semi, which is expected to be available in 2021. But the competition doesn't come solely from Tesla: Toyota and Hyundai, two hydrogen pioneers, are ahead of the game.

OTHER COMPANIES TO WATCH

ALSTOM
THE RAIL PIONEER

In 2016, at the InnoTrans conference in Berlin, Alstom presented the world's first hydrogen-powered train. Named the Coradia iLint, it began commercial service in Germany in 2018.

FOUNDED: 1928
HEADQUARTERS: SAINT-OUEN-SUR-SEINE (FR)
EMPLOYEES: 35,000
2020 REVENUE: €8.2 BILLION
ALO

PLASTIC OMNIUM
THE STORAGE TANK

The French automobile manufacturer has invested more than 200 million in hydrogen technology over the past four years. Now the results are in: in 2019, the company won its first order, selling 5,000 hydrogen storage tanks to a German manufacturer to power their buses.

FOUNDED: 1946
HEADQUARTERS: LYON (FR)
EMPLOYEES: 32,000
2019 REVENUE: €9.2 BILLION
POM

AIR PRODUCTS
THE GLOBAL LEADER

The largest supplier of hydrogen in the world, the US industrial gas specialist Air Products is currently producing what is essentially grey hydrogen.

FOUNDED: 1940
HEADQUARTERS: ALLENTOWN (US)
EMPLOYEES: 17,000
2019 REVENUE: $8.92 BILLION
APD

ABB
THE SHIPPING ADVENTURE

In April 2020, the Swiss giant signed a partnership with Bordeaux group Hydrogène de France to jointly produce fuel-cell systems based on technology from Canadian group Ballard that could be used to supply ships.

FOUNDED: 1988
HEADQUARTERS: ZURICH (CH)
EMPLOYEES: 144,400
2019 REVENUE: $27.98 BILLION
ABB

FOUNDED
1927

HEADQUARTERS
OSLO (NO)

EMPLOYEES
273

2019 REVENUE
$63.3 MILLION

NEL

The Nel hydrogen station manufacturing plant in Notodden, Norway.

NEL HYDROGEN
THE EXPLOSIVE NORWEGIAN COMPANY

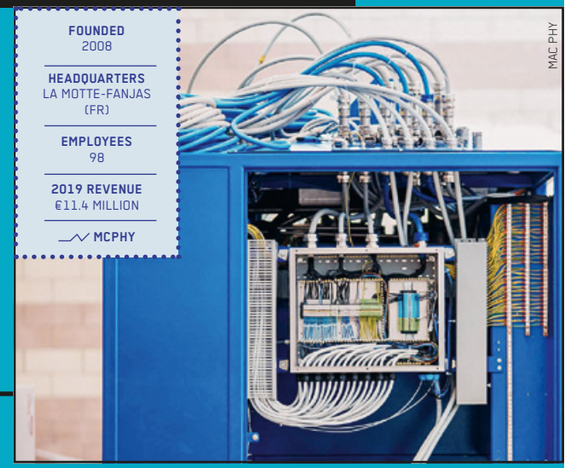
As Tesla once did, US start-up Nikola wants to develop its own network of hydrogen stations to support sales of its fuel-cell lorries (see also p. 50). The plan is an ambitious one: Nikola plans to build 700 filling stations in the United States and Canada by 2028, as well as about 50 in Europe. To achieve this, the start-up ordered 85 electrolysers from Norwegian company Nel Hydrogen in June 2020. Together, these machines will be able to produce 40,000 kilogrammes of hydrogen per year, given that, currently, a 40-tonne lorry uses between 9 and 10 kg of hydrogen to travel 100 kilometres. Currently, more than 3,500 Nel electrolysers are used around the world. The company also sells storage systems and vehicle charging stations. On 10 June 2019, a Nel filling station in Sandvika, near Oslo, exploded due to faulty assembly of a storage tank.

More than 3,500 Nel electrolysers are used around the world

The incident, which resulted in no casualties, caused the share price to drop 20% on the Oslo exchange and forced the company to ask its clients to close their filling stations during the investigations, particularly in Germany and the United States.

But that unfortunate period is now in the past. Driven by massive pro-hydrogen government programmes, Nel's share price has skyrocketed nearly 110% since the start of the year. "Several European companies such as Nel Hydrogen, McPhy Energy and ITM Power are in the race to be the leader of the electrolyser market," said Xavier Regnard, analyst for the bank Bryan, Garnier & Co. "But for now, it's hard to say who will win."

MCPHY
THE FRENCH START-UP



FOUNDED
2008

HEADQUARTERS
LA MOTTE-FANJAS (FR)

EMPLOYEES
98

2019 REVENUE
€11.4 MILLION

MCPHY

A McPhy electrolyser.

Created in 2008 and publicly listed since 2014, McPhy Energy is one of France's hydrogen pioneers. Initially focused on gas storage systems, the company diversified to include electrolysers (machines that can produce hydrogen), by acquiring Italian firm Piel in 2013, as well as hydrogen fuelling stations for vehicles.

McPhy installed a 2-megawatt (MW) electrolyser in Laage, Germany. Inaugurated in June 2020 and powered by renewable energy, this electrolyser can produce 300 tonnes of hydrogen per year without generating any CO_2 emissions. The hydrogen will be used to supply electricity and heat to the headquarters of the company Apex Energy and to a shopping area.

But McPhy is thinking even bigger, hoping to build 20 MW or even 100 MW electrolysers that have a higher capacity and can therefore reduce the costs of producing green hydrogen. In January 2020, chemical company Nouryon (formerly AkzoNobel) and gas firm Gasunie ordered a 20 MW hydrogen production platform from McPhy. This will be the largest of its kind in Europe and will be used in a factory in the Netherlands. Moreover, the two Dutch partners are already considering expanding the production power to 60 MW.

This is certainly a big order for McPhy, which continues to sign new contracts. On 30 July 2020 for example, the company announced that it will develop hydrogen infrastructure for the city of Dijon, France. Buses and refuse lorries will soon be hydrogen-powered. A few days later, on 3 August, a non-disclosed client purchased two McPhy hydrogen fuelling stations and a 1 MW electrolyser.

Certainly enough business to attract investors. Since the start of the year, McPhy's share price has increased nearly 490%. "McPhy is one of the best-positioned companies on the market to benefit from the hydrogen paradigm shift," said Xavier Regnard, analyst at Bryan, Garnier & Co. "The company can also count on support from energy giant EDF, which became its primary shareholder in 2018."

THE MICHELIN MAN IS FILLED WITH H2

Leading tyre company Michelin announced in November 2019 that it was partnering with Faurecia to create Symbio. This co-enterprise hopes to develop, produce and commercialise fuel cells for both light vehicles and heavy goods lorries. The ambitious French duo hopes to gain 25% of the global market and generate approximately €1.5 billion in revenue in 2030.

FOUNDED: 1889
HEADQUARTERS: CLERMONT-FERRAND (FR)
EMPLOYEES: 121,300
2019 REVENUE: €24.13 BILLION
ML

FAURECIA PARTNERING WITH HYUNDAI

In February 2020, the French automotive supplier announced that it had won the bid to supply Hyundai with 10,000 hydrogen tanks. These will be used to equip the 1,600 lorries that Hyundai will deliver to Switzerland by 2025 (see also p. 38).

FOUNDED: 1997
HEADQUARTERS: NANTERRE (FR)
EMPLOYEES: 115,500
2019 REVENUE: €17.77 BILLION
EO

PLUG POWER LIFTING UP AMAZON

Specialising in fuel cells, US company Plug Power is diversifying to control the entire hydrogen value chain. In June 2020, Plug Power announced it was acquiring two companies in the industry: United Hydrogen and Giner ELX. The first produces 6.4 tonnes of hydrogen per day and the second manufactures electrolysers. Plug Power's fuel cells power the forklifts for giants such as Carrefour, Walmart and Amazon.

FOUNDED: 1997
HEADQUARTERS: LATHAM (US)
EMPLOYEES: 835
2019 REVENUE: $230.2 MILLION
PLUG

TOYOTA,
THE PERSEVERING PIONEER

Postponed due to the pandemic, the 2020 Tokyo Olympic Games would have been quite the event to showcase Toyota's hydrogen technology. As the official partner of the event, the Japanese group provided the organisers with 500 Mirais – its fuel-cell car – to transport athletes. It was also supplying 100 hydrogen Sora buses, which have been on the market since 2018, to transport spectators around Tokyo.

Toyota has been a believer in hydrogen for a long time. While all the global manufacturers were focused on battery-powered electric cars, the Japanese company still does not have any lithium-ion powered models in its catalogue. Instead, the company prefers to develop hybrid models (petrol engine with an electric motor and supplemental batteries) and focus on hydrogen. In 2014, Toyota launched its Mirai (meaning "future" in Japanese). This was one of the first mass-produced fuel-cell vehicles sold in the world (along with the Honda Clarity and the Hyundai iX35). Six years later, only 10,000 Mirais have been sold. Comparatively, Tesla sold 367,500 vehicles in 2019 alone. But despite the low sales, Toyota isn't giving up.

Toyota wants to be able to produce 30,000 Mirai 2s per year after 2020

During the 2019 Tokyo Motor Show, the Japanese giant unveiled the Mirai 2, which will be available on the market by late 2020 in Japan and from 2021 in Europe. The group is currently increasing its production capacities to be able to produce 30,000 models per year after 2020, which is 10 times more than it produces now. Another model is also expected under Toyota's Nexus brand, as well as a large goods vehicle.

Toyota can promote this hydrogen-powered range during the 2024 Paris Olympic Games. For the event, the Japanese group will provide organisers with 3,000 hydrogen cars and 1,200 hydrogen buses. "The idea is to show that hydrogen can be a part of everyday life, and people will remember that from the Olympics," explained Yasunobu Seki, head of Toyota's Olympic projects department, a few months ago.

FOUNDED 1937
HEADQUARTERS TOYOTA CITY (JP)
EMPLOYEES 359,542
2019 REVENUE $274.5 BILLION
7203

Presented at the Los Angeles Auto Show in November 2019, the Mirai 2 will be available in 2021 in Europe. Currently, the manufacturer has not disclosed the technical specifications or the price.

FREDERIC J. BROWN / AFP

BOSCH

FOUNDED 2008
HEADQUARTERS GÖTEBORG (SE)
EMPLOYEES 48
2019 REVENUE $7.67 MILLION
PCELL

PowerCell and Bosch will build fuel cells together.

POWERCELL
THE SWEDISH OUTSIDER

The year 2019 will certainly be remembered as a turning point for fuel-cell specialist PowerCell. In May, the small Swedish company announced an agreement with German giant Bosch to develop polymer electrolyte membrane (PEM) fuel-cell batteries, which will be on the market no later than 2022. With this partnership, Bosch is entering the market for mobile fuel cells designed for lorries, buses and personal vehicles.

This is a very significant matter for the German supplier. In 2017, Bosch abandoned all work on developing battery cells for electric vehicles, due to its insurmountable lag behind the competition. To recover, the German company is betting on hydrogen – a turning point marked by the acquisition of an 11.3% stake in PowerCell in 2019.

For PowerCell, which has never turned a profit since it was founded, now is the perfect occasion to increase its volume. Thus far, the Swedish company has only supplied its technology for use in prototypes of cars and lorries. But Bosch is targeting the mass market. "Commercialising technology is one of our strengths. We are now going to take on this task with determination and develop this market," said Stefan Hartung, member of the Bosch board of management, in a statement. According to estimates from Bosch, up to 20% of all electric vehicles around the world will be powered by fuel cells by 2030, which could mean potentially several billion euros in revenue.

"With the combined weight of its clout and expertise, Bosch will provide our fuel-cell technology with the chance to gain a foothold in the automotive market," said Per Wassén, CEO of PowerCell, in a statement. "We couldn't imagine a better partner than Bosch for this." Most analysts recommend holding shares of PowerCell, which has already increased more than 60% since the start of 2020.

CUMMINS
THE CONVERTED MOTORIST

Known for its diesel engines, US firm Cummins acquired Canadian company Hydrogenics (which specialises in electrolysers and fuel cells) in 2019 for $290 million. In 2020, Cummins also increased its stake in Loop Energy, a Canadian manufacturer of fuel cells designed for lorries and buses.

FOUNDED: 1919
HEADQUARTERS: COLUMBUS (US)
EMPLOYEES: 61,600
2019 REVENUE: $23.6 BILLION
CMI

LINDE
THE GERMAN GAS GIANT

A competitor of Air Liquide and Air Products, the German giant has produced hydrogen since 1910, primarily to supply the chemical, metallurgical and petrochemical industries. Linde also produces charging stations for fuel-cell vehicles.

FOUNDED: 1879
HEADQUARTERS: GUILDFORD (UK)
EMPLOYEES: 79,886
2019 REVENUE: $28.2 BILLION
LIN

ITM POWER
THE BRITISH CONTENDER

A competitor of French company McPhy and Norwegian firm Nel, the UK start-up ITM Power produces electrolysers. Its share price has increased nearly 220% since the start of the year.

FOUNDED: 2011
HEADQUARTERS: SHEFFIELD (UK)
EMPLOYEES: 139
2019 REVENUE: £4.6 MILLION
ITM

STADLER
H_2 FOR RAILWAYS

In November 2019, the Swiss rolling stock manufacturer won a bid to deliver a hydrogen-powered train. This first model will begin service in California in 2024.

FOUNDED: 1942
HEADQUARTERS: BUSSNANG (CH)
EMPLOYEES: 10,918
2019 REVENUE: 3.2 BILLION SWISS FRANCS
SRAIL

CERES POWER
HYDROGEN FOR YOUR HOME

The UK company produces solid oxide fuel cells (SOFC) designed to supply electricity and heating to buildings. German group Bosch holds an 18% stake in the company.

FOUNDED: 2001
HEADQUARTERS: LONDON (UK)
EMPLOYEES: 240
2019 REVENUE: €16.4 MILLION
CWR

AIR LIQUIDE
THE GAS GIANT

With its blue hydrogen approach, the global leader in industrial gas hopes to decarbonise its hydrogen production. The company also builds hydrogen filling stations for vehicles around the world.

FOUNDED: 1902
HEADQUARTERS: PARIS (FR)
EMPLOYEES: 67,200
2019 REVENUE: €21.9 BILLION
AI

WEICHAI POWER
THE AMBITIOUS CHINESE COMPANY

In 2020, the diesel engine manufacturer inaugurated the world's largest fuel cell production site in Shandong, with a capacity of 20,000 units per year. A vast majority of the production will be used to equip buses.

FOUNDED: 2002
HEADQUARTERS: WEIFANG (CN)
EMPLOYEES: 42,000
2019 REVENUE: $25.23 BILLION
000338

HYUNDAI
THE KOREAN LEADER

With its Nexo SUV and XCient Fuel Cell HGV, Hyundai Motor Company is the first manufacturer to market a vehicle for the general public and an HGV that both run on hydrogen (see also p. 38 and 46).

FOUNDED: 1967
HEADQUARTERS: SEOUL (KR)
EMPLOYEES: 120,000
2019 REVENUE: $89.2 BILLION
005380

Ballard's factory in British Columbia.

BLOOMBERG / CONTRIBUTEUR

FOUNDED
1979

HEADQUARTERS
BURNABY (CA)

EMPLOYEES
700

2019 REVENUE
$106.327 MILLION

BLDP

BALLARD
THE BATTERY KING

Often presented as the global leader in fuel-cell batteries even though that claim cannot be verified, Canadian company Ballard is undoubtedly one of the pioneers of this technology. Originally created in 1979 to develop lithium-ion batteries, the company converted to hydrogen as early as 1983. Its past has given Ballard quite a bit more experience than its competitors. Ballard produces fuel-cell batteries that are used in hydrogen-powered buses, cars, trams, forklifts and even drones.

Currently, more than 760 buses equipped with Ballard technologies have been sold around the world, for a total of 20 million kilometres travelled. For example, hydrogen-powered buses from Belgian manufacturer Van Hool use fuel cells made by the Canadian firm, and the buses are used in London (UK), Pau (France), Aberdeen (Scotland), and Cologne (Germany). Very present in the gigantic Chinese market, Ballard also supplies batteries for the buses that travel between Foshan and Yunfu, but also for more than 500 lorries in Shanghai and for the first hydrogen-powered tramway in the world, developed by Chinese manufacturer CRRC.

Over 760 buses equipped with Ballard technologies have been sold around the world

Unlike many newcomers to the hydrogen market, Ballard is not in the red, with profits of $22.6 million in 2019. Most analysts recommend purchasing shares even though the price has already gone up significantly this year, with a more than 90% increase since 1 January.

The surprising market for "humanised mice"

The coronavirus epidemic has highlighted an obscure sector: the genetically modified mouse industry. We interview Alexandre Fraichard, CEO of genOway, one of the rare public companies active in this field.

BY BERTRAND BEAUTÉ

GENOWAY

At the start of the pandemic, while many countries were experiencing shortages of masks, screening tests and respirators, a different – and less public – shortage was affecting the scientific community: the lack of laboratory mice on which to test medicines and vaccines in the fight against coronavirus. But we're not talking about just any kind of mice. These types of experiments require mice that are genetically engineered to resemble humans. Alexandre Fraichard, co-founder and CEO of genOway, a French company that specialises in producing transgenic mice, explains further.

Why do we need genetically modified mice to test coronavirus treatments and vaccines? Can't we just use wild animals?

In their natural state, mice cannot be infected by the SARS-CoV-2 coronavirus, because they do not have the hACE2 receptor, which is the entry point where this type of virus enters human cells. And if the mice don't get sick, it's difficult to test the efficacy of potential treatments or vaccines on them. To solve this problem, we need to "humanise" the mice by modifying their genetic code to add the entry point for the virus, which is the gene for the hACE2 receptor.

Mice of this kind have been around for about a decade. In 2007, Dr Paul McCray of the University of Iowa produced a line of mice with hACE2 receptors. Though this type of mouse hadn't been used since, it was cryopreserved by the Jackson Laboratory. Before using the mice, we had to thaw the embryos in order to produce a new line of mice. But large-scale reproduction of these animals does take time. The Jackson Laboratory was only able to start delivering hACE2 mice to laboratories in June.

So is the shortage of transgenic mice to test coronavirus treatments over?

No, because there's another problem: the entry point of the virus wasn't put in place correctly, which means that the existing model of mice develops very different complications to those that are observed in humans, particularly cerebral pathologies rather than pulmonary issues. So we need to produce new mice that mimic the human situation more closely. Like other laboratories, genOway is currently working to develop such a model.

"We began a catalogue sales model in 2017"

When will it be ready?

During a pandemic, there is very strong pressure from the media to have everything ready right away. I understand the urgency of the situation, but creating the right model of transgenic mice takes time. We need 12 to 18 months. As I've said before, we'll be ready next spring.

Won't that be too late, given that potential vaccines are advancing so quickly (see also p. 66)?

No. When a vaccine is available on the market, and assuming that it's effective, there will still be many things about coronavirus that we need to understand, particularly the mechanics of the disease and the immune system's response. I'm not worried, because many laboratories will need our models to conduct this essential research, even if a vaccine is available beforehand. Furthermore, our models can be used for SARS-CoV-2 research, but also for work on other types of respiratory viruses. ▷

Alexandre Fraichard, who received a doctorate in cellular and molecular biology from the École normale supérieure de Lyon in 1997, and an MBA from HEC Paris in 1999, co-founded genOway in 1999.

GENOWAY

FOUNDED
1999

HEADQUARTERS
LYON (FRANCE)

EMPLOYEES
100

2019 REVENUE
€ 9.5 MILLION

ALGEN

Infectious disease seems to be an interesting market for your business. What percentage of your revenue comes from fighting viruses?

Almost none. Until the current pandemic, there was no market – infectious diseases are somewhat neglected compared to scientific research and public health policy. But I think that will change. In recent years, we've seen several successive epidemics, with SARS, H1N1 flu, Ebola and now COVID. All stakeholders now understand that only a research strategy conducted over the long term can prevent these health crises. That leads to an upturn in infectious disease research, which will induce higher demand for our genetically modified mice in order to mimic the human immune response to infections. So infectious diseases will become one of our primary markets, alongside immuno-oncology and inflammation.

How much does a genetically modified mouse cost?

Creating a bespoke mouse for a client costs between €50,000 and €150,000. Initially, that was our business model: companies would come to us to produce a line of mice with a particular modification in their genome. The client would then become the exclusive user of the mice that we made for them. But these very specific mice are difficult to sell, because development takes a long time. Only companies that are truly focused on ground-breaking innovation buy these mice.

That's why, in addition to our original business model, we began a catalogue sales model in 2017. With the catalogue approach, we choose which type of mice we will develop in partnership with a consortium of leading companies such as AbbVie, AstraZeneca, BMS, Pfizer and Roche, and then anyone can order the mice. Obviously, these models are not as expensive: catalogue mice are priced at around €100 each, and you often need hundreds of mice to conduct a research project successfully. But the main advantage for our clients isn't the price, but the deadline. Developing a bespoke mouse takes 12 to 18 months, whereas the catalogue models are available right away. Our goal is that by the end of 2021, we will have a full catalogue of about 40 immuno-oncology research models.

From an economic perspective, the catalogue models also have the advantage of being infinitely marketable, and can therefore generate significant margins once their development is complete. With this new business model, we're hoping to triple our revenue by 2024 to reach more than €30 million, compared to €9.5 million in 2019.

Who are your primary clients?

We mainly work with the pharmaceutical industry, biotechnology firms and academic laboratories. Of the 20 largest pharmaceutical companies in the world, 17 are genOway clients, including Roche, Pfizer and AstraZeneca. We generate 60% of our revenue in the United States and the rest in Europe and Asia.

What is the size of the global market for transgenic mice?

That hasn't really been studied. According to estimates, the global market for laboratory animals, of which 98% are rodents, is worth $3 to $5 billion per year. Transgenic animals only account for a low percentage of that total, probably around 10%. So it's a niche market, but it is growing extremely quickly.

Who are your main competitors?

There aren't that many, because in this market, companies really need to understand the needs of the pharmaceutical industry. Some academic laboratories develop their own models of mice, but they don't have the capacity to produce them on an industrial scale. As for big pharma, producing genetically modified animals isn't their job or their priority. They prefer to subcontract that work. So our primary competitors are indirect. They are mainly the large traditional laboratory animal breeders, such as the Jackson Laboratory and Charles River, which both have catalogues of modified mice, but the majority of their sales come from natural lines or older transgenic models. There are also a few CROs (contract research organisations) such as Biocytogen and Crown Biosciences. These companies supply services to the pharmaceutical industry and have developed a few models of genetically modified mice alongside their main business activities.

More and more people are raising their voices against animal testing. Are you concerned that the backlash will hurt your business?

Currently, cell- and computer-based testing cannot replace in vivo testing. Researchers who test on animals don't do so for fun – they do so because there is no other option. It's often the case that certain tests stop being conducted on animals and are instead conducted on cells. That happens when there is sufficient knowledge to allow the testing to be simplified to a cellular model. But it's impossible to stop testing on animals altogether for SARS-CoV-2 research, because this is a new disease and there's not a lot of information out there.

That said, I agree: we need to reduce the number of mice used in laboratories, according to the 3R rule (replacement, reduction, refinement). In this context, genetically modified animals are the guinea pig of choice, because if you use a model that is closer to human genetics, it will be more indicative of the actual human experience and as a result, you'll need fewer animals to run your tests. That's the trend we're seeing in the market: as the number of animals used in laboratories is trending downwards, the number of genetically modified animals is increasing significantly. Over the next five years, we're expecting an increase in our sales, with an average yearly growth of 25% to 35% over the 2020–2024 period. ◢

DIFFERENT TYPES OF MUTANT MICE

On 29 July, Moderna announced that its experimental vaccine shows promising results in monkeys. While monkeys and other animals, such as hamsters and ferrets, are being infected with SARS-CoV-2, there are a few advantages to using mice: they are small in size, can reproduce quickly and don't require costly infrastructure. Many teams are now working on developing genetically modified mice that can contract coronavirus. "But there are different types of these mice," warned Patrick Nef, former professor at UNIGE and founder of TransCure bioServices. At genOway, scientists use the CRISPR-Cas9 technique, which can add, remove or modify genes in mice DNA. For COVID-19, the technique can add the entry point for the virus. TransCure uses a different approach. It tests on immunodeficient mice, or mice that do not have an immune system. Human stem cells are injected into the bone marrow of the immunodeficient mice. The stem cells then differentiate to form a complete human immune system. These chimeric mice are a tool of choice to observe the human immune response.

In June, genOway announced the construction of a new laboratory to meet the growing demand. Here, an employee in the company's laboratory in Lyon.

GENOWAY

GETTY IMAGES

WAREHOUSES: THE SHOWPIECE OF E-COMMERCE

The e-commerce boom breathes new life into the goods storage industry. This significant trend is beneficial to real estate and logistics giants.

BY JULIE ZAUGG

The Ravenside Retail Park, located in the outer suburbs of London, occupies a surface area of nearly 12,000 sq. metres. It is home to many shops that sell furniture, mobile telephone accessories and home improvement supplies. But Ravenside is no longer bustling with people, and as a result, several shops are now closed, reflecting decreased appeal among Britons for brick-and-mortar shops. ▷

COMPANIES TO WATCH

PROLOGIS
THE KING OF INDUSTRIAL BROWNFIELD SITES

The company, created in 2011 from the merger between real estate groups Amb and Prologis, keeps purchasing more land on the edge of major cities to build warehouses. Prologis now has 3,840 locations in 19 countries, leased to more than 5,000 clients, including Amazon. In 2019, revenue grew 18.8%. Prologis benefited from the e-commerce boom during the COVID-19 epidemic; e-commerce now makes up 40% of its warehouse space, compared to 20% before the crisis. Most analysts recommend purchasing shares.

FOUNDED: 1983
HEADQUARTERS: SAN FRANCISCO (US)
EMPLOYEES: 1,700
2019 REVENUE: $3.3 BILLION
PLD

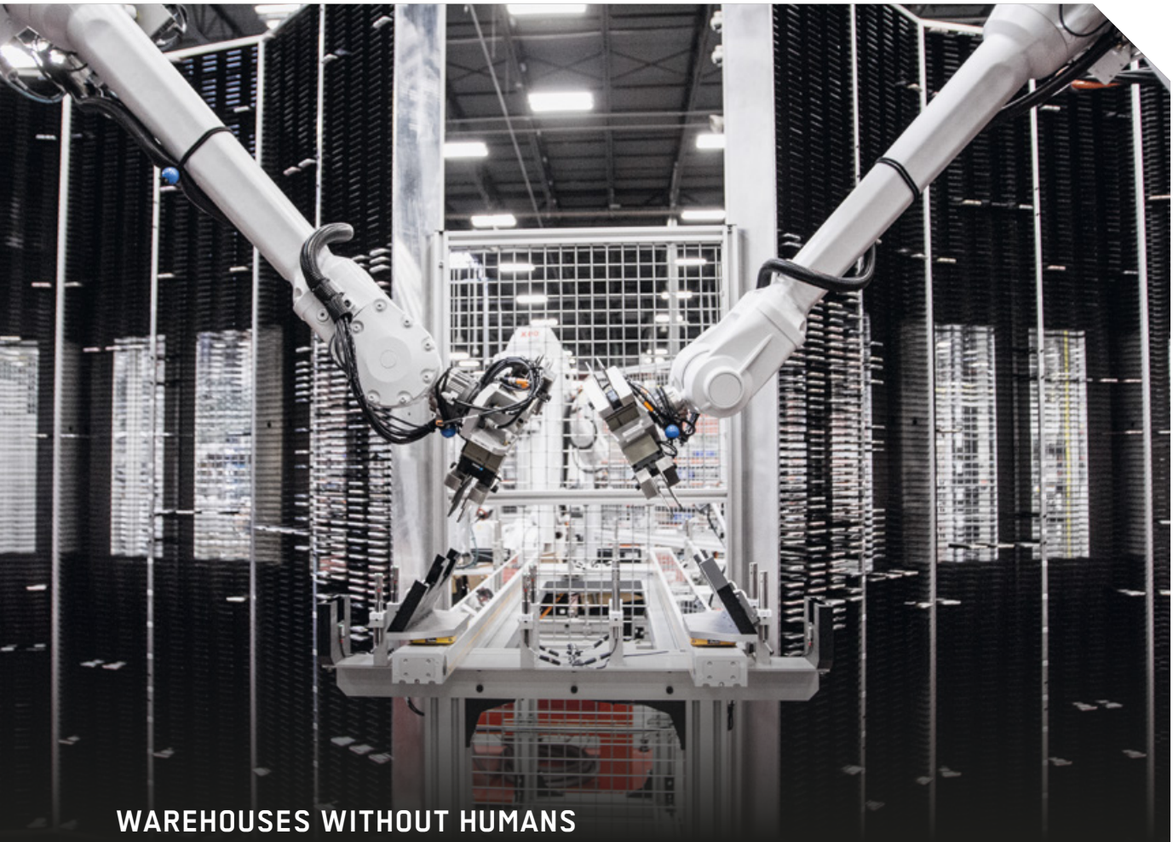
DHL
THE FREIGHT GIANT

The subsidiary of Deutsche Post generated 30%-40% of its revenue thanks to e-commerce. While warehouses aren't its primary business focus, it is a strategic area. "DHL pivoted, to offer end-to-end solutions to its clients," said David Kerstens, analyst at Jefferies, who recommends purchasing shares. Another advantage is that the company has invested heavily in automating its warehouses.

FOUNDED: 1969
HEADQUARTERS: BONN (DE)
EMPLOYEES: 380,000
2019 REVENUE: € 63.3 BILLION
DPW

A sign of the times, Ravenside was acquired in January for €51.4 million by Prologis, a real estate company based in San Francisco, which decided to transform the site into a giant e-commerce warehouse. Prologis, founded in 1983 by Iranian entrepreneur Hamid Moghadam, is an expert in this type of conversion. Its portfolio of warehouses is spread over 93 million sq. metres, more than 1.5 times the size of Manhattan, making Prologis the largest lessor of warehouses in the world.

In recent years, with the growth of e-commerce, the storage industry has become more significant. In the United States, there were 18,742 warehouses in 2019, up 24% from 2010. In India, the total surface area of warehouses in the country grew from 1.3 million to 3.7 million sq. metres between 2016 and 2019, which is an increase of 185%. "The COVID-19 pandemic has accelerated this trend even more, as many brands closed during quarantine and customers did not shop in physical locations because they were scared of contracting the virus," said David Kerstens, analyst at Jefferies.



XPO

WAREHOUSES WITHOUT HUMANS

"Now we have robots that can take goods off pallets, transport them and package them, eliminating the need for a human presence in warehouses," explained Sean Culey, expert in automated supply chains. These solutions have been adopted by most of the large warehouse chains, notably DHL, which was a pioneer.

The lack of humans means that space for humans to walk between the aisles is no longer necessary, and goods can be placed beyond where humans can reach on their own or with a forklift. "Warehouses can stack boxes up to the ceiling, which saves precious square metres," said Culey. Automation also increases speed.

There are some middle-ground approaches, such as equipping workers with an exoskeleton to help them lift heavier objects or providing augmented reality glasses, which can help workers visualise the contents of an order and determine where the items are located in the warehouse.

Modern warehouses are also equipped with sensors that can analyse in real time the amount of stock available and where it is located in the warehouse. They can then order additional stock if the product is running low, based on artificial intelligence software that can anticipate demand. "Inventory can be completed by a fleet of interior drones," said Culey.

Investment funds are not the only companies benefiting from this trend. Several players in the logistics segment also manage a network of warehouses as part of their freight operations. Their business model is slightly different, because these companies also offer a service to transport goods. Among logistics companies, "DHL is the leader with a 6% market share and 2,000 locations across 50 countries," said Kerstens. It is followed by US-based XPO Logistics and Swiss group Kuehne+Nagel. Logistics is an industry that benefits big players operating on a global scale. "Companies need to be able to invest large amounts of money upstream to purchase or let storage spaces and equip them with storage material," said Michael Field, analyst at Morningstar.

Some of these mega warehouses cover nearly 100,000 sq. metres

Logistics companies also have the advantage of offering end-to-end solutions. "Clients enjoy being able to have access to a network of warehouses on five continents, along with the ability to transport by air, land and sea," said Field. Companies that choose to externalise their entire logistics chain rarely turn back, according to the analyst.

While the explosion of e-commerce has increased demand for storing goods, it has also forced warehouse owners to reconsider the size and location of their warehouses. "Goods sold online are first funnelled into gigantic e-fulfilment centres located far from large cities," explained David Schoch, research director at CBRE. "From there, the goods are transferred to distribution centres located in the suburbs of large cities, in order to minimise last mile delivery costs."

So companies need large warehouses far from cities, as well as smaller closer locations. Eastern Europe and the US Midwest are emerging as hubs for the larger warehouses, due to the low cost of industrial real estate in those regions. Some of these mega warehouses cover nearly 100,000 sq. metres.

Fast processing times for orders (to appease customers who expect to receive their goods bought online in just a few days, or even in less than 24 hours) and the capacity to manage a significant amount of returns have become essential conditions in this industry. As a result, warehouse specialists have been forced to equip their locations with state-of-the-art technologies to automate order monitoring, optimise inventory management and predict when to re-order certain products that are running low (see inset on p. 64).

Despite their dominant position, warehouse operators still have competition. "Most of the major e-commerce platforms, such as Amazon in the United States, Zalando in Europe, and Alibaba and JD.com in China, have begun operating their own warehouse networks," said Schoch. Many of these e-commerce giants even aim to offer logistics solutions from one end of the supply chain to the other. Amazon already has a service of this type in the United States, and plans to offer it in the UK shortly.

But logistics companies still have a bright future ahead. According to Michael Field, e-commerce also includes a multitude of smaller players that could never do without the major warehouse operators. A majority of XPO Logistics' 50,000 clients are SMEs and start-ups that don't have the means to create their own logistics chain. ◢

COMPANIES TO WATCH

XPO
THE LOGISTICS CHAMPION

XPO Logistics manages the supply chains of 50,000 clients, operating 1,504 locations in 30 countries. The company expanded via a series of acquisitions between 2012 and 2015, all in the logistics segment. The share price increased by 1,000% between 2011 and 2019, making it one of the best performing companies on the Fortune 500 index. But David Kerstens, analyst at Jefferies, believes that XPO Logistics is under-valued and recommends purchasing shares.

FOUNDED: 1989
HEADQUARTERS: GREENWICH (US)
EMPLOYEES: 100,000
2019 REVENUE: $16.65 BILLION
XPO

KUEHNE+NAGEL
THE HIGH-END SWISS COMPANY

Founded in 1890 in Bremen, Kuehne+Nagel has a global freight network used by 400,000 clients. "Its warehouse solutions, which make up approximately 25% of its revenue, are an essential part of its offer," said Marco Strittmatter, analyst at ZKB. To improve its margins, the company seeks to specialise in storing pharmaceutical products, which require high-tech solutions such as maintaining the products at a certain temperature, explained Strittmatter, who gave the company a "Market Perform" rating.

FOUNDED: 1890
HEADQUARTERS: SCHINDELLEGI (CH)
EMPLOYEES: 80,000
2019 REVENUE: CHF 21.1 BILLION
KNIN

MODERNA SEEKS A MIRACLE VACCINE

The US biotech firm has received promising results from tests of its experimental SARS-COV-2 vaccine. But the company, which has generated both hope and dollars, still has everything to prove.

BY ANGÉLIQUE MOUNIER-KUHN

Fast, very fast. With a multitude of clinical trials in progress, the coronavirus pandemic has created a frenetic race for a vaccine. As of 31 July, 165 laboratories were on the hunt for the Holy Grail vaccine, according to the World Health Organization (WHO). One of these is Moderna Therapeutics, which seems to have taken the lead. After China published the genetic code of the coronavirus on 11 January, it took the American biotech firm only 42 days to create an experimental vaccine (mRNA-1273) and 62 days to start a phase I clinical trial. This is an unprecedented timeline in the pharmaceutical industry. And that's not all: if the next results are positive, Moderna expects to supply 500 million or even 1 billion doses per year as early as 2021, only one year after the start of the global health crisis. In comparison, it took five years to develop the rVSV-ZEBOV Ebola vaccine.

Moderna is able to move so quickly because it is using messenger RNA (mRNA), a first-of-its-kind technology in the vaccine world. Only Moderna and German companies BioNTech and CureVac are pioneering this technology. "We call messenger RNA the software of life. Your body is actually producing the vaccine," Stéphane Bancel, the newsworthy CEO of Moderna, likes to say. But the reality is a bit more complex.

Traditionally, vaccines are made from inactivated viruses that are injected to provoke a response from the immune system. Moderna's vaccine uses a different approach: instead of injecting an entire virus, the vaccine contains only a piece of the virus's genetic code in the form of messenger RNA. This molecule will prompt the cells in the body to produce a viral protein. The immune system is expected to then detect this protein and create antibodies that will protect a person if they contract the virus. According to Bancel, this technique has the advantage of being quicker and less expensive than traditional methods. But there is a but: messenger RNA technology has never been used to put a drug on the market. It remains experimental.

However, on 2 March 2020, Moderna CEO Bancel did not hesitate to confirm, in front of US President Donald Trump, that the vaccine would be ready in a few months. Comparatively, other more conservative industry leaders are expecting years of lead time. This bold statement has put Moderna in the global spotlight. Since then, every time the company issues a press release, Wall Street goes crazy. Its market capitalisation has increased four-fold since the start of the year, approaching $30 billion.

Industry disruption

From a scientific perspective, Moderna is advancing quickly. On 27 July, the company began phase III clinical trials for the vaccine, the last step before commercialisation. In the coming months, mRNA-1273 will be tested against a placebo on nearly 30,000 American volunteers. But other vaccines have made similar progress, particularly those from Chinese companies Sinopharm and Sinovac, which began their phase III trials before Moderna. The Pfizer/BioNTech partnership, which also uses mRNA technology, launched its phase III trial on 27 July, the same day as Moderna. Faced with this avalanche of trials, on 3 August Director-General of the WHO Tedros Adhanom Ghebreyesus called for caution: "There is no panacea and there may never be. Clinical trials give us hope. But that doesn't necessarily mean that we will have a vaccine."

mRNA made in Switzerland

For Moderna, success is a challenge that goes beyond the pandemic. "Until January, mRNA technology was still just a concept," said Martial Descoutures, analyst at ODDO BHF. "If the coronavirus vaccine is proven to be safe, Moderna will have the first proof of its technology's efficacy. This would give credibility to its entire portfolio of molecules in development. And most importantly, mRNA could revolutionise pharmaceuticals and lead to a third class of drugs that are able to target very varied pathologies that are hard to treat." If Moderna is successful, "the disruption could affect the entire biopharmaceutical industry", said JP Morgan in a recent report.

To succeed in this endeavour, Moderna can count on support from the US government. The company is one of five vaccine candidates that won financing from the Biomedical Advanced Research and Development Authority (BARDA) as part of "Operation Warp Speed" initiated by the White House. This operation supports the production of more than 300 million doses of a vaccine by January 2021. This public contribution is worth nearly $1 billion to Moderna.

In Basel, at the headquarters of Lonza, Moderna's advances are being closely monitored. Under an agreement signed on 1 May, the Swiss firm will produce the active ingredients of the vaccine, the mRNA, by mobilising up to four production lines: one in a factory in Portsmouth, New Hampshire, and three at the Visp site in the canton of Valais. "We have already begun producing small quantities on the production line in Portsmouth, where we are recruiting 70 people and investing 70 million Swiss francs," said Sanna Fowler, spokesperson for Lonza. Large-scale production is expected to begin as early as September, which is before the real efficacy of the vaccine is known.

Given the still-unanswered questions about mRNA technology, this haste seems bold. "We have evaluated the risks, and we are committed because we believe that this technology is promising," said Fowler. A view shared by the Confederation. On 7 August, the Federal Office of Public Health (OFSP) announced that it had entered into a contract with Moderna to purchase 4.5 million doses.

ANALYST ADVICE

AN ALREADY WELL-VALUED SHARE

JP Morgan is one of the first banks to dare to downgrade Moderna shares, albeit modestly, which are still popular among many analysts. "We are downgrading shares to neutral, following an increase of 385% since the start of the year (against +19.5% for the NASDAQ Biotechnology Index (NBI)), and 572% over the last 12 months," explained the bank in a note dated 20 July, in which the price target was set to $89. "To be clear, this is not a call on any sort of diminished expectations around the company or mRNA-1273 (the COVID-19 vaccine); we remain bullish on Moderna's long-term outlook (...) But we are simply unable to continue to fundamentally justify the shares." In addition to its COVID-19 vaccine, Moderna has two dozen programmes in its pipeline. One of its more advanced products, a cytomegalovirus vaccine, is only in phase II trials and is not expected to be ready for another three or four years. MRNA

GOLD CERTIFICATE: GOLD BECOMES MORE ATTRACTIVE

Invest in gold and generate passive income.
This is the concept behind Swissquote's Gold Active Certificate.

swissquote.com/gold

In these uncertain times for the markets, many investors are investing part of their portfolio in the "king of safe-haven investments". But rather than investing solely in ETFs, whose value simply tracks fluctuations in the price of gold, the Swissquote Gold Active Certificate offers a proactive and dynamic way to invest in gold over the long term.

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TO READ, TO DOWNLOAD

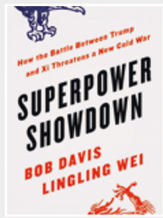
University of North Carolina Press, 2019
CHF 25.-

RACE FOR PROFIT

HOW BANKS AND THE REAL ESTATE INDUSTRY UNDERMINED BLACK HOMEOWNERSHIP

By Keeanga-Yamahtta Taylor

In 2016, the average income of Black households in the United States was $17,600, compared to $171,000 for white families. To better understand the reasons behind this disparity, Keeanga-Yamahtta Taylor, assistant professor of African-American studies at Princeton University, describes in *Race for Profit* the complicated history of home ownership access for Black families in the US, including official exclusion policies and implicit discrimination that is still present today. This timely book sheds a harsh light on racial inequality in the United States, a topic that has not been widely studied until now.



HarperCollins Publishers, 2020
CHF 30.-

SUPERPOWER SHOWDOWN

HOW THE BATTLE BETWEEN TRUMP AND XI THREATENS A NEW COLD WAR

By Bob Davis and Lingling Wei

In *Superpower Showdown,* two *Wall Street Journal* reporters describe the US-China trade war from within the two countries. This war began long before Donald Trump, though the superpowers' recent history laid the groundwork for this unprecedented confrontation. Having on-the-ground knowledge, the authors interviewed numerous decision makers from both sides. This book helps readers understand the rivalry between the nations and prepare for the next steps in this contemporary conflict.

App Store, Google Play, Free, in-app purchases

PHOTOROOM

PHOTOS WITH NO BACKGROUND

This is not just another Instagram filter app. PhotoRoom has just one basic feature, but it's very in-demand: removing or replacing the background in photos. This is ideal if you're taking pictures of items on a white background to try to sell online, or if you want to live out a tropical dream with palm trees behind you as you sit at your desk.

Google Play, App Store, Free

OPERA TOUCH

OPERA FIGHTS BACK

A long-time holdout in the browser wars, Opera has now released a faster version that is optimised for mobile navigation. During our test run, Opera Touch was powerful, quick, and very ergonomic. With this app, Opera will continue the fight against its eternal competitors, Chrome and Firefox.

App Store, Google Play, Free

TATTOODO

GOOGLE FOR TATTOOS

This is the app the tattoo world was waiting for. Tattoodo is a cross between a search engine and a social network. It is a database of tattoos where users can post their own designs or find inspiration for a new tattoo.

App Store, Google Play, Free

JQBX

LISTEN TO MUSIC WITH OTHERS

Listening to music is great, but listening with friends is even better. With JQBX, you can create or join rooms in which users can be a DJ and share their thoughts about the music in a dedicated chat channel. The only downside to this lovely app: you need to already have a Spotify account to use JQBX.

SWISSQUOTE SEPTEMBER 2020

ISTOCK

ISTOCK

TRAVEL

Tbilisi by day and by night

The capital of Georgia offers a variety of atmospheres for visitors. Our columnist rather enjoyed it!

BY SALOMÉ KINER

When you arrive at the Tbilisi airport, Georgian customs authorities will flip through and stamp your passport with the same seriousness as every customs agent in the world. They maintain their stone-faced composure as they give you back your documents – along with a bottle of red wine as a welcome gift. This surprising and delightful gesture is a perfect example of the Georgian spirit: Georgians are proud of their country, generous to a fault, and do not compromise when it comes to their fundamental values. Often conquered but never docile, Tbilisi is full of history and treasures its multicultural past. But the city, home to one and a half million people, is reborn at nightfall when the new wave of Georgians spills out onto the streets.

You'll find a Londonesque ambiance at La Fabrica, a former textile plant transformed into an urban artistic complex

SHUTTERSTOCK

CHARMING GEORGIAN FOLKLORE

A cross between martial arts, classical ballet and wedding parades, traditional Georgian dances spread the country's folklore around the world. Check out these three national companies: the bold Sukhishvili, where women dance in men's roles; Erisioni, which has a polyphonic choir; and the Rustavi troupe, whose dancers wear exquisite costumes. For a complete experience, the Georgian Dance Club offers beginner's courses.

Reserve via WhatsApp on +995 599 00 20 88

To truly understand this cultural, urban and social revolution, one must start with Tbilisi's past. First, visit the Narikala fortress, which was erected in the fourth century and is therefore older than the city itself. But the ruins of this secular fortress, built to monitor the Silk Road from above, aren't the only reason to ascend the hill. Located on one of Mount Sololaki's cliffs, the fortress offers a spectacular panorama of the Kura river, the two banks of the city, and Tbilisi's intricate neighbourhoods dotted with church steeples. You can travel on foot, starting in the old town and climbing a steep path through the forest, or take the cable car. The cable car drops you off at the entrance to a restaurant where you can taste the best ponchiki (sweet fried doughnuts) and wash it down with a tarragon lemonade, two specialities of Georgian cuisine.

As you descend the hill, you will pass botanical gardens and a path that leads to the Central Mosque, which is not far from the Grand Synagogue. This proximity demonstrates that Tbilisi is a crossroads of culture. Surrounded by its gigantic neighbours Russia, Turkey, Iran and Azerbaijan, and between the Orthodox world (it's a cradle of Christianity) and the Muslim world, Tbilisi has carefully chosen the very best qualities of both its European neighbours and Eastern cousins.

The architecture in the Dzveli Kalaki neighbourhood is proof of this, with traditional wooden houses that have been patched up countless times; swaying balconies sculpted like works of art; street vendors, old women wearing head scarves in front of their dried fruit stalls; the vestiges of caravan stopovers; and the Sioni Cathedral (built in the seventh century), the former residence of the Georgian patriarch. For a complete experience, take a detour to the Art Palace, which celebrates monuments of Georgian music and visual arts through time.

When you head back through the tiny streets of the old town, you will see cupolas made of light brick, which almost look like a cross between the trulli of Puglia and an onion dome. These domes are home to the famous Sulphur Baths, a local speciality (Tbilisi got its name from its thermal springs: "tbili" means warm) that you really must visit. The experience is quite unique. The gruff-looking employees, the odour of rotten eggs and the vigorous massages are all part of the adventure. Recently restored, the Chreli Abano is an ideal spot to try out this invigorating tradition.

With smooth skin and a refreshed spirit, you'll leave the baths and set off to discover the other side of Tbilisi, which is still in its early stages but already legendary. After the fall of the Soviet Union and the presidency of Mikheil Saakashvili, the younger generations are now keen to create an alternative cultural scene, taking cues from its European big sisters. You'll find a London-esque ambiance at La Fabrica, a former textile plant transformed into an urban artistic complex, complete with street art frescoes, shops owned by local creators, modern cafés, a hostel and a co-working space.

Nearby, Shavi Lomi is a popular restaurant among young people, serving excellent food and beer. In good weather, sit outside on a wooden deck chair in the garden-patio. Under its vaulted roof, the inside of the restaurant feels like a cosy home, with its frayed rugs, soft lighting and generous servings. An ode to delicious – often vegetarian – Georgian cuisine and a plethora of beverages. Night owls must visit Bassiani, a techno club located in the basement of the municipal football stadium with a former pool re-imagined as a dance floor.

GETTING THERE

The best time to visit is from April to October, but avoid July and August because of extreme heat. Flights depart from Zurich and Geneva with a stopover in Istanbul. Starting at 250 Swiss francs per person.

WHERE TO STAY

Rooms Hotel Tbilisi is a superb industrial-chic hotel in a former printing shop. Starting at 120 Swiss francs per night.

LGBTQ communities often gather here for a taste of freedom that's still too rare in public, making this avant-garde spot a symbol of the duality in Georgia and a society split between conservative powers and progressive activism. If you prefer twilight and catching a few hours of sleep instead, have a drink at other open-minded bars such as Cafe Gallery, Mozaika, or Success Bar. Or try Sky Bar, which isn't ground-breaking but does offer a panoramic view of Tbilisi under the stars.

SHUTTERSTOCK

AUTO

HONDA E

ENGINE:
REAR ELECTRIC, 35.5-KW LI-IONS BATTERY
POWER:
113 KW (154 HP), 315 NM
ACCELERATION:
0 TO 100 KM/H IN 8.1 S
PRICE:
FROM CHF 43,100.-

Masks off!

BY RAPHAËL LEUBA

Is it a boulevard bandit or city avenger? Behind the black stripe along the headlights hides a rather powerful small electric Honda. It takes away in one hand but gives back so much in the other.

We were anxiously awaiting this Honda e! Unveiled as a concept in autumn 2017, it was predicted to be a kind of "GTI for modern times", that is, a small electric sport car that offers a bit of passion in the strict world of green mobility. Testing out the actual model in place, in post-quarantine traffic, was a pleasant surprise, like a panda in the bear pit. Then we realise that the proportions of the car have changed since the original concept. Upgraded from a small stocky coupé, the e has evolved to a higher, more welcoming 5-door model (1.51 m wide and 3.89 m long).

New design

The energy density of current batteries is unable to offer a wide range of action for small-format cars. Therefore a careful design of the practical aspects and comfort is worth the challenge, so that these cars don't fall into the "gadget" vehicle category. Following this logic, the Japanese manufacturer revised its priorities to offer a posh city car that is totally high-tech. With side-view cameras, automatic door handles and a smartphone locking system, the exterior is impressive and foreshadows what's to come. Once inside, you are surrounded by a new design, with a dashboard reminiscent of a school desk plated in imitation pearwood. Above the dashboard are two rear-facing camera screens on either side of a blackboard with three high-resolution digital monitors.

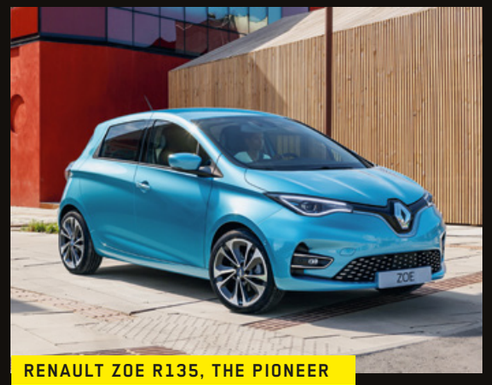
But this desk isn't for algebra or crayons. Instead, pixels galore display any type of information you can imagine: energy flows, destinations and all types of answers from the smart voice assistant "OK Honda". You need a bit of familiarity with touchscreens, but younger generations will love it. There's even an HDMI outlet and 230 V power to plug in a PlayStation. Standard assistance technologies include autonomous driving phases, handy for when you need to use the touchscreen to save your favourite DAB radio stations... One of the vehicle's rare buttons is for automatic parking assist. It's a bit superfluous given that the Japanese car, which is even narrower because it has no wing mirrors, is almost as short as a shopping trolley. The digital central mirror allows drivers to see more clearly, especially at night.

There's even an HDMI outlet and 230 V power to plug in a PlayStation

Powerful motor

The trendy, content, two-zone air conditioning, heated steering wheel and de-icing windscreen are all-high-end creature comforts of the Honda e, which is already impressive just in terms of filtering out motor and road noises. It's just important to remember that the use of all of these electric features does cost you in terms of range, which is the vehicle's Achilles heel if you take many long-distance trips. Heat alone eats up 10% of the range, according to the warning message. In a city-road-motorway mixed-use scenario on varied terrain while respecting limitations, we recorded an average consumption of 17 kWh/100 km, less than the 19 kW/h advertised. However, with a useful battery capacity of slightly less than 35.5 kWh, travelling 200 km without stopping becomes a challenge. It's also frustrating, because the powerful motor stays true to its roots and can make the car go quite fast, with even a sporty performance. The Honda e isn't lightweight (1.5 t) – and is worth its weight in gold (43,100 Swiss francs) – but in return, you get a vigorous 113 kW motor housed between the rear wheels and a perfectly balanced chassis. Our electric Zorro also encourages drivers to play with the paddles to vary the energy recovery and induced slowdown. With a bit of practice, you might even be able to forget the brake pedal... and a more timid competitor!

THE COMPETITION



RENAULT ZOE R135, THE PIONEER

Queen of the market and the new generation with more polished craftsmanship. Front-wheel drive with 135 hp and 245 Nm of torque, weighing in at 1.5 tonnes. This five-seater is larger (4.09 m) and has more storage in the boot than the four-seat Honda e, but it is less agile and a bit slower (0 to 100 km/h in 9.5 s). The 52 kWh battery is designed for weekend excursions, and can also be rented to lower the sale price. This R135 top-range model has fewer options compared to the Honda e, of which the standard model is very well-equipped. CHF 37,700.-

PEUGEOT E-208 GT, LOW-KEY

The electric version of the "2020 car of the year". Five-seat front-drive saloon car, 4.05 m long. Its low silhouette and sporty personalisation in both the interior and exterior partly justify its higher price. With 136 hp and 260 Nm for the 1.5 tonne vehicle, and acceleration to 100 km/h in 8.1 s, there's a 50 kWh battery for a semblance of versatility. Top speed of 150 km/h, slightly less than its competitors. CHF 39,950.-

BOUTIQUE

HARLEY GOES ELECTRIC

Forget everything you thought you knew about Harley-Davidson. The Milwaukee company has started from scratch when designing its first electric motorcycle, a sporty roadster called the "LiveWire". The bike's 105 hp and 116 Nm, available at all times, guarantee explosive acceleration. The electronic components are also high-end. Harley claims the bike's city range is 158 km.

harley-davidson.com/ch

From CHF 36,500.-

A PROJECTOR FOR GAMERS

Optoma hit the nail on the head with its new UHD42 projector, sized for video games. Equipped with a native full HD resolution, it is also capable of simulating a 4K resolution via software processing. The refresh rate in particular reaches 240 Hz, which guarantees an unprecedented sharpness. Note that this frequency doesn't apply to 4K sources, which are limited to 60 Hz. The minimal 15.7 ms input lag (latency time) is also top-of-the-line. Performance in cinema mode is also impressive, with vibrant, correctly-calibrated colours.

optoma.com

From CHF 1,459.-

POLAROID RETURNS AGAIN

Polaroid Originals has created a new instant camera: the Polaroid Now. Along with a colourful pop design, the Now includes autofocus, which was missing from its predecessors. With a flash and timer, the camera can also produce double exposures. The 750 mAh battery will last for 15 packs of eight photos.

polaroid.com

CHF 139.-

POCKET SOMMELIER

MyOenoScan is a scanner that you place in a glass of wine. It tells you more information about the type of wine based on four categories: body, tannins, acidity and development. Drinkers can provide a score for each category to indicate if they enjoy the wine. Over time, the MyOeno app refines its analysis and builds a personalised database that suggests new bottles to try based on the drinker's ratings.

myoeno.com

CHF 79.-

A HI-FI CONNECTED GEM

French brand Cabasse created the Pearl Akoya to compete with Devialet's Phantom Reactor. Don't be fooled by its ultra-compact size (22 cm wide): the Pearl Akoya contains a lot of technology and decibels. This smart speaker, available in shiny black or pearly white, is equipped with its own amplification system that has a total power of 1,050 W RMS. Loads to keep you entertained. Audiophiles will be glad to hear that the sound quality is in line with the brand's reputation. A dedicated stand can be purchased separately. You can also pair two Pearls for stereo sound.

cabasse.com

CHF 1,690.- (per speaker)

WIRELESS HEADPHONES FOR MUSIC LOVERS

Sennheiser headphones enjoy a solid reputation among audiophiles, and the German brand's "Momentum True Wireless 2" wireless smartphone headphones continue this tradition. The audio quality is neutral and balanced, making these headphones a serious alternative to competitor models from Apple and Sony in particular. Active noise cancellation, customisable settings, voice assistant, equalizer... All of the features are top-notch.

sennheiser.com

CHF 349.-

SMART GUITAR

Connected to a tablet or a computer via Bluetooth, the "Jamstik Guitar Trainer", a smart guitar, teaches beginners how to play, acting as a virtual teacher, using optical sensors and a system that detects your finger placement. Players can also use the guitar to record music and enhance the notes with sound effects. It comes with a carrying case and a strip.

jamstik.com

CHF 190.-

SHUTTERSTOCK

TRIED AND TESTED

ANDROID WITHOUT GOOGLE

BY GÉRARD DUCLOS

Swissquote Magazine tried LineageOS, an alternative version of Android without the intrusive Google services.

Two operating systems dominate the smartphone world: Apple iOS and Android, developed by Google. For users concerned with the safety of their personal data, this means choosing which digital giant will end up with your data. Both iOS and Android, installed by default, need permanent access to a lot of your personal data in order to function.

While Apple's system is too locked down to allow for even the slightest modification, Android is the opposite, made up of various configurable layers in which changing the settings can result in very diverse user experiences. The base layer, the Android system, is published open source by Google. It is freely accessible and can be modified by anyone.

It is exactly this versatility that allows users, given certain conditions (such as material compatibility and whether or not the manufacturer locks its telephones), to install "alternative ROMs", or modified versions of Android.

One of these versions is LineageOS, an older ROM that is noteworthy due to the fact that it has removed all Google services that are integrated by default on commercial Android telephones, such as Google Play Store, Google Maps and Google Analytics.

To install, all you need is a compatible device (in our case a Samsung S9). The installation is relatively simple: just download the adequate ROM on the LineageOS site and "flash" it, or copy it, to your telephone. Beware: copying the program will delete any data that is currently on your device!

Once the installation is complete, the smartphone will smoothly restart using the new operating system. Surprisingly, the interface is very high-quality, and upon first glance, LineageOS looks very similar to the classic Android system: language selection, the various settings, sending and receiving SMS, telephone calls and the touch screen... Everything works right away with no issues. The basic installation comes with a few standard applications, such as a camera feature and an app for your contacts.

Of course, it gets more complicated when users want to install their favourite applications, such as WhatsApp or e-banking applications, since the device doesn't have Google Play Store or a linked Google account. While most of the applications available on the Google Play Store can be downloaded directly from the developer or from alternative "stores" such as APKPure or Aurora Store (which downloads directly from Google Play Store, no Google account necessary), the apps will not work if Google services are not installed on the device.

Messaging apps, for example, are constantly communicating with a Google service to activate notifications when the phone is idle. For WhatsApp, the solution is to configure the app so that it is never inactive, which slightly increases battery use. Finally, we recommend looking for alternatives in the free app store F-Droid (available on any version of Android), where certain classic apps such as Telegram are also available.

Despite these few predictable inconveniences, the experience is very positive, to the point where at the end of the test period, we decided not to go back to the commercial version of Android. Please note that for less advanced users, the French foundation /e/ offers reconditioned smartphones that you can buy with their own version of LineageOS pre-installed, also called /e/.

BORN IN LE BRASSUS

AUDEMARS PIGUET
Le Brassus

RAISED AROUND THE WORLD

AUDEMARS PIGUET BOUTIQUES : ZURICH | GENEVA