Investment Recipes

by AtonRā Partners

SPECIAL ISSUE

2020 Review and 2021 Outlook

18 DECEMBER 2020

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On the Menu

2020 Review and 2021 Outlook

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Editorial

The purpose of this special issue of **Investment Recipes** is to recap our investment themes, assess their results, and check if the catalysts we foresaw unfolded as expected or if any adjustment is needed going forward.

Through this document we bring a more global view of the essential objectives underscored throughout our bimonthly and ad-hoc research reports. We believe that this document will also serve as a valuable guide for our customers to review each of the themes they are invested in.

A blessed festive season to all and may the New Year bring good health, happiness and good fortune.

Your AtonRâ Partners Team.

GLOBAL MACRO – IS MONEY STILL WORTH SOMETHING?

2020: A Year Of Superlatives

Global economy lived through unprecedented times

2020 will be remembered by many as a singular year. The global economy broke and distorted every pattern of the business cycle through the shortest but deepest recession in a century.

- GDP fell the most in Q2 (-32%) to recover the most in Q3 (+33%).
- We witnessed the fastest and largest global coordinated monetary and fiscal stimulus, exceeding $11tn globally (G20), but also oil trading at negative prices or U.S. Initial Jobless claims jumping to 30x its average.

Monetary and fiscal policies unite!

All central banks and governments reacted very fast to ease financial conditions, in the first fully coordinated monetary and fiscal intervention on a global scale.

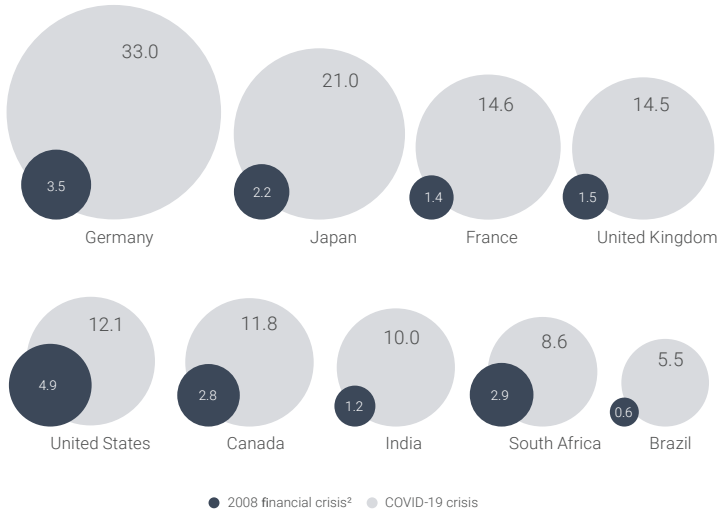
- The FED slashed its rates to zero, restarted QE as well as inundated the globe with USDs to the tune of $3.5tn, while U.S. Congress committed to >$2tn of fiscal stimulus, of which ~$300bn in direct checks to individuals.
- The ECB bought >$1.5tn of assets, on top of individual European member states fiscal plans, and in Japan the stimulus exceeded 20% of GDP.

Not the usual business cycle

The 2020 recession was not a classical credit-driven cycle, but a massive supply shock instantly followed by a massive demand shock.

- It was the largest exogenous shock in modern history, highlighting both the fragility and anti-fragility of many sectors in the economy.
- Everyone was forced to experience first-hand new trends like digitalization, mobile payments, cloud services, e-commerce.

COVID-19 ECONOMIC-STIMULUS RESPONSES OUTSIZE 2008 FINANCIAL CRISIS



Source: McKinsey

¹ 2019 GDP taken into account for values related to COVID-19 crisis.
² Data published by International Monetary Fund in March 2009; includes discretionary measures announced for 2008–10.

Source: Global economic policies and prospects, International Monetary Fund (IMF), March 2009, imf.org; government sources; IHS Markit; IMF; press search; The state of public nances: Outlook and medium-term policies after the 2008 crisis , IMF, March 2009, imf.org

Covid-19 – Impact

The hyper-accelerator effect

The 2020 global pandemic played the role of a hyper-accelerator for many existing or nascent trends. It has exacerbated opposites as well.

- Awareness about the Green Economy, Healthcare systems, IT Technology (Cloud, AI, Automation) and Education.
- Globalization vs. regionalization, old vs. new economy, social and economic inequalities.

Uneven impact, diverse policy response

Populations and businesses were not all affected in the same way. This put the fiscal policy center stage, as it allows for a more tailored response and stimulus.

- Monetary policy tools are designed to impact the economy as a whole, while fiscal policy can potentially differentiate at more granular level, like sectors or even individuals.

Economic inequalities at the forefront

The uneven impact of the crisis has transpired into the job market data. Inequality runs across different social groups and needs careful consideration to avoid potentially explosive situations down the road.

- Employment losses are the largest for the least-educated, the youngest and the lowest-earning cohorts.
- By August, white Americans had recovered more than half of their job losses, while black Americans had barely recovered a third.

Outlook – Global (1/2)

Headlights turning green

Zero interest rates for the foreseeable future, a muted inflation, strong growth (mainly driven by innovation in healthcare and technologies as well as business reopening), combined with common willingness among monetary and fiscal policy-makers to do 'whatever it takes', is the perfect combination for higher equity markets.

- Central Banks have committed to easy money until inflation overshoots – but structural deflationary effects of aging demographic and technological innovation, make an inflation spike in 2021 unlikely.
- Global fiscal policies will continue to remain supportive for the economy.

Covid-19 impact being better integrated

With a vaccine available, political measures will tend to be less coercive than preceding ones, allowing for a better economic recovery.

- The devastated state of certain parts of the economy is the consequence of political measures aimed at sheltering the intensive care units of hospitals.
- Lockdowns mainly affected SMEs which are the core of the real economy.

Vaccine not the panacea

Being able to research, develop, manufacture and deliver a vaccine against a novel virus in a few months is mind blowing. Adoption may be slower than expected.

- It clearly shows the level of innovation that is happening in the healthcare sector.
- Vaccination campaigns are unlikely to be effective before 2H 2021, mostly because of logistic constraints.

Outlook – Global (2/2)

A flood of money

As we wrote, the huge scale of the global fiscal and monetary stimulus implies the risk of unintended side effects. Most notably the erosion of the perception of the value of money and a possible lack of confidence in it.

- Real assets are the only shelter against a de-facto currency devaluation.

Real assets

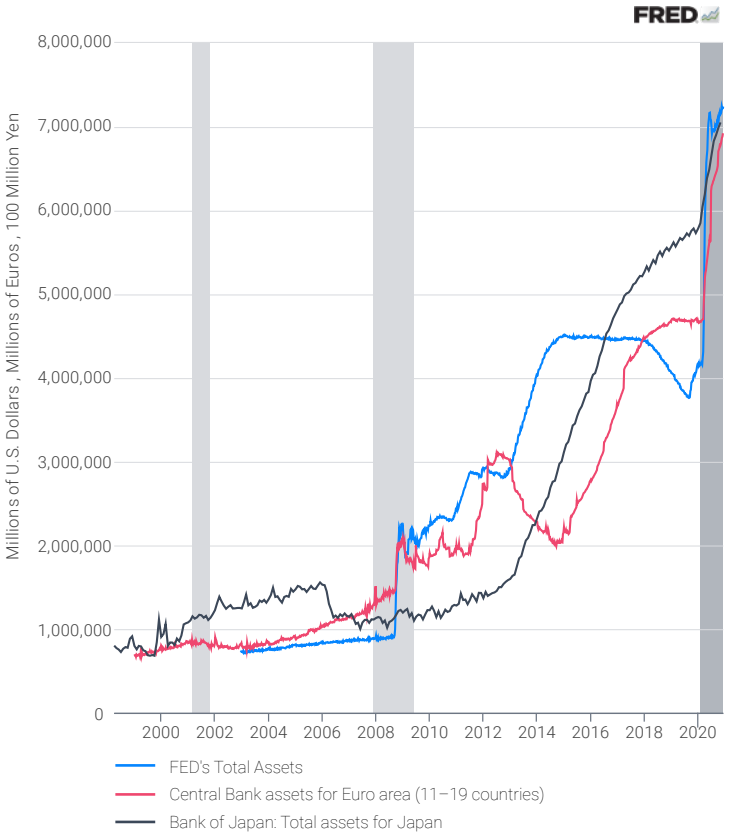
Besides real estate (for which the entry ticket is expensive) or selected crypto-currencies (for which the risks are not yet fully understood) investors are left with the option to buy gold (but offering no yield) or equities, which represent a real business that is usually able to generate extra yield.

- Healthy balance sheets and sound business models will likely command a significant premium.

Tail- and head-winds

Here we summarize the main positives and negatives we see from a global macro perspective, before going into more detail in the following pages.

- Positives: zero interest rate policies (free money environment), no short-term inflationary risk, central bank's put, strong innovation accelerating growth.
- Negatives: Covid-19 still likely to last for some time, with the risk of earning disappointments, a very bullish consensus (low short interest and long equity is now a crowded trade) and a tail risk of inflation upward pressure.



Outlook – Europe

Next generation E.U.

Italy, the first European country hit by Covid-19, asked E.U. for help, but the initial response was, at least, disorganized. During summer though, European leaders managed to co-ordinate and the E.U. Council, for the first time, decided on a common fiscal stimulus program.

- A €750bn fiscal stimulus over three years, backed by mutualized debt.
- The so-called Recovery Fund, will also support European sustainability and technological goals.

European central bank

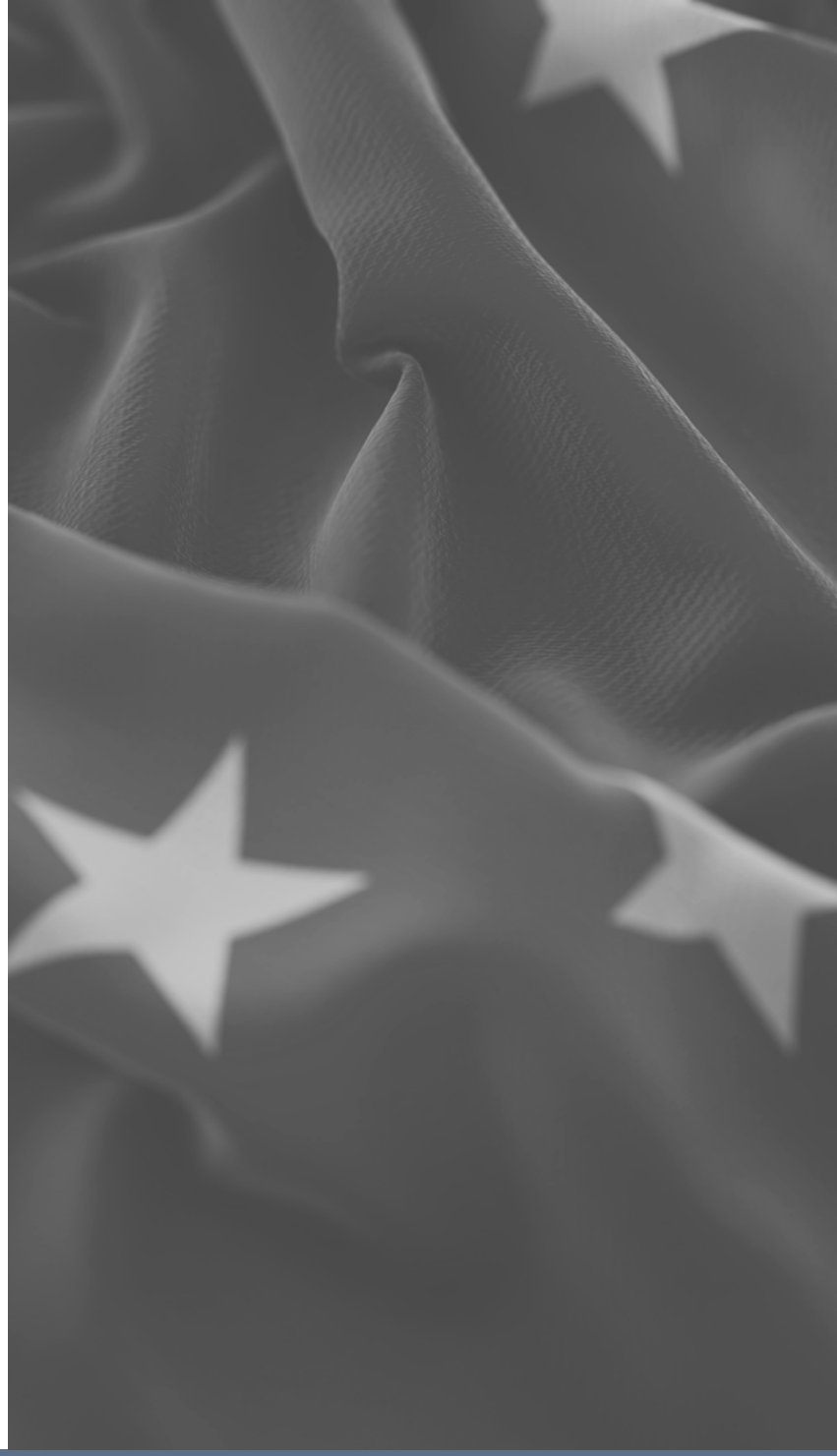
Like the FED, the ECB has reacted to the pandemic with a number of measures to support the financial system. We expect these to be continued, and even increased in case of a severe market drawdown. Also, the inflation model may be adjusted, again following the FED's leadership.

- The ECB announced it will be by buying >$2tn of assets.
- Equity market intervention in the form of buying ETFs, like the BoJ did, should not be ruled out.

Economic recovery

European GDP dropped by ~25% because of the pandemic. The recovery will take some time to complete, but a strong rebound from a low comparison basis will show in 2Q and 3Q 2021, driven by the southern E.U. countries.

- Vaccination campaigns will slowly but steadily allow for a lift of the more coercive measures.
- The fiscal stimulus from the Recovery Fund should benefit primarily the southern countries, like Italy and Spain, that have been hit the most.



Outlook – USA (1/2)

General

The U.S. comes out of a tumultuous election year and is on the verge of a massive vaccination campaign. Fiscal measures are largely anticipated by the market, but inflation should remain tame.

- A 1Q21 negative growth is likely, but the favorable comparison basis should lead to strong growth in the remainder of the year. Fiscal stimulus of about $1tn in 1H21 is likely and would certainly add an extra boost.
- Short-term inflation will be kept in check by slack in the labor market and continuous technological innovation. A rise in longer-term inflation expectations could be spurred by a fiscal cliff and stronger than expected demand boost.

Elections aftermath

The likely outcome of a divided parliament is pretty much a status quo that should reduce the short-term growth expectations, but more importantly reduce volatility.

- A divided parliament will have a difficult time in shifting significantly key policies like capital gain or corporate taxes, drug pricing, etc.
- The flip side of the coin is that stimulus may be lower than expected and not directed to consumption.

Infrastructure in a Green America

No major infrastructure bill has passed during Trump's administration, despite bipartisan support. Biden aims for (re)building a Green America.

- >66% of Americans view infrastructure spending as « very important ».
- Infrastructure spending generates jobs, an impellent need. Bipartisan agreement is thus likely, and a meaningful portion of stimulus should be directed to green projects.

Outlook – USA (2/2)

Inflation

Our baseline is that structural forces in developed economies are deflationary (demography, offshore manufacturing, technology, etc.) but we should not rule out the possibility of a strong pick up in long term inflation expectations and thus a meaningful steepening of the yield curve.

- In the past 25 years, observation showed no clear link between money growth (monetary stimulus) and inflation – but what if monetary combines with fiscal?
- The saving rate is still at historical highs, and when the economy « reopens » we could see a surge in spending, potentially resulting in upward inflationary pressure.

Fiscal cliff

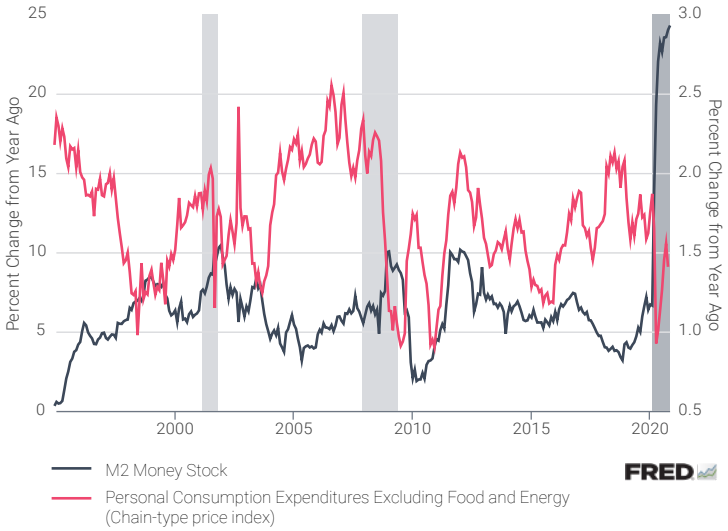
The issuance of Treasury debt to fund the stimulus is simply huge and could lead to a fiscal cliff (less demand, more supply) and a rise in long-term yields.

- The FED will be the key actor, by adjusting its pace of asset buying, and openly targeting a flattening curve. « Operation Twist » could be re-enacted.

Monetary and fiscal policy

Yellen is expected to be the new Treasury Secretary, following her stint as the FED Chair, suggesting there will be full coordination between fiscal and monetary policies, which should smoothen the coming fiscal cliff and reassure the markets.

- At the helm of the FED, Yellen successfully managed the recovery policies (tapering asset purchases and raising rates without causing market turmoil).



Outlook – China (1/3)

14th Five-Year Plan (FYP)

China's current growth model is unsustainable, in a structural slowdown with a long-term headwind of aging demographics, and the challenge of debt deleveraging. In October, the main lines of the 14th FYP disclosed how China aims to become more resilient to the globalization via a Dual Circulation Strategy.

- Shifting China from high-growth into sustainable, high-quality growth, particularly via artificial intelligence and renewable energy.
- Dual Circulation refers to both domestic and international circulation: China aims at growth to be driven by internal demand, urbanization and the resulting consumption.

Shifting strategy towards high-tech

Self-reliance in core technologies is a strategic pillar for economic development and a key geo-political competitive factor. China is thus shifting its strategy to leap-frog western leaders and to impose its leadership via advanced technologies.

- Semiconductors but also AI and quantum computing were added to the list of key strategies warranting state-sponsored research funding for the next 15 years.

Covid-19 impact

While Covid-19 first emerged in China, they quickly imposed strict containment measures to the population, probably preventing the virus from spreading out across the country.

- The economy recovered quickly and almost completely, thanks also to its monetary and fiscal stimulus.
- Until late 2020, no 2nd wave has been reported.

Outlook – China (2/3)

Money

Contrary to the U.S., China is building a strong industrial and manufacturing tissue, to back the Yuan as a trusted currency. The Yuan would first become a regional currency with more than 2bn users in east Asia before competing with the USD as a global reserve currency.

- The growing importance of China in international trade already justified the inclusion of the Yuan in the IMF's Special Drawing Rights.
- The PBoC FX reserves jumped to a 7-year high, probably to mitigate Yuan appreciation.

Central Bank Digital Currency (CBDC)

With the advent of Yuan as strong currency and the appetite to control both its population and their finance, e.g., Social Credit System (SCS), China is at the forefront of CBDC.

- PBoC already tested the e-yuan in various cites, with a possible partial rollout planned for the 2022 Winter Games.
- Combining CBDC with SCS, the PBoC may take full control over individuals' accounts.
- It may also be a tool to curb the rising « power » of Chinese Big-Tech companies, whose services are already deeply embedded in the day-to-day life of consumers and merchants.

Inflation

In late 2020, China's CPI turned negative, the first time since the '08-'09 financial crisis. Although food (notably pork) prices dropped, other structural reasons might explain this negative print and ultimately the PBoC might be forced to devalue the Yuan.

- The tools are many, but the PBoC might not want to decrease interest rates to keep capital inflows given the spread with other sovereign debt.

Outlook – China (3/3)

Sovereign debt

Chinese government bond yields at >3% clearly stand out in comparison to historically low long yields for sovereign debt of developed countries. It represents another opportunity for China to spur its development and strengthen its foothold within the global financial system.

- Foreign holdings of China debt surged to $275bn, up from $100bn in 2018.
- Opening the financial sector will bolster the Dual Circulation Strategy.

Corporate debt

China corporate bond market saw a record number of defaults in the past years, including from state-owned enterprises (SOE). There are growing suspicions of « controlled » defaults, where the government is letting SOE default to push the corporate sector to deleverage, increase competition, and improve fiscal discipline, which would help attract foreign capital.

- The defaults led the one-year interbank rate to rise from 1.5% to more than 3.4% in a few months, mainly impacting China's smaller lenders.

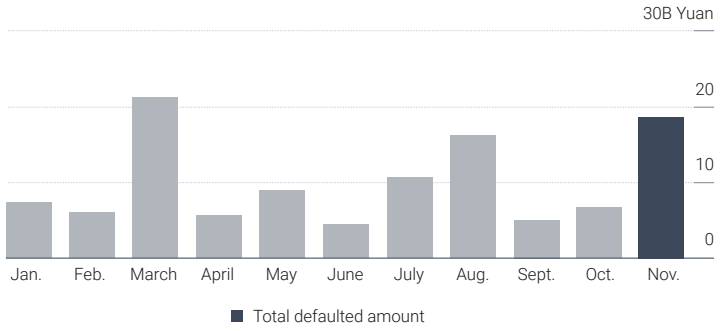
China-U.S. relationship

Although Biden is perceived to have a more positive stance with respect to China, it would not be surprising if he, and the entire U.S. administration, maintain a certain strong hand, knowing that the U.S. administration still considers China as an enemy.

- The « tech-war » could determine the winner-takes-all for decades to come.
- China decided to diversify from its USD dependency and issued EUR denominated bond, that, even at a negative yield, met with strong demand (bid-to-cover ratio of 4.5x).

FOREIGN BUYING OF CHINESE GOVERNMENT BONDS HITS RECORDS THIS YEAR

CHINA'S DOMESTIC BOND DEFAULTS REACH AN EIGHT-MONTH HIGH IN NOVEMBER



SOURCE:
Bloomberg

Food For Thoughts (1/2)

Monetary policies evolution

In the current monetary system, central banks set the level of short-term interest rates to steer the economy. But every recession meant further cuts, until zero or even negative levels, and a loss of effectiveness. Various asset purchase programs seemed to be the solution, up to the pandemic, when a coordinated fiscal and monetary mix was introduced, to facilitate financing of the huge deficits caused by fiscal policies targeting precise sectors.

- We expect the Central Banks to stay steady in their asset purchase programs, with a slight bias towards tapering upon a stronger growth recovery in H2.

Central Banks' Put and growth stocks

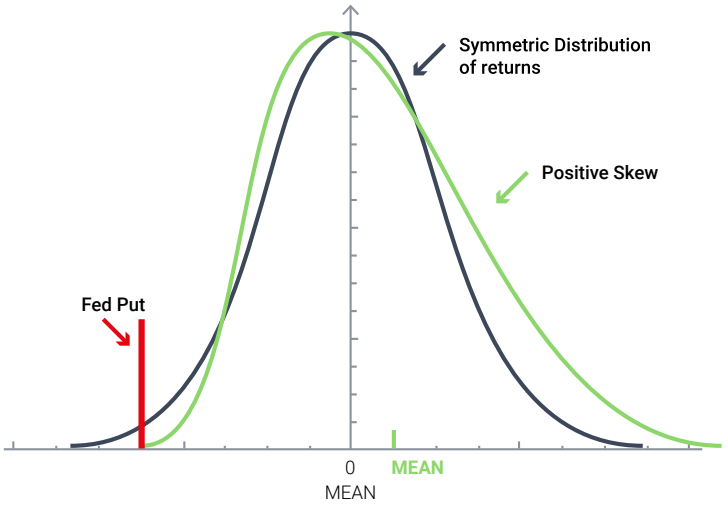
The Central Banks' Put, i.e., the belief they will do whatever it takes to rescue the economy and the financial market, serves better growth stocks. This assumption cuts the left tail of the outcome distribution, skewing it to the right, i.e., yielding higher average probability of outcome (higher positive Beta).

- Growth stocks have a wider dispersion of potential outcomes (higher Beta).

Negative Yields and growth stocks

Because of various factors such as demographic, low inflation, but also financial crisis, interest rates have trended down for the past 40 years. Growth companies' performance is highly dependent on low interest rates, mainly because strong growth requires cheap financing.

- Short term interest rates are at zero or negative in many developed countries.
- There is currently more than $17tn worth of negative-yielding debt, even on corporate bonds.



Food For Thoughts (2/2)

Technology adoption – price is everything

Mass adoption takes time. Many technologies exist in laboratory but are never used. There are many hurdles, which, when overcome, spur fast adoption and define new trends. The determining factor for mass adoption is price parity.

- Awareness of the price parity moment is key to understanding the growth of a given technology.

Growth stocks are safer than bonds

In a free money environment (ZIRP), high-quality growth stocks are safer than bonds, offering a much better risk adjusted return, especially if yields increase. A shift from bonds to quality growth stocks could be in the making?

- A bond will lose in value for the small coupon it yields.
- High-quality growth stocks are able to generate steady and growing cash flow even in the middle of the deepest recession.
- Japanese's Government Pension Investment Fund (GPIF) set a precedent in 2014, doubling its equity exposure as the JGB was yielding close to zero. Other multi-billion asset managers could eventually follow the GPIF, spurring massive inflows towards growth equities.

Demography orienting innovation

An aging population means consumer spending is declining over time, which might imply slowing growth, especially for consumer driven economy. But given the wealth levels of the elderly, we can expect their consumption to continue but become concentrated in fewer sectors, notably healthcare.

- Healthcare innovation for the aging population creates tremendous growth opportunities, which could even compensate a general consumer slowdown.

Catalysts

- **Monetary and fiscal policies.** Continued massive fiscal and monetary stimulus across the globe, zero (negative) interest rate policies and subdued inflation combined with effective vaccines and economy reopening: all point to a rosy outlook for equities.
- **U.S. politics.** A balance of power in the U.S. implies more purposeful measures and political actions, reducing the overall uncertainty.
- **China.** The shift from high growth to sustainable growth via massive investments in technologies, renewable energy and healthcare for its aging population.

Risks

- **U.S. yield curve steepening.** A rise in interest rates due to oversupply of Treasury along with a Central Bank tapering or due to higher inflation expectations because of all the accommodative measures, a surge in spending or a rise in commodities prices.
- **Bullish consensus.** Market positioning may be too complacent with very high bullish sentiment, historically low short interest and high historical valuation of all assets.
- **Trade tensions.** Full war (cyber, tech, …) between China and the U.S. or an alliance of U.S. and E.U. against China.

Bottom Line

- Many global structural ingredients remain supportive for the equity markets. Innovation is bound to continue across sectors, and thus accelerate growth, notably in technologies related to Artificial Intelligence (major disruptive trend of the century in every sector), healthcare (aging population) and renewable energy (climate change awareness).
- Our portfolios are all interconnected by their exposure to innovation, technology and ultimately strong growth. The interest rates environment remains a key factor, and we keep monitoring signs of potential shifts either in policy or market expectations, but we have also built our portfolios to be intrinsically resilient, by focusing on high-quality growth stocks, with sustainable and sound business models.

AI & ROBOTICS – THE FORCE AWAKENS

Accelerating From Here

It is just the beginning

Since the inception of the Artificial Intelligence (AI) & Robotics theme in 2015, datacenters have been one of the most interesting playgrounds. This trend reinforced in 2020, as social-distancing accelerated the importance of the cloud.

- Cloud companies have continued spectacular growth, in particular Microsoft enjoyed massive growth for Azure and Teams (its cloud collaboration solution).
- Merger & acquisitions hit records in the semiconductor and software space, as companies are vying to capture value in AI & Robotics' fast-growing markets.

Disruption doesn't happen overnight…

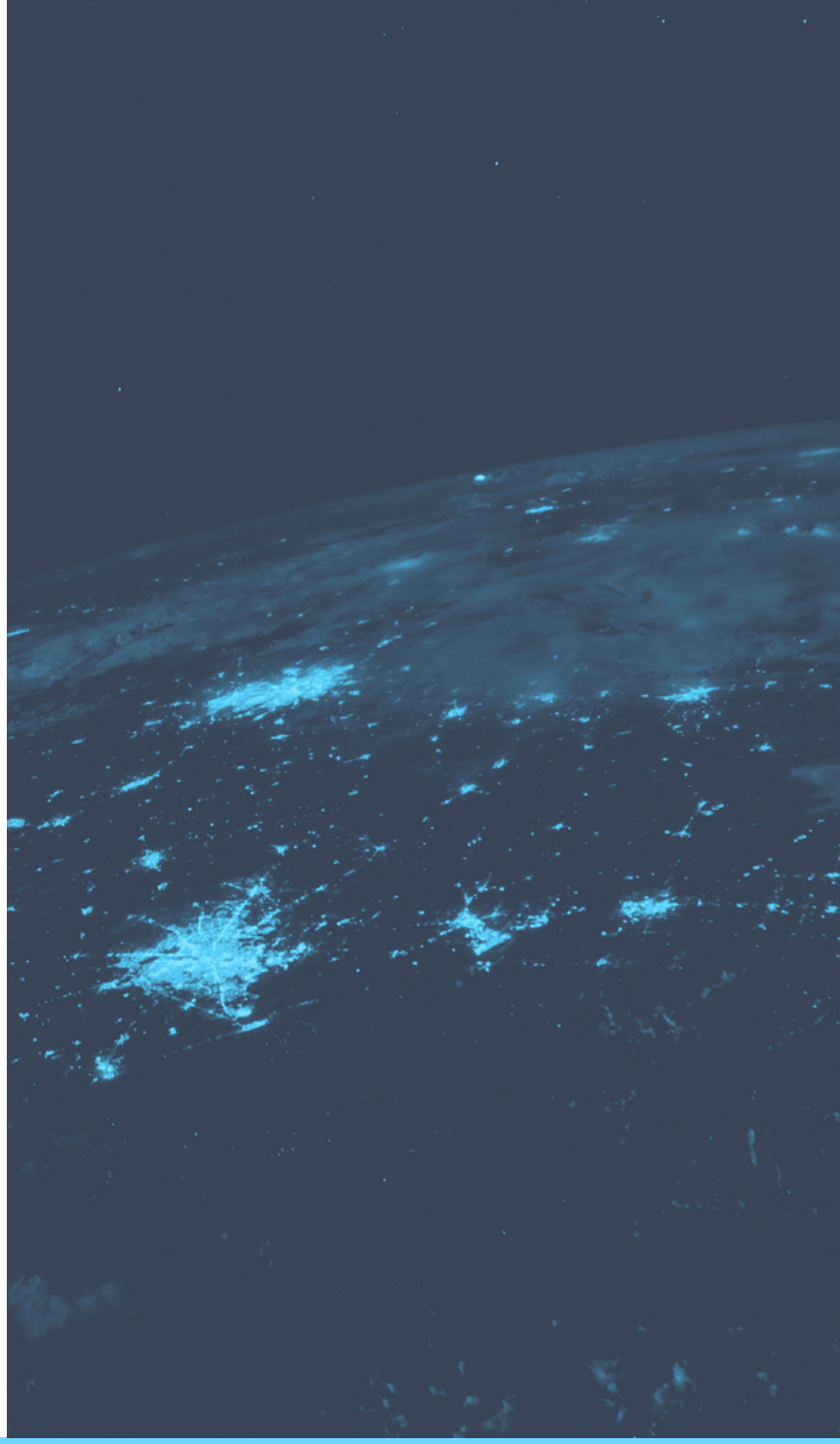
Pervasiveness of AI & Robotics has been at the core of our investment thesis, yet the timing of technologies adoption sometimes proves slower than expected.

- 5G and high-speed networks have been delayed by the pandemic and growing U.S.-China tensions, postponing Internet of Things (IoT) and edge computing.
- Autonomous cars are still in the making, despite the impressive improvements in computing capabilities, as sensors and ecosystems are maturing.

… but sometimes faster than expected

Black-swan events happen. This year, it was in the form of a global pandemic which started in China, with global negative impact on the economy.

- China first-in, first-out management of Covid-19 allowed the country to accelerate investments in AI & Robotics, reinforcing our views on the region.
- AI adoption in healthcare happened much faster than expected due to the urgency of tracing, mitigating and treating the pandemic.



SOURCE:
Gartner

Covid-19 – Impact

Acceleration of social trends

With Covid-19 and the consequent social-distancing measures, digitalization and remote cloud-based work and communications made their entry in everyone's life. The trend, which was already strong with digital natives, is now ubiquitous.

- The pandemic validated cloud's value proposition, propelling its market above $300bn in 2021 (a 20% faster growth than previously expected).
- Automation and virtualization have therefore been confirmed as a core driver of global economy.

Digitalization and automation trends reinforced

Covid-19 has accelerated the digitalization of work, assets, workflows and logistics. This lays the demand foundations for faster infrastructure growth.

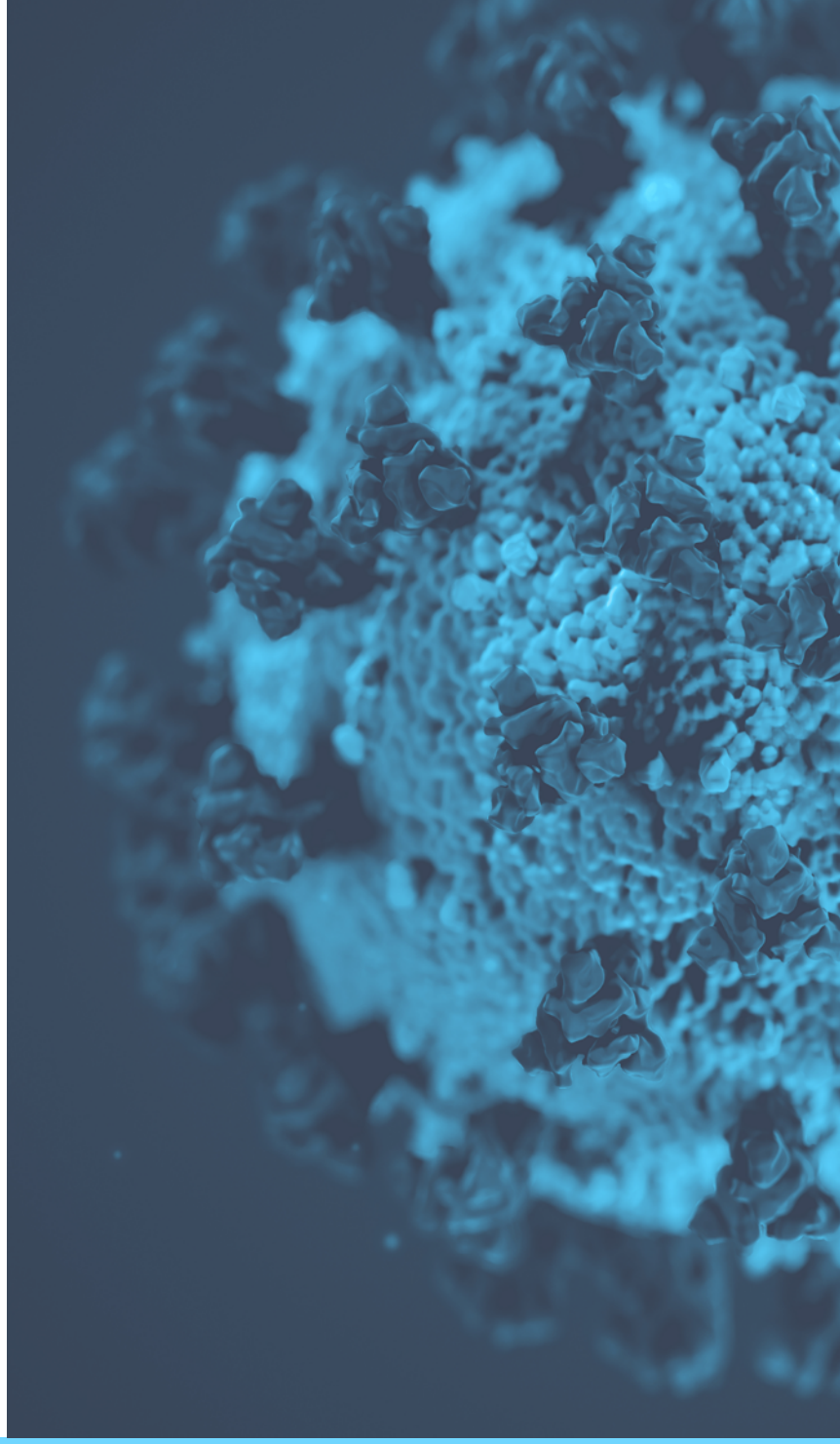
- Collaboration software like Zoom or Teams have experienced massive growth, solidifying consumer applications and calling for more infrastructure.
- Logistics automation appeared as a key driver of the industry in a post-covid world.

AI & Robotics accelerated in 2020

Covid-19 started in China and impacted negatively the global economy. Lockdowns as well as various limitations slowed down infrastructure spending and shed light on supply chains fragilities and regional ecosystems.

- China increased its commitment to AI & Robotics, reinforcing our positive views on the region.
- AI & Robotics participated the mitigation of the pandemic, confirming our views on the application opportunities.

SOURCE:
Gartner



Outlook – AI

Datacenters – the divergence of convergence

The demand for datacenters will continue to grow, driven by explosive data created and consumed both at the edge (IoT, near the source) and at the core (Cloud, distributed) – IDC estimates a sextillion bytes were created, accelerating.

- We expect AI, computational storage and data-centric accelerators to grow in importance and believe the datacenter components market will be north of $100bn in 2025, up from $47bn in 2020.
- The >$40bn server processor market will get more competitive, as Intel is losing ground from a dominant position (notably to AMD and Nvidia/ARM)

Edge computing – "chi va piano, va sano e va lontano"

Cloud, networks and edge are evolving towards a continuum of computing. Orchestration of such complexity drives the demand for products to manage, monitor and secure cloud services and machine-to-machine interactions.

- Edge computing is an emerging market opportunity for AI and is concomitant with the advent of the Internet of things (IoT).
- We believe it is a ~$100bn opportunity by 2025, where terminals other than PC and mobile will grow ~50% 5Y CAGR.

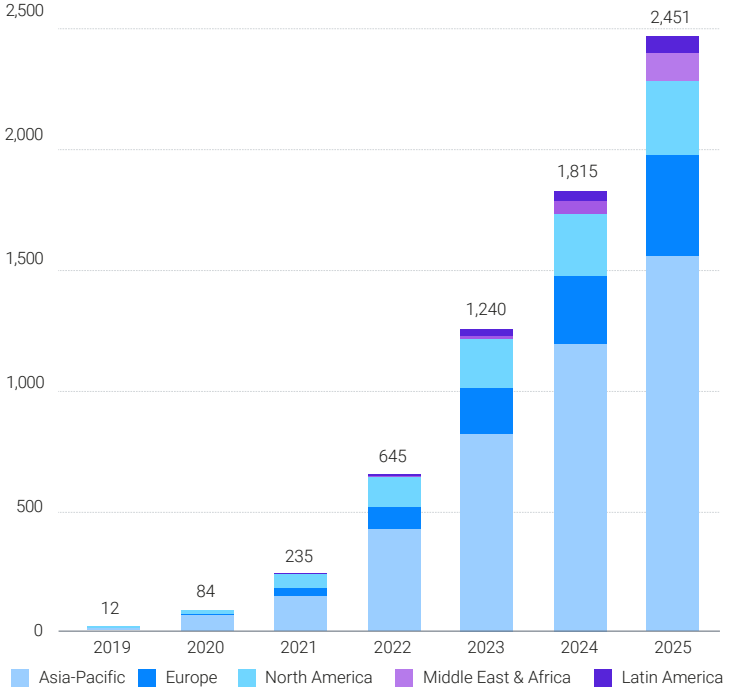
5G – taking off in 2021

Limitations imposed on Huawei have delayed the global roll-out and induced a shift from classical telecom infrastructure to Open Radio Access Networks (RANs), which provide radio connection between machines and the core network or backbone (which relies increasingly on optics).

- Open RAN is a massive opportunity for virtualizing networks and new players.
- Fiber optics are deployed in datacenters to increase data transmission rates.

"The most important technologies in 2021 will be AI, 5G, and IoT, according to a newly released global survey of CIOs and CTOs by the technical professional organization IEEE."

GLOBAL 5G ADOPTION TO TAKE OFF IN 2021



Source: Ericsson Mobility Report

SOURCE:
IDC, McKinsey, Fior markets, LightCounting& II-VI Estimates

Outlook – Application Drivers

Healthcare is having an AI moment

The mass availability of labeled image sets (medical imagery and microscopy) and clinical data enable deep learning models to improve diagnostics, predict evolutions and highlight biological relationships to accelerate drug development.

- The Cambridge-1 supercomputer will be the first supercomputer dedicated to healthcare research and is expected to come online by 2021 (Nvidia).
- DeepMind AI just solved a 50-year-old biology 'grand challenge' in late 2020 by determining a protein's 3D shape from its amino acid sequence..

Natural Language Processing (NLP) targets superhuman abilities by 2021

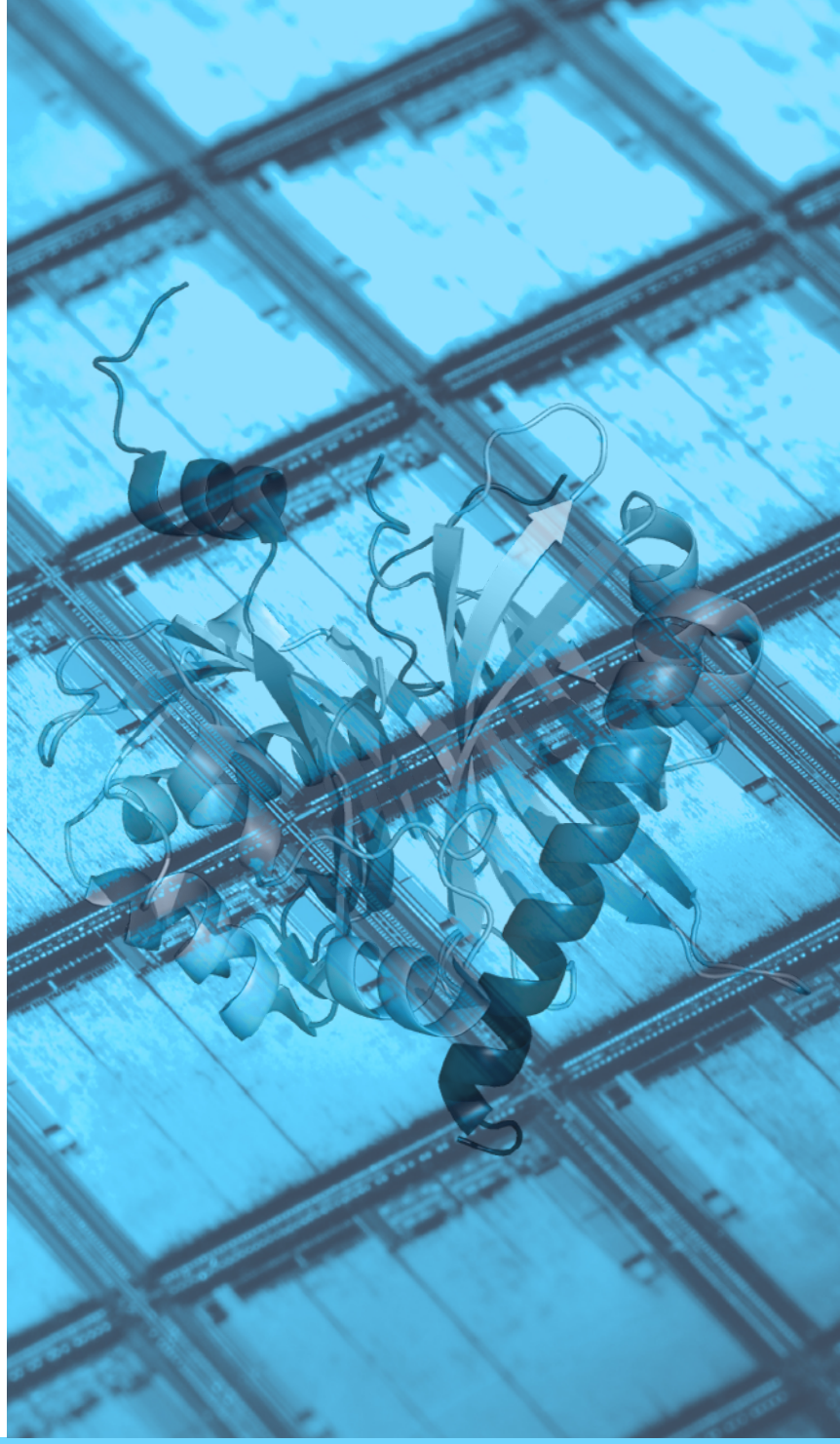
NLP is now outperforming humans on the most challenging benchmarks and start demonstrating abilities regarding knowledge and problem solving.

- Insight engines (search, NLP and AI, such as IBM Watson or Mindbreeze) grow in adoption as they manifest value in unstructured and semi-structured content.
- Emerging NLP engines (pushed by Microsoft, Google, Facebook) are massively available to unlock new use-cases for knowledge automation applications.

Gaming is augmenting reality

The next-generation console cycle has just started (Sony and Microsoft) and AMD and Nvidia rolled out their new generation products, all in Q4 2020.

- Gaming hardware is expected to be strong in 2021 as new-gen consoles get adopted and the PC market is undergoing a massive upgrade cycle.
- Although expectations for portable augmented reality headsets may have been overinflated, we expect Apple to change the game in 2021/2022.



SOURCE:
Company sources, Wikipedia

Outlook – Robots

Autonomous Vehicles are most transformative

2020 was a pivotal year for the autonomous vehicle (AV) market. Promises of fully autonomous cars happened to be overly ambitious, yet automated warehouse robots are already there and have helped e-commerce cope with the pandemic-related surge in demand across the supply chain.

- AI supercomputers are entering the market in 2021/2022 (e.g., Mobileye L2++, Nvidia Drive, Tesla) and will enable L4/L5 quicker than commonly thought.
- Autonomous Mobile Vehicles (AMVs) will grow with the on-demand economy.

Industrial robots increase productivity

Driven by process automation, industrial robots will return to rapid growth in 2021. The overall number of industrial robots operating is expected to be above 3mn in 2020, with new installations close to historic highs.

- China is on track to account for ~45% of all industrial robot shipments by 2021.
- Cobots grew +11% in 2019 and still double digit in 2020, despite negative growth for all other types of industrial robots and likely to accelerate going into 2021 as sensors and computing power are increasingly cheaper.

Robots get a software upgrade

Cloud software specializing into robotic process automation (RPA) have been under the spotlight in 2020. As robots and worker interactions are expected to increase in quantity and quality, software plays an increasing role.

- Gartner is seeing RPA as the fastest growing market in enterprise software.
- The Robotics-as-a-Service (RaaS) era is rapidly approaching, bridging together cloud-based automation with on-site robotic hardware.

SOURCE:
International federation of Robotics, Gartner

Outlook – China Attracts Investments

Tensions with the U.S. energize self-sufficiency projects

The arm-wrestling engaged by the Trump administration has pushed China in a corner, leading to high uncertainty, further compounded by the U.S. leadership transition.

- A relief is in the interest of both sides and would be positive for the whole technology ecosystem.
- New U.S. measures might lead China to retaliate if technologically cornered, e.g., by disrupting Taiwan and TSMC, the cornerstone of Western supremacy.

Made in China

The efforts to become technologically self-sufficient will increase as the country set an explicit goal for tech-independence beyond Made in China 2025, and Covid-19 highlighted the challenges of overseas supply chains.

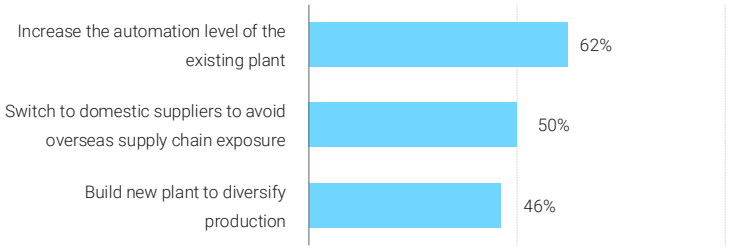
- China already represents 60% of the global AI spending and is a leader in facial recognition, smart surveillance and autonomous vehicles.
- With the blessing of China's central government, local cloud and e-commerce giants (Baidu, Alibaba, Tencent) will continue to federate domestic investments in AI.

China accelerates investments in automation

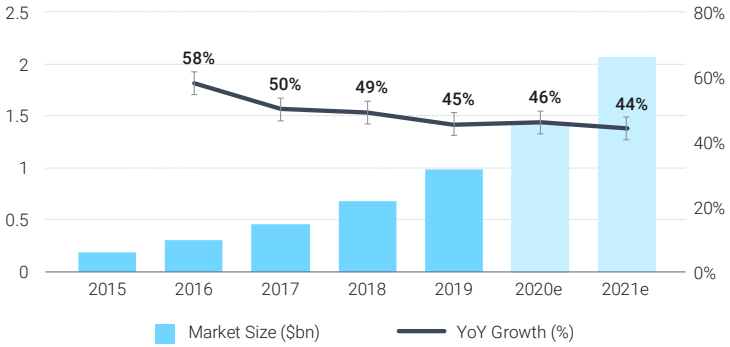
As China grows older and labor cost increases, domestic companies increase investments in robotic automation and look for strengthening local ecosystems.

- The warehouse robotics segment in China has seen a 51% revenue CAGR in the past four years, increasingly relying on local suppliers.
- As we wrote, China represents almost half of global industrial robot shipments.

CHINA C-SUITE EXECUTIVES ON HOW TO ENSURE STABLE OUTPUT POST COVID-19



AUTOMATED GUIDED VEHICLE (AGV) AND AUTONOMOUS MOBILE ROBOT (AMR) MARKET SIZE IN CHINA (2015–2021E)



SOURCE:
Tencent Research Institute and IT Juzi (The State of Art and Trend of Venture Investments in China and the U.S. in 2017), UBS, China Mobile Robot & AGV Industry Alliance

2020 – A Glance In The Rear-View Mirror

Autonomous car ecosystem

Mercedes-Benz and NVIDIA join forces to create in-vehicle computing system and AI computing infrastructure.

- Velodyne launches a $100 Lidar unlocking new fields and potential applications.

Caterpillar acquires Marble

The acquisition brings delivery robot expertise to the world's largest construction equipment.

- Autonomous Mobile Robots (AMR) is to grow 5Y CAGR 20% representing a $11bn market.

Intel delays its roadmap

Slowdown in innovation has a global impact on the AI & Robotics market and investment (until the company gets replaced by competitors).

- The global cloud processor market is expected to grow to $75bn in 2025.

Chinese stimulus plan

China increased investment in AI, robotics and infrastructure in response to Covid-19 and U.S. sanctions.

- An unprecedented spending of $3.6tn over the next five years was announced.

IMPACT

H1 2020

IMPACT

U.S. administration ban of Huawei

Countries have been considering if they should follow the U.S. and most have delayed the roll-out of 5G networks.

- 5G infrastructure is participating in enabling a $100bn edge computing market in 2025.

Wave Computing files for bankruptcy

The company, which had acquired the microprocessor IP pioneer MIPS Technologies in 2018, was considered a leader in the making for AI accelerators.

- IoT AI computing is expected to be a $5bn market in 2025.

Covid-19 shakeups working habits

Remote work and social distancing emphasizes the importance of cloud infrastructure.

- Microsoft Teams had ~20mn users at the end of 2019, this grew to 44mn in April 2020 and 115mn in the summer (towards 10x YoY).

AI finds disease-related genes

AI reveals patterns in huge amounts of gene expression data and discover groups of disease-related genes.

- The use of AI in healthcare has been significantly accelerated by the Covid-19 pandemic and is projected to be a $30bn market by 2025 (a ~50% 5Y CAGR).

2020 – A Glance In The Rear-View Mirror

Semiconductor consolidation

A spate of acquisitions were announced in a very short period of time, reshaping the competitive landscape.

- Semiconductor M&A hit an all time high, driven by consolidation in chips for datacenters with deals > $100bn.

First AI-driven aerial combat training

Human pilot fought for the first time an AI-controlled opponent through an AR interface.

- The human opponent was reported not to have scored a single hit.

Apple launches its 5G iPhone

The launch is likely to boost the popularity and the rollout of 5G networks.

- Roll-out has just started in the U.S., and the iPhone is accelerating competition between operators.

Major chip generation

New releases and surprising products reshaping the established order in several segments.

- AMD/Nvidia released next-generation products, Apple, Amazon and Marvell proved ARM CPU.

IMPACT

H2 2020

IMPACT

U.S. administration crackdown on SMIC

A negative for China and Huawei, likely pushing China towards tech-independence.

- China's role in the technology ecosystem is fundamental as 60% of the global semiconductor is used in China.

Waymo launches its driverless robo-taxi service

Driverless rides with no human attendant will now be available at greater scale in Phoenix, U.S.

- Robo-taxi market is expected to be the first embodiment of autonomous cars and to grow above 100% CAGR in the next 5Y.

AMD and IBM announce a partnership

The companies are joining force to advance the hybrid cloud confidential computing, easing the transition to public clouds.

- The hybrid cloud market is expected to be $140bn in 2025, growing 23% CAGR as on-premise services are transferred to the cloud.

Launch of the new XBOX and PlayStation

This new cycle start is positive for the A.I. hardware supply chain and augmented reality applications.

- The gaming market is expected to grow to $180bn in 2021, with more than 2bn gamers across the globe.

2020 – Capital Markets

A historical year for semiconductors M&A

Following a muted first half 2020 (barely $2bn in deals, including Dialog/Adesto), semiconductor companies walked their way through a historical year. 2020 will likely beat 2015 when more than 30 deals valued at $108bn were announced.

- In July, Analog Devices announced a final agreement to acquire Maxim ($21bn).
- Then, multiple deals driven by AI & Robotics were announced: Nvidia/ARM ($40bn), AMD/Xilinx ($35bn), Intel/SK Hynix ($9bn), Marvell/Inphi ($10bn).

Automation and platforms drive software M&A

As for previous years, M&A have been very active in the software space. Although it is a more fluid space than hardware, market leaders have leveraged their stratospheric valuations to grow their competitive position and market reach.

- Salesforce to acquire Slack ($27bn) as Twilio acquired Segment ($3bn) and Facebook - Kustomer ($1bn) in moves marking the convergence of platforms.
- Microsoft actively expanded in IoT (CyberX), process automation (Softomotive), 5G network virtualization (Metaswitch networks and Affirmed Networks) and most notably NLP (OPenAI GPT-3 exclusivity deal, >$1bn).

Return of the IPO

Digitalization drives companies into the capital markets, as they up their game in cloud, analytics and AI and find massive funding through capital markets.

- Three of the 10 biggest tech IPOs have happened in 2020 (Snowflake, Airbnb, Doordash) amongst many poster names (Zoom, Palantir, C3.ai, Unity, etc.) and several sensor companies (Allegro Microsystems, Velodyne, Luminar. Innoviz).
- A lot is announced for 2021 with Databricks, UiPath, etc.

SOURCE:
Forbes, Kander10

Structural Trends – Inflection Point

Infrastructure phase to accelerate

AI relies on computing and data; it is seen as the largest boost to global growth for the coming decade and, as such, promises returns on infrastructure investments.

- Cloud computing and high-speed connectivity (e.g., 5G, Space) are required to enable applications like IoT, Virtual/Augmented reality and automation.
- AI relies on fundamental technologies, such as high-performance computing, laser communication and sensing, which benefit form the expanding infrastructure.

Robot assistance is everywhere

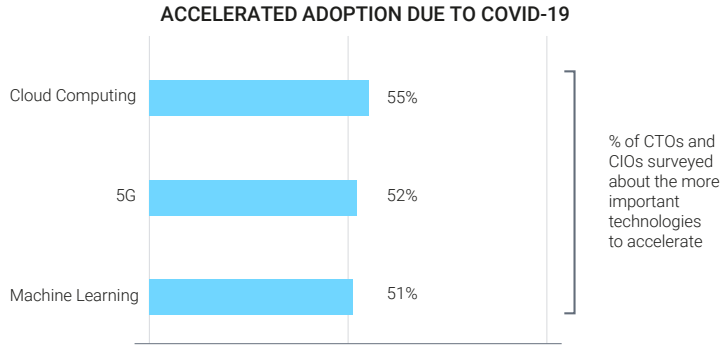
Robotics is increasingly pervasive with a landscape ranging from powerful industrial arms, autonomous vehicles, cobots and insight engines or chat-bots.

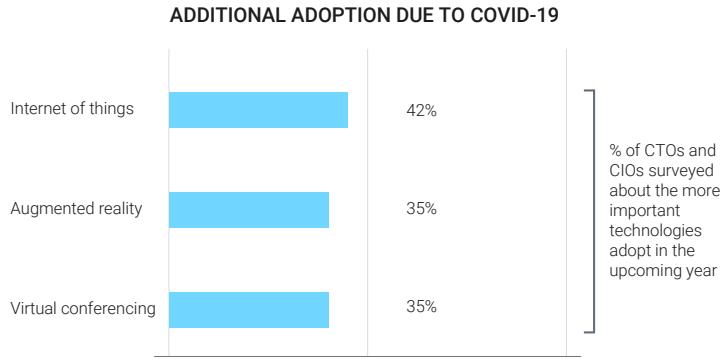
- Edge computing relies on sensors and low-power computing to enable real-time decisions, providing autonomy to robots, vehicles and IoT nodes.
- Warehouse autonomous vehicles and cobots have been instrumental to support the explosive e-commerce demand and enabled suppliers to test drones and autonomous vehicles to deliver goods without any human involvement.

AI and Robotics spark a new era in human history

The convergence of information technology, robotics, biotechnology and nanotechnology redefines what it means to be human and our species' limits.

- Cloud-powered insight engines and Natural Language Processing (NLP) get us closer to quasi-natural and knowledgeable human-machine interactions.
- Neuro- and mechatronic prosthetics, brain-machine interfaces, DNA-editing and AI-discovered treatments are opening the door for augmented humans.





SOURCE:
Forbes, Kander10

Structural Trends – AI & Infrastructure

Datacenters continue running the show

After warehouse-scale operations powering virtualized solutions, datacenters are evolving towards disaggregated composable architectures to optimize resource allocation and high-performance computing.

- Such architecture demonstrated 2x computation per power unit, an improvement needed to deal with explosive global data usage.
- Datacenters are converging with super-computers (as we wrote last year, and was illustrated by the Nvidia/Mellanox, HPE/Cray and AMD/Xilinx deals)

5G promises new universes

Despite delays, the rollout of 5G is a technological necessity (latency, bandwidth) to power the new always-connected world (IoT, autonomous driving). 5G has been elusive and taking longer to materialize, still we see it as a major driver for the industry.

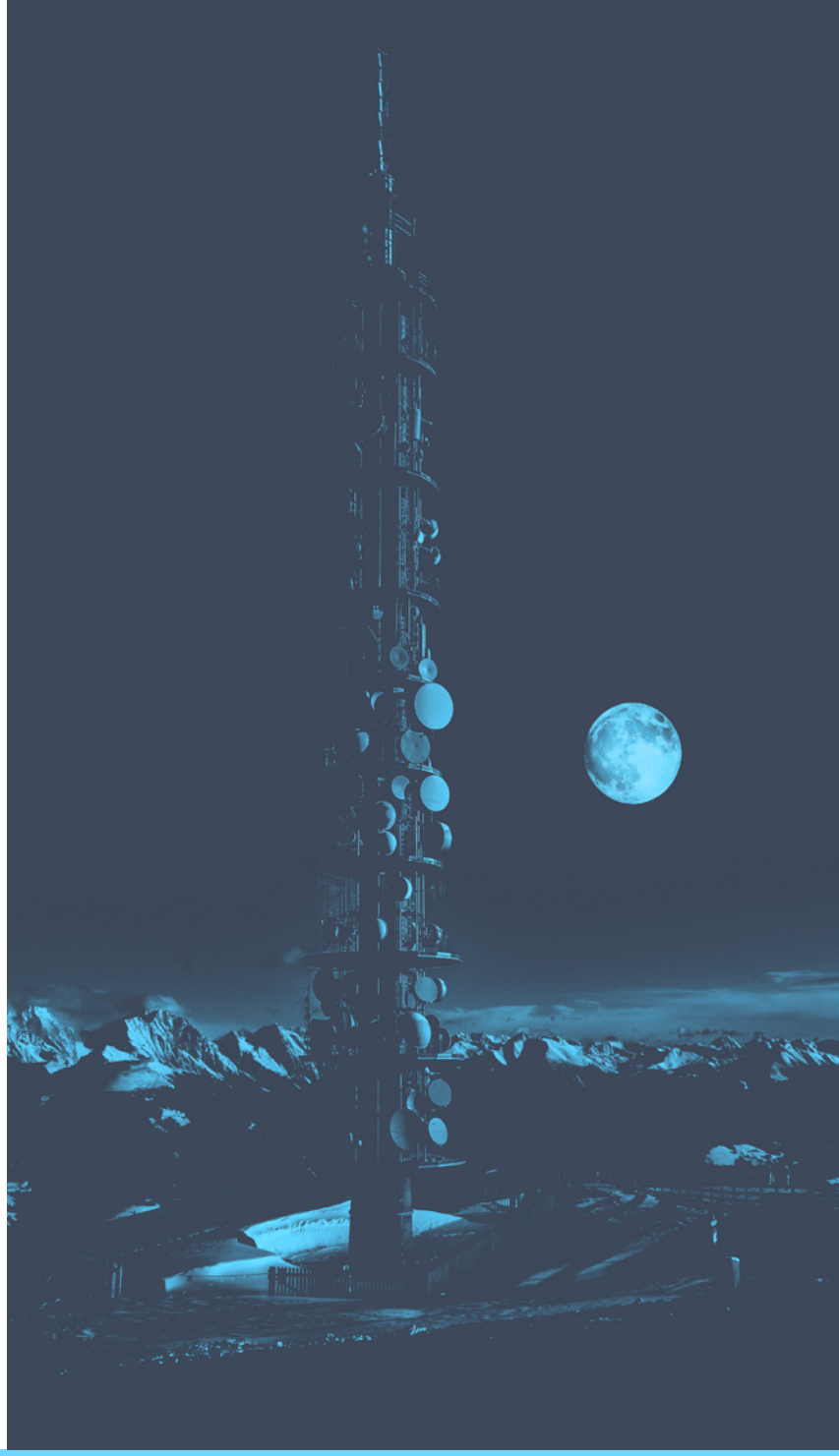
- 5G offers 100x the speed and capacity and 1/20 the latency of previous networks. Investments in 5G infrastructure are expected to grow at a 29% CAGR.
- 5G-related applications are expected to add $2-3tn to global GDP.

Space is the new frontier

The materialization of ubiquitous connectivity translates into the roll-out of Low-Earth Orbit (LEO) broadband satellite constellations connecting remote areas and leveraging AI for earth observation, agriculture, power generation, and security.

- SpaceX's Starlink service in the U.S. has already entered beta testing.
- The broadband market is expected to represent 40% of the Space economy by 2040 (vs. less than 5% in 2020).

SOURCE:
IDC, McKinsey, Market Study Report, GSMA Intelligence, World Economic Forum



Structural Trends – Optics

Optical networks are back

Digitalization, AI and robotics spark an unprecedented explosion in data traffic, that in turn is driving the growth of large cloud data centers. Only fiber optic links can handle the bandwidth when moving data through the 5G backbone, between and inside hyperscale datacenters.

- The market for datacenter interconnects is expected to grow +67% in 2021 and continue with a 2Y CAGR >50%.
- 5G optical access market is nascent and is expected to grow >$1bn by 2022.

Augmented reality and robotic sensors come to light

Laser sources are core elements of 3D sensing systems. As Lidar sensors get cheaper, they become ubiquitous in consumer devices, autonomous vehicles and collaborative robots. We believe the point of inflection happened in 2020.

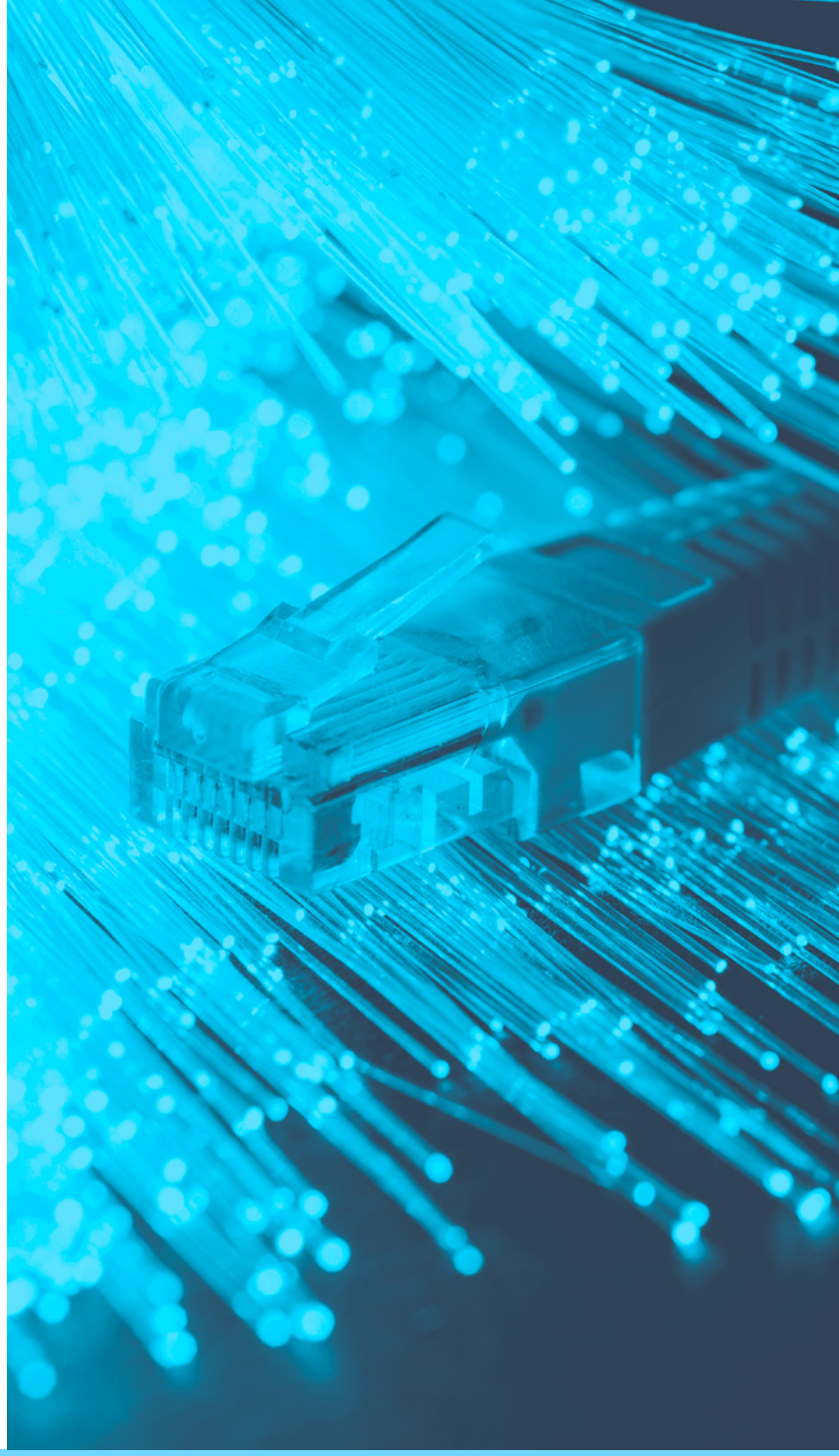
- Velodyne and Luminar went public as the first pure play Lidar companies, with automotive systems priced in the range of $100s (Velabit, Iris, etc.).
- Apple integrated Lidar in its iPad and iPhone product lines for augmented reality.

Connectivity for the skies and beyond

Lasers are the cornerstone of a new generation of global high-data rate and long-distance communication networks, interconnecting LEO constellations' satellites (SpaceX, Amazon, Telesat) as well as air and ground terminals.

- Lasers enable high-speed data transfer over vast distances, and global coverage.
- Focused beams allow ultra-secure communication of key data, such as Quantum Key Distribution (QKD) through satellites that relay quantum signals.

SOURCE:
Inphi, Lightcounting, II-VI



Structural Trends – High-Perf Computing

Semiconductors lead the dance

The evolution and scale of AI technology has a strong impact on the components segment, with an ongoing shift from traditional to specialized systems.

- CPUs are increasingly replaced in specific workload by GPUs and FPGAs, which deliver greater efficiency and the ARM architecture is gaining traction.
- High-bandwidth memories such as GDDR6x and HBM are instrumental for AI accelerators, and computational storage with SSD or 3DXPoint technologies are serving a market of $15bn in 2025 (+54% 5Y CAGR).

NLP unlocks new use-cases

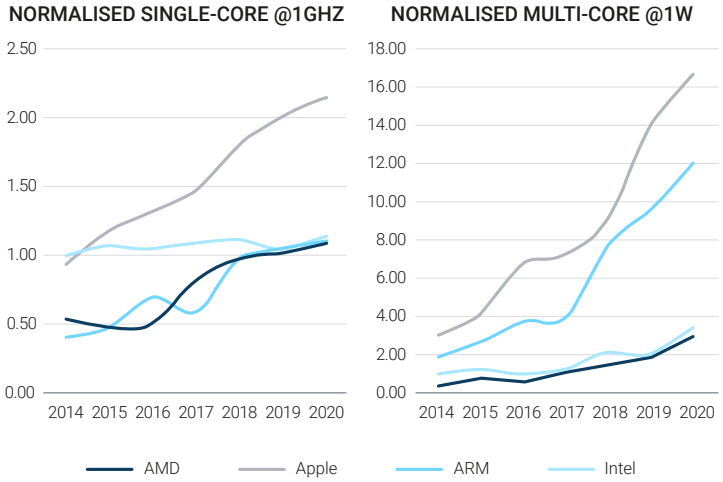
NLP's popularity is only beginning (e.g., smart assistants) thanks to mass availability of data and processing power. Improvements brought by new algorithms will only amplify this trend and serve as foundation to accelerate multiple fields of AI.

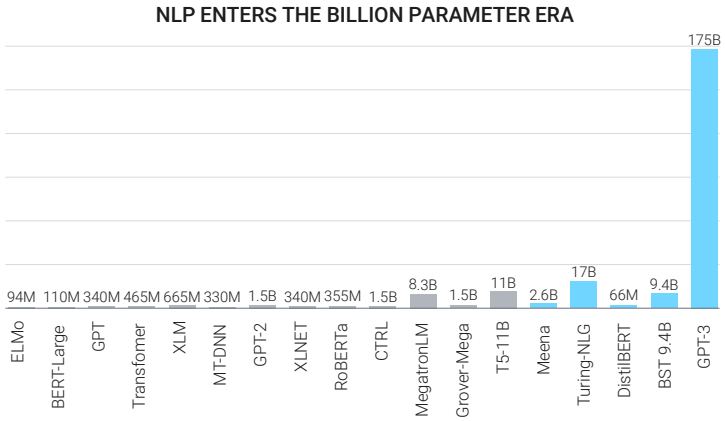
- Algorithms like GPT-3 outperform humans on most benchmarks.
- These superhuman abilities will transform their use beyond mere language translation to unexpected and novel use cases.

Healthcare, a revolution in the making

The depth of analysis offered by AI makes it unescapable in biology and healthcare in order to enhance every aspect of the industry.

- AI already helps practicians in establishing and supporting diagnostics.
- AI-driven models outperformed traditional ones in the fight against Covid-19 and accelerate drug discovery, industrialization and clinical trials.





The number of parameters indicates how many different coefficients the language modeling algorithm optimizes during the training process.

SOURCE:
State of AI 2020, AtonRâ Research

Structural Trends – Edge computing

Edge computing is not ubiquitous yet

While edge-computing is considered as necessary to enable real-time processing in IoT, its deployment has been delayed by the limits of current networks and low-power processing technologies.

- Edge is the counterpart to cloud and provide autonomy to IoT nodes.
- Technologies required to establish this continuity are progressively appearing (e.g., AI-integrated cameras to monitor Covid-19 spread).

Autonomous Vehicles are set for a careful roll-out

Autonomous driving's roll-out has been slower than initially expected but is work in progress. The transition from traditional vehicles will be progressive and is set to have a huge impact on society, environment and on the current auto industry.

- A whole ecosystem has developed from sensing to processing, from which some champions (e.g., Nvidia) are already emerging and replacing former ones (OEMs).
- Autonomous taxi services have already launched in Phoenix, U.S. and many tests are live in the U.S. and China.

Gaming is driving technology innovation

Despite the launch of cloud-based services, the console segment remains the core-driver for both hardware and software players. Graphics technology explore new AI algorithms to improve quality and reality of virtual worlds.

- A new cycle has started in late 2020 with the launch of the new generation of consoles, expecting to be a major revenues driver.
- Online gaming is gaining momentum, either through mobile or cloud services.

Structural Trends – All robots

Industrial robots - an unsung opportunity

A new generation of robots is progressively taking the relay of the first automation wave. It promises increased efficiency and productivity gains through better integration among human workers and new business models.

- So-called cobots are relying on advanced sensors and contextual awareness.
- Decreasing costs are driving their adoption, with double-digit growth rates, and Covid-19 has accelerated automation to improve business resilience.

Service robots – unlimited applications, slow adoption

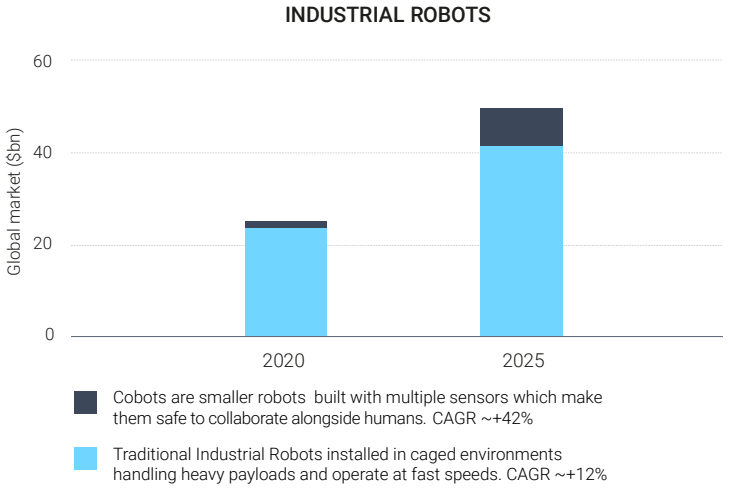
Services robots are gaining in popularity by providing assistance and high added-value to humans in a variety of tasks, although their rollout is currently limited by the delay of edge computing.

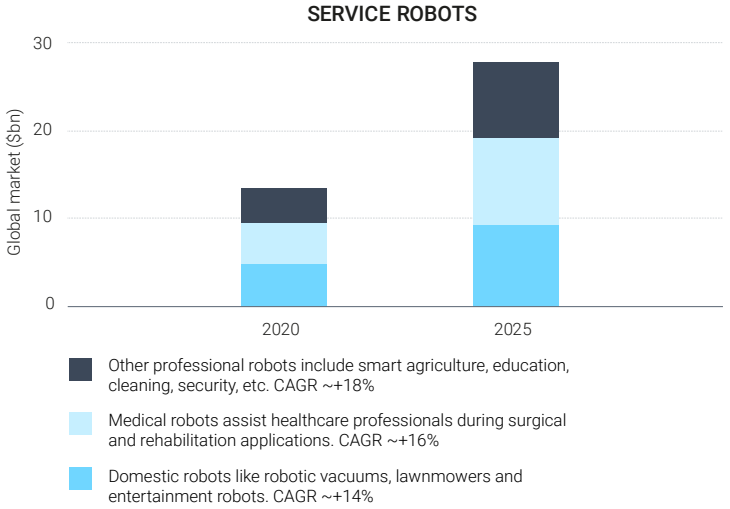
- Domestic robots' adoption is already witnessing an inflection point.
- The hottest market remains surgical robots witch c. 30% growth rates, thanks to the high added-value provided.

Software robotics – joining physical and virtual automation

The emergence of cloud-based software specializing in robotic process automation (RPA) is paving the way for Robotics-as-a-Service (RaaS). It is yet another embodiment of our 'automation everywhere' long term thesis and one of the fastest growth segments, expected to account for $16bn in 2025 (36% 5Y CAGR)

- RPA is seen the fastest growing market in enterprise software (5Y CAGR >30%).
- RaaS is expected to grow to 1.3mn units in 2026, or nearly $34bn.





SOURCE:
Gartner, ABI Research,Trusted Business Insights , Mordor Intelligence, Grand View Research

Structural Trends – Collaborative robots

Collaboration outperforms "replacement of human workers"

As usages change, new processes emerge to make optimal use of collaborative robots. AI, edge computing and sensing, enable robots to sense and respond to their environment and be increasingly alongside humans.

- MIT found that robot-human teams are 85% more productive than either alone.
- Amazon is pioneering the use of co-bots to help with faster order fulfilment, reducing time to ¼ thanks to human-robot collaboration, and Mercedes-Benz reintroduced humans as it found that cooperation was more productive.

Collaborative industrial robots show strong growth

Manufacturers still struggle to hire qualified workers. Collaborative robots enable humans and robots to work in the same space, increasing employee's productivity, capabilities and skillset. Co-bots sales are expected to increase at a >40% CAGR.

- Manufacturing co-bots' market is still in its infancy, with ~5% of industrial robots installed in 2019 yet growing 11% in a global market declining -12% (vs. 2018).
- Collaborative robots are expected to increase their share to ~25% by 2025 as manufacturers enable more collaborative applications and upskill their legacy robots.

Robots will get smarter, more collaborative

Together with the adoption of AI technologies, collaborative robots requires multiple sensors including skin sensing, force-torque, cameras, Lidars, haptics, etc., pushing the envelope of technology and software.

- Beyond industrial, healthcare is a huge opportunity for collaborative robots as they participate in surgery, treatments (e.g., oncology), physical and neuro-rehabilitation.
- Universal Robots (owned by Teradyne, part of our portfolios) leads the market.

SOURCE:
International Federation of robotics, loup venture, universal robots, 360 research reports, Wikipedia

Structural Trends – Beyond robots

Humanoid Robots are rapidly expanding

Humanoid robots are service robots built to look and behave like humans and interact with humans in a natural way.

- The humanoid robot market is projected to be $3.9bn in 2023 (52% 5Y CAGR).
- AI news anchor started in China in 2018 and debuted in Korea this month. Such AI copies everything from human anchors, from looks all the way to their facial and body mannerisms as well as the sound of the voice.

Knowledge automation will power the new normal

With the spectacular progress of NLP technologies, knowledge automation is becoming real, and can be integrated with chatbots to enable complex decision-making and natural interaction.

- Google assistant, Amazon Alexa, and Apple Siri correctly answer 80% to 90% of the questions they are asked.
- Leading NLP algorithms like GPT-3 have demonstrated human-like writing and reviewing capabilities, opening the door for multiple applications in legal, finance, insurance, marketing, etc., addressing a $500bn market in 2025.

AI and Bionics augment humans

The neural prosthetics market has been slowly evolving, with applications in cognitive disorders, ophthalmic disorders, motor disorders, and auditory disorders.

- AI and Robotics advances are transforming the capabilities of prosthetics.
- The global market is expected to be around ~$15bn in 2024 and will accelerate as more edge computing and sensing capabilities become available.

SOURCE:
Report Buyer, "Humanoid Robot Market by Component, Motion Type, Application and Geography – Forecast to 2023", GrandView Research

AI & Robotics for dummies (1/2)

Artificial Intelligence

AI is a set of technologies that enable machines to mimic human behavior and give them the ability to perform tasks that are thought to require intelligence.

- AI is embodied in the form of robots (either virtual or physical) that can learn and perform action autonomously (training and inference).
- The AI revolution started about 10 years ago when GPU accelerators and large data set availability moved Deep Learning from theoretical to practical.

Robotics

Robotics involves design, construction, operation, and use of robots. The goal of robotics is to design intelligent machines that can help and assist humans

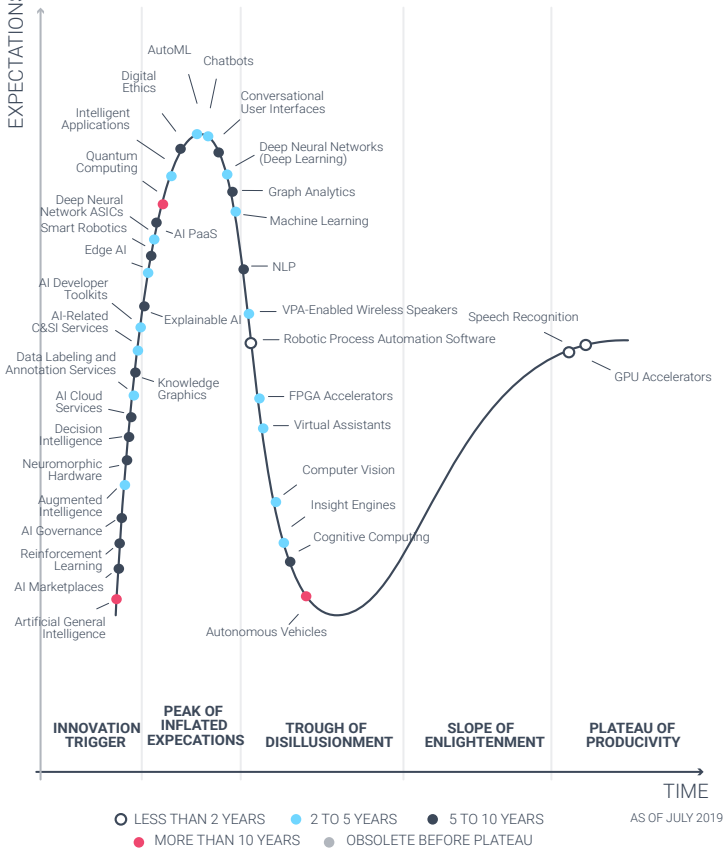
- Robotics develops machines that can substitute for humans and replicate human actions autonomously. It is usually associated with mechatronics.
- The concept of robotics is embracing virtual robots and Robots-as-a-Service as massive cloud computation capabilities are integrated with edge devices.

Automation

Automation is the application of technology, AI and robotics to achieve outcomes with minimal human input.

- Data automation and insight engines are a set of technology applied to describe, discover, organize and analyze data, with the aim of delivering it proactively in the context of digital workers, customers or processes.
- Robotic Process Automation is a set of technologies based on metaphorical software robots and on AI and digital workers.

GARTNER HYPE CYCLE FOR ARTIFICIAL INTELLIGENCE, 2019



SOURCE:
COLLECTIVE RESPONSIBILITY, International Federation of Robotics

AI & Robotics for dummies (2/2)

Traditional infrastructure

AI algorithms heavily rely on semiconductors to run. Their increasing complexity and popularity have given birth to various combinations of computing systems.

- CPUs and various silicon memories (Dynamic Random-Access Memories) and various forms of Non-Volatile Memories remain at the core of the infrastructure.
- GPUs and FPGAs are increasingly used thanks to their ability to parallelize computing tasks.

Multiple computing elements and electronic chips

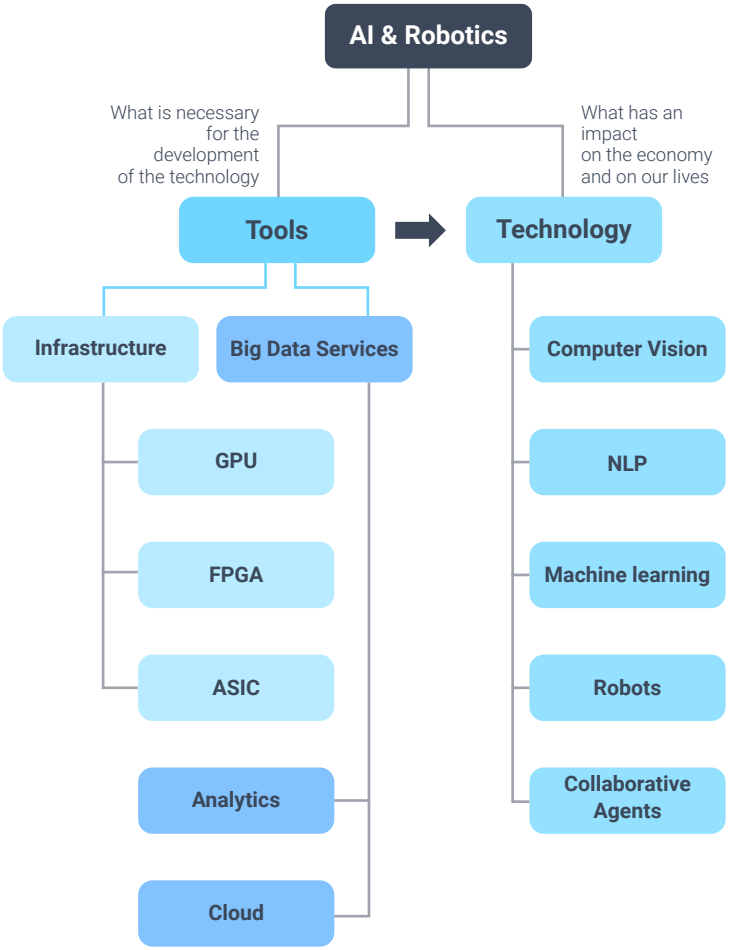
As the pace of development of AI algorithms is hindered by the bottlenecks of traditional computing architectures, a new breed of chip design is appearing to address this problem and legacy architecture evolve.

- Hyper-parallel architectures, like GPU, are evolving into "sea of cores" processor architectures such as Data Processing Units (DPUs), which act together as systolic arrays, accelerating linear algebra computations.
- Neuromorphic chips mimic the structure of neurons, looking to achieve brain-like performance. The neuromorphic technology is still in its infancy.

Centralization remains

The amount of computing power required to run AI algorithms is too important to be done locally. Decentralizing applications processing is a major challenge addressed by edge-computing, yet technology points to a computing continuum.

- Applications using NLP such as AI assistant rely on an internet connection.
- Edge-computing will not replace core datacenters but come as a counterpart, enabling real-time decisions and collaborative agents.



Catalysts

- **Moore's law is very much alive.** Silicon foundries have been introducing advanced semiconductor processes in late 2020. This technology will improve the performance of the infrastructure which powers AI & Robotics products and enable lower power consumption and higher capabilities.
- **5G is live and ramping up.** As the roll-outs accelerate, the technological upgrade will fuel the rise of a new ecosystem and will open new opportunities, notably in edge computing and Internet-of-Things applications.
- **NLP blends with knowledge automation.** The acceleration in language processing is only at its premises and will allow massive productivity gains, notably through collaborative robots and knowledge automation software.

Risks

- **China / U.S. escalation.** Placed into a technological corner following U.S. sanctions and export control, escalation is a possibility to consider and would impact the semiconductor ecosystem and global value chain.
- **Restrictive regulations.** AI algorithms require an endless amount of data, which become increasingly protected by governments due to privacy and security concerns.
- **Public backlash and ethics consideration.** Public opinions and some notable individuals are increasingly concerned regarding autonomous AI & Robotics catastrophic scenarios (à la Skynet), as there are global social concerns about robots replacing humans and the future of work.

Bottom Line

- The year 2020 and the Covid-19 impact has highlighted the need for global automation. AI has a major role to play in this perspective, as is expected to bring massive efficiency and productivity gains through technologies such as NLP and co-bots. 5G may have turned into a buzzword, yet it is finally a reality with the rollout of both infrastructure and compatible devices. The global availability of high-speed and low-latency networks enable the edge computing wave and is foundational to new technologies such as autonomous driving.
- Datacenters will continue being at the center of the game. Yet we expect a different dynamic with the rise of composable and disaggregated infrastructure redistributing the cards between chip players and architectures, notably the potential power coup from ARM chips.

Companies mentioned in this article:

Alibaba (9988 HK), AMD (AMD US), Apple (AAPL US), ARM (not listed), Baidu (BIDU US), Google (GOOG US), Intel (INTC US), Microsoft (MSFT US), Mobileye (not listed), Nvidia (NVDA US), SpaceX (not listed), Sony (6758 JP), Tencent (700 HK), Teradyne (TER US), Tesla (TSLA US), TSMC (2330 TT)

BIONICS – GIVING MEDICAL TECHNOLOGIES NEW WINGS

Selecting Innovation

Bionics is stronger than ever

The core fundamentals driving our Bionics strategy are stronger than ever. The Covid-19 pandemic exacerbated the existing challenges of the healthcare system. It has also reinstated health as a top priority.

- Innovations in medical technology proved their value proposition in reducing healthcare costs while improving people's safety and quality of life.
- The sector responded at a fast speed, resulting in amazing advances in many Bionics segments.

Careful selection is needed

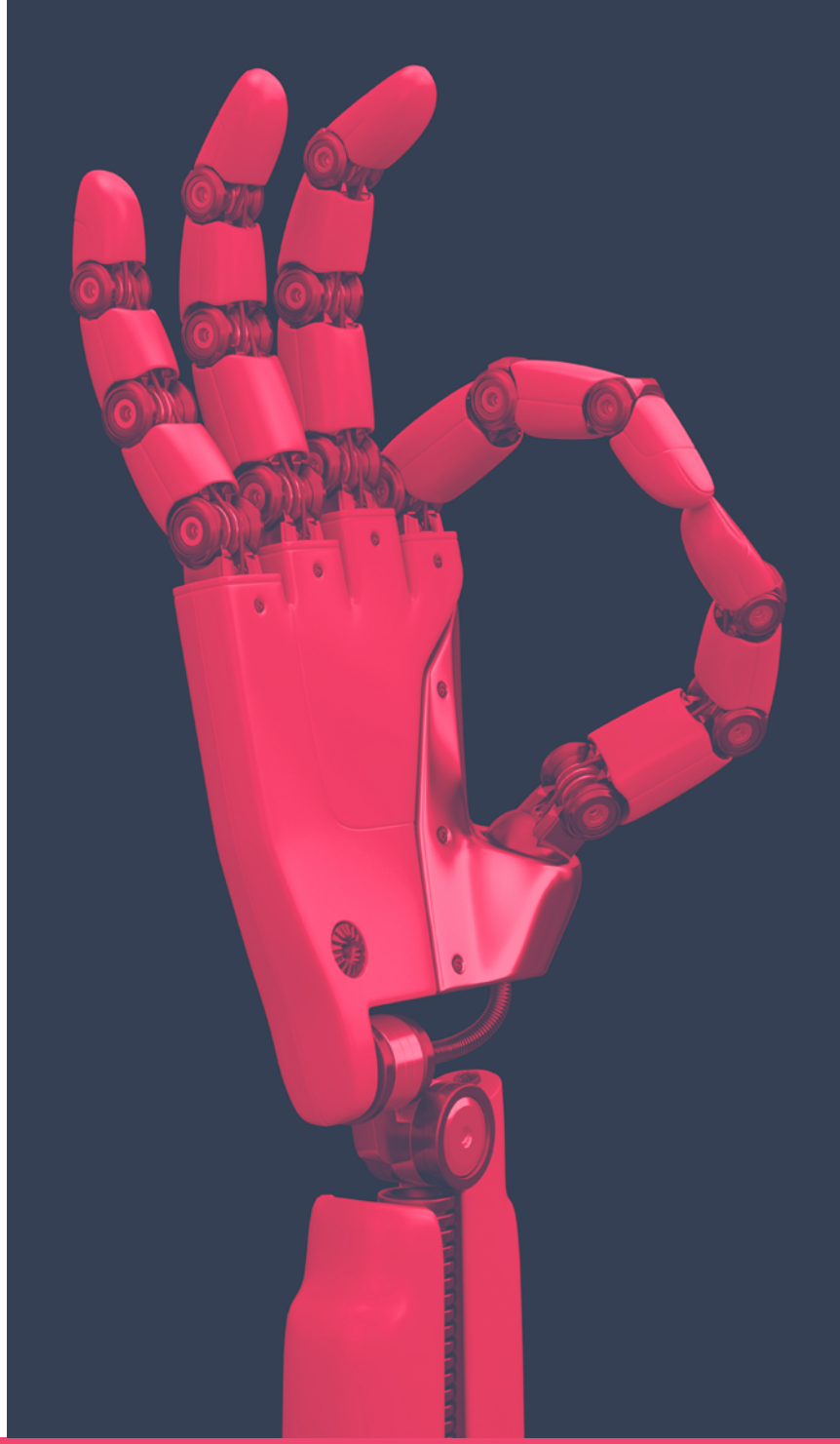
Some catalysts unfolded as expected while others were challenged by the pandemic. Therefore, the sectors' results had a lot of dispersion.

- Large MedTech FY2020 revenue declined to the tune of 10%.
- Orthopedic/cardiovascular were the most hit with sales declining up to 85%.
- Digital health and genomics observed the strongest growth with sales >80%.

For a brighter future

Some sectors in the Bionics theme are expected to unlock their power while others start their consolidation phase.

- A revolution in the fields of medical oncology and bio-production is just around the corner.
- Regulation and reimbursement will continue to keep pace with innovation.
- Chinese MedTech is a must-have notably in areas such as genomics, cardiovascular and digital health.



Covid-19 – Impact

Digital health: from luxury to necessity

Social distancing restrictions brought telemedicine into the spotlight with rocketing adoption. The pandemic induced a set of favorable regulatory and reimbursement policies, which are set to become permanent.

- More than 130 digital health services have been covered by Medicare.
- The digital health market is now estimated to grow at an average of 30% CAGR over the next five years, and the addressable market to reach $640bn.

Strong demand for In Vitro Diagnostic (IVD) tests

Companies in the genomic and synthetic biology sectors leveraged their knowledge in the fight against Covid-19 by developing a broad set of tests to detect the presence of the virus. A vaccine won't mean the end of this market.

- Biden plans to increase the reimbursement for Covid-19 tests and to create a strategic stockpile for potential future outbreaks.
- Covid-19 related IVD tests generated $9bn in revenue, or more than 10% of the overall IVD market.

Surgical robots in slow motion

The pandemic forced hospitals to forgo elective procedures and delayed the launch of new medical robots. Robot-assisted surgery volumes fell sharply as a result.

- Growth in the robot-assisted surgery should resume in 2021.
- This market, where Intuitive Surgical commands the highest share, represents a $24bn addressable market by 2025 with a CAGR of 24%.

SOURCE:
The Worldwide Market for In Vitro Diagnostic Tests, 13th Edition,
Surgical Robots Market Size By Component (...) Competitive Market Share & Forecast, 2019–2025,
Digital Health Market Size By Technology (...) Competitive Market Share & Forecast, 2020 – 2026

Outlook – Regulation

Towards a value-based system

The U.S. is slowly shifting towards a value-based system, where payments and approvals are based on health outcomes, enabling the healthcare system to create more value for patients.

- The FDA plans to consider the improvement in patients' quality of life when evaluating the approval of medical devices.
- A recent regulation will reduce legal risks for medical device manufacturers participating in value-based arrangements with providers.

Innovative sectors receiving attention from the FDA

The FDA is actively evaluating the evolving role of emerging technologies in medicine, looking for better ways to evaluate and approve these devices.

- Sectors receiving regulatory attention this year include artificial intelligence, digital health, Augmented Reality and Virtual Reality (AR & VR), and genomic-based tests.

Innovation award winners: neuromodulators and liquid biopsy

This year, we witnessed a wave of breakthrough device designations for neuromodulation systems and blood-based diagnostics, indicating a spate of new devices is coming.

- Neuromodulation, a field dominated by the likes of Medtronic, Abbott, Boston Scientific, and Nevro, has suffered from a lack of innovation.
- However, innovation in these fields will reach the market faster, as the label accelerates their time to approval.

SOURCE:
FDA Launches the Digital Health Center of Excellence

Outlook – Reimbursements

Bridging the "valley of death"

Medical device manufacturers have long lamented what they call "a valley of death" between the time a device gains approval and when Medicare grants reimbursement. Filling this gap will ease access to needed therapies and break down barriers to adoption.

- In the U.S., the traditional process for reimbursement coverage takes 9 to 12 months to finalize.

From innovation to adoption

The Centers for Medicare & Medicaid Services (CMS) expects to introduce a faster coverage pathway for FDA-designated breakthrough devices. Innovative medical devices will benefit from faster Medicare reimbursement.

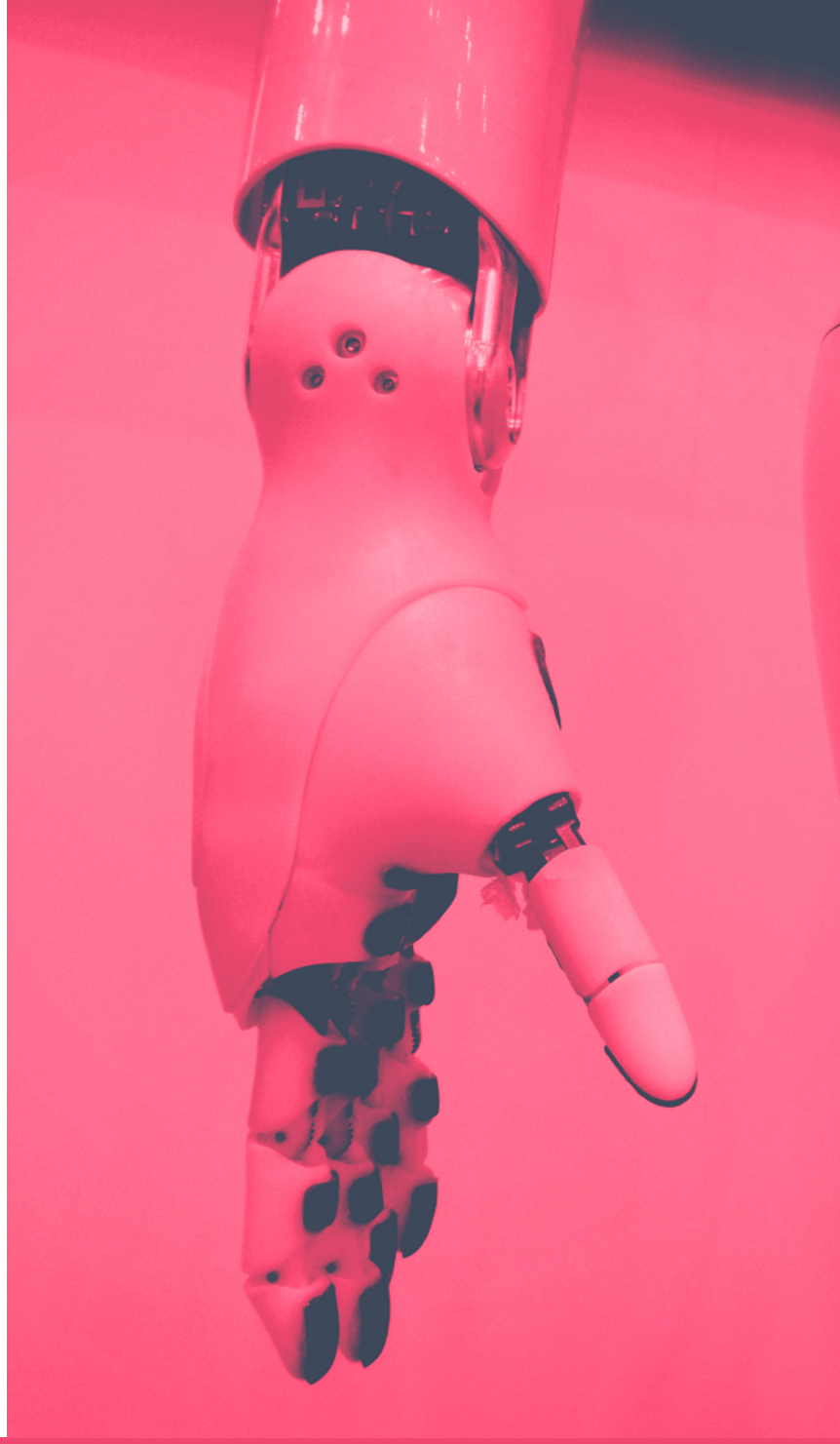
- CMS will cover the devices for up to four years from the date they receive U.S. marketing authorization.
- The coverage pathway would probably reduce chronic health issues and therefore, some costs for Medicare down the line.

An explosion of positive decisions

The CMS has already issued a flurry of favorable decisions for several innovative technologies and services.

- CMS wants to change payment rates for home health providers, to be implemented by the 1st of January 2021.
- Exoskeletons, artificial hearts, liquid biopsy for colorectal cancer, genetic tests for breast and ovarian cancers, have been among the beneficiaries of new favorable reimbursement policies.

SOURCE:
Proposed Medicare Coverage of Innovative Technology (CMS-3372-P)



Outlook – Digital Health (1/2)

Telemedicine going mainstream

Social distancing has boosted healthcare's digitalization at an unprecedented pace. Although the use of telemedicine may decrease from peak-pandemic levels, digital health is here to stay, and the time has come to consolidate.

- CMS wants to make some of these emergency changes permanent, starting from the 1st of January 2021.
- The FDA has launched the Digital Health Center to build a tailored regulatory process for digital health technologies.

Digital health providers are surfing the wave

Remote monitoring technologies and telemedicine have been at the forefront of the pandemic response, and 2020 has seen a surge in digital health IPOs, and the largest M&A deal ever in the space.

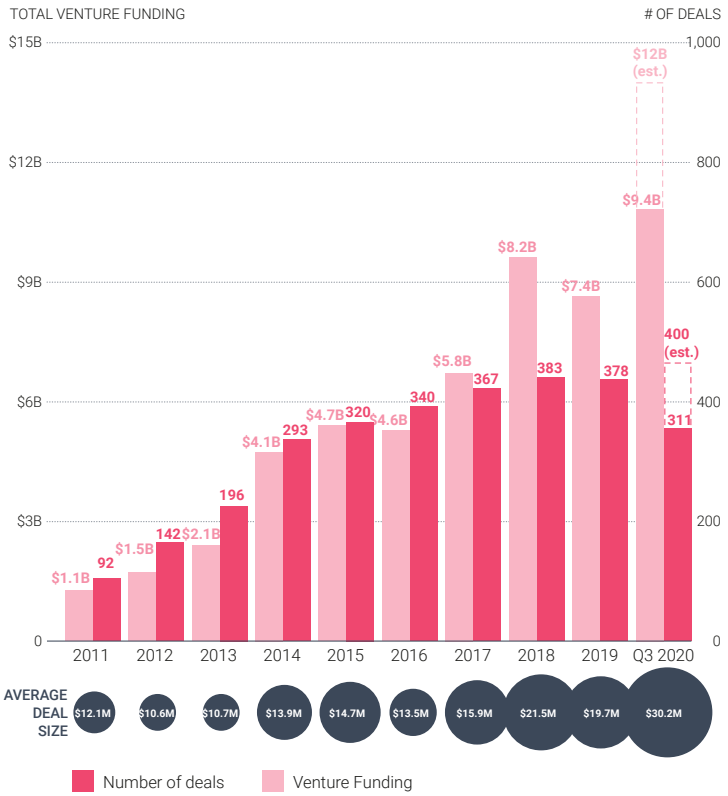
- Teladoc bid $18.5bn to buy Livongo, a move with far-reaching implications.
- It is estimated that 20% of healthcare services can be virtualized, representing up to $250bn each year in the U.S. alone.

Wearables are becoming ubiquitous

Smart connected devices were initially designed to monitor simple vital parameters like heart rate during sport. Wearables are expanding their market and are entering hospitals with new sensors to monitor a much larger number of parameters.

- FDA has exceptionally allowed continuous glucose monitoring (CGM) devices to be used in hospital settings.
- iRhythm, Apple, and Fitbit (Google) are eyeing atrial fibrillation, a condition affecting 33.5mn people worldwide.

DIGITAL HEALTH FUNDING AND DEAL SIZE



SOURCE:
McKinsey Analysis: Up to $250B of Healthcare Could Be Virtualized

Outlook – Digital Health (2/2)

Insulin pumps & CGMs on the rise

The strong adoption of wearables, such as insulin pumps and CGM systems, will continue unabated into 2021 with the launch of new, improved products and easier access through the pharmacy channel.

- Dexcom plans the full rollout of G7, the company's new CGM sensor, that will be cheaper to produce and more accurate than currently marketed G6.
- Tandem expects approval by FDA of t:sport, its latest smart insulin pump.

Smartphone-connected wearables will drive adoption

Wearable devices are now connecting with smartphones, eliminating the need for a dedicated monitor, and giving greater insight into health data to patients and doctors. This is expected to expand adherence to wearable technologies.

- Tandem's t:slim X2 and Insulet's Horizon are subject to FDA review for approval about being controlled directly via a smartphone's app.

Tech giants entering the field

Digitalization of healthcare is attracting Big-Tech companies in the digital health space, especially into wearable devices and pharmacy. In 2020, smartwatches added several features to track cardiac rhythm and blood pressure.

- In August, Fitbit and Withings revealed their new smartwatch with an integrated electrocardiogram (ECG) to monitor cardiac rhythm.
- In November, Amazon launched an online pharmacy for delivering prescription medications in the U.S., competing with the GoodRx.

SOURCE:
The Dex Factor – coming in 2021, Dexcom's G7 CGM sensor,
Innovations in Progress,
Amazon launches online pharmacy service

Outlook – Artificial Organs

Artificial pancreas: a major catalyst for diabetes tech growth

When CGM devices and insulin pumps talk together, the artificial pancreas shows up. The commercialization of this technology is expected to increase the adoption of insulin pumps and CGM devices.

- Insulet plans to launch its new artificial pancreas, Horizon (slated to be integrated with Abbott and Dexcom CGMs) in H1 2021.
- Beta Bionics is preparing to submit its breakthrough-designated iLet system, a fully automated system, to the FDA for approval.

Brain: neuromodulation devices are undergoing a renaissance

Neuromodulation devices are catching up with innovation. New players bring less invasive, long-lasting, and more connected devices, shaking a market once dominated by large MedTech companies.

- 2020 has seen an unprecedented number of FDA breakthrough device designations for neuromodulation devices.
- Elon Musk's Neuralink implant, discussed in a recent article, is expected to start its first-in-human trial in 2021.

Liver, heart and ears are benefitting from major changes

Favorable reimbursement policies have been established for innovative at-home dialysis systems, artificial hearts, and ventricular assist devices (VAD). A clear regulatory pathway for Over-The-Counter (OTC) hearing aids is work-in-progress.

- U.S. Senators urged the FDA to favor the creation of OTC hearing aids, as high costs and excessive regulations remain barriers to adoption.

SOURCE:
Neuromod devices at the fore in latest FDA breakthrough designations,
Insulet's pivotal study back on track, setting up Horizon launch in early 2021

Outlook – 3D Printing

Redesigning the MedTech supply chain

The Covid-19 crisis pointed out supply chain issues, and 3D printing took its chance to show its potential in redesigning the supply chain of the medical device industry.

- During the pandemic, the technology has been repurposed to print replacement valves, Covid-19 testing swabs, personal protective equipment (PPE) and ventilators.
- Trump signed "Buy American" executive order in August 2020, to encourage the manufacturing of selected drugs and medical devices within the U.S.

Personalizing orthopedics, surgery and dentistry

3D printing continues to make inroads in the orthopedic, surgery, and dental sectors. Large medical device companies are acquiring the technology, mostly through M&A deals and partnerships.

- This year, Medtronic acquired Medicrea, a developer of patient-specific, 3D-printed titanium spinal implants.
- In December 2019, GE Healthcare partnered with Formlab to 3D print patient-specific anatomical models based on imaging data.

A step towards tissues and drugs

3D printing has the potential to transform drug manufacturing. The technology is also making its first steps into the bioprinting of cell tissues and human organs.

- In April 2020, FabRx released M3DIMAKER, the first 3D printer to manufacture personalized medicines.
- Next year, Organovo plans to start the first-in-human trials of its 3D printed liver patch.

SOURCE:
FabRx's pharmaceutical 3D printer for personalised medicines, M3DIMAKER™, is now available!
Medtronic to Acquire Medicrea

Outlook – Genomics (1/2)

The DNA: a powerful source of information and… innovation

Genomics uses the powerful lens of Next-Generation Sequencing (NGS) to unlock DNA's secrets and give better insights about our health. NGS enables medical applications such as liquid biopsy tests and cancer vaccines.

- The first NGS-based liquid biopsy test, Guardant Health's Guardant360, has been approved by the FDA in August.
- Ancestry launched the first NGS test that screens for genes associated with cancer, heart diseases, and blood disorders.
- This year, CMS announced coverage of FDA-approved diagnostic tests for breast and ovarian cancer using NGS.

A $100 genome might open up limitless opportunities

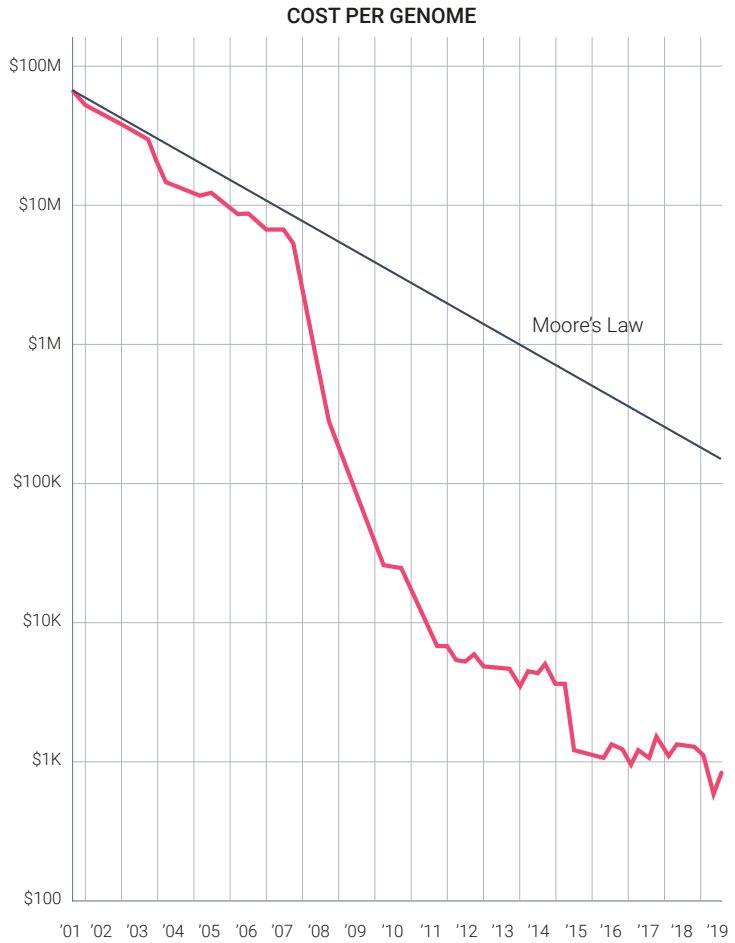
Some industry leaders envision to break the "$100 genome" bar in the near term. At this price level, the adoption of technologies relying on DNA sequencing would significantly accelerate.

- Nebula Genomics began offering whole genome sequencing for $299.
- Chinese's BGI Genomics plans to make it soon cheaper than $100.

Eager to know your true biological age?

NGS is pushing the frontiers of biology, and this year the technology allowed significant advancements in epigenetics. This field studies the mechanisms affecting how genes are read by cells, ultimately having an impact on aging.

- Elysium Health is developing an at-home DNA test to determine biological age and informing people how they're aging at the cellular level.
- As the field evolves, age-reversal therapies may emerge in the future.



SOURCE:
Guardant360 CDx – P200010,
How Can the Liquid Biopsy Market Realize Its $30B Potential?
China's BGI says it can sequence a genome for just $100

Outlook – Genomics (2/2)

From sequencing to liquid biopsy: the Holy Grail of cancer

Liquid biopsy has revealed its potential to detect early-stage cancer, follow its progression during drug therapy or allow the selection of personalized treatment, and there is much more to come.

- In the years ahead, the U.S. total addressable market may range between $30bn and $130bn annually, with asymptomatic screening and recurrence monitoring representing the most significant opportunities.
- The CMS proposed a coverage policy for blood-based colorectal cancer tests once every three years.

2021 will be key for liquid biopsy

Besides early-stage cancer, next year will bring a new wave of products for a wide range of applications and the achievement of some important clinical milestones.

- Grail has slated the commercial launch of its early-stage pan-cancer tests, Galleri and DAC, in H2 2021. A recent partnership with the U.K. government could lead to a routine use of this test throughout the nation.
- Exact Sciences plans the U.S. launch of its liver cancer blood test for high-risk patients.

When AI comes into the labs

So far, liquid biopsy has been able to detect only a small subset of cancer types with well-known DNA mutations. However, this technology's greatest ambition is the early detection of a much larger number of cancers using the same drop of blood.

- Once a dream, AI algorithms are now turning this technology into reality by analyzing many cancer mutations and improving diagnostic accuracy over time.

Total U.S. addressable market by application				
Asymptomatic screening	**High-risks screening**	**Therapeutics selection**	**Recurrence monitoring**	**Biopharma development**
$5-50bn	$2-5bn	$2-5bn	$20-75bn	$1bn
Grail (Illumina), Thrive Earlier (Exact Science), Burning Rock Biotech, Guardant Health, Freenome	Exact Sciences (liver), Guardant Health (lung)	Guardant Health, Foundation Medicine (Roche), ArcherDx (Invitae)	Adaptive Biotechnologies, Natera, Guardant Health, Invitae	Adaptive Biotechnologies, Natera, Guardant Health, Invitae, Personalis

SOURCE:
Grail Hopes to Take Early Cancer Detection to New Level by Going Public

Outlook – Synthetic Biology

Synthetic Biology: no longer a matter of "if" but "when"

As written in a recent article, advances in synthetic biology are driven by the drop in the price of DNA synthesis, unlocking opportunities for new disruptive applications.

- Twist Bioscience Corporation announced this year the storage of an entire Netflix episode in synthetic DNA.
- Japanese startup, Spiber, is producing clothes in spider silk made by microbes, replacing petroleum-based fibers.

The only missing element: Bio-foundries

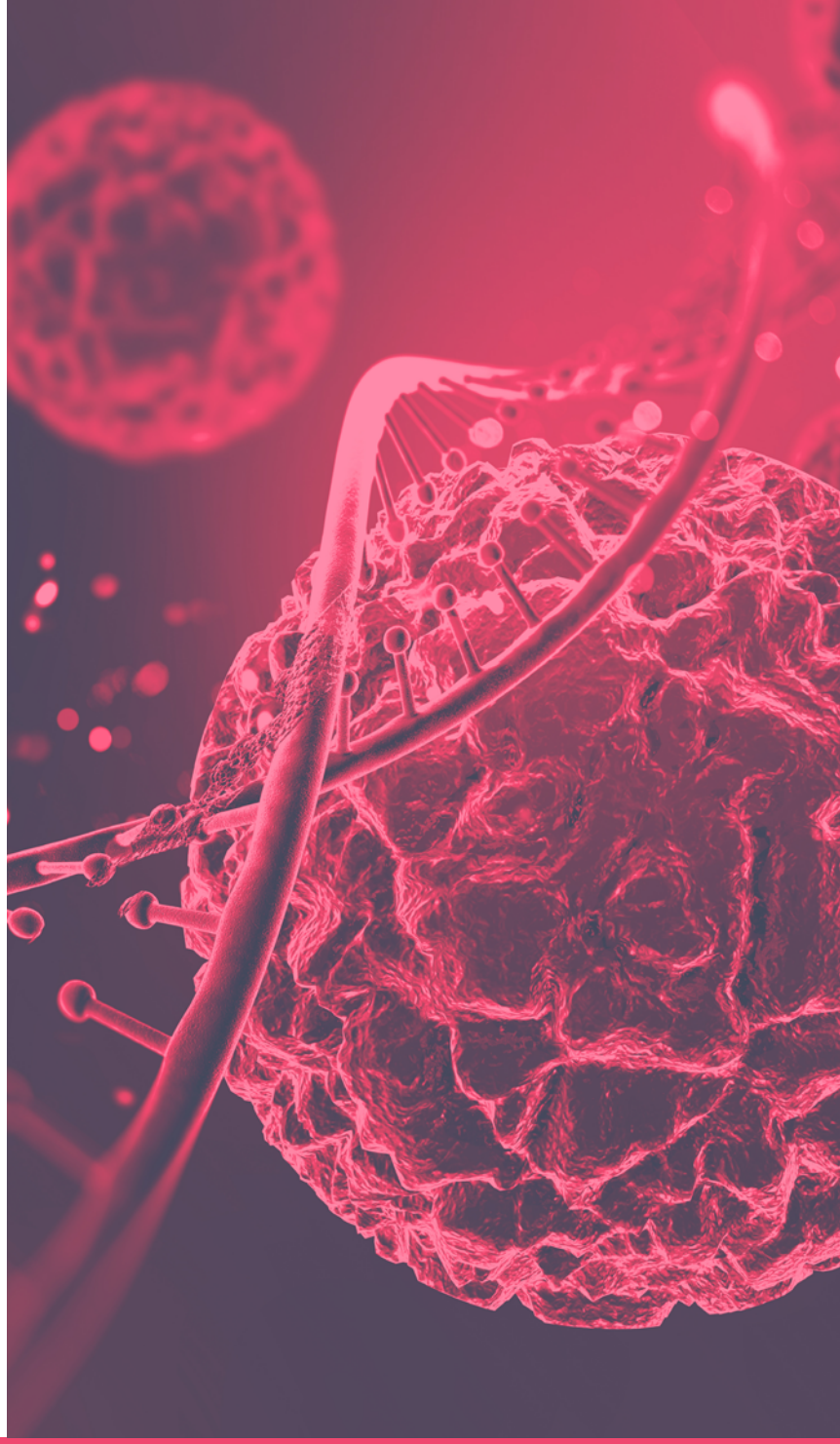
Bio-foundries are the missing element that will unleash the potential of synthetic biology. Some players are building huge cellular factories to manufacture everything from raw materials to DNA.

- Bio-foundries will disrupt the way products are created and will drive synthetic biology's transition from R&D to real-world applications.
- Ginko Bioworks received $1.1bn in loans from the U.S. Government to manufacture raw materials for Covid-19 vaccines, including Moderna.

Synthetic genes: the picks and shovels of synthetic biology

Advances in robotic systems, gene-editing techniques, and new bio-technologies have given a novel life to the field. Located earlier in the value chain, these technologies are responsible for the chemical production of the synthetic genes.

- Advances in semiconductors allowed the chemical reactions in miniaturized silicon chips, disrupting precision, scalability and price of DNA synthesis.



SOURCE:
Twist Bioscience Synthetic DNA Stores New Netflix Original Series 'BIOHACKERS',
U.S loans $1.1 bln to Ginkgo Bioworks for pandemic effort

Outlook – Interventional Devices

Innovation is disrupting traditional medical devices

New game-changing technologies are replacing more traditional medical devices. This is particularly true for cancer and cardiovascular diseases, where conventional treatment techniques need a breath of fresh air.

- Mini-invasive technologies aim to reduce the overall cost of patient care while improving clinical outcomes.
- In 2020, Abbott received E.U. approval for Tendyne, a cardiac (TMVR) device.

Only the best survives

Competition for these technologies has proven to be less fierce as the devices' complexity and high regulatory requirements represent significant barriers to entry and a hurdle to remain in the market.

- Boston Scientific withdrew its Lotus Edge TAVR device from the market.
- Novocure, Shockwave, and Abiomed hold respectively a monopoly on TTF therapy, IVL technology and Impella.

No signs of slowdown in 2021

Companies have generated robust clinical data validating their technologies, and these efforts are now bearing fruits. The sector has experienced strong performance in 2020, and we expect the momentum to continue next year fueled by new clinical milestones, products approval, market expansion, and reimbursement decisions.

- Shockwave expects to receive approval for its IVL system next year.
- As we discussed, TTF therapy, is expected to reach major clinical milestones during the next year.

Innovative interventional solutions	Description
Intravascular Lithotripsy (IVL) technology	A new treatment that uses shockwave to disrupt heavily calcified lesions in blood vessels.
Tumor Treating Field (TTF) therapy	TTF therapy is a new cancer treatment that applies an electric field to inhibit cell division in cancer cells.
Transcatheter Aortic Valve Replacement (TAVR) / Transcatheter Mitral Valve Replacement/Repair (TMVR), etc.	A minimally invasive procedure to replace or repair a narrowed valve that fails to open properly.
Impella	A tiny pump inside of a catheter inserted into the patient's heart to assist blood flow.

TTF Therapies	Expected
Data from phase 2 pilot HEPANOVA trial in advanced liver cancer	Q1 2021
Data from phase 2 pilot EF-31 trial in gastric cancer	2021
Interim analysis of phase 3 pivotal LUNAR trial in non-small cell lung cancer	2021
Complete interim analysis of phase 3 pivotal PANOVA-3 trial in locally advanced pancreatic cancer	2021
Interim analysis of phase 3 pivotal INNOVATE-3 trial in recurrent ovarian cancer	2021

SOURCE:
Boston Scientific calls it quits on Lotus Edge TAVR program,
Shockwave completes enrolment in study of coronary intravascular lithotripsy

2020 – A Glance In The Rear-View Mirror (1/2)

The first-ever screening trial of a liquid biopsy

Thrive Earlier Detection published data from its 10k-patient Detect A trial showing acceptable specificity and very good sensitivity.

- Promising set of data for early cancer detection tests.

Whole genomic sequencing becomes cheaper

Nebula Genomics, began to sequence for just $299.

- Chinese giant BGI Genomics announced it will soon make genome sequencing cheaper than $100.

The world's smallest heart pump enters clinical trials

The FDA has approved Abiomed's first-in-human trial of the Impella ECP.

- Impella ECP is the world's smallest heart pump with peak flows greater than 3.5 L per minute.

The first FDA approved video game for Attention Deficit Hyperactivity Disorder (ADHD)

Technologies such as the Akili's Interactive EndeavorRx device offer a non-drug option for improving symptoms, with fewer side effects.

- Prescription of digital therapeutics are emerging.

IMPACT

H1 2020

IMPACT

Covid-19 impact – Q1 results

Sales of medical device for elective, non-urgent procedures fell sharply.

- Medical devices companies Q1 results revealed a sharp drop in sales for routine diagnostic tests and devices for elective procedures.

FDA is adapting to the emerging role of AI in medicine and liquid biopsy

FDA discussed the appropriate study designs needed to demonstrate the safety and effectiveness of cancer screening.

- Announced a workshop to evaluate the role of AI in imaging.

A new proposed coverage change for VAD and artificial hearts

CMS was reconsidering to expand the coverage of artificial hearts and VAD (decision confirmed in December).

- The decision is set to facilitate patients' access to these technologies.

Abiomed faces CMS reimbursement cut of about 25%

Despite this decision, other Impella procedures are slated for payment increase.

- The policy changes for FY2021 would take effect starting October.

2020 – A Glance In The Rear-View Mirror (2/2)

Liquid biopsy for early-stage cancer has the chance to be validated in real world

Grail announced a commercial partnership with the U.K. government.

- The collaboration could lead to the routine use of its liquid biopsy throughout the nation.

The first blood test to help diagnose Alzheimer's disease

C2N Diagnostics has started commercializing a test that measures two types of amyloid particles plus various forms of a protein.

- The test reveals whether someone has a gene that raises risk for the disease.

CMS did not finalize national pricing for Extended Holters

CMS has decided to not finalize national pricing for the technology.

- Uncertainty around reimbursement as it is to be established with local Medicare Administrative Contractors.

Lab-grown meat alternative is emerging

Singapore becomes the first country to approve lab-grown meat and a restaurant in Israel started offering lab-grown chicken.

- Israeli startup SuperMeat and Eat Just are offering lab-grown chicken.

IMPACT

H2 2020

IMPACT

The first NGS based liquid biopsy test has been approved by the FDA

The Guardant360 received FDA approval based on clinical and analytical validation data from more than 5'000 samples.

- The approval allows the test to be reimbursed under the existing CMS national coverage determination.

The smallest CGM device reaches the commercial market

Abbott's Freestyle Libre 3 received CE Mark.

- CGMs are becoming smaller and smarter, which should help increase people adoption for artificial pancreas.

Collaborations between synthesis and sequencing

Collaboration in the field of DNA data storage to establish the foundations for a cost-effective commercial ecosystem.

- Twist Bioscience, Illumina and Western Digital, along with member organizations, created a comprehensive roadmap to interoperability.

Bio foundries are receiving huge funding and fueling demand for synthetic DNA

U.S. government has agreed to loan Ginkgo Bioworks $1.1bn for Covid-19 testing.

- Production of raw materials for therapies that may help address future pandemics.

2020 – Capital Markets

M&A activity

Despite a light H1, M&A activity rebounded during the third quarter of the year, driven by digital health and liquid biopsy deals.

- The two largest deals: Teladoc's purchase of Livongo for $18.5bn and Siemens Healthineers's acquisition of Varian Medical Systems for $16.4bn.
- Illumina made an $8bn move to buy Grail, while Exact Sciences acquired Thrive Earlier Detection for $4bn.

IPOs

This year, the total capital raised for IPOs was the third highest on record, driven by the genomics (especially liquid biopsy) and digital health sectors.

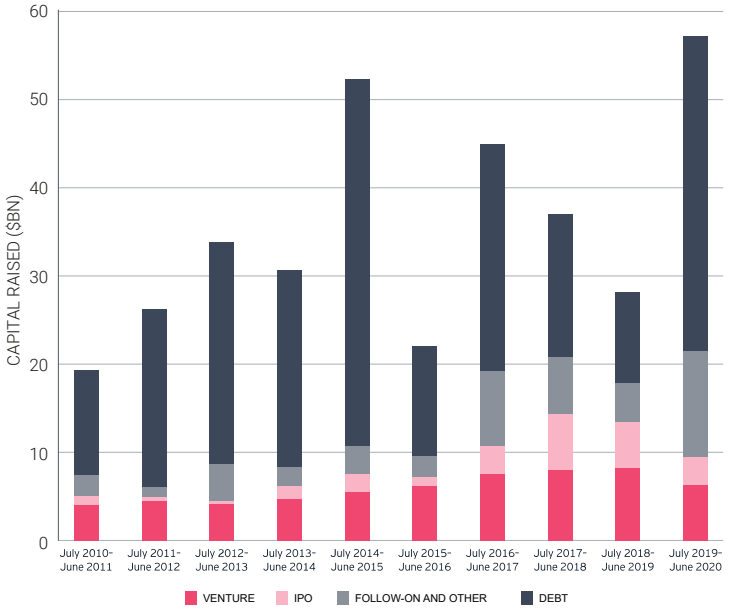
- Among the biggest deals: GoHealth raised $914mn, bringing the initial valuation to about $6.6bn, while Amwell raised $742mn for an initial valuation of $3.96bn.
- China joined the party with three liquid biopsy IPOs: Anpac Bio-Medical Science, Genetron Holdings, Burning Rock Biotech.

Venture Capital (VC)

VCs participate in ever-larger rounds for relatively de-risked companies, making considerable bets on liquid biopsy and digital health companies.

- The first biggest amount raised in liquid biopsy was Grail's $390mn series D round, followed by the $165mn funding of Karius.
- Zwift raised the largest digital health round, worth $450mn in a series C funding, followed by Alto Pharmacy and Oscar Health.

CAPITAL RAISED IN THE U.S. AND EUROPE BY YEAR



Source: EY, BMO Capital Markets, Dow Jones VentureSource and Capital IQ.
Numbers may appear to be inconsistent because of rounding. Private investments in public equity included in "follow-on and other."

SOURCE:
Teladoc To Buy Livongo Health In $18.5 Billion Virtual Care Mega-Deal,
GRAIL Announces $390 Million Series D Financing

Structural Trends (1/3)

Synthetic Biology – Close to unleash the unlimited power

Synthetic biology is a genetic engineering approach that manipulates the organisms' genomes using chemically synthetized DNA, for medical and industrial purposes. It is a tool to unlock the potential of biotechnology and has a wide-range of applications, including life science, chemicals, energy, and agriculture.

- The establishment of bio-foundries, advancements in sequencing technologies and further reductions in the costs of DNA synthesis will allow a more efficient and scalable creation of end-products.

VR & AR – A bridge between the physical and virtual world

The adoption of VR & AR in medicine is still in the early-innings. VR and AR promise to improve the precision, speed, and safety of medical procedures. Preference for non-invasive procedures and the need to reduce healthcare costs are driving expansion in the medical field.

- The FDA plans to accelerate the development of medical applications for immersive technologies.
- Digitalization of healthcare is increasing adoption of AR/VR, especially for patients' rehabilitation and during surgical procedures.

Digital Health – At the speed of light

Digital health involves the use of mobile health (mHealth), telemedicine, as well as wearable devices to support the delivery of health care.

- Driven by the Covid-19 crisis, reimbursement parity for telehealth services is approaching at a rapid pace.
- 5G technology will boost communication and data management, which will unleash the full potential of self-monitoring devices.

Structural Trends (2/3)

Medical Robots – The surgeon of tomorrow?

Surgical robots are used to perform complex procedures with more precision and control compared to conventional techniques, while less invasive. In addition, robot-assisted surgery is cost-effective and improves clinical outcomes.

- Medical robots' companies benefit from the advances of nanotechnology and semiconductors to disrupt the surgical sector.
- 5G will make remote robot-assisted surgery more accurate and reliable.

3D Printing – Rethinking the MedTech supply chain

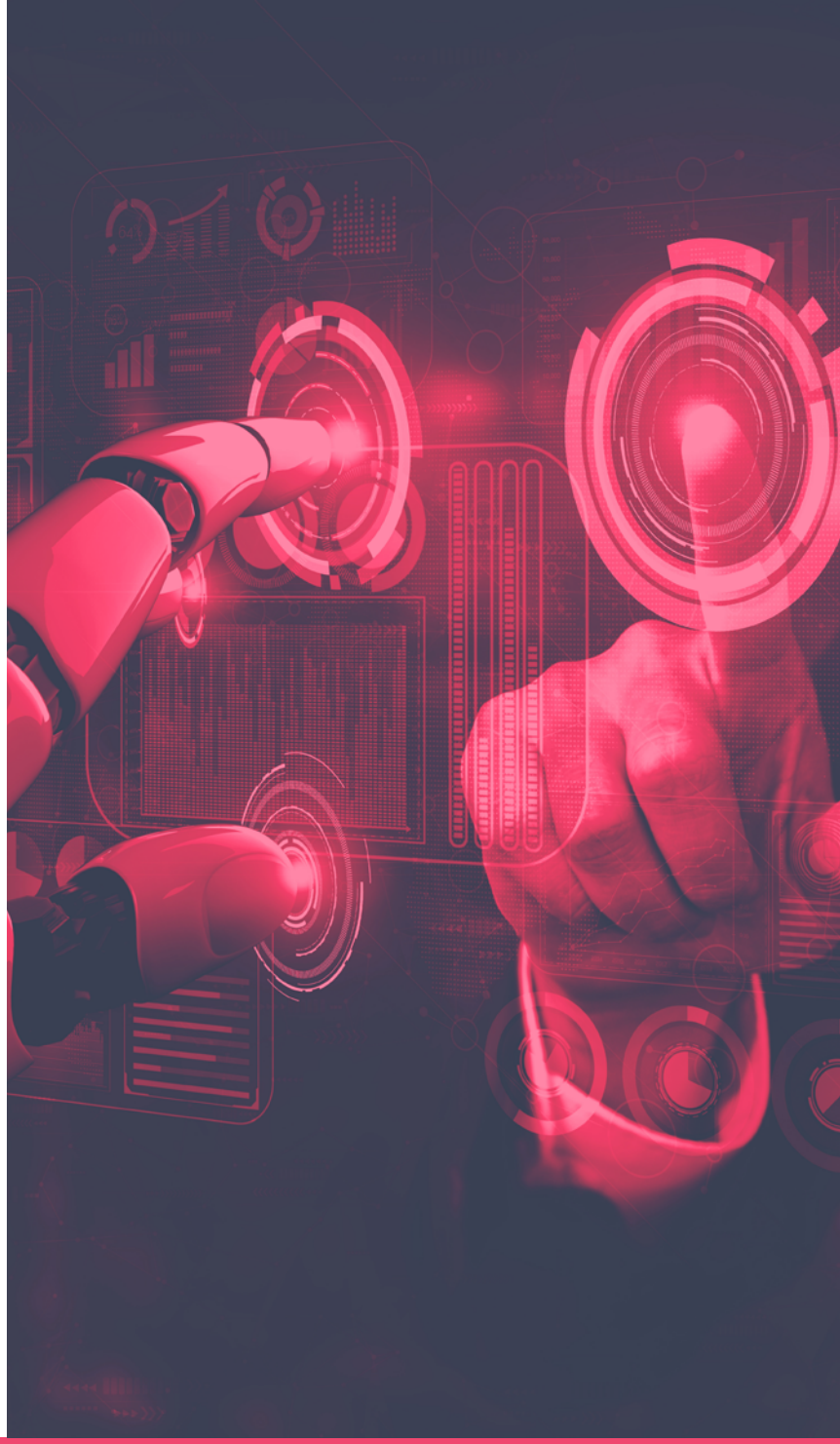
Today, we already print medical objects, from basic tools to custom-made prostheses. Tomorrow, we'll print human cells to replicate living tissues and organs, bringing new solutions to the organ shortage crisis.

- Covid-19 highlighted supply chain issues and the need to promote in-house manufacturing of medical supplies, increasing the adoption of 3D printing.
- Bioprinting living tissues is underway, boosted by advances in synthetic biology and tissue engineering.

Regenerative Medicine – A step towards natural healing

Regenerative medicine offers solutions to heal damaged tissues and organs. The sector includes tissue engineering, a field focused on growing tissues and functional organs in a laboratory. Investment opportunities start to unfold, bringing new regenerative medicine solutions to patients and clinicians looking for faster and more natural healing.

- The FDA has published a policy framework to support and expedite the development of regenerative medicine products.



Structural Trends (3/3)

Artificial Organs – Coming back to life

New medical technologies are developed to mimic the functions of human organs. The artificial pancreas is emerging to regulate blood glucose level of diabetic patients automatically. Hearth, limbs and ears have also made significant headway.

- Unprecedented progress in AI algorithms and semiconductors allows the miniaturization and the development of smarter artificial organs.
- Reimbursement expansion and lower prices are lowering barriers to adoption.
- 3D printing is bringing down the costs of some artificial organs (e.g., limbs).

Genomics – The next medical revolution is coming

Significant headway in AI and sequencing are making precision medicine a reality, enabling the development of genetic testing and liquid biopsy.

- Studies are establishing the clinical utility of these applications and are inducing more reimbursements in the field.
- The rapid decrease of human genome sequencing price is a major driver to move liquid biopsy from labs to real-world applications.

Innovative Interventional Solutions – Ripe with opportunities

Minimally invasive solutions are revolutionizing the treatment of cardiovascular diseases and cancer, shortening recovery times, and increasing cost-effectiveness.

- Oligopolies are common in this industry and companies have built solid clinical data over the years to strengthen their market position.
- The sector's growth is fueled by an expanded reimbursement coverage, new clinical results and product approvals.

Bionics for dummies (1/2)

Union makes power

Bionics focuses on highly unmet medical needs to improve people's quality of life, while reducing healthcare costs. AI, robotics, sequencing, digitalization, are joining their forces to fight against the oldest human threat: diseases.

- Bionic limbs controlled by brain implants, blood-based tests to diagnose cancer: every day more technologies move from being a futuristic promise to a reference point for innovation.

Bionics – high tech medical devices

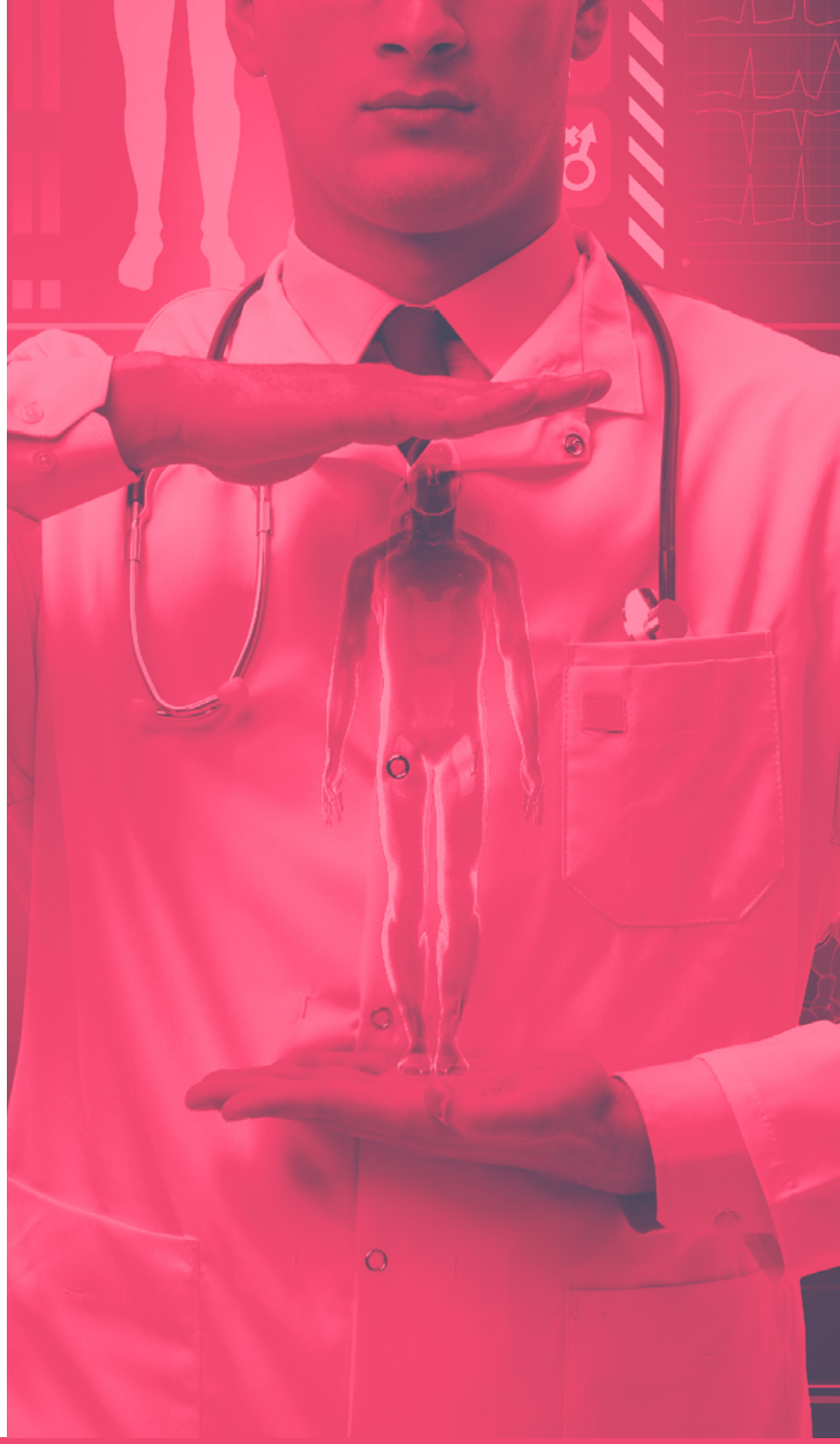
Bionics provides exposure to disruptive high-technology devices originating from the convergence of biology and electronics. High-technology devices typically face greater barriers to entry, thus competition in this segment is far more limited.

- High R&D costs, stronger patents protection, and greater regulatory scrutiny from the FDA, turn into higher profits for those that succeed.

No longer a starry-eyed vision of the future

Our investments in the Bionics thematic focus on revolutionary sectors such as synthetic biology, digital health, genomics, 3D printing, medical robots, regenerative medicine, artificial organs, AR/VR, and innovative interventional solutions.

- With reimbursements and regulation policies well established, medical devices are developed in a blooming environment that drives commercialization and adoption.



SOURCE:
Twist Bioscience Synthetic DNA Stores New Netflix Original Series 'BIOHACKERS',
U.S loans $1.1 bln to Ginkgo Bioworks for pandemic effort

Bionics for dummies (2/2)

Synthetic Biology – Making The Impossible Possible

Synthetic Biology: living organisms are fully redesigned with synthetic DNA to revolutionize medicine, agriculture, food, and many other industries. We invest in bio-foundries and synthetic DNA technologies, the underlying tools enabling the evolution of synthetic biology's applications.

VR & AR – Transformative Technologies For Medicine

Who wouldn't prefer to perform rehabilitation while playing videogames? What if surgeons could achieve better surgeries with detailed virtual models of a patient's anatomy? Immersive technologies have already entered the surgical practice, and new medical applications are rapidly evolving.

Digital Health – The Era Of Patient Empowerment

Healthcare is moving out of the hospitals, and the human body is becoming the biggest data platform, opening new opportunities in telemedicine, remote monitoring, and wearable devices.

Medical Robots – New Means For Better Medicine

Surgical robots and automation assist medical personnel in routine and complex tasks, helping reduce healthcare costs while providing better outcomes for patients.

3D Printing – The Solution To The Organ Shortage Crisis?

Today, 3D printing is mainly used for custom-made prosthetics (hearing aids, orthopedic implants, surgical tools, dentistry), but the technology is making giant leaps into human tissues, organs, and drugs.

Regenerative Medicine – A Bit Of Me

Some animals have impressive regenerative capabilities: the Axolotl has the power to regrow limbs, heart, and other organs. What about humans? Regenerative medicine brings new solutions to patients and clinicians looking for faster and more natural healing.

Artificial Organs – The Bionic Man Is Now A Reality

Artificial organs restore or even enhance human body functions. Artificial limbs, hearts, and pancreas are becoming part of our everyday life, and this is only the beginning.

Genomics – Towards Precision Medicine

Each patient is different and unique in front of a disease… so must be the treatments. DNA sequencing combines with AI to disrupt the way we diagnose and treat disease with the emergence of liquid biopsy.

Innovative Interventional Solutions – Disruptive MedTech

As more patients ask for non-invasive procedures, new emerging technologies are disrupting the standard of care. Major technological innovations in the therapeutic areas of cardiovascular diseases and cancer are on their road.

Catalysts

- **The launch of breakthrough products and the achievement of important clinical milestones.** Next year we expect the commercial launch of disruptive technologies and the announcement of new validating clinical data (e.g., early-stage cancer tests, TTF therapy, bio-foundries, etc.).
- **M&A activity may bounce back.** We may see a rebound in 2021 M&A activity, driven by high available capital and distressed assets. Deal activity is likely to remain strong for liquid biopsy and digital health sectors.
- **Innovation is bringing payers on board.** Starting next year, CMS will cover FDA approved medical devices granted Breakthrough status along with other innovative medical technologies (e.g., telemedicine, liquid biopsy tests, artificial organs, exoskeletons, etc.).

Risks

- **Supply chain disruption.** Shortages during the lockdown highlighted how relying on foreign countries can become a major issues for the medical devices supply chain. However bringing manufacturing capacity back home faces many challenges.
- **Development timeline may be further delayed.** 2020 has seen a lot of clinical trials and market approvals from regulatory authorities delayed by the Covid-19 pandemic. Further delays might be observed in the coming year, depending on the evolution of the pandemic.
- **MedTech manufacturers gain more time to adapt to the new E.U. regulations, but the change is inevitable.** The E.U. is creating more regulations around MedTech, and companies need to adapt to it. The Medical Device Regulation (MDR) deadline has been delayed to May 2021.

Bottom Line

- Covid-19 pandemic has ruled the medical device industry with an uneven impact across the segments, but the value of technology and healthcare has never been more obvious. 2021 is waiting around the corner with astounding innovations: blood-based tests able to spot cancer in asymptomatic patients, 3D printing technologies expanding to drugs and tissues, living organisms used to manufacture medical and industrial products, etc. All this is made possible by the convergence of different branches of technology like AI, robotics, sequencing and digitalization.
- In our portfolios we are carefully selecting the most promising segments of this industry, and the focus in 2021 will be even more on quality growth, driven by solid R&D potential, robust business models and attractive competitive landscape.

Companies mentioned in this article:

Abbott (ABT US), Abiomed (ABMD US), Akili Interactive (not listed), Amazon (AMZN US), Amwell (AMWL US), Ancestry (not listed), Anpac Bio-Medical Science (ANPC US), Apple (AAPL US), Beta Bionics (not listed), BGI Genomics (300676 CH), Boston Scientific (BSX US), Burning Rock Biotech (BNR US), Butterfly Network (BFLY US), Dexcom (DXCM US), Eat Just (not listed), Elysium Health (not listed), Exact Sciences (EXAS US), FabRx (not listed), FormLabs (not listed), GE Healthcare (GE US), Genetron Holdings (GTH US), Ginkgo Bioworks (not listed), GoHealth (GOCO US), GoodRx (GDRX US), Google (GOOGL US), Guardant Health (GH US), Illumina (ILMN US), Insulet (PODD US), Intuitive Surgical (ISRG US), iRhythm Technologies (IRTC US), Medtronic (MDT US), Moderna (MRNA US), Nebula Genomics (not listed), Neuralink (not listed), Nevro Corp (NVRO US), Novocure (NVCR US), Organovo (ONVO US), Phenomix Science (not listed), Shockwave Medical (SWAV US), Spiber (not listed), SuperMeat (not listed), Tandem Diabetes Care (TNDM US), Teladoc Health (PACB US), Twist Bioscience (TWST US), Withings (not listed).

BIOTECHNOLOGY – FROM VILLAIN TO SAVIOR

Covid-19 positively disrupted the healthcare industry

Putting healthcare back at the center

The world suddenly stopped early in 2020, realizing a simple biological entity could jam the entire world economy in less than 3 months. The Covid-19 pandemic showed everyone that "health is what matters most".

- Technological innovations in the drug development sector became the most important factor in the global strategy to combat the virus implications.
- In only ten months two novel vaccines were developed, whereas it would have taken ten years or more not too long ago.

Changing the investment perception of the whole industry

Once an industry beleaguered by fears over declining drug prices, the pandemic allowed the Biotech industry to make a strong case that focusing on drug prices (or 13% of healthcare costs) is not the right way to contain healthcare cost inflation.

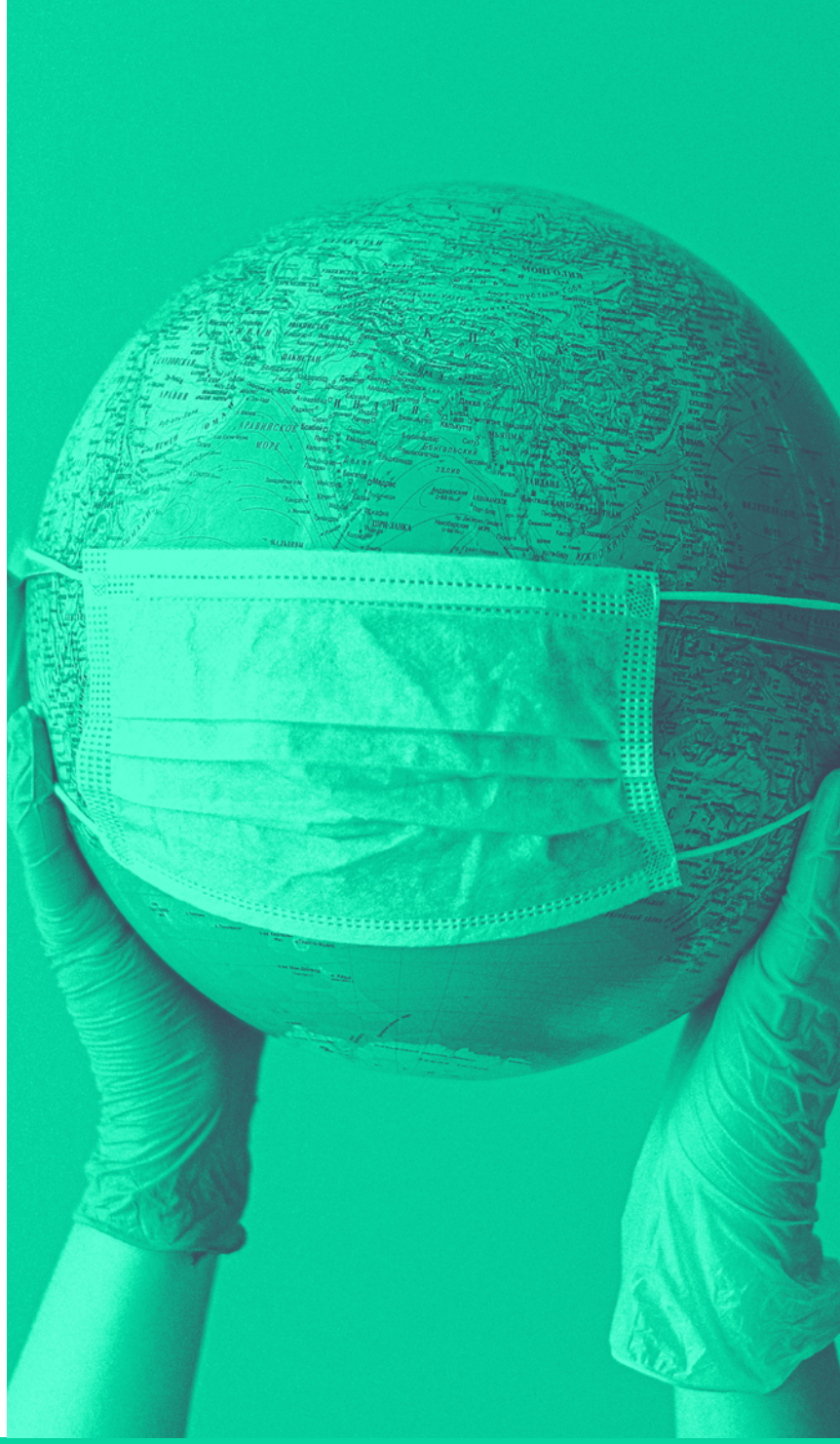
- Governments pledged huge sums of taxpayer's money into the sector.
- Vaccines faced little headwinds despite maintaining 80% plus gross margins.
- The industry was able to prove that it did cut the development timeline by a factor of ten and, along with that, R&D spending.

Re-uniting public and private interests

The medical breakthroughs achieved with Covid-19 established closer and kindlier ties between governments and the industry. This shift is of considerable magnitude and set to stay and continue, likely providing the industry the support it deserves.

- Going forward, this balance should be aligned with the need to make sure subsequent virus editions see more immediate therapeutic involvement.

SOURCE:
Photo by Anna Shvets from Pexels



Outlook – Regulation (1/2)

Biden and a new FDA commissioner are strong catalysts in the U.S.

The recent U.S. elections outcome points to a best-case scenario for the industry, effectively putting a political headwind to rest and allowing to refocus on fundamentals. The nomination of a new FDA commissioner has been stated as a top priority by Biden. We expect the choice to be relatively credentials-driven.

- Biden presidential win was a moderate risk to begin with: as a centrist he is a long-standing opponent of far-left initiatives such as Medicare for All.
- The worst case-scenario would have been a blue wave, where draconian drug pricing reforms could advance.

The E.U. supports clinical trial reforms

EMA has received a positive industry feedback as it suggested to simplify clinical trial requirements. This follows the catastrophic results of its precedent reforms that forced companies to outsource clinical trials outside Europe.

- The number of applications to carry out clinical trials in the E.U. fell by 25%, costs increased significantly, and launching delays rose by 90%.

Chinese focus on local R&D starting to bear fruits

The Chinese government presented a number of reforms in the "Healthy China 2030" plan, aiming to prevent and control major diseases by encouraging R&D in the strategic biotechnology sector.

- In 2018, the number of patents filed by Chinese companies literally exploded and was twice as much as those filed by U.S.

Outlook – Regulation (2/2)

An ever-increasing set of rules have crippled ROI…

FDA, EMA, ICH, ISO, NMPA have all multiplied regulatory requirements. Billions of dollars are diverted in regulatory functions and fines for non-compliance, increasing the pressure to only bring best-in class drugs to the market.

- Global regulatory affairs outsourcing market is expected to be worth $14.3bn by 2026, a CAGR of 12%.
- Over $15bn were fined to pharmaceutical companies in the U.S. alone over the last 10 years for quality related issues.

… but regulatory organs are getting up to speed with the R&D

Agencies are adopting new approval modalities (e.g., biomarker vs. functional data), aligning with the most recent R&D trends and supporting faster drug development processes.

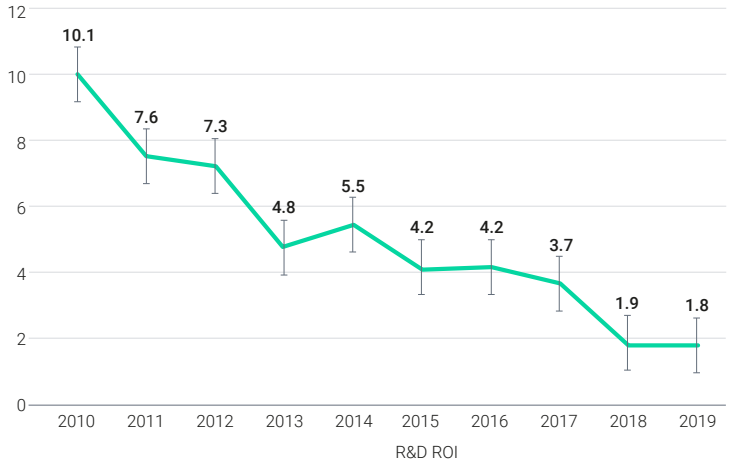
- Growing utilization of AI and high-sensitivity diagnostics have already accelerated the drug development process, and agencies are following suit.

Drug pricing as the last intense battlefield

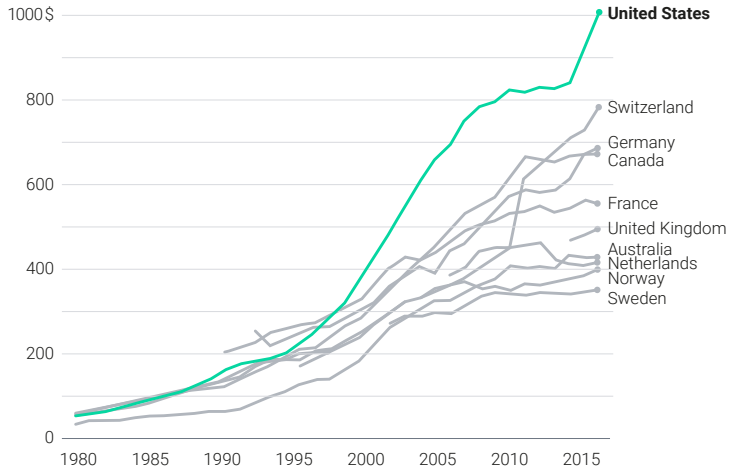
The drug pricing issue and fear of major reforms always lurk around. Companies are instating new pricing model as a proof of good faith hoping to prevent massive changes in drug pricing.

- For Zolgensma, Novartis has adopted an annuity pricing model by which its $2.1mn cost is paid in installments.
- CAR-T treatments, carrying a +$280k price tag, have outcome-based agreements meaning patients pay the full price only if they respond to treatment.

R&D RETURN ON INVESTMENTS



ANNUAL RETAIL PRESCRIPTION DRUG SPENDING PER PERSON



Outlook – China: The Next Biotech Hub

An unavoidable market

China's biopharma market is entering a new cycle, with a favorable regulatory framework. As a result, it is now the world's fastest-growing biologics market.

- China expects to maintain a 19% CAGR in the coming years, rising from ¥260bn in 2018 to ¥640bn in 2023.
- The inclusion of biotechnology to the "Made In China 2025" plan is spurring local innovation by modernizing the clinical trial process.

From importer to innovation exporter

Currently China relies on importing patented western drugs. Deep reforms and an ambitious strategy are supporting a biotech boom that we expect to potentially reverse the situation.

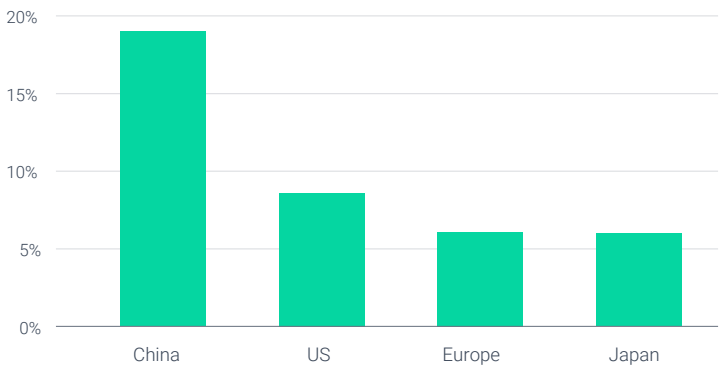
- China is a cell therapy research powerhouse, and specifically hosts more CAR-T clinical trials than anywhere else in the world.
- Legend Biotech, a Chinese cell therapy company made the largest biotech IPO of the year, raising $490mn.

Driven by strong fundamentals

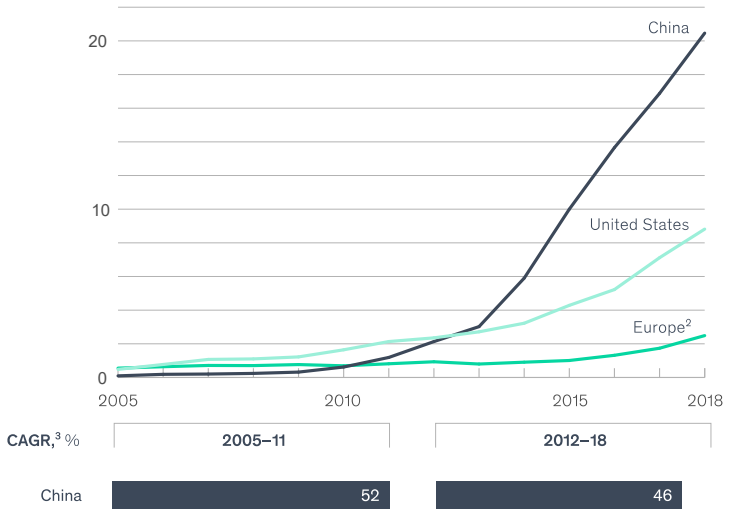
China is currently the 2nd largest biologics market in the world behind the U.S. and leveraging a significant competitive advantage: local players can rely on huge source of medical data, high mobile adoption and AI capabilities.

- China has the largest diabetic population in the world, with more than 100mn adult patients.
- Aging population means cancer incidence is expected to increase by 97% through 2035.

BIOLOGICS MARKET CAGR (2018–2023)



PATENT REGISTRATIONS FOR NEW MEDICINES BY REGION, THOUSAND



Outlook – Biologics Copycats

Biosimilars are not a walk in the park

Unlike small molecules, biologics are made from living organisms and, therefore, slight variations are inevitable even when copied. Due to these possible differences, physicians are often reluctant to prescribe biosimilars.

- The FDA introduced the Biosimilars Action Plan (BAP) to tackle these challenges and increase adoption.
- The biosimilar market in the U.S. is expected to grow to $13.3bn by 2025, at a 24% CAGR. In the E.U. biosimilars still have a very modest market share.

Patent expiry is not the end of the world (or the franchise)

Unlike with generic drugs, patent expiry for biological products typically does not imply an immediate price and market share erosion.

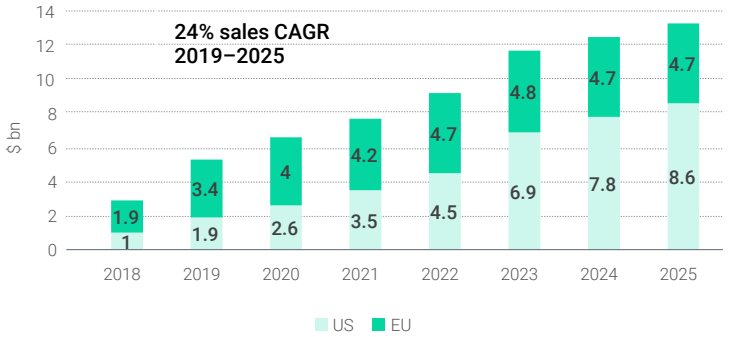
- Neulasta, Amgen's immunology $4bn annual sales blockbuster, is still maintaining >65% market share 2 years after biosimilar launches.
- Markets with fewer biosimilars typically display a 15%-18% price difference from branded drugs; in more competitive ones the difference can reach 25%.

Market evolution

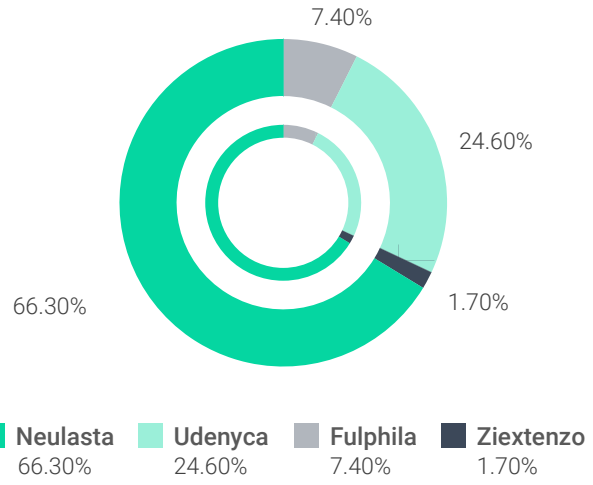
A conclusion rising from the aftermath of the Covid-19 crisis is that local pharma independence has become strategic, as global interests may not align under a public health crisis.

- Indian API (raw drug ingredients) and generic drug makers have been squeezing pricing in the U.S. market in the past decade, a trend expected to stabilize or reverse as local players are likely to be prioritized.
- Domestication efforts on biopharma's supply chain are likely to persist long after the pandemic wanes.

THE BIOSIMILARS MARKET



NEULASTA MARKET DYNAMICS
2-YEAR POST BIOSIMILAR ENTRY



SOURCE:
Leerink, IQVIA

Outlook – AI pervading all healthcare segments

Drug discovery

Use of advanced research algorithms can not only define the best biological targets for a given disease but also select the best drug candidates.

- Scientific literature about AI implications in drug discovery doubles every 3-5 years since 2000.
- Between 2013 and 2018, +300 deals have been made between AI organizations and Biopharma companies.

Clinical trials

Patient recruitment and follow-up are two of the main hurdle of clinical trials. Slow patient enrollment alone can delay clinical trials for up to 3 years. Both steps could be facilitated using AI during the clinical trials.

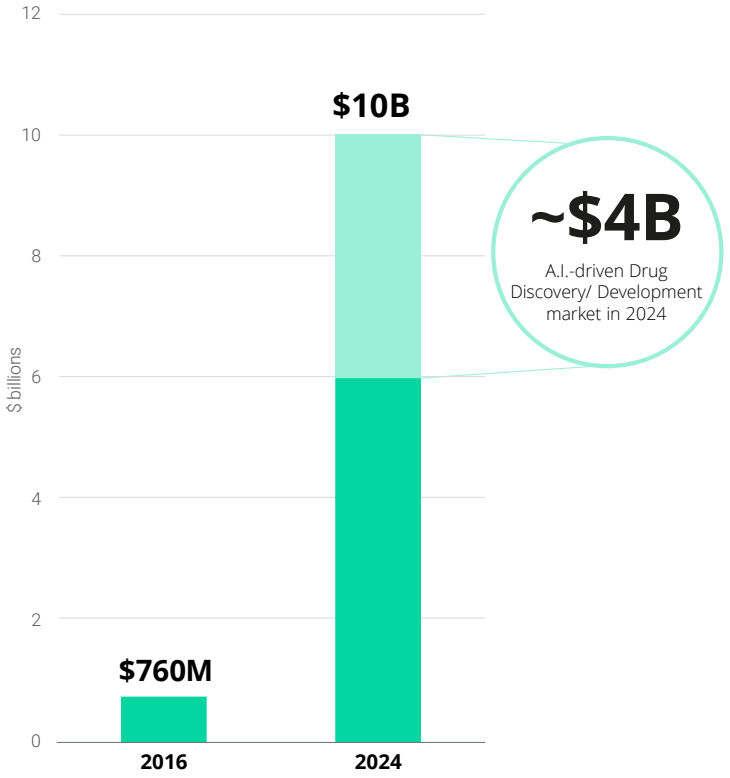
- IBM's Watson for Clinical Trial Matching system increased the average monthly enrolment for breast-cancer trials by 80%.

Streamlining the commercialization-phase services

Marketing drugs is currently costly and reduces resources that could potentially be devoted to R&D. AI-driven marketing to target key audiences cuts down significantly these costs.

- At most big biotech companies, the Marketing & Sales budget exceeds by far the Research & Development budget.
- AI-based marketing such as provided by IQVIA resulted in increasing revenue on average by 10-15% on an unchanged cost basis.

GLOBAL A.I. HEALTHCARE MARKET*



*Source: Biopharmatrend.com, PMLiVE, and Global Market Insights, Inc.

SOURCE:
Multichannel Marketing (Mcm) In-Flight Optimization

Outllook – Big-Tech, Big Threat

Google is taking over the drug discovery

Now able to solve with AI a 50 years old issue - predicting correct protein folding – Google could start in-housing or selling drug discovery services to Biotech companies.

- This could lead to a boost in collaboration between AI and Biopharma companies.

Amazon is taking over the drug distribution

"Amazon Pharmacy" is now operational. Pharmacy benefit managers worry about their position as industry middleman in the U.S. is threatened.

- In 2018 Amazon bought PillPack for $753mn to enter the $500bn U.S. prescription drugs market.

Apple is taking over patient-data handling

Apple with its industry leading standard on data confidentiality is merging patient records, wearable data and telemedicine.

- The Apple Watch is already a wearable with medical device properties like an ECG.
- Siri could become Health Insurance Portability and Accountability Act (HIPAA) compliant be also used also as a medical device, facilitating patient follow-up and monitoring compliance with treatment.

Outlook – CROs & CDMOs

CROs help clinical trial complexity and patient enrollment/follow-up

The big Biotech and Pharma players are increasingly outsourcing clinical trials, given the high costs. CROs are also helping for patient recruitment and follow-up, two of the main hurdle of clinical trials

- Clinical outsourcing was a $31.6bn market in 2018 and is expected to grow at a CAGR of 12% to reach $45.2bn by 2022.
- AiCure's software, an application using the patient's cellphone camera to record treatment uptake, increased by >20% the patient adherence to its treatment.

Lean R&D companies need strong CDMOs

The biopharma industry trend is to get leaner and more R&D focused. This trend requires these companies to partner with strong CDMOs to take care of the actual manufacturing.

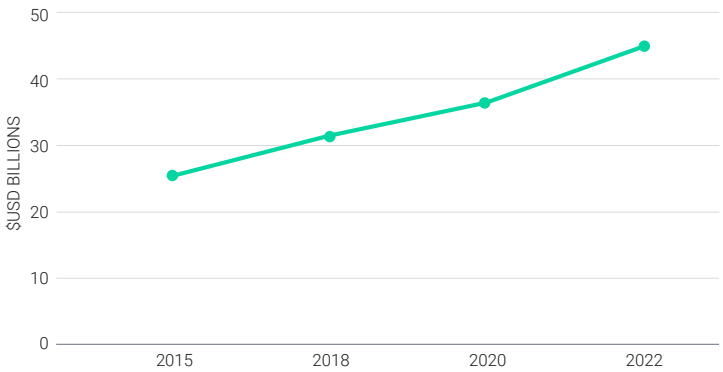
- In 2020, Big Pharma such as GSK and Pfizer are divesting part of their manufacturing businesses to focus on R&D.
- CAGR for the CDMO market is 6.9% between 2018 and 2025 with an expected market size of $157.7bn.

CDMOs not only manufacture drugs but improve the yield

Improving the yield on drugs and especially biologics production can drastically improve profit margin. CDMOs' expertise enables more efficient manufacturing processes, a critical step to compress cost and improve drug production.

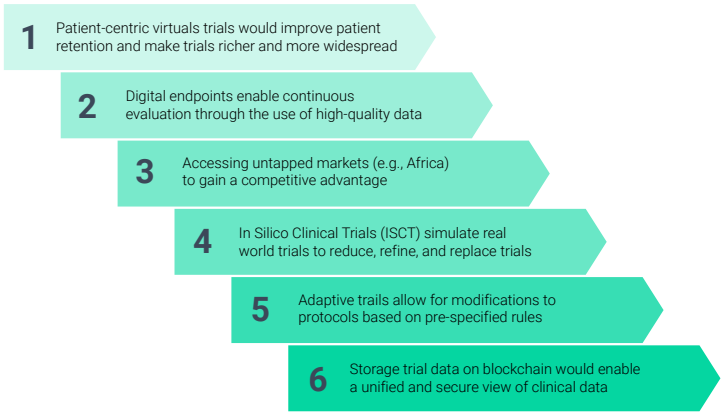
- Single-use technology implementation in the manufacturing processes increases capacity by 40-100% and achieves a per batch cost savings of 23% to 42%.
- CDMOs like WuXi biologics have reported on average a 7.4x yield improvement.

MARKET FOR CRO-CONDUCTED CLINICAL DEVELOPMENT GROWTH



Source: Data pooled from Before Analysis & Contract Pharma

6 INTERVENTIONS THAT WILL CHANGE THE WAY THE CLINICAL TRAILS ARE CONDUCTED



Outlook – Therapeutic Area: Infectious Diseases

mRNA platform validation thanks to Covid-19

The main theme looking backwards and onwards is the overwhelming success of mRNA vaccines in combating the current health crisis.

- Readily adaptable and scalable to new pathogens, we expect these vaccines to gradually expand throughout the infectious disease space.
- Next year we expect to see more results from these platforms in influenza, Zika and CMV (Cytomegalovirus).

Structural changes in the space

The long duration of vaccine studies has historically been the most important barrier to entry, alongside the non-inferiority trial design. Also, massive non-dilutive public funding to these innovative platforms means that effectively innovation is financed with public funding and is bound to accelerate its development.

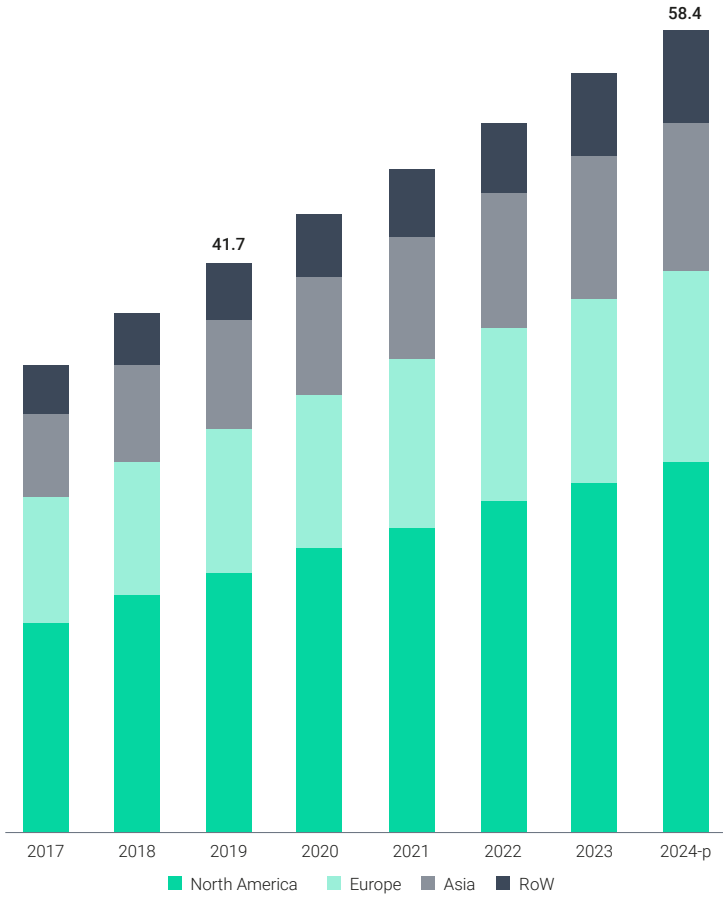
- It is very likely that new vaccine studies will adopt shorter timelines, and adaptive trial designs, similar to recent studies (from phase 1 directly to phase 2/3 with interim readouts).

Nucleic Acid-based therapies entering the battle

Nucleic acid-based therapies (mRNA, DNA) could represent the next generation of treatments for infectious diseases. By promising greater efficacy or adaptability, they could progressively gain substantial market share within this market.

- After mRNA validation on Covid-19 in less than one year, we expect mRNA platforms to dominate vaccine development in the foreseeable future.
- RNAi-based medicines for the treatment of hepatitis B are a significant industry-wide focus and expected late-stage results should validate the versatility of these platforms.

VACCINES MARKET, BY REGION ($BN)



SOURCE:
Markets and markets

Outlook – Therapeutic Area: Cardiovascular

The world's most common disease needs transformation

Cardiovascular (CV) diseases are the deadliest in the U.S., with direct medical costs expected to reach $1.1tn by 2035. However, the CV market is valued at only $80bn, a fraction of its cost to society, partly because it's mostly covered by generics.

- Estimates indicate 41% of Americans have some form of cardiovascular risk factor (i.e., hypertension or high cholesterol).
- CV drugs have one of the highest R&D cost burden, due to the large-scale trials generally required for approval and reimbursement.

Here comes precision medicine

Advances in identifying molecular risk factors for CV disease, and introduction of efficient inhibition mechanisms are moving fast and could change this market. RNA interference is an extremely effective and convenient platform for CV drugs, due to its strong affinity to liver targets and convenient dosing.

- The $10bn acquisition of inclisiran, a siRNA-based therapy for high cholesterol could mark a turning point for the segment.
- Studies on hypertension, hypertriglyceridemia and dyslipidemia, among others that could revolutionize the space, are entering late-stage studies.

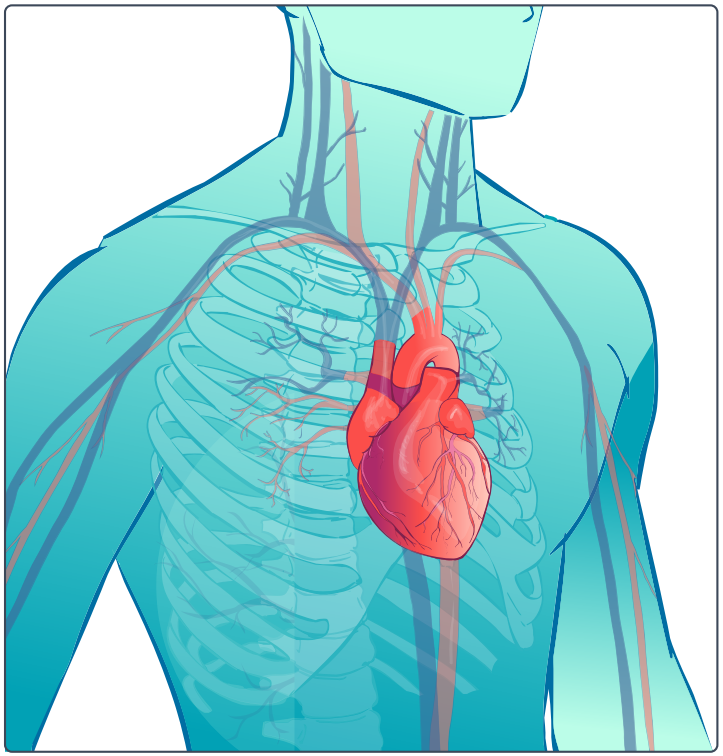
A winning combination to transform the sector

The CV space is profiting from moving to genomically-identified pathways and, in parallel, targeting those via novel technologies. The shortening timeline trend, precision medicine and Covid-19 resolutions, could have one of the largest impact on this space. Genetically identified targeted patient populations drive capital efficiency and strong clinical outcomes.

- Such transformation spurred for Bristol's acquisition of Myokardia for $13bn.
- 2 out of 3 +$10bn M&A deals this year were for drugs in the space, indicating interest, and perhaps understated growth rate.

SOURCE:
UBS; national cancer institute

CARDIOVASCULAR SYSTEM



Outlook – Therapeutic Area: Immunology

Immunology momentum to continue

Immuno drugs modulate an immune system imbalance, mostly overactivation conditions including rheumatoid arthritis, and multiple sclerosis. This therapeutic area, which produced some of the highest selling drugs in history such as Humira, is benefiting from molecular advances and a wave of exploratory pathways.

- Immunomodulation is expected to reach $61.3bn by 2026, it represents the fastest growing sub-segment in biotech with a CAGR of 14.3%.

Lessons from immuno-oncology

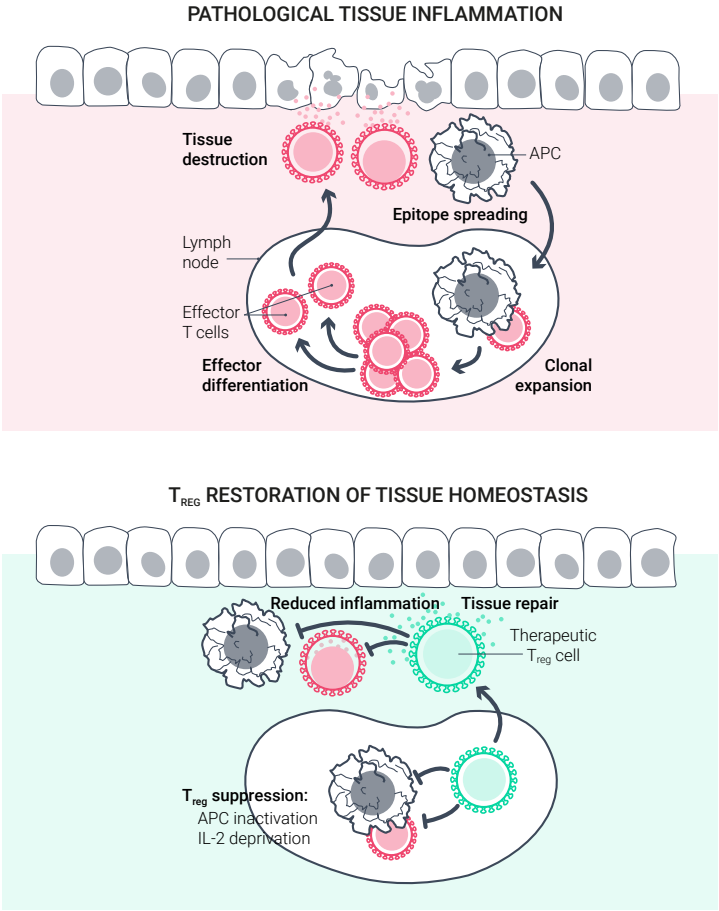
In large part the innovation in the space is imported from biological findings in oncology on how to stimulate and optimally target the immune system. The area mirrors in perception how immuno-oncology looked 10 years ago, and we expect this space to adopt a similar development strategy.

- Industry focus is moving to biomarker-driven targets, aiming at smaller subset of refractory patients, targeting the root cause rather than effector cells.
- FcRn targeted antibodies (modulation of the immune system) have shown impressive results so far, and more data are expected next year.
- New modalities such as checkpoint inhibition in autoimmune diseases, aiming to target key regulators and T-Reg cell therapies are among next value drivers for this space.

Combining advances in biology with AI

Advancements in sequencing of immune cells such as T and B cells receptors, powered by AI models are becoming an applicable reality (Immune cells genomes are not static).

- Clinical studies which are relatively short in time and smaller in size are contributing to the positive momentum. The introduction of more surrogate endpoint in the regulatory process is a net positive.



SOURCE:
https://science.sciencemag.org/

Outlook – Therapeutic Area: Oncology

Precision oncology gets crowded

Biologics and novel immunotherapies have been an industry-wide pipeline focus in recent years. But the segment is reaching maturity and faces risks as market faces strong competition.

- Personalized medicine was first applied in precision oncology, thus shortening regulatory timelines and accelerated approval modalities are mostly implemented and are not expected to benefit further this segment.

Cancer vaccine the next big thing

Cancer vaccines are designed to trigger the immune system to be more receptive to signals found at the surface of cancer cells. The two key elements needed to enable cancer vaccines are finally coming together.

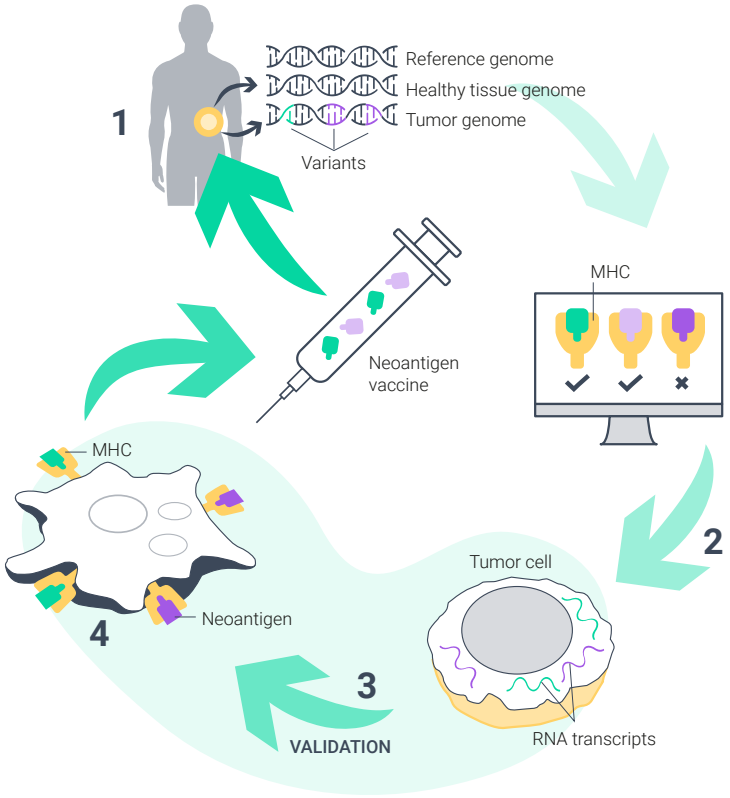
- Identifying and predicting the genetic mutations in the tumor have been boosted by the utilization of AI in genomics.
- Advancements in the immuno-oncology platforms allow for delivering antigens able to elicit an adequate response from the immune system.

mRNA platforms the key to a juicy market

Estimates about the market for cancer vaccines point to ~$10bn in 2025 with a CAGR of ~10%. The combination of readily available next generation sequencing tools and the ease of mRNA synthetization make cancer vaccines easy to personalize and produce.

- The easiness with which mRNA platforms are adaptable make them an ideal candidate for creating personalized cancer treatments.

CANCER VACCINE



SOURCE:
Nature

Outlook – Therapeutic Area: CNS

The revival of the Central Nervous System market

Historically affected by lower probability of trial success hurdle (e.g., 99% failure rate in Alzheimer's), and less-understood biology, the market is finding renewed interest and is expected to become one of the fastest-growing segments.

- The past two years saw record financing for CNS-focused start-ups.
- The market is currently growing at a modest CAGR of 5.9% though it is expected to accelerate in coming years.

New technologies in neurodegenerative diseases

Neurodegenerative diseases, saw little innovation in the past decades. Intriguing technologies we expect to drive growth in the space include using the Microbiome for Alzheimer's disease, a possible DNA-based treatment for frontotemporal dementia, and personalized cell therapy for Parkinson's, among others.

- The standard of care in Parkinson'sdisease is still Levadopa, a drug approved in the 70's.

FDA's evolving approach to the space is a game-changer

The agency's neurology department went through restructuring with an apparently favorable results for drug companies. Reliance on a single controlled study, looking beyond firm statistical significance, and possible subgroup analysis are some of the public comments pointing to substantially lower regulatory hurdle.

- The agency's standpoint regarding aducanumab was unprecedently favorable to Biogen but also to companies across the space.
- Giving such importance to the unmet need is especially important for developers focusing on diseases such as ALS (Amyotrophic lateral sclerosis) and Alzheimer's.

SOURCE:
Grand View Research

Outlook – Therapeutic Area: Rare diseases

Orphan drug hype slowing down

Easy access to capital and regulatory flexibility drove strong growth in the rare disease space in recent years, however signs of deceleration are evident.

- There are an estimated 7000 rare diseases with only 5% having an approved treatment, suggesting still a strong potential.
- Accelerated approval is becoming the norm for indications with strong surrogate endpoints such as Sickle Cell Disease and Primary Hyperoxalurias.

Gene therapy opportunity not fully materialized

Industry focus is on orphan diseases with well known molecular pathology, mainly monogenic conditions such as SMA (Spinal muscular atrophy) and hemophilia. As a result, increased pipeline congestion increases the risk for clinical performance.

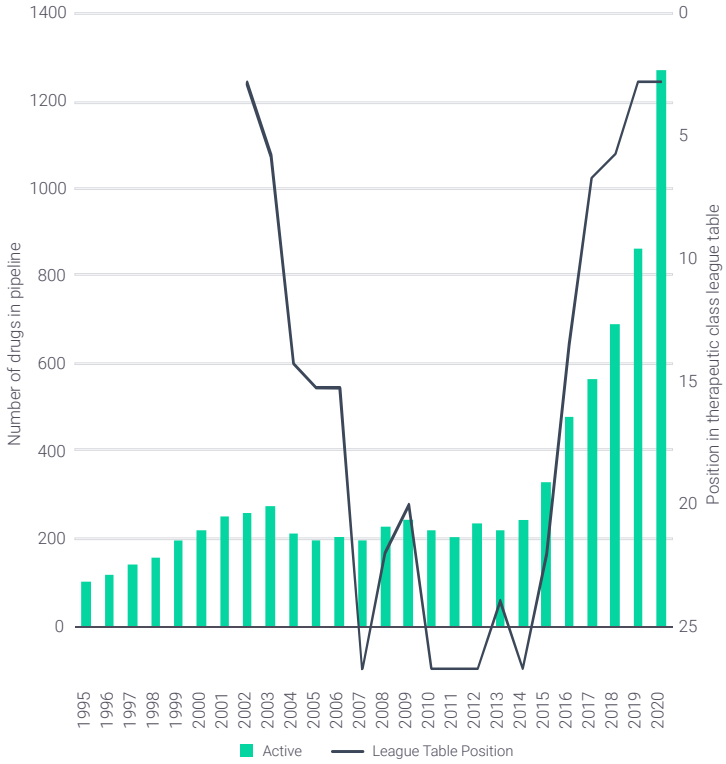
- Only 2 gene therapies are approved to date (Zolgensma, Luxturna).
- Flagship programs experienced major setbacks in 2020, including Biomarin's (efficacy), Audentes/Astellas (safety) and Sarepta (manufacturing).

Selectivity is key

A pipeline of next-generation nucleotide-based therapies is entering the early in-human studies and could become important rare-disease modalities. Notably new technologies enabling re-dosing and larger genetic inserts could overcome many challenges of first-generation treatments.

- Interest for RNAi therapies in the orphan space will be driven by extra-hepatic data in diseases such as cystic fibrosis and Huntington disease, while Antibody-Oligonucleotide conjugates' focus is going to be especially on Duchene Mascular Dystrophy (DMD).

THE ONGOING RISE OF GENE THERAPY



Note: tracking of Therapeutic Category league tables only began in 2002.
Source: Pharmaprojects®, January 2020

SOURCE:
Pharma Intelligence

Therapeutic Areas : 2021 Calendar (1/3)

CNS diseases

Datapoint and regulatory updates

07/03 – Biogen; PDUFA Aducanumab for Alzheimer's disease – A positive FDA decision will restore enthusiasm into the neurodegenerative sector.

03/04 – Acadia Pharma; PDUFA for Nuplazid for the treatment of hallucinations and delusions associated with dementia-related psychosis (DRP)

Mid 2021: Neurocrine; Schizophrenia PoC Phase 2 data

Q4 2021: Cortexyme; topline Phase 2/3 GAIN trial results – Alzheimer's Disease (microbiota approach to AD)

Conferences

APA – American Psychiatric Association and AAN – American Academy of Neurology, (April).

AAIC – Alzheimer's Association International Conference (July)

ANA – American Neurological Association (October)

CTAD Clinical Trials on Alzheimer's disease (November)

Oncology & Hematology

Datapoint and regulatory updates

21/02: Exelixis; PDUFA for OPDIVO/ CABOMETYX in advanced renal cell carcinoma

28/02 Regeneron; PDUFA for Libtayo to treat patients with first-line locally advanced or metastatic non-small cell lung cancer (NSCLC)

Q3: BioNtech (mRNA); Topline interim data from Phase 2 trial in first-line melanoma

Conferences

ASCO "American Society of Clinical Oncology" conferences: gastrointestinal cancers (January), SITC immuno-oncology (February), Genitourinary cancers (February), the main ASCO event (04–08 June 2020).

ESMO (the European one) – September 2021.

Society for Immunotherapy of Cancer (November)

American Society of Hematology Annual Meeting (December)

Therapeutic Areas : 2021 Calendar (2/3)

GI & liver diseases

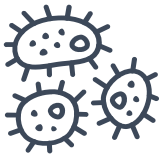
Datapoint and regulatory updates

Q1: CymaBay; in PBC (rare liver disease) study – global 52-week phase 3 registration study (response) to begin enrolling patients

Q1: Seres; Update on Phase 3 SER-109 on C.Difficile

Conferences

European Association for the Study of the liver 2021 (end of June)



Rare diseases

Datapoint and regulatory updates

25/02: Sarepta / BioMarin; PDUFA for treatment of Duchenne muscular dystrophy

Q1: Amicus; Data from Phase 3 PROPEL study – Pompe disease

H1: Vertex; AAT update Phase 2 data

During 2021: UniQure expects to file for its gene therapy for approval on Hemophilia B

During 2021: Neurocrine; Valbenazine Huntington's disease Ph 3 Top line data

Q1: Alnylam; Topline results from HELIOS-A Phase 3 study – ATTR amyloidosis (RNAi)

Q1: BioMarin; Results from Phase 3 study – severe hemophilia A

20/08: BioMarin; PDUFA for vosoritide NDA for children with achondroplasia

During 2021: Ionis; Pivotal phase 3 results for RG6042 – Huntington's Disease

Conferences

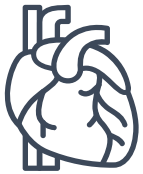
Gene Therapy for Rare Disorders (February)

Annual SMA Conference (June)

ASGCT – American Society of Gene and Cell Therapy (May)

NACFC – North American Cystic Fibrosis Conference (Sept–October)

Therapeutic Areas : 2021 Calendar (3/3)



Metabolic & Cardiovascular diseases

Datapoint and regulatory updates

11/02: Regeneron; PDUFA for evinacumab BLA as an adjunct to other lipid-lowering therapies in patients with homozygous familial hypercholesterolemia (HoFH)

LATE 2020/Q1 2021: Novartis/ Alnylam; approval decision for Inclisiran to lower LDL cholesterol.

During 2021: Intercept; OCA on NASH potential NDA resubmission to FDA

Conferences

ACC – American College of Cardiology (May).

IAC – International Academy of Cardiology meetings (end of July)

AHA – American Heart Association (mid-November)

Immunology

Datapoint and regulatory updates

Q1 2021: ArgenX (immunology FcRn); Submission for approval in Generalized Myasthenia Gravis (gMG)

Q1 2021: Immunovant; phase 2 data in Generalized Myasthenia Gravis (gMG)

H1 2021 – Curevac; Covid mRNA vaccine Ph2/3 update

H2 2021 Alexion Pharma; Ultomitis in gMG Phase 3 data

Conferences

The American Association of Immunologists (May)
34th World Congress on Vaccines and Immunization (June)

2020 – A Glance In The Rear-View Mirror (1/2)

"Cluster of pneumonia of unknown etiology"

On 5 January, a cluster of pneumonia is reported in China.

- 7 days later, the genetic sequence of Covid-19 is publicly shared.
- In March, the global research roadmap defined the main priorities including diagnosis, therapeutics and vaccines.

Will Moderna find the first vaccine against coronavirus?

In February, Moderna announced that its first vaccine would be tested in Phase I study. This record speed confirms the rapid adaptability of Moderna's RNA platform.

- Delivery of the first batch takes place only 42 days after the sequencing of the virus' genome, which allowed the identification of the sequence used for the vaccine.

A first regulatory approval in our portfolios

Esperion received U.S. approval for bempedoic acid for patients with too high levels of so-called "bad" cholesterol (LDL) and approval for Nexletol with Merck's cholesterol pill Zetia.

- As we wrote in the Outlook 2020, we expected this approval however commercialization during Covid-19 outbreak is likely to be challenging.

IMPACT

H1 2020

IMPACT

Drugs' approvals within our portfolios have continued

Two approvals occurring in Q2:

- Neurocrine's Opicapone in Parkinson's disease.
- Immunomedics' treatment for metastatic triple-negative breast cancer.

A"wave" of biotech IPOs starting in May

The IPO activity broke records in H1, an extremely positive sign for the sector, regaining investor confidence.

- There were 26 IPOs in the biotechnology sector during the first half of the year, raising a total of $4.8 bn.This compares to $3 bn raised in the first half of 2019.

The attractive gene editing sector

Vertex and CRISPR Therapeutics released early positive data in two rare blood diseases. First time that patients have been successfully treated with CRISPR.

- Two people with beta thalassaemia and one with sickle cell disease no longer require blood transfusions during 15 months and 9 months.

The treatment expected to be the first on NASH refused by the FDA

Intercept received a Complete Response Letter (CRL) from the FDA regarding its application for obeticholic acid (OCA) on NASH, the fatty liver disease.

- The benefits of OCA are uncertain. Intercept will have to submit post-interim data from the ongoing study and may try to seek regular approval in 2021.

2020 – A Glance In The Rear-View Mirror (2/2)

The Covid vaccine entered Phase 3

Moderna and BioNtech began Phase 3 in early summer, a record time in clinical trial execution, and released Phase 1.

- Initial data from phase I studies from mRNA approaches have shown promising results, inducing antibody and cellular responses. Safety has so far been acceptable.

M&A activity rebounded in August

Two noteworthy deals marked the recovery of the M&A activity after a nearly dead half year.

- Sanofi bought Principia for $3.7bn and J&J acquired Momenta for $6.5bn.
- Following the rebound in M&A activity in August, Gilead acquired Immunomedics (in our portfolios) for $21bn.

CDMO/ CRO: the big winners

R&D and manufacturing outsourcing companies and biopharmas reinforced their relation during this covid period.

- Siegfried partnered with BioNtech on covid vaccine manufacturing. As for Moderna, Lonza will be its partner.
- Wuxi Biologics, doubled the number of new projects due covid programs.

Validation of mRNA-based vaccine

BioNtech and Moderna released interim Phase 3 data showing an impressive efficacy of > 94% with no major safety issues. AstraZenaca vaccine, non mRNA based, appears to be less effective (~60%).

- This represents a turning point in the fight against the virus, but also a validation for this new tech, mRNA.

IMPACT

H2 2020

IMPACT

Political attempt to lower drug prices

Pt. Trump made a political move by signing four executive orders to lower drug prices: cap U.S. prices based on a basket of foreign countries, importation from Canada and removal of rebates.

- These executive orders are not a major threat and/or will have little impact.

Biden wins the election

Biden has promised to expand Obamacare, which could ultimately be positive and partially offset the negative effect of lowering drug prices. Biden's plan for healthcare is broad but moderate and expected.

- Under a split Congress scenario, the most aggressive bills such as Medicare direct negotiation on drug prices would be extremely unlikely to succeed.

Setbacks on gene therapies

BioMarin received a CRL from the FDA regarding its application for its Gene Therapy on Hemophilia A. The FDA is delaying approval, by asking at least two years of follow-up.

- Following the rejection of Biomarin's gene therapy, the FDA is asking Sarepta and Regenxbio to provide more supporting data before initiating their Phase III studies.

The UK becomes the first in the world to approve an mRNA vaccine.

The Government approved Pfizer-BioNTech's Covid-19 vaccine for use before the FDA and EMA. The UK has ordered a total of 40mn doses for 2020 and 2021.

- BioNtech and Moderna submitted applications in early December to the FDA and EMA for emergency use. Decisions from will be made before 2021.

2020 – Capital Markets

M&A - The big biotechs keep buying the small ones

Weighed by major disruptions in 2020, deal activity is likely to pick up in the coming year. The pillars for M&A are well in place: expected macro stability coupled with historically low multiples for large pharma companies.

- Fundamentals are strong: plenty of cash and low debt/EBITDA for buyers in addition to low-interest rates.
- Tech platform companies (RNA-based, cell therapy), immunology and cardiovascular sectors, as well as AI-driven platforms, are the hottest targets.

IPO – A focus on early–stage biotechs

Biotech IPO market reached an all-time high in 2020 with >70 pure-play biotechnology deals (vs. 45 in 2019). Most IPO were early-stage companies facing less binary clinical risk, and therefore offering a compelling exposure while technologies mature.

- More than 60% of 2020 IPOs are for companies still in preclinical stage.
- The outperformance of recent IPOs is often related to the technological innovations introduced.

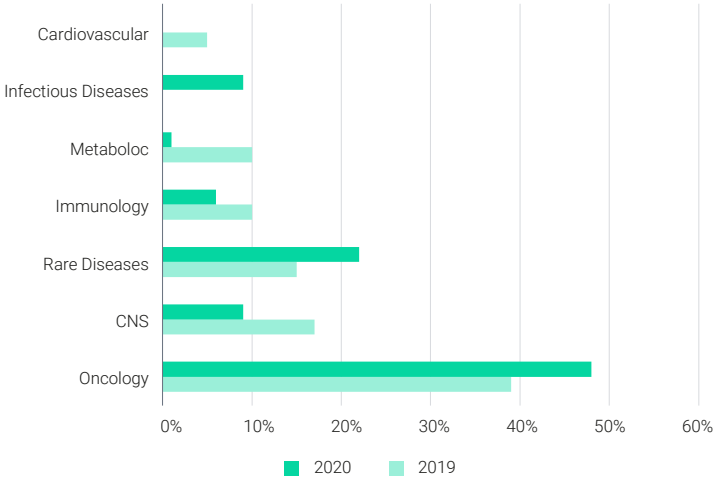
Venture Capital – Key takeaways

2020 is a record year of biopharma VC financing globally; money raised in the first three quarters almost equals the entire 2019. The focus was on China, with a third of the largest VC deals going to Chinese companies.

- 4 of the largest round A 2019-2020 deals have already gone public in 2020, corroborating the shortening timelines trend.
- One of the largest A rounds in recent years went to EQRx, a company dedicated to improving drug development efficiencies.

M&A BREAKDOWN 2019 VS. 2020

IPO PER THERAPEUTIC AREA 2019/2020



SOURCE:
Biopharmadive / Chimeraresearch

Structural Trends (1/2)

Therapeutics areas impacted by Covid-19

Despite an expected $4.9bn decline in total prescription drug sales, overall growth could still reach 3.7% this year. Slower traffic in hospitals and pharmacies had an impact on the demand for prescription drugs.

- Diagnostic and treatment/surgery procedures have been canceled, including up to 2.3mn cancer surgeries. Oncology is expected to lose $1.2 bn in sales.
- On the other hand, demand for influenza vaccines (up to 51% over the 2019-2020 season) and respiratory drugs has increased.

More clinical trials, more opportunities

The Biopharma industry is pushing to bring new treatments by multiplying the on-going clinical trials. This trend is robust and seems unaffected in 2020.

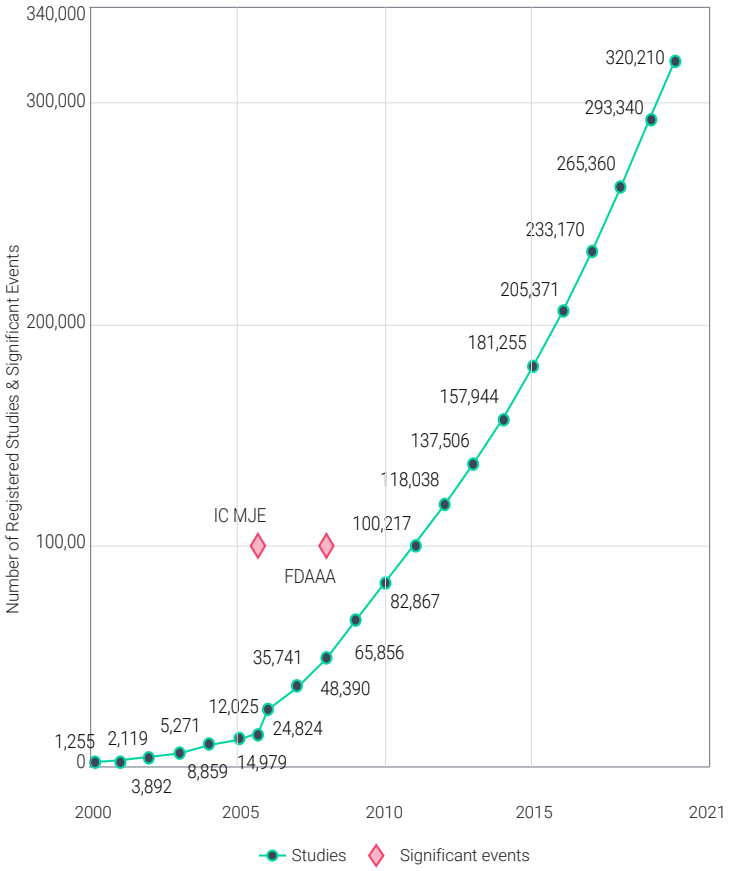
- In 2020 there have been more clinical trials running than during the whole 2000–2010 period.
- Increase in clinical trials complexity has not halted the growth in clinical trials number, neither did the current covid pandemic.

New technologies and therapies are hitting the market

Following the first CAR-T cell therapies launch in 2017, RNA-based drugs are now entering the market. This wave of innovation boosts investments in hot areas such as next-generation cell therapy or gene editing (e.g., CRISPR).

- 2020 is poised to become the year of the first approved mRNA-based drug.
- In 2020, >$1bn were invested in CRISPR-based companies, more than triple last year investments. Vertex and Regeneron expanded their collaborations with CRISPR Therapeutics and Intellia, two leaders in CRISPR/ Cas-9.

NUMBER OF REGISTERED STUDIES OVER TIME
AND SOME SIGNIFICANT EVENTS (AS OF OCTOBER 24, 2019)



SOURCE:
Evaluate Pharma World Preview 2020, FDA ClinicalTrials.gov

Structural Trends (2/2)

Regulators are enablers rather than barriers

2020 and the Covid-19 pandemic have put regulators under the spotlight, highlighting their crucial role in bringing new therapeutics to the market. Tight relationships and efficient processes are speeding up approval timelines.

- In 2019, 60% of CDER's novel drug approvals (29 of 48) used one or more of these expedited programs, bringing new therapies to patients, months, or even years, sooner than expected.

Increase in clinical trial success favors early investment

Increasing knowledge in biology and access to massive chemical/biological/genomic databases have enabled better drug selection and posology, thus increasing clinical trials success. This leads to more confident investment in companies with only preclinical/phase1 compounds.

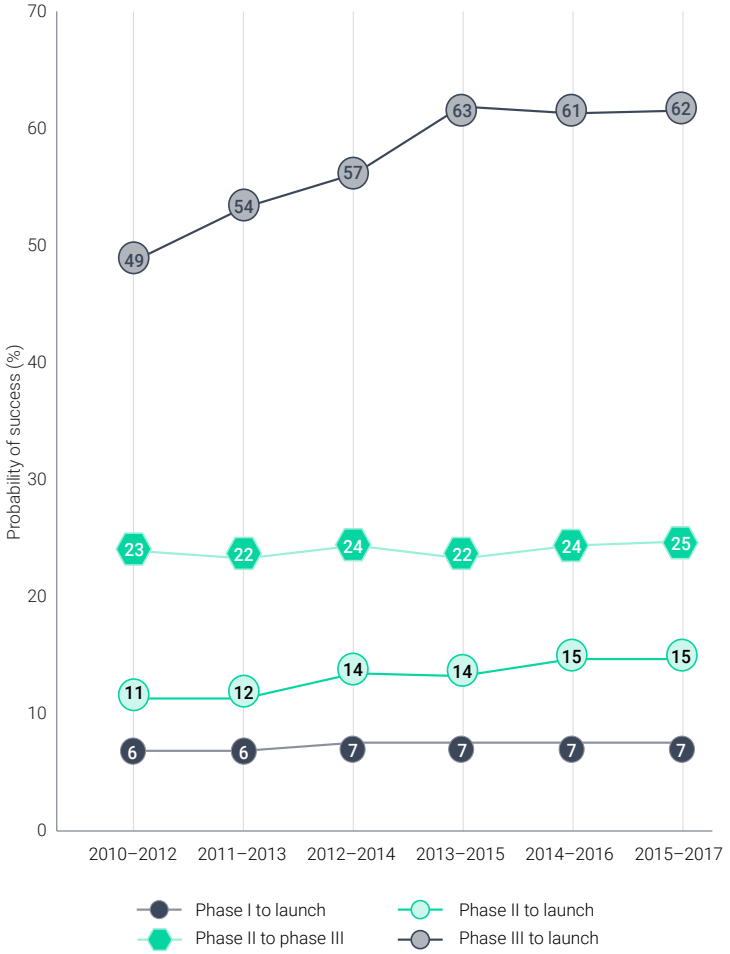
- Of the 75 IPOs in 2020, 54% were in preclinical/Phase I for their lead compound.
- Shorter trials with higher success rates also mean longer exclusivity in drugs sale, given that patents last 20 years (including the clinical trials period).

New approaches in clinical trials are speeding up approvals

Automatic data capture and digitalizing standard clinical assessments, coupled with adaptative design can massively accelerate the length of clinical trials. We expect to see more innovative design approaches to clinical trials in the coming years.

- For example, combining these techniques has enabled Merck to move from new drug application to initial approval in just 4 years for its Keytruda immunotherapeutic.

PROBABILITY OF SUCCESS IN CLINICAL TRIALS



SOURCE:
Clinicaltrials.gov / Nature Review

Biotechnology For Dummies

THERAPEUTIC AREAS

Oncology

Targeted therapies, immuno-oncology, cell therapy, and combinations are all treatments being developed to fight cancers . AI in genomics will lead to more personalized treatments and better diagnosis.

Lifestyle & Cardiovascular diseases

Shift in lifestyle and bad habits have contributed to an increase in cardiovascular diseases, certain forms of diabetes, liver diseases (NASH) and many types of cancers.

Rare diseases

More than 7'000 rare diseases have been identified from oncology to neurology and hematology with 5% only having an appropriate treatment.

Central Nervous System (CNS) diseases

There is an important unmet need in CNS. Discoveries on how diseases are working will pave for new working drugs from genetic to degenerative diseases.

Infectious diseases

Caused by pathogenic organisms (bacteria, viruses, parasites). mRNA platforms to dominate vaccine development in coming years.

Immunology

Our immune system protects against infections with different weapons. If it doesn't work, it can cause diseases such as autoimmune-diseases, allergies and cancer.

NEXT-GENERATION MODALITIES

DNA-gene therapy

Gene therapy seeks to introduce genes into a patient's body with the goal of treating, preventing or potentially curing a disease. Oncology and rare diseases dominate gene therapy drug development.

Cell therapy

The next generation of cell therapies will expand their use by overcoming existing limitations. Companies are currently working on the transition from liquid cancers to solid tumors, on allogeneic CAR-Ts or on new antigenic targets.

RNA-based drugs

siRNA and Antisense Oligonucleotide lead to the inhibition of protein production and mRNA lead to protein production. They have the potential to treat variety of diseases such as cancers, rare diseases, infectious diseases.

Gene editing

Gene editing is a type of gene therapy that allows precise modification of DNA sequences. Several approaches exist today but the well-known technique is CRISPR-CAS 9.

SOURCE:
Clinicaltrials.gov / Nature Review

Catalysts

- **GAFA Therapeutics.** Big-Tech could solve small biotech issues (Protein folding, drug distribution, Big Data analysis…) and further the merging between tech and health companies
- **Personalized medicine 2.0.** Genomic testing and mutation-based targeting will expand to therapeutic areas outside oncology, increasing efficacy and reducing R&D and public health costs.
- **Changing in regulatory landscape.** Regulatory adaptation of biological endpoint, and reduction in clinical trial requirements, in the back of covid success will accelerate timelines and probability of success.

Risks

- **mRNA safety issue.** FDA will require a minimum of 6-months safety follow-up for full approval and patients in the ph.III studies will be followed for 2 years, a safety signal from these platforms could adversely impact the sector.
- **Blue wave.** Democratic success in the January senate elections could turn the table on the political landscape and open the door for reforms, specifically relating to drug pricing.
- **Cybersecurity.** This year, the adoption of decentralized and virtual trials, along with the rise of data and the development of strategic "drugs" such as the Covid-19 vaccines, could lead to an increase in cybersecurity attacks, including espionage, and sabotage.

Bottom Line

- Health is undervalued, this pandemic showed us the tremendous importance of the biotech sector. Transformative patient outcomes resulting from an innovative biotechnology industry have never been so evident as they did in the passing year, across modalities and therapeutic areas. Improving R&D efficiency and higher rates of clinical success coupled with a supportive regulatory environment and diminishing political pressure set the stage for one of the most favorable environments for biotechnology investments, and 2020 was only the beginning.
- In our portfolios, we currently have exposure to all the subthemes including an exposure on China. Next year AI-driven companies as well as Chinese biopharmas will be continuously monitored, and their exposure may increase.

Companies mentioned in this article:

Acadia Pharma (ACAD US), AiCure (Not listed), Alexion Pharma (ALXN US), Alnylam (ALNY US), Alphabet (GOOGL US), Amazon (AMZN US), Amicus (FOLD US), Apple (AAPL US), ArgenX (ARGX BE), Astellas (4503 JP), AstraZeneca (AZN GB), Audentes (Not listed), BGI Genomics (300676 SH), BioMarin (BMRN US), Biogen (BIIB US), BioNtech (BNTX US), Bristol-Myers Squibb (BMS US), Cortexyme (CRTX US), CRISPR Therapeutics (CRSP US), Curevac (CVAC US), CymaBay (CBAY US), Esperion (ESPR US), Exelixis (EXEL US), Gilead (GILD US), IBM (IBM US), Immunomedics (acquired by Gilead), Immunovant (IMVT US), Intercept (ICPT US), Ionis (IONS US), J&J (JNJ US), Lantern Pharma (LTRN US), Lonza (LONN SW), Merck (MRK US), Moderna (MRNA US), Momenta (Acquired by J&J), Myokardia (Acquire by BMS), Neurocrine (NBIX US), Novartis (NOVN SW), Phenomix Science (Not listed), Principia (Acquired by Sanofi), Regeneron (REGN US), Regenxbio (RGNX US), Sanofi (SAN FP), Sarepta (SRPT), Schrodinger (SDGR US), Seres (MCRB US), Siegfried (SFZN US), UniQure (QURE US), Vertex (VRTX US), Wuxi Biologics (2269 HK)

FINTECH – DEMOCRATIZING FINANCIAL SERVICES

Embrace The Fintech Revolution

The digitalization of a major industry

The world is digitizing. Banks and insurances follow the same trend. Financial organizations are at the center of our societies. Their digitalization is changing our relationship with money and our behavior towards financial services.

- Banking does not require having access to a relationship manager anymore.

From mobile payments to open banking

Governments around the world are strongly pushing for cashless societies. The fintech revolution started with mobile payments, which are now close to mass adoption. Open banking and technologies like artificial intelligence or blockchain are transforming and democratizing all the other financial services.

- Fintech is a value proposition for everyone, as everyone is somehow financially underserved.

Investment opportunities down the road

Thanks to Covid-19, digital payments and the fintech industry have experienced a multi-year acceleration in just a few months. Millions of people trust fintech companies, often as their primary provider. As business models are maturing, the competition with traditional players is only beginning.

- Our investment universe, composed of technology enablers and challengers, is growing and offers new and exciting opportunities.

Covid-19 – Impact (1/2)

Record metrics

Covid-19 created business opportunities for the payment industry. The World Health Organization (WHO) quickly encouraged the use of contactless payments, as cash was considered as a possible vector of Covid-19 transmission.

- Although the virus can survive up to 28 days on banknotes in a laboratory, WHO later affirmed that transmission risks with cash were tiny.
- According to Visa, about 50 countries have now a >50% penetration rate for contactless payments (vs. 30 countries before the pandemic).

A boost for the shift to e-commerce

Lockdown measures around the world and the closure of many "non-essential" shops encouraged people to shop online. Countries that have brought the pandemics under control demonstrated that the degree of reversion to the past behaviors is low.

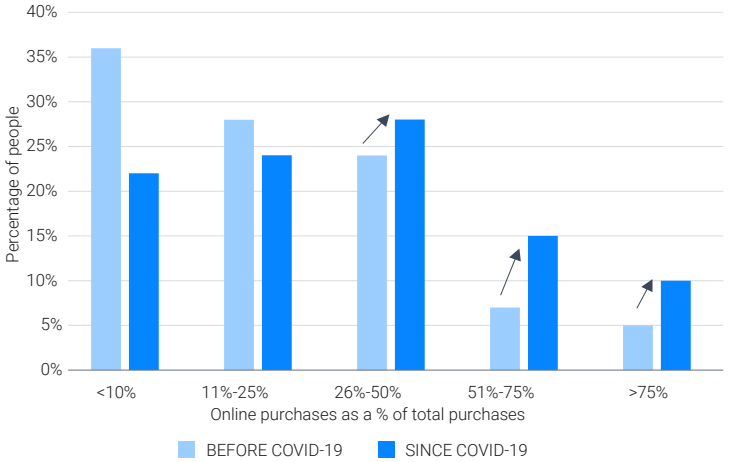
- Record on-line sales of food, games or hardware supplies largely offset the loss of volume from the travel or the entertainment industries.

Digital payments beating records

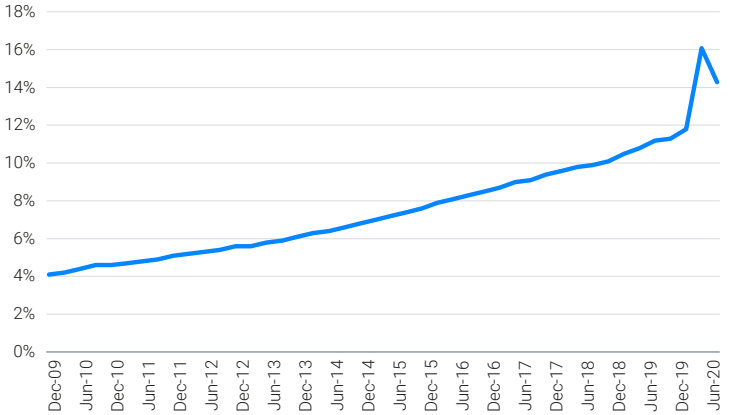
Payment processors are among the winners of the crisis. A surge in new users accompanied a record total volume processed. Given the circumstances, older generations were a major driver of digital payment and e-commerce growth. Covid-19 acted as a catalyst to change people's consumption behavior.

- The fastest-growing demographic for PayPal in Q2 were people over 50.

HALF OF THE PEOPLE SPEND AT LEAST 25% OF TOTAL SPEND ONLINE (SURVEY)



ECOMMERCE RETAIL SALES AS A PERCENTAGE OF TOTAL SALES



SOURCE:
Commonwealth Scientific and Industrial Research Organisation, Visa, McKinsey

Covid-19 – Impact (2/2)

Digital Banking truly mainstream

As bank branches were closed, people turned to digital banking. Challenger banks experienced a surge in new users, and traditional players had to upgrade their digital proposition. Branch and ATM closures help banks reduce costs.

- In the U.S., 20'000 branches could close in the next decade (vs. 4'500 or 6% of total branches since 2010).
- In Switzerland, 30-40% of ATMs are expected to disappear within 5 years.

An advantage during the Paycheck Protection Program (PPP)

Fintech players came to the rescue of SMEs when PPP was released. Incumbent banks prioritized larger enterprises and did not have the technology to treat thousands of applications. PPP was an opportunity to bring new clients to the fintech platforms and to retain existing customers within the fintech ecosystem.

- The PPP authorizes up to $669bn in forgivable loans to small businesses.
- Kabbage processed 300k loan requests (second-largest volume) for $7bn.

Stimulus checks and trading

Stock trading was among the most common uses for the $1'200 stimulus checks received by Americans. Locked at home and with plenty of free time, many first-time investors turned to trading apps to profit from high volatility in the markets.

- Square Cash App or Robinhood experienced meaningful uplift from users depositing $1'200 or $2'400 in April 2020.

SOURCE:
OCC, FDIC, SIX, Kabbage, Square, Robinhood

Outlook – One-Stop Shops

Re-bundling financial services

The time when fintech startups were proposing a single service is gone. As companies mature and user base grows, fintech giants want to cover the entire financial life cycle: save, pay, invest, tax, borrow, lend, insure, retire, inherit.

- Square started with a credit card reader in 2010 but extended its service offering to now include stock trading or treasury management, among others.

Simple interface for improved user experience

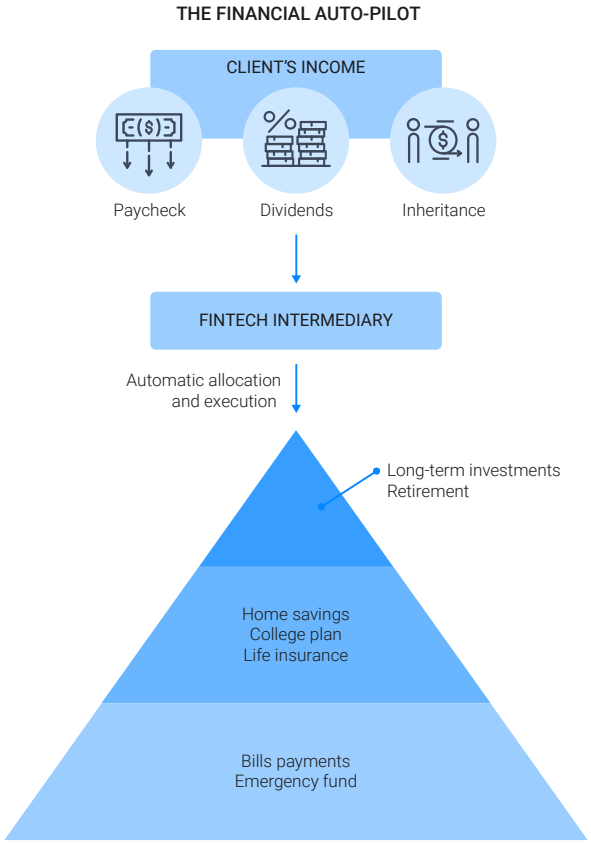
The success of fintech companies is largely due to simple user experience. These firms have reduced to a couple of clicks what was required to be done in a banking branch for hundreds of years. As the product mix enriches, the customer-centered approach of fintech apps will have to keep their ease of use.

- If payment cards have not yet disappeared, it is because they are convenient to use. Fintech apps must target the same level of experience.

Investments for everyone

The next generation of apps will be like a Fitbit which automatically tracks personal activities. Fintech apps will be on an auto-pilot mode, paying bills and investing excess savings to achieve financial goals. Market knowledge will not be a barrier anymore. The next generation of robo-advisors is coming, and the use of artificial intelligence will create more personalized portfolios.

- Out of the approx. $60tn AuM in North America, less than $300bn are managed by robo-advisors.
- Firms like Wealthfront and Betterment are driving this trend in the U.S.



SOURCE:
Square, UX Planet, Forbes, PwC, Investopedia, Wealthfront, AtonRâ Partners

Outlook – Blockchain

Central banks to revolutionize the monetary system

As economies go digital, a central bank digital currency (CBDC) ensures that the general public retains access to the safest form of money. Central banks in developed countries are accelerating their digital currency projects, given the geopolitical consequences of leaving China alone and the threat caused by stablecoins like Libra's Facebook.

- The Chinese e-Yuan is expected to be ready for the 2022 Olympics.
- A reduced version of Libra (renamed Diem), pegged to the USD, is expected for Q1 2021.

Development and deployment

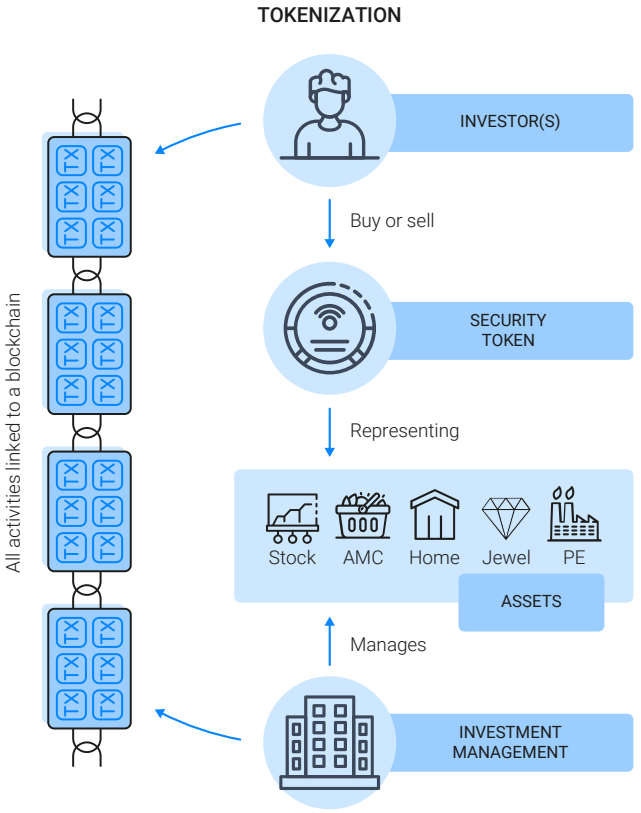
Slowly but surely, real-life applications of blockchains are being implemented. Interoperability with complex legacy systems has been improving. In parallel, research projects that could change the financial infrastructure are ongoing.

- Blockchain can disrupt payments, trading, insurance, lending, etc.
- Ethereum 2.0, a widely used protocol for smart contracts, will improve blockchain scalability issues.
- With a 2019–2024 CAGR of 69%, blockchain development is the fastest-growing sub-theme in our fintech universe.

The end of the illiquidity conundrum

We believe that digital assets have the possibility to improve the liquidity of illiquid assets. Blockchain offers new possibility to create investment vehicles combining all types of securities. Development of tokenization will accelerate next year.

- Advantages include transferability, transparency, speed, price and efficiency.
- Tokeny Solutions and Templum are some of the firms in this ecosystem.



SOURCE:
Deloitte, BNY Mellon, AtonRâ Partners

Outlook – Regulatory Changes

Fintech charter on the table again

As the number of users grows, protecting consumers will again be a hot topic in 2021 for regulators. Fintech startups fear a slowdown in innovation, if regulations increase. But as business models mature, many fintech leaders have decided to get a banking license to offer deposit or lending without needing any partnership.

- The SEC launched FinHub to create a positive regulatory environment.
- Square, SoFi or LendingClub were granted bank charters recently.

Finally, the year of a Bitcoin ETF?

The SEC Chairman, crypto skeptic Jay Clayton, intends to resign at the end of 2020. His departure could pave the way for regulatory changes on digital assets and eventually the launch of a US-based ETF on Bitcoin.

- Gary Gensler, an MIT professor and specialist in fintech and blockchain, leads the financial policy transition team for President-elect Biden.
- All ETFs projects on crypto were rejected for fears of market manipulation and concerns over security classifications.

Increased focus on regtech

The financial sector has been deregulated under the Trump administration. Biden could reinstate some Dodd-Frank-era financial reforms. More regulations imply more costs for the banks. This would represent tailwinds for regtech.

- Regtech accelerates the digitalization of administrative burden and reduces regulatory compliance expenses.
- The regtech market is expected to reach $17bn in 2024 (5-year CAGR of 24%).

SOURCE:
MIT, Fortune, Deloitte, Companies' press releases, AtonRâ Partners

Outlook – Payment Industry

The year Westerners could adopt QR codes

While mobile payments in Asia were built on QR codes, the U.S. and Europe relied on Near Field Communication (NFC) chips. QR codes have the advantage of connecting our online identity and data to the offline world. Payments get more intuitive through QR codes than NFC, improving user experience.

- Companies like Apple or PayPal are pushing QR codes.
- It is not the first time QR codes appear – make-or-break year.

Real-time and account-to-account (A2A) payments

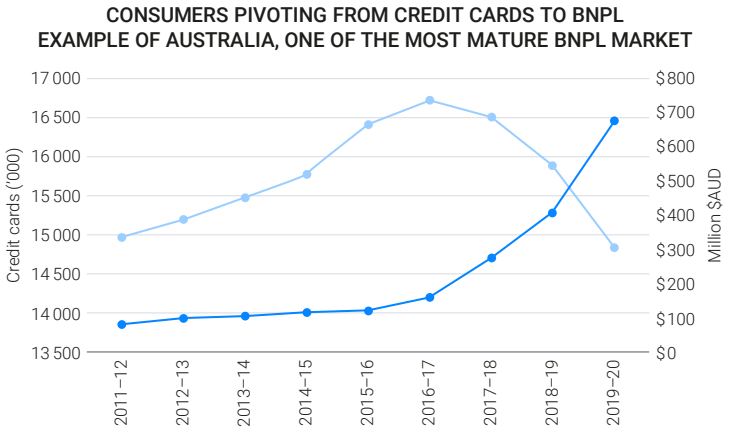
2021 will see a record number of financial institutions upgrading their systems to accept real-time payments and reduce back-office processes. Moreover, open banking facilitates A2A payments, where banking account details are provided through simple methods like QR codes. Peer-to-peer (P2P) payments are only starting.

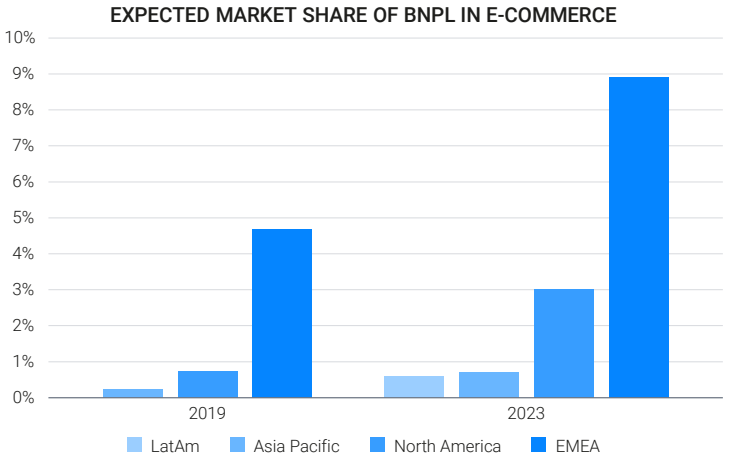
- Cross-border payments will be the next area with scope for improvement.
- Real-time payments imply real-time anti money laundering (AML) and compliance checks, another activity with high growth potential for regtech.

The digitalization of installment payments

"Buy now, pay later" (BNPL) is the fastest growing global payment method. It represents the merger of paytech and alternative lending. Merchants receive the full amount upfront. The credit risk is supported by the payment provider. BNPL is an alternative to credit cards and increases the average transaction value.

- In North America and EMEA, BNPL is expected to account for 3% and 9% of e-commerce payments by 2023, respectively.





SOURCE:
Andreessen Horowitz, Worldpay, IBISWorld, Reserve Bank of Australia

2020 – A Glance In The Rear-View Mirror

U.S. fintech entering China

Mastercard won approval from the People's Bank of China (PBOC) to set up a bank card clearing business in China. This approval proves that the government is willing to open up its financial industry, the largest and most mature fintech market in the world.

- Out of the 8.8bn bank cards issued in the country, less than 10% are credit cards.

A boost from Covid-19

In their initial recovery plans, many governments around the world dedicated funds to financial innovation.

- The UK government announced a fintech sector review to support growth and competitiveness.
- Australia re-opened submissions to its Select Committee on Financial Technology and Regulatory Technology to evaluate the impact of Covid-19 on the fintech sector and to provide support.

The fall of Wirecard

After months of speculations about Wirecard's financial statements, KPMG announced that it could not verify most of the profits reported from 2016 to 2018. In June, police investigated Wirecard's offices. Wirecard announced then that €1.9bn were missing. Bankruptcy was unavoidable.

- The fall of Germany's tech darling leaves more space for its European competitors.

Libra applies for FINMA payment license

We believe Libra has the potential to democratize blockchain technology. But the project proposed by Libra has significantly evolved since its announcement, and what will be offered looks less exciting.

- As of early December 2020, the approval of the FINMA license has not been released yet. The official launch date of Libra is still expected for Q1 2021.
- We intensively covered the Libra projects, e.g., in A Libra Debunking and in Libra (un) chained.

IMPACT

H1 2020

IMPACT

Yapeal receives first FINMA fintech license

The neobank will be able to offer Swiss IBAN without leaning on an established bank for connection to the payments system. Switzerland tries to be at the forefront of the fintech revolution and is offering attractive regulatory conditions that take into account the limited budget of many innovative firms.

- The fintech license caps deposits at CHF100mn only; it should be considered as a first step before a regular banking license.

Microsoft unveils "Money in Excel"

Users will have the ability to import their bank and credit card account data into Excel, thanks to a partnership with Plaid. Plaid confirms its status of essential provider for fintech players. Microsoft joins the fintech party and adds a product for the booming personal finance market.

- At this time, Plaid confirmed it was in talks with 25% of Fortune 100 companies about serious fintech initiatives.

EU antitrust regulators target Apple

Regulators are concerned that Apple Pay is the only payment service allowed to use the "tap and go" functionality on iPhones. If Apple loses the case, consumers will have more choice for this functionality, and merchants may propose cheaper alternatives.

- Apple argues that it is for security reasons that third-party developers do not have access to the NFC chip.

SOURCE:
KPMG, Companies press releases, AtonRâ Partners

2020 – A Glance In The Rear-View Mirror

Robinhood postpones its UK launch

The company refocuses its effort on its home market. International expansion for fintech companies is difficult, because of the various regulations.

- The arrival of Robinhood in Europe could have disrupted a brokerage market that still relies on old-fashioned but transparent fee schedule.

New features for Square's Cash App

SMBs employees can get a portion of their wages ahead of time (on-demand pay). An instant payment feature lets businesses fund payroll immediately, without having to route the funds through an external bank account.

- Square had more than 30mn users at the end of June 2020.

Decentralized Finance (DeFi) in demand

DeFi crosses the $10bn mark for the first time in Total Value Locked (TLV), the balance of ether (ETH) and other tokens linked to smart contracts. DeFi refers to a financial ecosystem built on peer-to-peer open-source applications that interact on top of blockchain networks.

- We deep-dived into the subject in Decentralized finance, system revolution or craze?

PayPal offers crypto trading

U.S. users can trade different cryptocurrencies, including Bitcoin (BTC) and Ethereum (ETH). Through this service, PayPal is joining competitors like Robinhood and Square. PayPal merchants will have the possibility to be paid in these cryptocurrencies.

- The service is proposed through a partnership with Paxos, a company we had already introduced in our article on the Latest developments on blockchain in finance.

IMPACT

H2 2020

IMPACT

Crypto custody for U.S. banks

The Office of the Comptroller of the Currency (OCC) clarified that national banks have the authority to provide cryptocurrency custodial services to cryptocurrency businesses. The move will enable financial institutions to extend their services in the realm of digital assets.

- This is one of the rare regulations in favor of digital assets in the United States which could trigger a change of paradigm.

Temenos for Varo's core-banking system

The neobank became the first U.S. fintech to earn a national banking license. The move outlines the need for challengers to rely on state-of-the-art systems. Partnerships among fintech companies will be a key element of future growth.

- Varo had over 2mn users in June 2020.

Ant Group IPO delayed

It was supposed to be the mother of all fintech IPOs, valuing the company at more than $250bn and raising $35bn.

- Chinese authorities have fintech companies in sight and is the entire Chinese fintech industry that is exposed in the short-term.
- Ant will have to raise additional capital and the IPO is likely postponed until 2022.

SOURCE:
Companies press releases, AtonRâ Partners

2020 – Capital Markets

Private markets

Private companies are one of the driving forces of the future of fintech. Barriers to enter this industry are low – at the end, fintech is mostly about software. Less PE funding deals were done in 2020, due to Covid-19. But the mega-deals are on the rise. Private companies are gently maturing.

- Despite the slowdown in VC-funding in 2020, the total financing remains above the level of 2018 (ex-Ant Financial $14bn round this year).

A year full of acquisitions

Following the mega-deals of 2019, 2020 has surprised us by the diversity of the transactions. The consolidation wave in the payment industry has hit Europe. API developers which provide the plumbing between fintech companies and banks have been actively sought.

- 2019 was intense with >$75bn of M&A in the U.S. payment industry.
- We explained the M&A frenzy of credit card companies in this article.

More IPOs to come

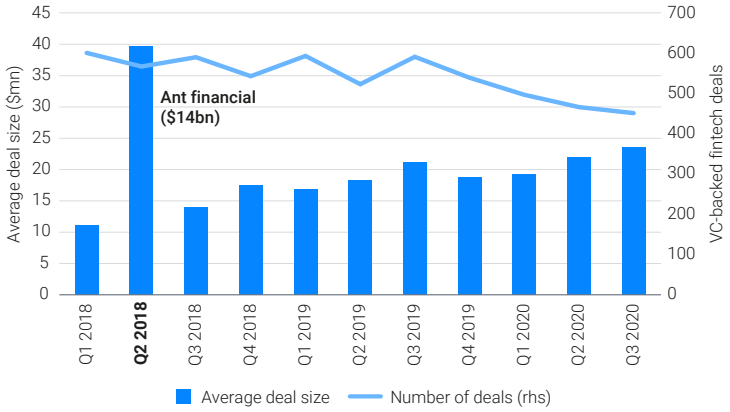
We expect our investment universe to grow significantly next year. Like in 2020, we should have a good mix of technology enablers (e.g. nCino or Duck Creek), and challengers (e.g., Lemonade or Lufax).

- There were 70 fintech unicorns at the end of Q3 2020 (58 as of Q3 2019).
- Most of these unicorns are based in the United States.

SELECTED FINTECH M&AS (2020)

Announced Date	Acquirer	Target	Deal size
Jan-20	Visa	Plaid	$5.3bn
Feb-20	Morgan Stanley	E*TRADE	$13.1bn
Feb-20	Intuit	Credit Karma	$7.1bn
Feb-20	Worldline	Ingenico	$8.6bn
Apr-20	SoFi	Galileo	$1.2bn
Apr-20	Binance	CoinMarketCap	n/a
May-20	Tencent	AfterPay	(5%) $300mn
Jun-20	Mastercard	Finicity	$985mn
Jul-20	Black Knight	Optimal Blue	$1.8bn
Aug-20	American Express	Kabbage	n/a
Aug-20	Apple	Mobeewave	$100mn
Aug-20	Roper Tech	Vertaforce	$5.35bn
Aug-20	Intercontinental Exchange	Ellie Mae	$11bn
Oct-20	Stripe	Paystack	$200mn
Oct-20	Nexi	SIA	$5.3bn
Oct-20	NEC	Avaloq	CHF2bn
Nov-20	Nexi	NETS	$9.2bn
Nov-20	Nasdaq	Verafin	$2.8bn
Nov-20	Lightspeed	Shopkeep	$473mn
Dec-20	Lightspeed	Upserve	$430mn
Dec-20	Affirm	PayBright	CAD 340mn

PRIVATE MARKETS ACTIVITY (2020)



SOURCE:
CB Insights, Statista, Companies' press releases, AtonRâ Partners

Structural Trends – Towards Cashless Societies (1/2)

A New Paradigm thanks to mobile phones

Cell phones have become essential for many people throughout the world. Providing payment solutions on these devices has been a natural development. The emergence of mobile payments accelerated the pace of innovation in fintech.

- 4.8bn people have a mobile phone, of which 3.5bn are smartphones.
- The first significant deployment of mobile payments was in Africa to improve financial inclusion.

Rising Adoption Rates Globally

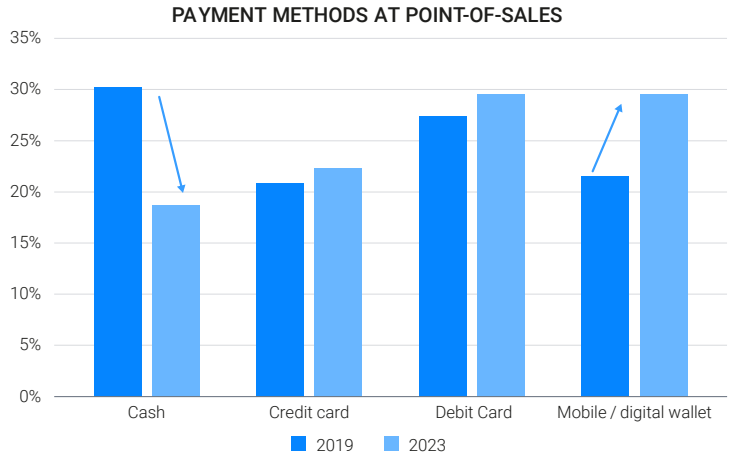
Globally, the use of cash has been on a downward trend. Storing cost or security risk are among the disadvantages of holding cash. The payment method that benefitted most from a lower use of cash has been mobile phones.

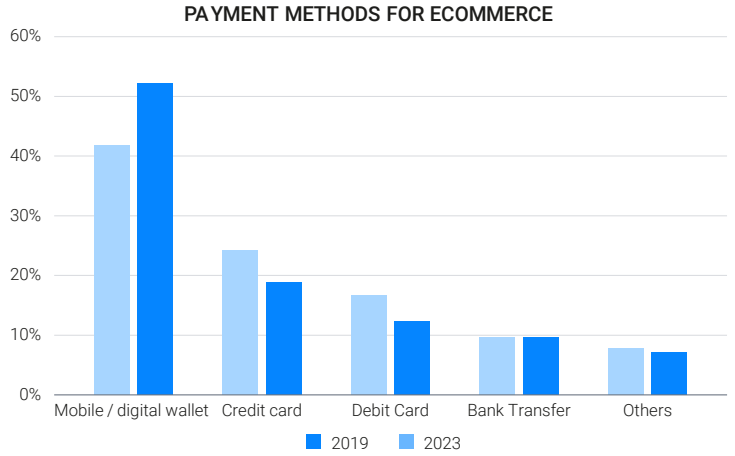
- At point-of-sales, payments by phones will reach ~30% by 2023, more than any other payment method.

Digital payments get boosted by the rise of e-commerce

Cash is not king on the internet. The shift from brick-and-mortar to on-line shopping is benefitting digital payment solutions. Mobile wallets are already globally considered to be the preferred payment method for e-commerce and will gain further market share going forward.

- E-commerce still has a huge potential as it only accounts for a fraction of total retail sales globally, at ~20%.





SOURCE:
Statista, Worldpay, eMarketer, AtonRâ Partners

Structural Trends – Towards Cashless Societies (2/2)

Asia is leading the way for mobile payments

Adoption of mobile wallets is much higher in Asia than in the rest of the world. The region leapfrogged the payment cards and went directly from cash to mobile payments.

- More than 50% of total retail sales in Asia are paid via mobile phones.
- China's mobile payment giants WeChat Pay (Tencent) and Ant Group (Alibaba) have 900mn and 800mn users, respectively.
- Asia is for the largest region for e-commerce, ~$2.5tn out of a total of $5.0tn should be spent online in 2020.

Growth story in the rest of the world is intact, but slowing

Mobile and digital payments still have growth potential in Europe and North America. Competition from payment cards is more important in these regions. But payment processors, which are exposed to all types of digital payments, will keep benefitting from the transition to a cashless world.

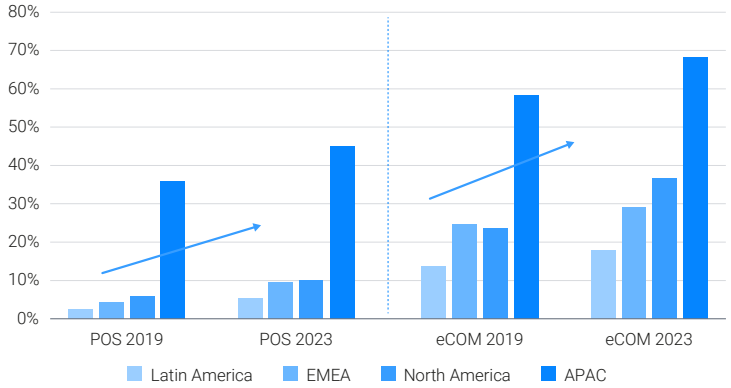
- Growth rates of digital payments will go down as cash disappears.

Unequal adoption rates across countries

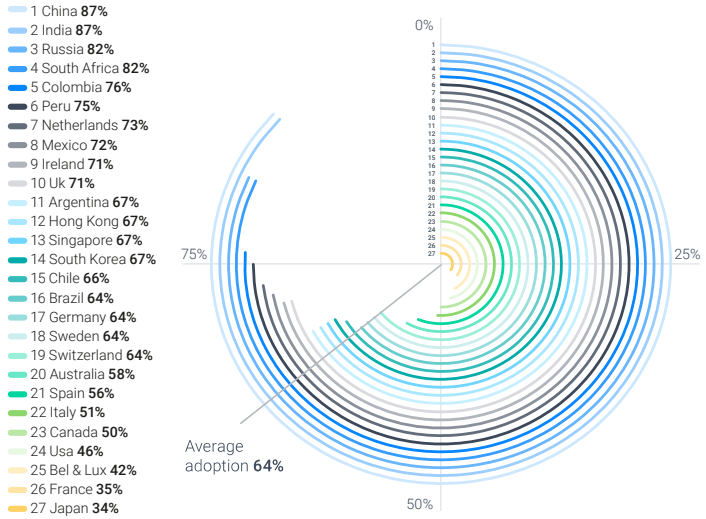
The adoption of mobile payments or fintech services in general is not linked to economic development, but rather to the access to traditional banking players, the age of the population and the level of trust in technology. The regulatory framework and government incentives act as accelerators to adoption.

- For example, cash-friendly Japan had to offer rewards in 2019–2020 for digital payments to encourage people to change their payment habits.

MOBILE PAYMENTS ACROSS REGIONS: POINT-OF-SALES VS ECOMMERCE



CONSUMER FINTECH ADOPTIONS ACROSS 27 MARKETS (2019)



SOURCE:
Worldpay, Bank for International Settlements, Ernst & Young, AtonRâ Partners

Structural Trends – Digitalization (1/2)

The digitalization of a multi-trillions dollar industry

Banking incumbents are losing market share against newcomers. As fintech services are maturing, pressure on revenues and margins will intensify. Banks must digitize to automate their operations, reduce costs, and expand their offering to meet customers demand and new banking behavior.

- In 2018 finance and insurance represented 7.4% of U.S. GDP (or $1.5tn).

Budget of a digital transformation

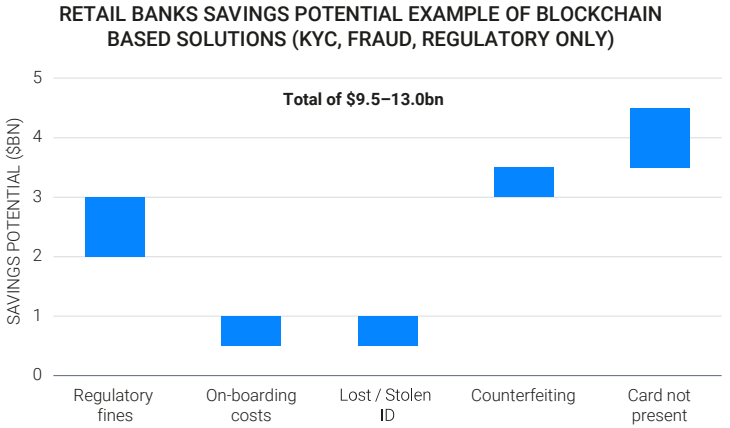
Banks reduced their innovation budget during the '08-'09 financial crisis, which resulted in the emergence of the first wave of fintech players. They cannot repeat the same mistake. The difficulty is to maintain legacy systems while investing in tomorrow's platforms.

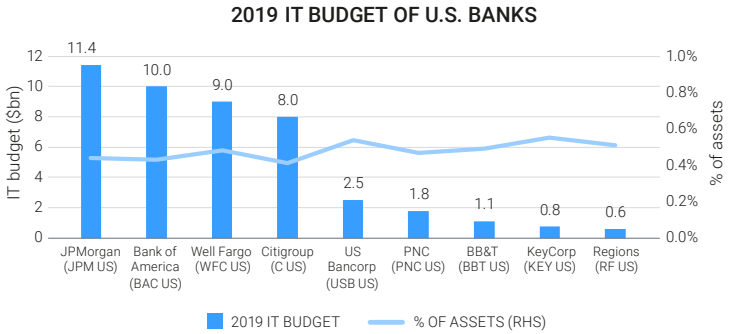
- The top-10 U.S. banks spend more than $45bn on IT.
- Newcomers do not have the burden of legacy systems and can implement from scratch state-of-the-art core banking systems.

Thousands of institutions to partner with

When it comes to open banking APIs or programming, smaller institutions do not have the in-house capabilities to develop their digital offering. Outsourcing and partnerships with fintech companies is the only solution to upgrade their offering.

- Lack of digital know-how partially explains the ongoing consolidation wave for the 5'700 European banks and the 10'100 U.S. banks and credit unions.
- About half of the 5'000 FDIC-insured banks have less than 50 employees.





SOURCE:
U.S. Department of Commerce, UBS Evidence Lab, McKinsey
European Banking Federation, FDIC, National Credit Union Administration

Structural Trends – Digitalization (2/2)

Building tomorrow's infrastructure

Open banking is the promise to give back to the clients control over their data. Users are not dependent on their bank's digital offering anymore. They can cherry-pick their service providers while maintaining their existing bank account.

- The infrastructure that connects all actors is based on application programming interface (APIs).
- We wrote an introduction to open banking in Decentralized finance, system revolution or craze.

Implemented through regulations or market forces

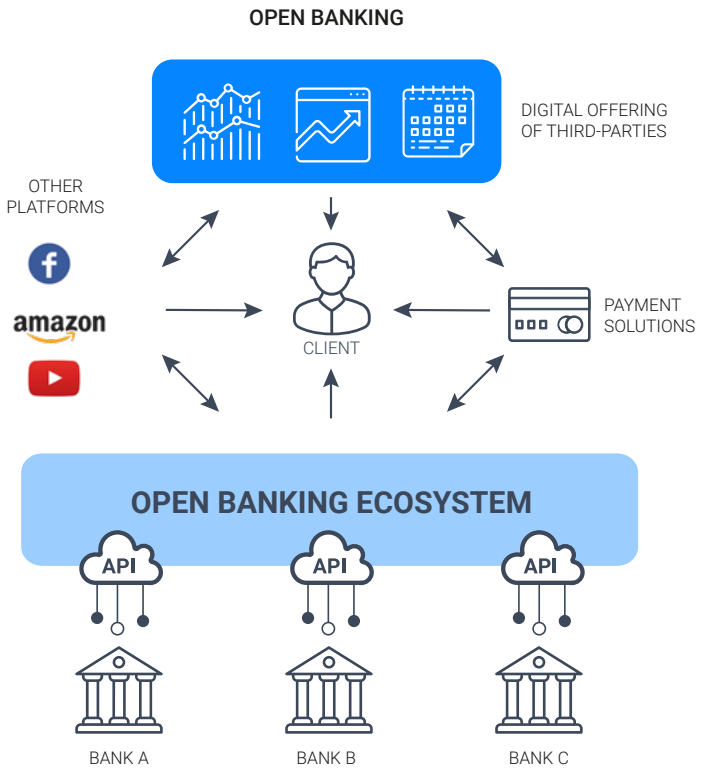
Open banking in Europe is being driven by the regulatory framework. But traditional players have not embraced its potential yet. In the United States, an innovative ecosystem is appearing to meet clients' needs in digital finance.

- The E.U. Payment Service Directive 2 went into effect in September 2019.
- Leading APIs providers are U.S.-based: Plaid, Marqeta, DriveWealth, etc.

Opportunities and challenges

User experience, mostly facilitated by these APIs, remains a major competitive advantage for fintech apps. But all firms rely on the same API providers. Innovation must be continuous to differentiate services.

- In the open banking framework, banks become simple partners of fintech companies that have not (yet) applied for a bank charter.



SOURCE:
U.S. Department of Commerce, UBS Evidence Lab, McKinsey
European Banking Federation, FDIC, National Credit Union Administration

Structural Trends – Serving The Underserved

Gen Y, Gen Z, and tech-savvy people

Younger generations were the first to embrace the fintech revolution. Fintech apps have often become their primary and only banking relationship. As they increase their paychecks and inherit from their parents, they will maintain their current banking behavior.

- U.S. millennials will receive $68tn from their baby boomer parents by 2030.
- In parallel, the potential to bring older people to these platforms is huge.

And all the others!

Fintech goal is to democratize financial services for everyone. Many people do not make the best use of their financial access, due to a lack of financial literacy. For instance, most people keep their savings in cash instead of investing them.

- In a high-income country like Singapore, 48% of people think they will not have enough money in retirement, because they underinvest their savings.
- Money supply (M2) reaches $19tn in the U.S. and €14tn in Europe!

Potential in Emerging Markets

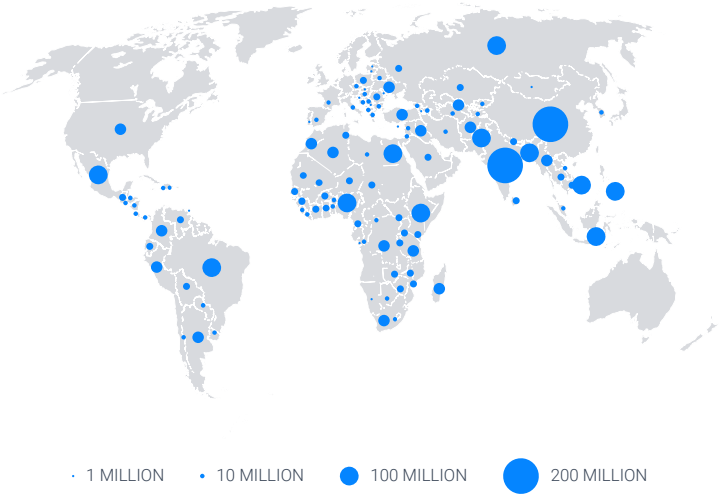
The financial industry is not as developed in developing countries as in the rest of the world. Supported by government policies, technological companies fill the gap left by traditional players. Fintech provides financial services to the masses that were once only available to the affluents of these countries.

- In 2017, 1.7bn adults in the world still had no access to a bank account.
- Digital finance could add $3.7tn to the GDP of emerging countries within a decade, according to McKinsey.

USER AGE STATS OF SELECTED FINTECH COMPANIES

robinhood	Average age is 31 (2020)
venmo	50% of users are 25 to 34 (2019)
monzo	72% of users are less than 32 (2019)
Revolut	Average age is 35 (2020)
afterpay	Average age of US users is 33 (2019)

1.7BN ADULTS HAVE NO BANK ACCOUNT (2017)



SOURCE:
Coldwell Banker, WealthEngine, Forbes, Monetary Authority of Singapore, FED, ECB,Companies' releases, businessofapps.com, McKinsey, World Bank – Global Findex Database

Structural Trends – Big-Techs

From fintech to techfin

When it comes to artificial intelligence, cloud computing, and customer analytics, Big-Tech companies have a clear advantage over financial institutions. It is a natural expansion to see these companies adventure into financial services. Their M&A activity on fintech providers has been ramping up for years.

- Amazon fintech M&A activities goes back to 2006 when it acquired a SMS payment service, TextPayMe.

Big-Tech will remain technology vendors

Big-Tech move in financial services spurs financial innovation for pure fintech players. Incumbents are more at risk of losing market share. Regulatory constraints should discourage Big-Tech applying for bank licenses. Banks will become an interchangeable partner for Big-Tech. Margins will deteriorate.

- Goldman Sachs reportedly spent $300mm developing the Apple Card.
- Google has partnered with 11 institutions to launch Plex in 2021, a checking account service.

The holy grail to financial data

The interest of Big-Tech is not linked to financial services, a low margin business compared to their traditional activities. They want to increase brand loyalty, keep customers captive on their platforms, and, above all, get additional personal data.

- Apple Pay will process 10% of global card transactions by 2025 (5% now).
- In 2021 Libra will be proposed to Facebook's 2.7bn active users.

SOURCE:
Amazon, Google, Wall Street Journal, Bernstein

Fintech For Dummies

The world is digitizing, the financial industry too

The pace of innovation in financial technology has been accelerating lately. This is just the beginning of a secular trend, as technology and digitalization are reshaping the financial industry.

- The way people bank is quickly changing.

A booming ecosystem

Banks and insurers have no choice but to invest heavily as Fintech will spark major operating efficiencies through increased automation. It is also expected to lift the financial industry's revenue outlook through enhanced customer experience and engagement.

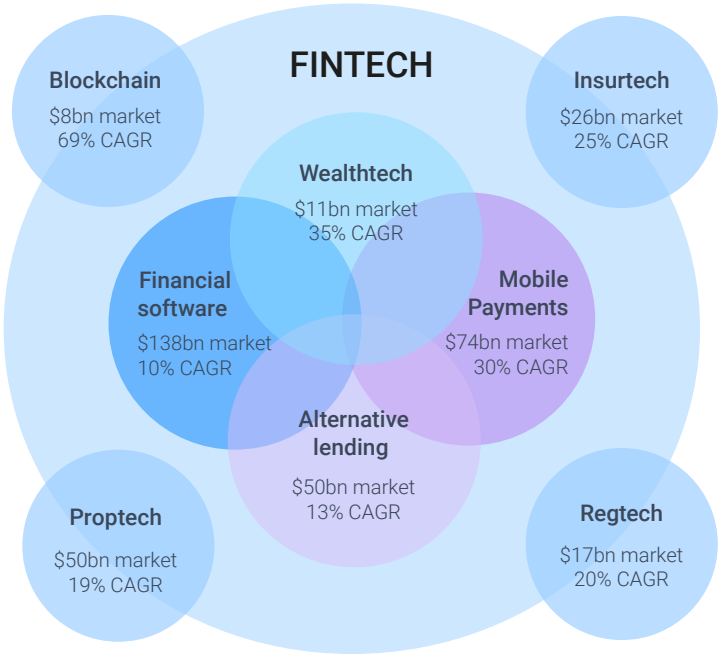
- New applications rely on the latest technologies, including blockchain, cloud computing, APIs, artificial intelligence, and big data.

Investment universe

Our investment universe is composed of all the companies that are active in the transformation of the financial industry. We distinguish the technology enablers and the challengers, i.e., the new entrants that want a piece of the cake.

- This includes firms active as internet and mobile financial platforms, payment networks and processors, hardware providers for financial services and software vendors, among others.

2024 MARKETS & 2019–2024 CAGR



2024 market & CAGR 2019–2014
Illustrative relationships

SOURCE:
CBInsights, University of Cambridge, PwC, KPMG, Grand View Research, AtonRâ Partners

Catalysts

- **Blockchain.** Distributed ledger is probably one of the technologies with the most potential to disrupt the financial system – operations, transparency, efficiency, etc. The arrival of CBDCs could yield to unexpected innovations.
- **Challengers' IPOs.** Newcomers are about to go public and the entire ecosystem will benefit from these hot IPOs. The younger generations that use these apps will have new names to invest in – so will we.
- **Competition.** Thanks to APIs, technology is not a barrier to entry in this ecosystem. Major product launch by Big-Tech and banking charters taken by challengers increase the competitive environment. Higher competition will force companies to innovate and differentiate their offering.

Risks

- **Chinese regulations.** The Chinese government and Central Bank fear that Big-Tech creates systemic risk for the financial system. The delay of Ant Group IPO was just the tip of the iceberg, more regulations are coming for the largest fintech industry in the world.
- **Default of a challenger.** Some challengers struggle to monetize their huge client base and are burning cash. If a fintech like Monzo or Revolut is not able to raise private money and defaults, it could harm the industry.
- **Cyberattack on stablecoin.** Libra will potentially be used by millions of people next year, who do not have any blockchain knowledge. Cyberattacks are likely to target these new users. A massive breach will slow down the democratization of this technology.

Bottom Line

- Given the weight of the financial industry in our societies, the fintech ecosystem is changing the world. Financial services are being democratized and banking behavior is quickly evolving. This revolution started about a decade ago, and all the pieces of the jigsaw puzzle are falling into place.
- Our fintech portfolio is mostly exposed to technology enablers. As the investment universe expands and business models matures, we will increase our allocation to challengers. At the sub-theme level, we will keep a highly diversified portfolio. We have started reducing the exposure to mobile payments in 2020 and will continue this trimming process. The rising adoption rates of this payment method reduce the growth perspectives.

Companies mentioned in this article:

Alibaba (BABA US), Amazon (AMZN US), Apple (AAPL US), Betterment (not listed), DriveWealth (not listed), Facebook (FB US), Goldman Sachs (GS US), Kabbage (not listed), LendingClub (LC US), Marqeta (not listed), PayPal (PYPL US), SoFi (not listed), Square (SQ US), Templum (not listed), Tencent (0700 HK), Tokeny Solutions (not listed), Wealthfront (not listed)

SECURITY AND SPACE - ON THE LAUNCHPAD

When The Stars Align

Accelerating towards growth

In the early stage of its digital and tech transformation, the security and the space sectors are enjoying a massive boost in capex and government spending while mutually boosting and fueling each other.

- We anticipate huge investments into the Internet of Things (IoT), Artificial Intelligence (AI), and Machine Learning (ML), greatly advancing the space and security industries. This trend should accelerate and last for the next decade.
- Developments in space will require more cybersecurity, which in turn needs space-based communications.

Unlimited potential in space

Space exploration, communication, and defense remain the major sources of upside. We believe governments will continue providing an extra boost to exploring space and developing space-based weaponry solutions. Space travel generates high hopes to extend the addressable market.

- Information from satellites fuels a substantial part of the technology (navigation, telecommunications, tracking) that is pivotal in the defense environment.

Continuing shift from “armed” to “cyber” defense

We continue to stress that governments and corporations have no choice but to continue reinforcing their security against a backdrop of rising cyber threats. Evolving IoT and the fast transition to cloud triggered by Covid-19 reiterated our firm conviction in cybersecurity, hence our considerable exposure in the portfolio.

- As we correctly expected, cyber-attacks on utilities and public infrastructure kept increasing throughout 2020, totaling over 1mn recorded hacking cases.

SOURCE:
AtonRâ Partners

Covid-19 – Impact

More positives than negatives for Space

Covid-19 had little immediate negative impact on the space sector. On the other hand, demand for satellite imagery increased to monitor the pandemic outbreak and its consequences on human activity and the environment.

- The biggest hit was felt by smallsats launchers, which were ultimately granted help by the U.S. government.
- Private investments resumed in Q3 after a pause in Q2.

Potential but unlikely public fallout

Space exploration is expensive and relatively abstract for many. In a tense socio-economic context, this could result in public budget cuts and overall lower investments, although its weight in the total public budget is relatively low.

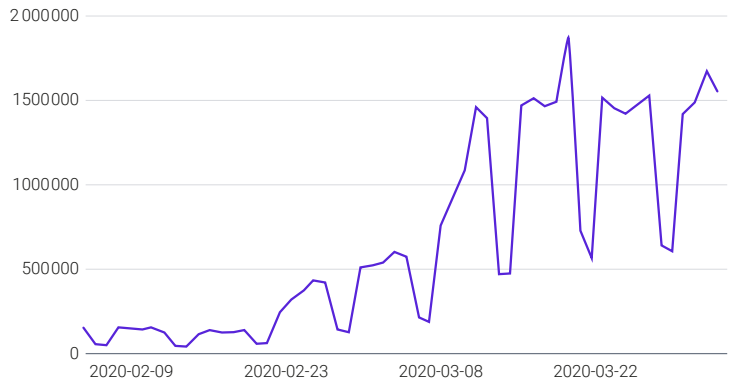
- NASA's budget is less than 4% of Medicare's.
- Currently, 71% of Americans consider NASA is necessary, 73% a source of pride.

Cybersecurity firms have to analyze user behavior and interests

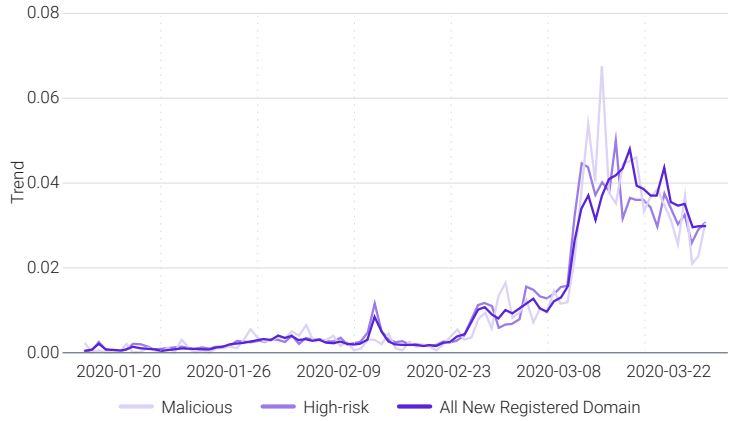
Cybercriminals are always preying on trending topics, and Covid-19 has been a boon. Cybersecurity firms had to quickly develop tools to monitor user interest for such topics to protect clients from malware, phishing, scams, and "coin mining".

- Covid-19 spurred a 10x increase in the number of coronavirus-related domain names: out of 116k, ~2k were considered "malicious" and ~40k "high-risk".

NUMBER OF UNIQUE CORONAVIRUS RELATED URLS VISITED



DAILY DOMAIN REGISTRATION TRENDS



SOURCE:
Wild Wide Web,
The FY 2021 Federal Budget Sustains Cybersecurity Funding, But Could Growth Be Slowing?
NASA, Space Exploration, and American Public Opinion,
Studying How Cybercriminals Prey on the COVID-19 Pandemic

Outlook – Space (1/3)

SpaceX to remain far ahead

"Old Space" is lagging SpaceX, which leverages its ability to reuse launchers, thus cutting costs and rapidly iterating. Competitors accumulate technological lag, project delays, and cost overruns, giving SpaceX even more advantage.

- ESA's Ariane 6 requires extra funding (€230mn) and has been delayed to 2022.
- Vega witnessed two failures, and Vega-C has been delayed to 2021.
- The U.S. projects SLS (launcher) and Starliner (spacecraft) are facing setbacks.

Rise of a new ecosystem

Decreasing launch costs, driven by the combination of reusability, rideshare and regular launches, will fuel the rise of the small satellites ecosystem: propulsion systems, orbit delivery, in-space manufacturing, and AI-driven imagery services.

- Covid-19 has increased demand for satellite imagery to monitor the outbreak and its impact on human activity and the environment.
- 2021 will see the launches of several new-generation space tugs.

The decisive year for small launchers?

The pandemic has severely impacted small launcher players. 2021 could mark the beginning of a Darwinian selection process.

- Cheaper rideshare on bigger rockets is a significant threat.
- Consensus evaluates the market to be big enough only for a handful of players versus several dozens already in development or operational.
- Governments will have the upper hand to pick the chosen ones.

SOURCE:
Space News, CNBC, ESA,
AtonRâ Partners

Outlook – Space (2/3)

The year of LEO constellations

After much waiting, 2021 may finally mark the true start for low Earth orbit (LEO) constellations with the first commercial service launch and satellite coverage ramp-up.

- LEO orbit (attitude of up to 2'000 km) provides high bandwidth and low communication latency while remaining easily accessible for crew and servicing and requiring the lowest amount of energy for satellite placement.
- SpaceX Starlink is expected to be commercially available after the end of the U.S. beta testing (already running), OneWeb will resume launches and Telesat is expected to start its infrastructure deployment.

Additional listings

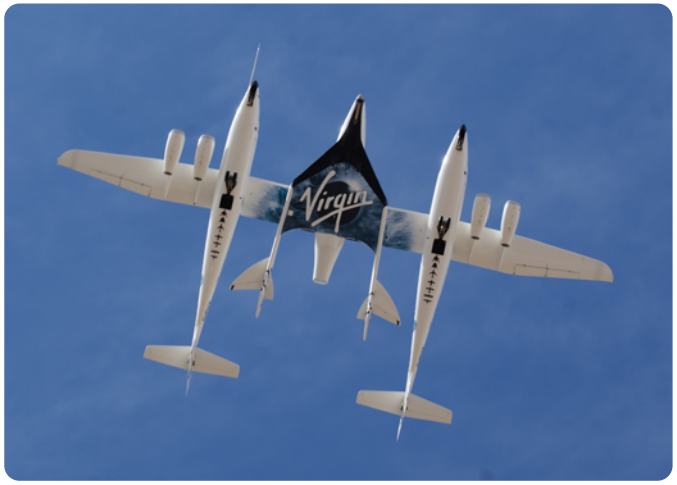
In the wake of the successful Virgin Galactic listing, more companies are expected to become public, providing an exit to VCs and additional investment opportunities.

- Momentus' listing will start in 2021 through a SPAC.
- Telesat announced its listing through a merger with Loral Space & Communications, expected to close by Q2/Q3 2021.

Debris becoming a hot topic

Space debris is becoming an increasing concern along with the rise of mega-constellations that magnify the risk of collision, but also provide opportunities for new business models using innovative approaches and technologies.

- Astroscale will launch a test mission to capture and deorbit debris.
- LeoLabs will keep deploying its AI-powered automatic debris tracking and collision avoidance system.



SOURCE:
Via Satellite, AtonRâ Partners, Wikipedia, CND

Outlook – Space (3/3)

Militarization of space

Armed forces will also use easier access to space to deploy additional capabilities, either through their projects or by leveraging already existing civilian infrastructure.

- Tests are ongoing to connect Starlink with military assets.
- The development of military projects (e.g., the U.S. AMBS program) is expected to generate significant investments into the whole space ecosystem.

The NASA uncertainty

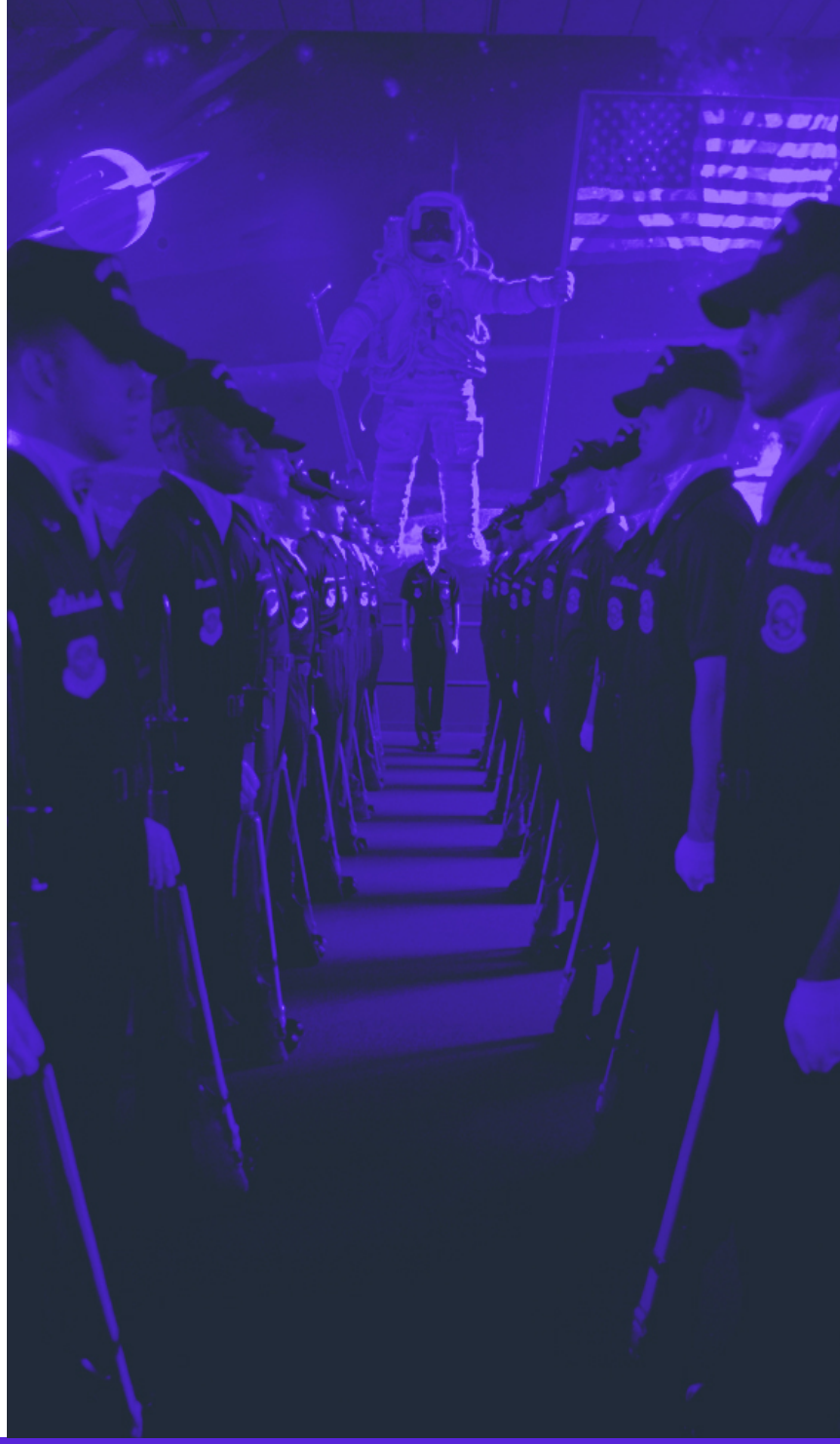
The new U.S. administration may bring potential changes to NASA projects, meaning possible major shifts in project priorities depending on the new space strategy and uncertainties regarding Trump's administration lunar projects.

- NASA Administrator Jim Bridenstine has announced his departure.
- Biden campaign did not issue a space policy statement.
- 2021 may see, therefore, significant shifts in the U.S. space policy.

Space tourism to take off

2021 may mark the first commercial launches for space tourism players, denoting the beginning of a new long-awaited era of space services.

- Virgin Galactic is set to launch its first commercial flights. Ticket prices may drop below $60k in a few years, according to Virgin Galactic CEO George Whitesides.
- Blue Origin will complete its final test launches and initiate its commercial launches.



SOURCE:
ABMS moves ahead with second round of contract awards, AtonRâ Partners

Outlook – Security (1/3)

Chinese ambitions will drive the space and security markets next year

Heavily investing into the space industry, supporting private actors, and devoting high R&D capex to new security measures, China has high ambitions and is pushing the U.S. to be excited about space (and space defense) again.

- China is already launching more rockets than the U.S. since 2017, has landed a rover on the dark side of the Moon, and is working on a large LEO space station, with multiple modules launching in 2021.
- Additionally, in 2021, China will continue setting up a fully autonomous Moon hub to gain a first-mover military advantage on the Moon.

Geopolitical tensions will continue breeding cyber-warfare

Governments will remain the most cyber-targeted entities in 2021. Upgrades and digitalization of public infrastructure, e.g., electric utilities, create large cyber-vulnerabilities and pave the way for cyber-attacks in case of conflict.

- Most critical objects such as the FBI, prisons, defense sites, and transport hubs are located near still unprotected public utilities that already get attacked daily.

Cybersecurity to protect satellites from non-kinetic attacks

A booming smallsat industry has yet to prove its satellites and data's cyber-integrity. This data feeds the entire tech and defense ecosystem and ensures global stability. As a result, the demand for cybersecurity will surge in 2021.

- CEO of HawkEye 360 John Serafini expects “significant dollars” to be injected into cybersecurity systems to ensure that the data created by satellites can be validated.

SOURCE:
Smallsat industry faces challenges to growth,
AtonRâ Partners, Forbes

Outlook – Security (2/3)

A global transition to the cloud will require additional security

Cloud has introduced many security challenges, with the top 3 being data encryption, traceability, and security. With the pandemic accelerating the shift to the cloud, demand for cybersecurity will also grow next year.

- Failure to appropriately encode or delete data in the cloud allows criminals to access data more easily versus hacking into a user's device.
- Researchers at Proofpoint detected over 15mn unauthorized login attempts to cloud networks, of which 400k were successful.

Internet of Things to create more vulnerabilities

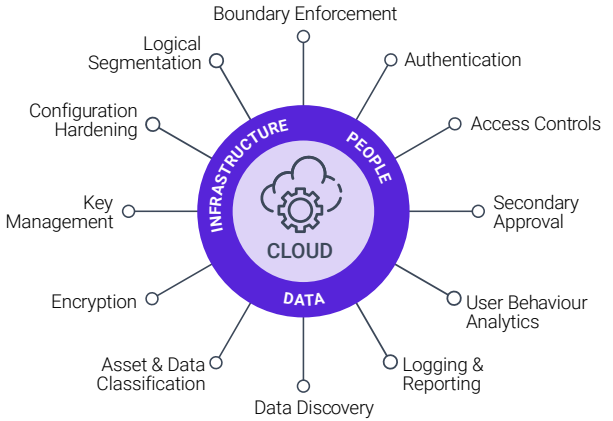
The number of IoT devices is expected to increase by 7% next year, driven by the consumer side, e.g., smart homes, and industrial IoT such as connected machinery. Each device is an additional entry point and must be digitally secured.

- Hackers broke into a casino network through a thermometer in a lobby fish tank.
- FDA is issuing alerts on several smart medical devices, e.g., cardiac devices and insulin pumps, which may be remotely accessed and used against patients.

Smart locks to gain wider consumer and regulatory adoption

Smart locks, devices that may be remotely controlled and allow couriers to deliver packages inside your house (lower risk of potential theft), are set to take-off next year. This growth will further be supported by developing online shopping.

- The rise of in-home delivery services like Amazon Key will propel the smart lock growth to 24% YoY for the next five years.
- Deployment of smart locks is expected to be the fastest-growing segment within the smart home security space.



SOURCE:
Cloud security: new report says 60% of major us firms have been hacked, AtonRâ Partners, Wikipedia

Outlook – Security (3/3)

Aging population to propel smart home security growth

As the number of seniors is expected to increase by 15% in 2021, interest in home safety for seniors will rise. Smart security sector and Big-Tech players such as Apple will continue connecting with the health market as they already do with a smartwatch.

- Cameras and sensors may analyze if a person with Alzheimer's has left the building or if an inhabitant has fallen unconscious and notify family or hospitals.

Rising costs of data breaches to drive digital security

World Economic Forum (WEF) continues to rank "Cyber-attacks" and "massive data fraud" among the top five global risks, and 2021 will not be an exception. The risk comes in hand with high costs, mainly loss of credibility, reputational blow, legal issues, and loss of consumer records, and requires significant investments in cybersecurity.

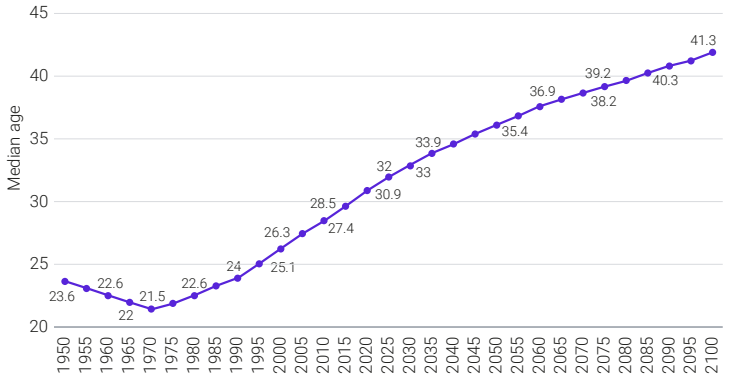
- The average total cost of a single data breach in 2020 was $4mn (the Healthcare industry being on top with ~$7mn). Overall, a 130% increase since 2006.
- Customer data remains the most expensive and most often stolen type of record, which comes at a $150 cost per lost or stolen record.

Multiple attack vectors require multiple technologies

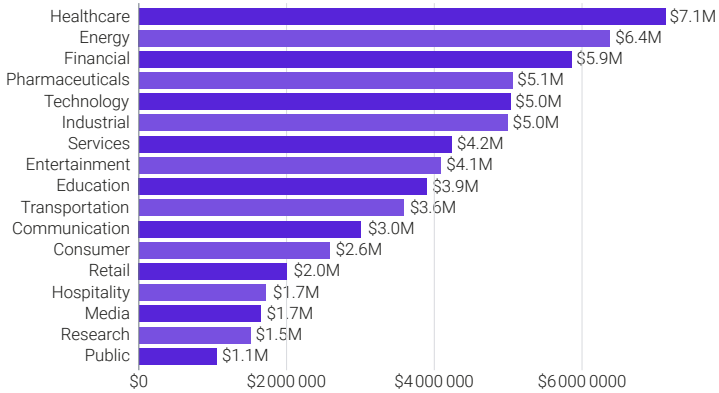
The most prominent attack vectors will remain cloud misconfiguration and human error. To tackle them, corporations and governments will boost their 2021 budgets for new technologies such as AI, facial recognition, behavioral profiling.

- Trump administration proposed for the FY2020 budget to allocate around $19bn for cybersecurity and cyber operations, a 12% increase over 2020.

PROJECTED GLOBAL MEDIAN AGE FROM 1950 TO 2100



AVERAGE TOTAL COST OF A SINGLE DATA BREACH



SOURCE:
Wild Wide Web,
The FY 2021 Federal Budget Sustains Cybersecurity Funding, But Could Growth Be Slowing?
AtonRâ Partners

2020 – A Glance In The Rear-View Mirror (1/2)

Increase in the number of near-collisions

Collisions between space debris and satellites become an increasing concern due to their potential damage on spacecrafts.

- ISS made 3 maneuvers to avoid such debris.

Utilities sectors under attack

Utilities were compromised in a series of cyberattacks underlining the increased need for cybersecurity spending.

- Azerbaijan was targeted by an unknown group focusing on their wind turbines.
- Hackers targeted the control systems of water treatment plants, pumping, and sewage stations in Israel.

Potential birth of Biometrics Agency

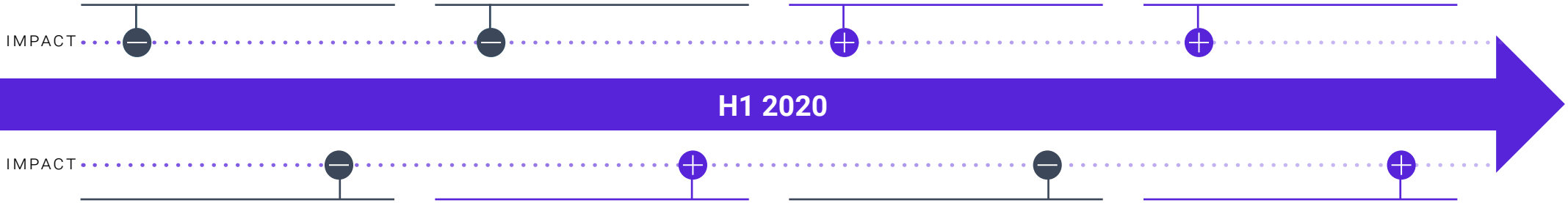
Experts called for an FDA-style government body to regulate facial recognition given how important biometric security becomes.

- A 57-page report "Facial Recognition Technologies in the Wild: A Call for a Federal Office," outlined challenges, the key concepts for the FDA model, and the current regulatory environment.

Chinese stimulus plan

The 3rd-generation of the Chinese space-positioning system is now fully operational, marking a new step in Chinese technological capabilities.

- It offers a precision up to 10cm for military purposes.



Mitsubishi loses 8'000 personal records

Losing personal data remains the biggest and the most expensive concern driving the need for cybersecurity.

- The firm announced that a massive cyberattack caused the loss of personal data of 8'000 individuals and sensitive business information.

First commercial docking

Executed to extend the commercial life of an Intelsat geostationary satellite and to move its position, it represents a milestone for satellite servicing.

- Satellites' usable life may be extended by at least 5 years.

The biggest confirmed leak of 2020

With data and reputation loss companies are required to pay hefty fines, prompting bigger investments in cybersecurity measures.

- Chinese hackers accessed the travel records of 9mn EasyJet customers and stole credit card details of 2k customers.
- Airlines group IAG is still appealing against a $225mn fine after losing data in 2018.

Next-generation in security

With global infrastructure scaling up, firms need to produce improved security measures and heavily invest to innovate.

- Palo Alto Networks introduced the world's first IoT security service with AI and ML to recommend security policies in real-time.
- Fortinet released a firewall capable of serving hyper-scale and 5G environments.

2020 – A Glance In The Rear-View Mirror (2/2)

Government constellation

The U.S. Space Development Agency signs the contract for the initial tranche of its surveillance constellation. It marks the beginning of massive government LEO constellations.

- The system will ultimately comprise over 1'000 satellites.

Air Force to Space Force

The news confirms the American plans to be more active in space and space defense.

- More than 1'000 Air Force cybersecurity operators will transfer to Space Force to offer expertise in cyber defense and space programs.

First operational Crew Dragon flight

First launch of a 100% U.S. manned mission in orbit since the retirement of the Space Shuttle in 2011. The U.S. had to rely on Russian rockets.

- Max crew capacity is 7 vs. 3 for Soyuz, although NASA opted for 4 astronauts.

Major space defense test

For the first time, a ballistic missile target was destroyed outside Earth's atmosphere by a missile defense interceptor.

- This was possible thanks to the sensors that detected and tracked the target as part of the space-based early warning system.

IMPACT

H2 2020

IMPACT

Cyberattacks disturb the death toll

Some industries digitalize faster than their ability to secure all the connections, which sometimes may lead to a fatal outcome. Cybersecurity is at the heart of the digital shift.

- A cyberattack on a hospital led to the death of a patient who was redirected to a wrong facility.

Beginning of the Starlink beta

With this beta, SpaceX successfully demonstrates its technological capacity and highlights the opportunities offered by LEO broadband constellations vs. traditional Geosynchronous Equatorial Orbit (GEO) broadband services.

- The service delivers speeds over 100mbps with low latency.

Successful Rocket Lab recovery

Although achieved through parachute-enabled sea landing, it marks a major technological milestone and an important step towards reusability and lower costs.

- Full reusability may allow to cut prices by over 30%.

Successful landing of a Chinese mission on the Moon

The mission highlights Chinese space desires and its increasing rivalry with the U.S.

- China planted a flag on the Moon right before launching the vehicle carrying lunar dirt and rocks back to the Earth.

2020 – Capital Markets

M&A

Both segments showed active M&A, with the biggest drivers being expanding the commercial footprint and acquiring new technologies. Deals remained smaller in the Space sector due to the earlier stage of the "New Space" market, while there were important deals in Security, although smaller in size compared to 2019.

- Veeam was acquired for $5bn, RSA for $2.75bn, Forescout for $1.9bn.
- OneWeb was acquired by the UK Govt. and Barthi Global for $1bn, exiting bankruptcy in the process.

IPOs

2020 witnessed some large IPOs in the Security segment. The Space sector took a breath after the Virgin Galactic 2019 IPO, but several listings are already in the pipeline for 2021 and are likely to mark the beginning of a new wave of listings.

- Snowflake was the biggest software IPO ever at $70bn.
- The year also saw the listings of Palantir ($22bn) and McAfee ($8bn).

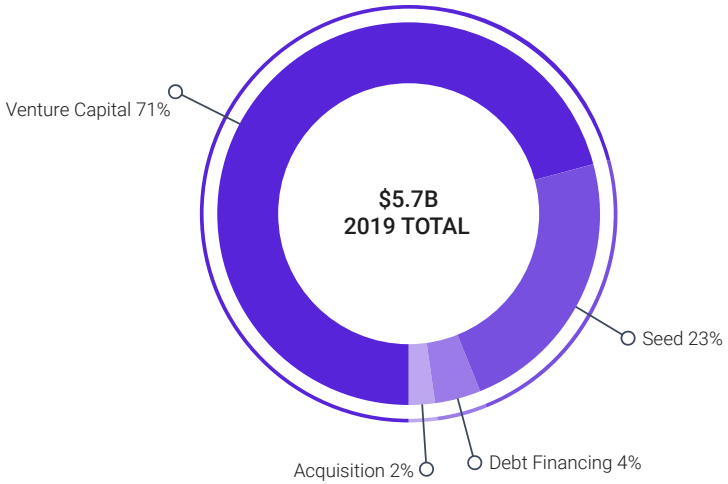
The private sector continues to boost the space sector

The Space industry continues to be greatly supported by heavy investments from top venture capital firms (e.g., Sequoia) as well as the Space Barons (i.e., Musk, Bezos, Branson). Despite a substantial slowdown in Q2 caused by Covid-19, private funding is expected to break a new record in 2020.

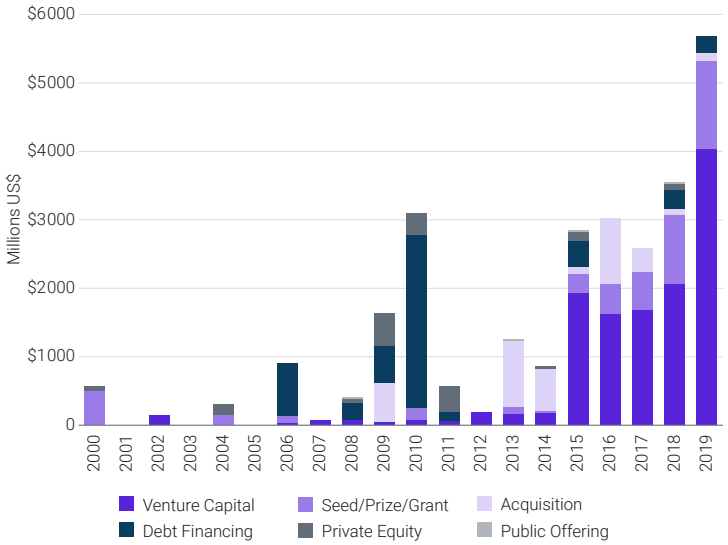
- 71% of the 2019 private funding came from venture capital, vs. 4% from debt.
- 2019 was an exceptional year at $5.7bn (+63% YOY), and in the first 9 months of 2020 funding is already up 10%.

SOURCE:
Space industry rebounds from pandemic,
Bryce Space & Technologies,
AtonRâ Partners

71% OF SPACE INVESTMENT IN 2019



THE MIX OF TYPES OF INVESTMENT IN SPACE COMPANIES VARIES FROM 2000 TO 2019



Structural Trends – Why Space?

Exploiting lunar resources

Moon is believed to have abundant resources of helium-3 (He-3) thanks to its lack of magnetosphere. This isotope may be used as a fuel of choice in future fusion reactors, although the technology has yet to be proven.

- Lunar He-3 resources are estimated at up to 1mn tons.
- 100 tons of He-3 would be enough to power the entire Earth for a year.
- The first commercial fusion is not expected before at least 2050.

Business opportunities

First-mover advantage as a phenomenon is present in all industries, and space is no exception. Starting building the space business before everyone else may have its own pitfalls such as public criticism but may yield unending gains in the long-term.

- Richard Branson founded The Spaceship Company in 2005, and after 15 years of development, numerous delays and disasters, the spaceship is ready to launch.
- Blue Origin, founded by Jeff Bezos in 2000, is developing a reusable rocket and spacecraft that would carry three or more astronauts to the edge of space.

Space tourists

Space tourism has been a reality since Dennis Tito boarded the ISS in 2001. Costs have now decreased, and technologies improved enough to make the addressable market much larger and profitable.

- Space tourism will be enabled by suborbital flights allowing a 0G experience.
- Several technologies may co-exist: rockets, balloons, special planes.
- Key players are Virgin Galactic and Blue Origin, with prices ~$250k.

SOURCE:
Could the moon fuel Earth for 10,000 years? China says mining helium from our satellite may help solve the world's energy crisis, NASA,
AtonRâ Partners

Structural Trends – Satellites (1/2)

For now, satellites are the stars (of the show)

Decades after the initial launches, Space is now a firmly established market. It is essentially driven by the satellite segment, either through the launch ecosystem or through enabled services.

- The Space economy was estimated at $366bn in 2019.
- The complete satellite segment accounted for 74% of the market.

Services about to mutate

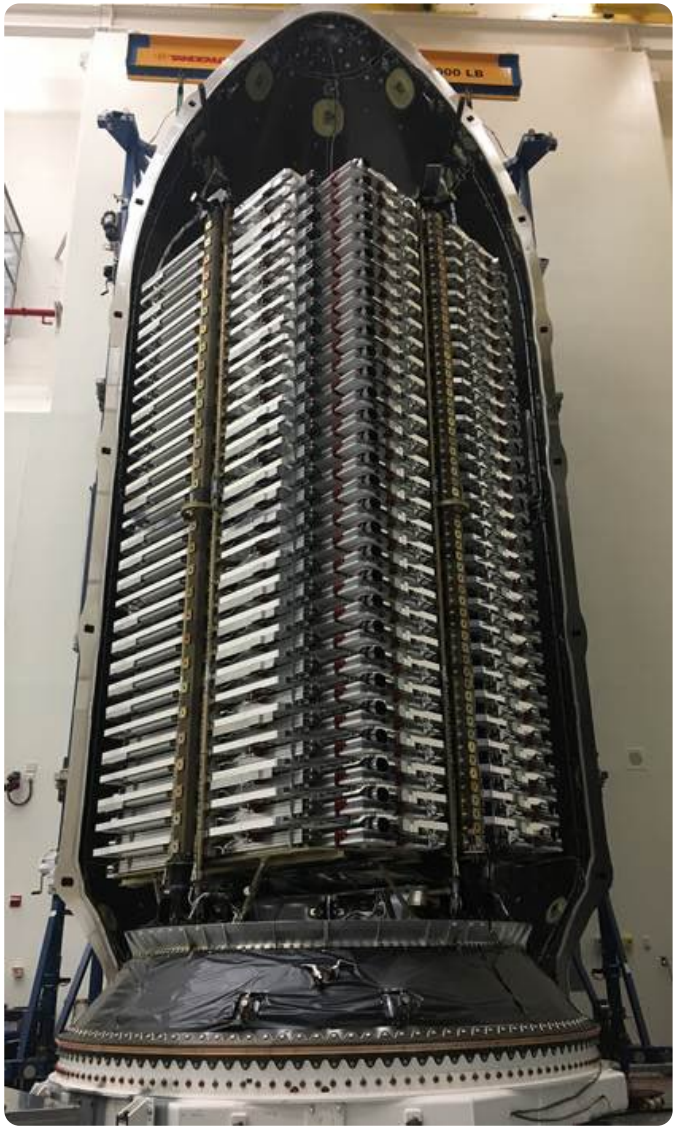
TV still accounts for most of the satellite-service market. Yet, broadband delivery is set to skyrocket, with LEO constellations offering a lower price and a better quality of service compared to traditional GEO services.

- The TV market came in at $92bn vs. $2.5bn for broadband in 2019.
- Broadband is expected to grow at a 30% CAGR over the coming years.

Constellations: a game-changer

Massive LEO constellations will enable global broadband coverage with high bandwidth and low latency. This will represent a true game-changer for both consumers and the supply chain.

- SpaceX already launched a beta and targets a constellation of 42k satellites.
- OneWeb, Telesat, and Amazon also have projects totaling over 4k satellites.



SOURCE:
Bryce Space and Technology, Northern Sky Research, Twitter, AtonRâ Partners

Structural Trends – Satellites (2/2)

Ever-decreasing launch costs

Decreasing launch costs are the main enabler of space market growth. They are today driven by satellites rideshare, regular launches, but most of all by reusability, a prowess deemed impossible less than a decade ago.

- SpaceX is a pioneer and untouched leader in that field.
- Other players, such as Rocket Lab, are trying to follow the same path.
- Bigger launchers (e.g., Starship) are expected to help lower costs.

The small satellites revolution

Small and nanosatellites have become technologically feasible and sufficiently powerful to fulfill the required duties, giving birth to a whole ecosystem and expanding the addressable market to unsuspected uses.

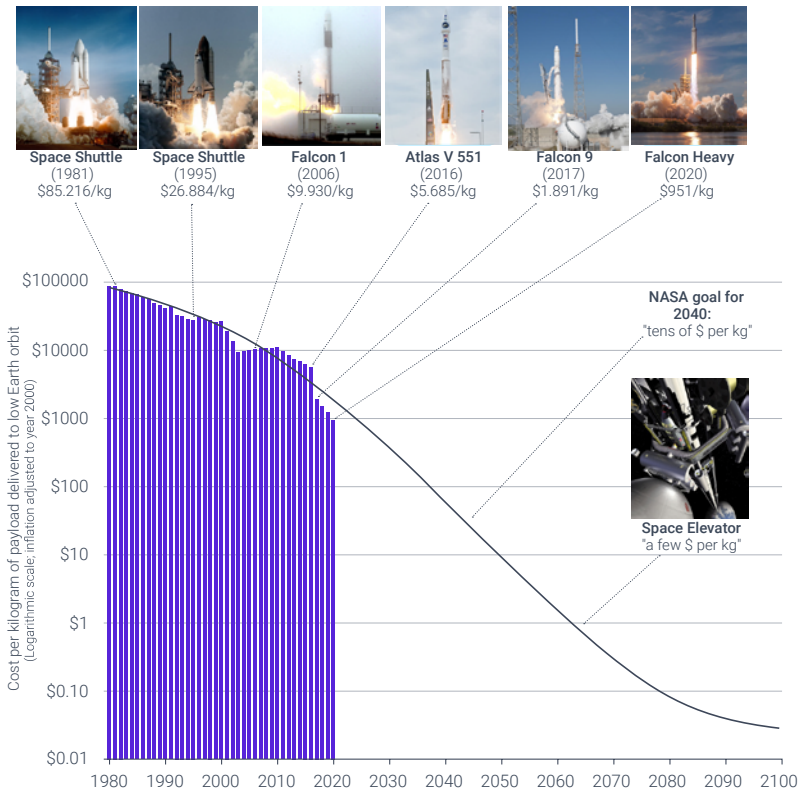
- This market is expected to reach $2.8bn in 2020.
- It is expected to grow at a 20.5% CAGR in the next 5 years.

At the forefront of innovation

Space remains a key sector in innovation, either through materials, propulsion systems, assembly processes, or through leveraging other technologies. These innovations then spread to the rest of the world.

- 3D printing is already in use (e.g., SpaceX, Relativity Space).
- AI already processes a vast amount of data from observation satellites.
- Space innovation already gave birth to digital cameras, wireless tools, and LEDs.

LAUNCH COSTS TO LOW EARTH ORBIT, 1980–2100



SOURCE:
MarketsandMarkets,
Company sources,
AtonRâ Partners

Structural Trends – Ethics, Environment & Health (1/2)

The problem of global surveillance

The proliferation of observation satellites and their increasing imaging capacities paves the way to the complete end of privacy, with not a single point of Earth potentially remaining out of sight.

- Regulation will be a necessity, as these imaging services become accessible to the majority.
- Live individual tracking from space remains science-fiction (for now).

Environmental impact: existing, but limited

Rocketry has historically been a source of pollution on launch. However, recent hardware shows sensible improvement with reusability and new fuels, which will offset the growing number of launches.

- New rocket fuels are made of methane instead of kerosene or toxic compounds.
- Rockets are now reused instead of burning into the atmosphere.
- There have been only 102 launches in 2019 vs. 39mn plane flights.

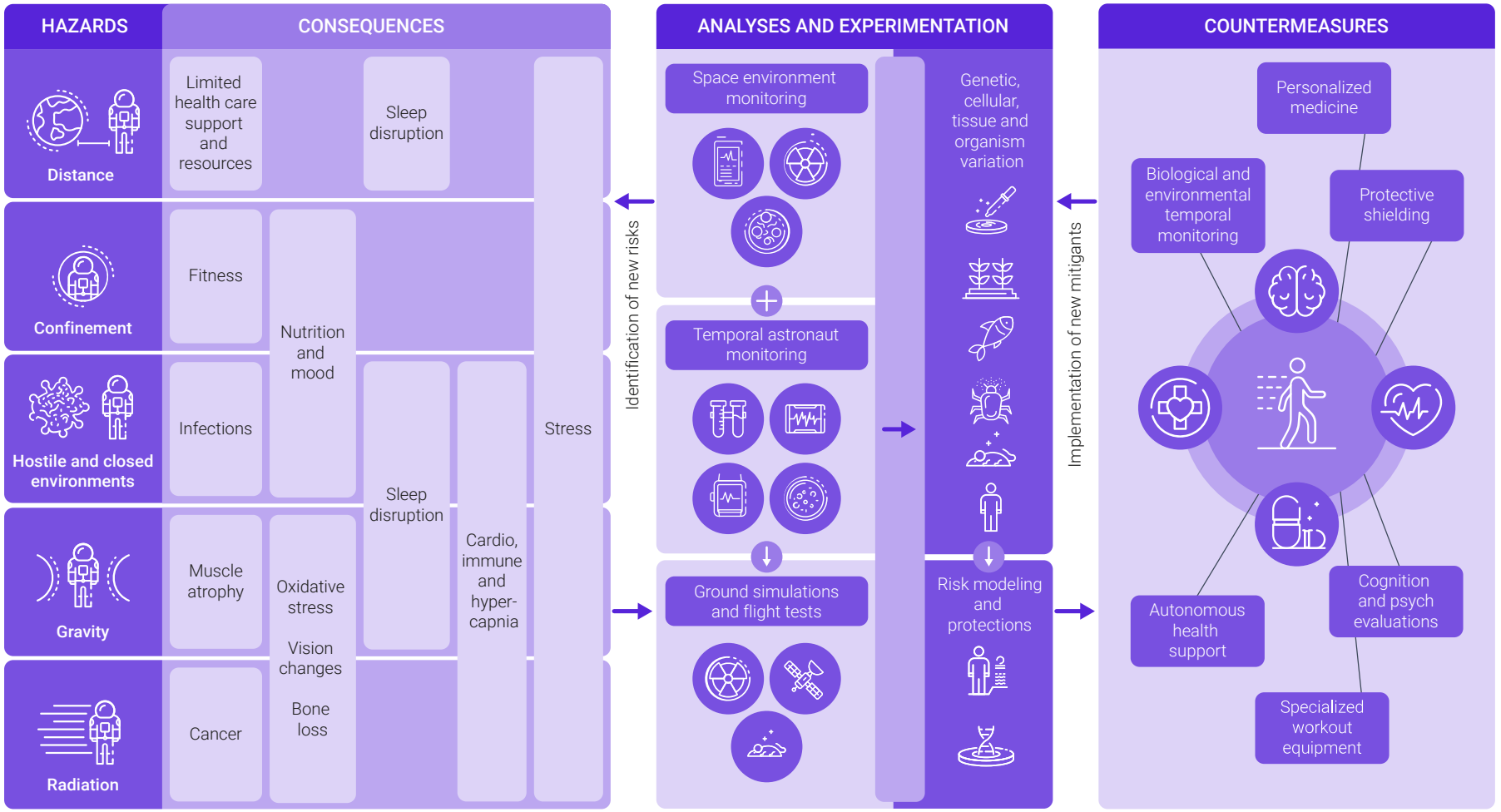
Space is not your friend

Even in the relative comfort of a spacecraft, space is a very hostile environment for humans due to radiation exposure. Distance from Earth and the lack of gravity can also take a mental and physical toll.

- The adverse effects of microgravity on the human body and the remedies have been studied since the beginning of space exploration.
- Extraplanetary exploration will require specific spacecraft design and planning.

SOURCE:
Fundamental Biological Features of Spaceflight: Advancing the Field to Enable Deep-Space Exploration, AtonRâ Partners

Structural Trends – Ethics, Environment & Health (2/2)



Structural Trends – Governments

NASA: Moonwalking (again)

NASA remains a significant funding source but is torn apart between political quarrels, loss of internal competencies, and insufficient resources to address its missions.

- NASA's budget increased by 5.3% in 2020 to $22.6bn.
- The Trump administration ordered NASA in 2019 to return to the Moon by 2024. NASA warned this objective alone would cost $35bn.

Space military spending on the rise

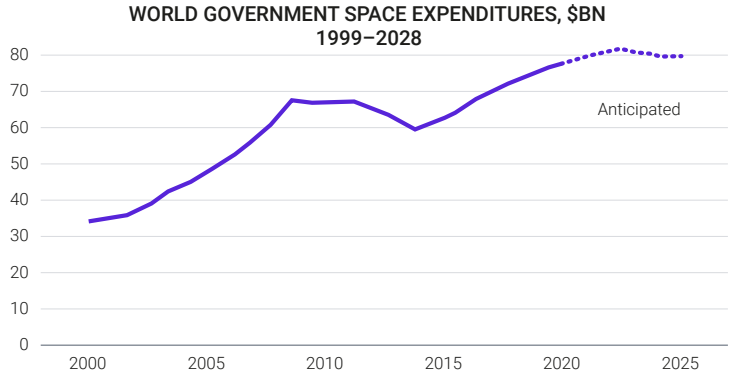
Military spending represents an increasing share of investments due to political tensions, percolating into the civilian ecosystem, and somewhat driving innovation.

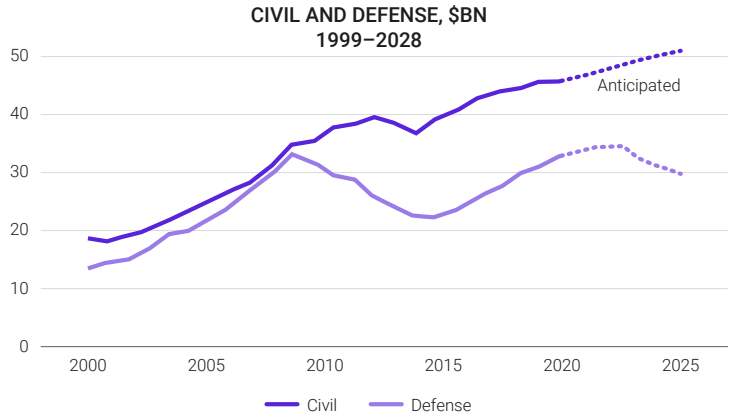
- The U.S. Space Force budget equals 60% of NASA's. Total official military U.S. space budget was up 27% in 2020 ($18bn) vs. flat for the whole DoD.
- Pentagon has initiated the deployment of military constellations.
- The CIA has its own VC company Q-Tel that invests in Silicon Valley firms.

China reheating the sector

Since the last Moon landing in 1972, the U.S. budget for space exploration had nosedived, while China started pouring cash into space and creating comfortable conditions for private investors. This induced a ripple effect for other countries, especially the U.S., who need to step up to stay in the game.

- After China published its space doctrine, the U.S. Congress reversed the diminishing space budget trend. 2018 and 2019 saw increases of 8% and 3.5%.





SOURCE:
NASA, ArsTechnica, Space.com, The Risks and Rewards of Growing U.S.-China Space Rivalry, AtonRâ Partners

Structural Trends – Cybersecurity

Growing attack surface

The cyber-attack surface is increasing quickly. Not only faster 5G networks create new vulnerabilities by further integrating the Internet with physical infrastructure, but cloud migration also requires more sophisticated cybersecurity solutions.

- As Covid-19 is accelerating digitalization, cybersecurity will benefit from the global efforts to ramp up digital infrastructure.
- For example, from miles away, a "smart" kettle may be hacked to take over your Wi-Fi network, consequently your smart home, and your life.

Remote work is here to stay

The benefits of remote working became apparent for both employees and employers. Solutions to support remote work are being implemented for the long-term and require strong cybersecurity.

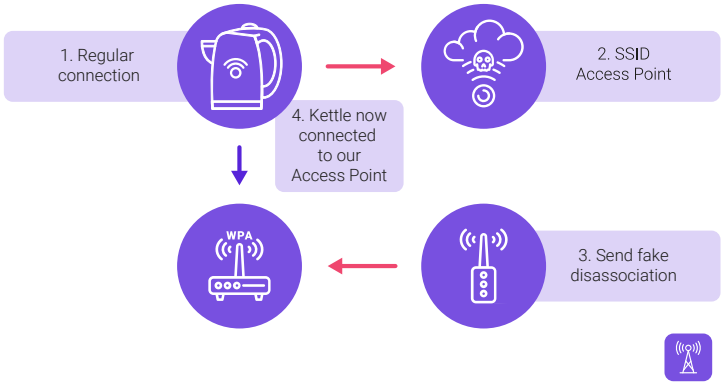
- Over 90% of successful attacks are due to human error and poor judgment.
- Being disconnected from the company network adds additional risk. Spending on robust digital information security solutions will be essential.

Cybercrime on the rise

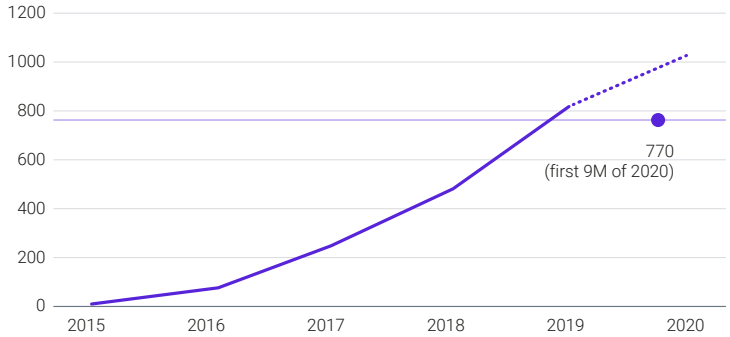
The world's highest criminal growth (at 13% YoY) is happening in the digital space. It is fueled by rising geopolitical tensions, the relative convenience and anonymity of the Internet, and the fact that information theft is the most lucrative and safest crime.

- Experts find annually 5x more malware.
- The rise of the Dark Web gave hackers easier access to malware.

IKETTLE WI-FI HACK



NUMBER OF CYBER-RELATED CLAIMS



SOURCE:
Cybercrime To Cost The World $10.5 Trillion Annually By 2025, AtonRâ Partners

Structural Trends – Privacy

Rising privacy concerns

The cybersecurity market is driven by rising privacy concerns and digitalization of previously analog industries such as healthcare. Protecting personal records is vital if hospitals and the healthcare industry want public opinion to embrace this change.

- According to the "Cost of a Data Breach Report 2020," data breaches exposed more than 8bn consumer data records in the last two years.
- The healthcare system and governments are the most cyber-targeted entities.
- Investments in healthcare cybersecurity are expected to show a 15% 5Y CAGR.

Privacy requires more biometrics

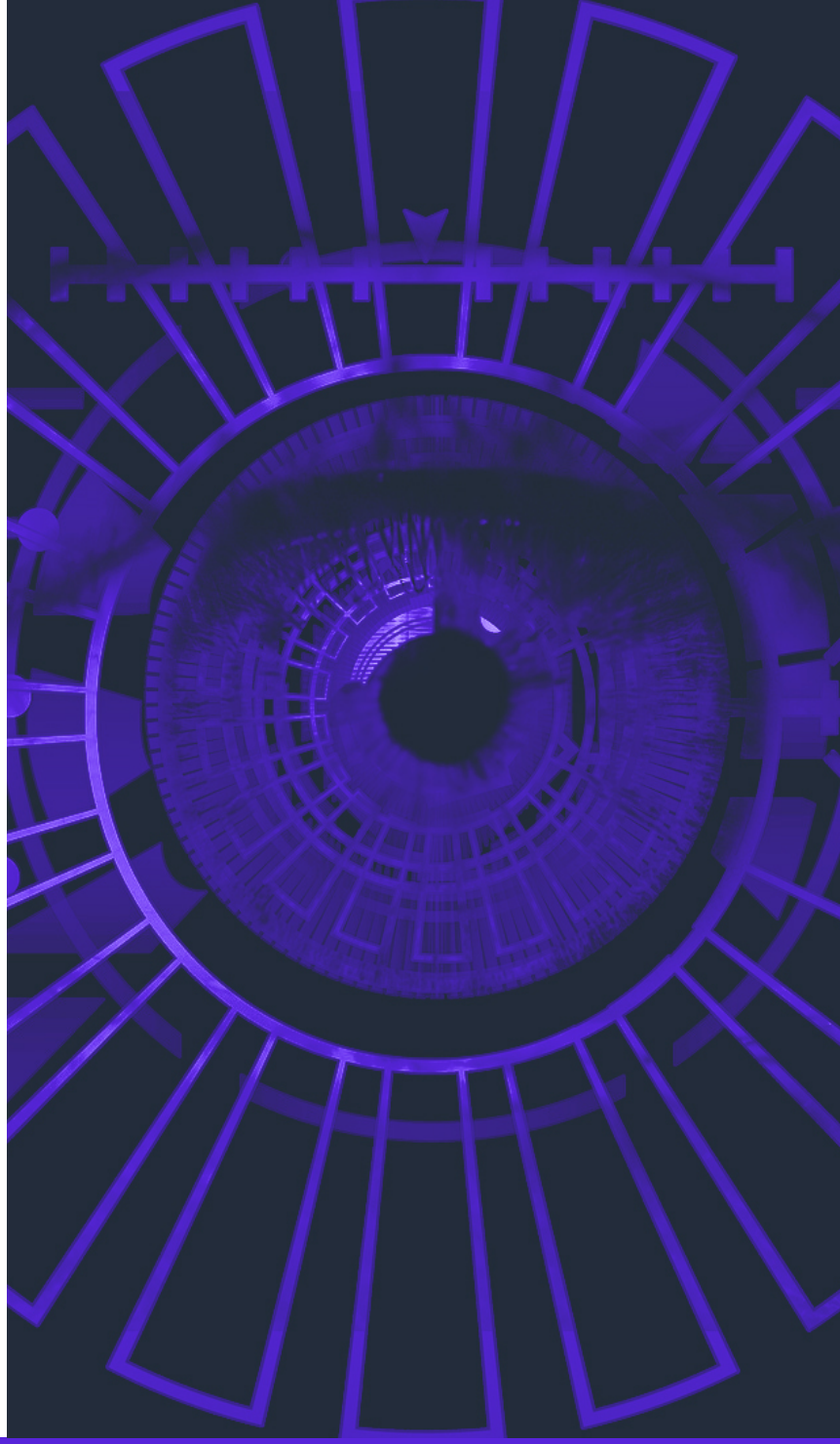
Naturally, biometrics is being employed together with other technologies such as AI. Rising concerns for privacy further made biometrics inseparable from e-visas, e-passports, and smart credit cards.

- Digital identity, voice & speech, and 3D sensors are the main segments of growth.
- Globalization and recovery of the travel industry will be driving the global demand for biometric solutions in the long-term.

More stringent security frameworks

Security frameworks for public spaces and infrastructure are being reinforced globally, boosting demand for scanners, detectors, and other security devices.

- AI is used to analyze scans and detect threats.
- The next developments include the real-time analysis of mobile and 3D environments.



SOURCE:
Average Cost of a Data Breach in 2020: $3.86M,
Healthcare Industry To Spend $125 Billion On Cybersecurity From 2020 to 2025,
AtonRâ Partners

Structural Trends – Insecurity

A high perception of crime

While the crime itself is falling annually, perception of crime has remained at historically high levels of 60-70% over the past 20 years. People want more security from the government and are encouraged to invest in smart home security.

- Smart security is complex, but technology is becoming more effective, easier, and cheaper to install and use, considerably driving demand.
- Big Data and AI enable real-time threat analysis, and their synergy with facial recognition further reduces the inconvenience of annoying false alarms.

Automation and AI are a double-edged sword

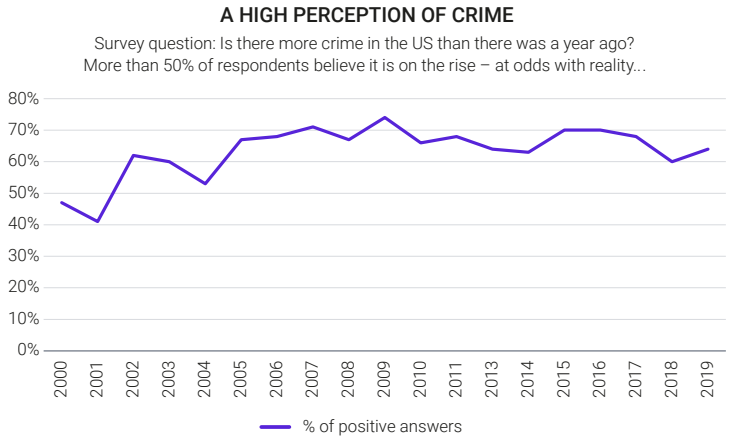
AI & ML may positively and negatively affect the security sector, but in both cases will boost the sector in the long-term. They enable security tools to be automated and upgraded but may also emulate "human-like" content to bypass cyber filters.

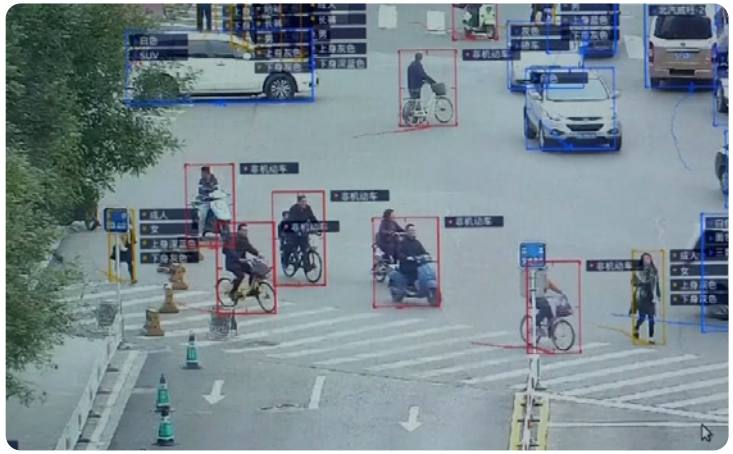
- AI may now mimic voices, accents, and faces, bypassing common security measures.
- Automated security solutions save on average 50% of breach costs annually.

Thermal and video cameras will remain vital for security and healthcare

The pandemic has urged governments to switch to thermal cameras for better population tracking and control during Covid-19. Besides, the installed camera base had to be expanded significantly to improve coverage.

- The number of installed cameras will reach 20.4mn in 2024, up from 5.1mn in 2020.
- High-tech surveillance is more efficient than traditional manned guarding.





SOURCE:
Installed base of video cameras to reach 420 million by 2024,
Average Cost of a Data Breach in 2020: $3.86M,
AtonRâ Partners

Structural Trends – Quantum

Exploring the Quantum dimension

Quantum computers represent an existential threat to the public key encryption algorithms that run our digital world. The rollout of this new breed of computers will break the security algorithms currently in use in electronic infrastructure.

- Quantum cryptography (based on the production of truly random keys) is a promising approach to take on the challenge.
- Toshiba aims at generating $3bn in revenue from its technology by 2030.

The winner of the quantum race

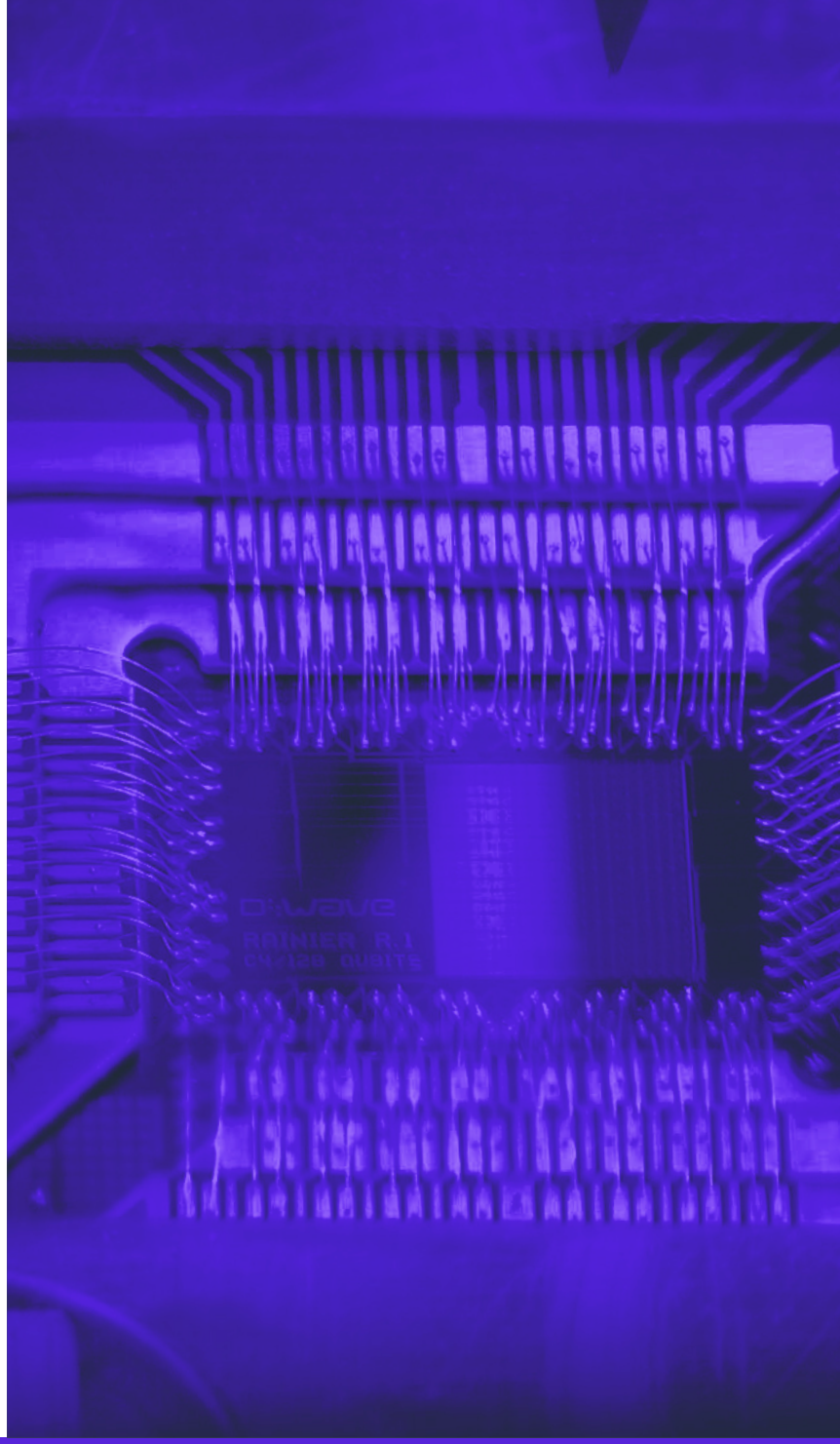
The race is on to pick the winners for post-quantum encryption and signatures methods. The winner of this algorithm race will also require dedicated hardware representing a quantum leap in computational performance.

- IBM quantum roadmap targets a 1'121-qubit machine as soon as 2023 and plans to launch a 127-qubit processor in 2021 and a 433-qubit machine in 2022.
- Amazon, Google, D-Wave, and Intel are developing quantum projects.
- China claims to have achieved quantum supremacy.

Most promising approach

Fully Homomorphic Encryption (FHE) is a revolutionary approach that allows information to be processed while encrypted, hence never revealed.

- Current computing relying on the traditional Von Neumann architecture has hit the wall and cannot deliver the 1'000'000x performance boost required.
- Cornami claims they can deliver this performance through a novel approach based on more node interconnection (fabric computing).



SOURCE:
AtonRâ Partners, Wikipedia

Structural Trends – Securing Food And Minds

Extreme climate conditions

Global warming and climate changes exert pressure on agriculture. Rising temperatures speed up insects' metabolism while opening new habitats. To survive and protect crops, new agriculture is emerging: precision farming.

- With enhanced data collection, satellites will provide pivotal data to forecast weather, build scenarios, analyze soils, guide tractors, and optimize production despite the global climate change.

Unsafe food

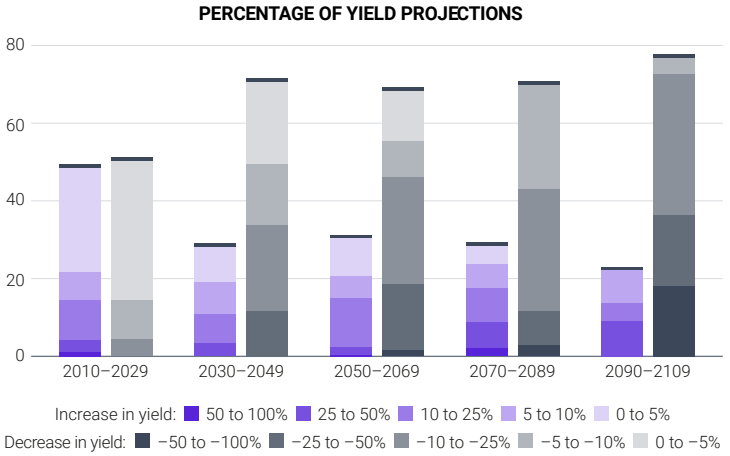
Apart from naturally harmful bacteria, people tend to overuse chemical substances to protect the crops. Both cause more than 250 different diseases, and advanced safety checks are required to find wider adoption to detect food contamination.

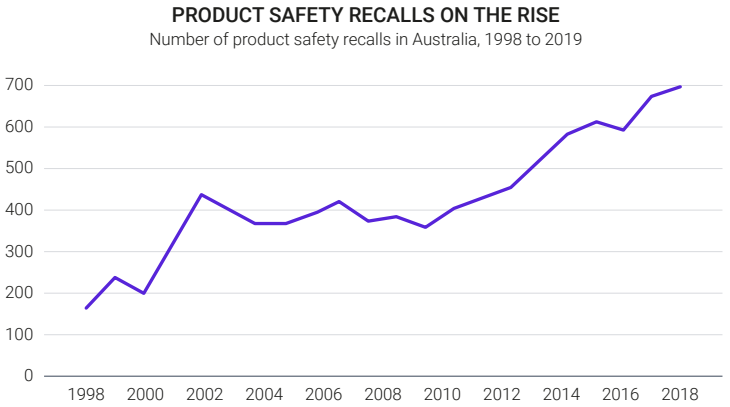
- 600mn people get sick eating contaminated food every year, and 420k die from it.
- The food safety sector is primed for growth.

Being notified allows for better risk management

People, organizations, and countries increasingly desire to be notified about critical events directly affecting them. Big Data, 5G, IoT, and mobile devices are at the heart of a Critical Events Management sector that is gaining traction.

- Players in this field automate critical event management while promptly communicating with the right stakeholders at the right moment.





SOURCE:
Here's how climate change could cause insects to destroy our crops,
Foodborne Germs and Illnesses,
AtonRâ Partners

Security And Space For Dummies (1/2)

Hitting the sweet spot

Security & Space portfolio comprises the segments at the junction of Space, Defense, and Technology, set to show healthy growth over the next few years.

- The space industry is at the point today comparable to the Internet in the mid-1990s. The sector is rapidly growing and expected to double in size by 2030.
- The Defense sector grows steadily as security threats are intensifying.
- Global security is increasingly dependent on digital security, subsequently leading to an increasingly important allocation of defense budgets to cybersecurity.

Dimensional shift

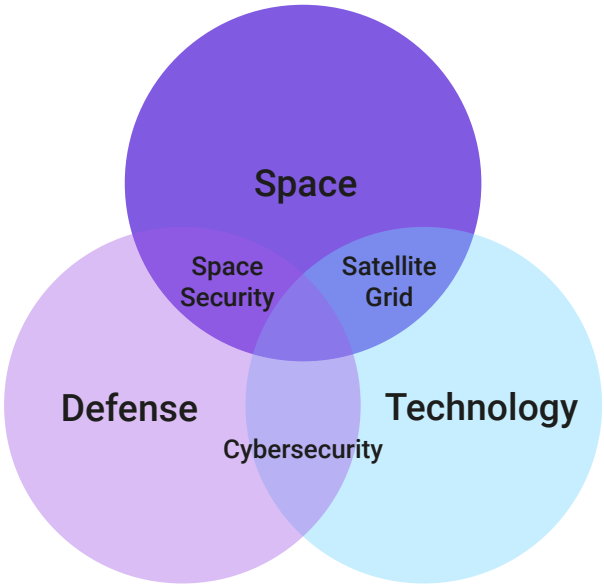
The defense sector is now heading toward space and digital, the fastest-growing sectors in the foreseeable future. Cybersecurity is vital to avoid attacks and espionage, while satellite-data is pivotal in the Defense environment.

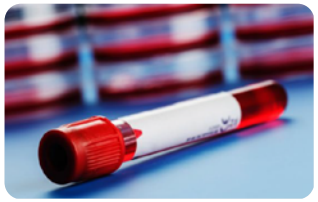
- The 2020 U.S. budget authorizes to spend up to $17.4bn for cybersecurity-related activities, a 5% increase over 2019.
- The new U.S. Space Force's budget is already equivalent to 60% of NASA's one.

On a lookout for sector synergies

Transformative technologies, often a byproduct of defense and space R&D, are drastically improving human life and inevitably redefine how we safeguard our lives.

- The GPS was started by the U.S. DoD in 1973, while the first blood bank was created in 1917 for the U.S. Army Med Corps.
- The first automatic injection device, the ComboPen, was invented in the 1970s for the army. The civil device for allergic reactions, the Epipen, was approved in 1987.





SOURCE:
Global Defense Budget Estimated at USD 1.8 Trillion in 2020 and Is Forecast to Grow to Approximately 2.3 Trillion by 2028,
Cybersecurity Funding,
AtonRâ Partners

Security And Space For Dummies (2/2)

The need for a timely cyber intervention

Common security tools initially look for a malicious file in the system, often too late. The cybersecurity tool is expected to automatically look over all the user steps and detect mischief, guaranteeing intervention as soon as necessary.

- Automation of cybersecurity platforms would mean the involvement of ML algorithms to detect, analyze, and containerize threat.
- Governments have a complex digital fingerprint and a canny unwillingness to update infrastructure to adequate cyber defenses due to high costs. This makes them perfect cyber targets – public entities suffer from ever-increasing attacks.

Private companies are steering the industry

Private players are now investing heavily in space businesses. Similarly, space exploration is no longer a public-only matter, highlighted by NASA astronauts transported by Space X.

- Telecommunications increasingly rely on privately-owned satellites.
- Blue Origin and Virgin Galactic aim to open space for commercial trips.

Cybersecurity is a top-of-the-list concern

Investing as much as necessary to develop cybersecurity solutions becomes essential when a single breach into a system can threaten millions of users. Also, data, personal or not, feeds and optimizes the entire tech ecosystem, and tampering with it may disrupt the whole value chain and overall world stability.

- Accessing devices, opening doors, or getting into buildings require different layers of protection, but all examples are trivialized when considering how vital medical devices must remain inaccessible to malignant third-parties.

SOURCE:
AtonRâ Partners

Catalysts

- **Ubiquitousness.** Space-enabled services are about to become ubiquitous thanks to a burgeoning ecosystem and constellation projects. This will trigger a virtuous cycle of growing demand and investments.
- **Post-pandemic world.** Durable remote-work, increasing digitalization, and the corresponding increasing impact of cyberthreats (e.g., ransomware, state-sponsored attacks) will spur interest in security.
- **Listings.** Two space players have already announced they would go public through non-IPO processes. With probable additional listings, the interest for the sector is going to increase, and our investment universe to expand.

Risks

- **Slow reaction time.** Cyberthreats are evolving so quickly that there is a risk for the whole ecosystem to fail to adapt fast enough. Decision-makers may also fail to embrace this change and to consider adequate investments.
- **Space debris.** The exponential number of orbiting satellites in LEO constellations and the corresponding increase in chain-reaction collision risks would threaten, if not put at a halt, most space projects and services.
- **Immaturity.** The new space ecosystem is made of highly innovative start-ups with high expectations baked-in. Failure risks (both technological and financial) are therefore elevated and could discredit the sector.

Bottom Line

- Security and space industries should continue to significantly benefit from the exponential increase of connected devices, the integration of artificial intelligence into cybersecurity and satellite imagery, as well as a steadily decreasing satellite launch costs. In the space segment, satellite constellations, the smallsat ecosystem, and commercial space travel are expected to remain at the forefront. The emergence of cyber warfare and a worrisome Chinese space doctrine describing the militarization of space will further prompt substantial investments into R&D, the space industry, and security businesses.
- We remain exposed to the most prominent sectors in our Security & Space portfolio, with substantial exposure to cyber and smart home security. With the progress in space and cloud, we will remain heavily oriented towards cloud security and look for ways to increase our exposure to space.

Companies mentioned in this article:

Amazon (AMZN US), Apple (APPL US), ArianeGroup (not listed), Astroscale (not listed), Blue Origin (not listed), Cornami (not listed), D-Wave (not listed), EasyJet (EZJ LN), Forescout (not listed), Fortinet (FTNT US), Google (GOOGL US), HawkEye 360 (not listed), IAG (IAG LN), Intelsat (INTEQ OTC), LeoLabs (not listed), Loral Space & Communication (LORL US), McAfee (MCFE US), Microsoft (MSFT US), Momentus (Current: SRAC US // FY21Q1: MNTS US), OneWeb (not listed), Palantir (PLTR US), Palo Alto Networks (PANW US), Proofpoint (PFPT US), Q-Tel (not listed), Relativity Space (not listed), Rocket Lab (not listed), RSA (not listed), Snowflake (SNOW US), SpaceX (not listed), Spire (not listed), Telesat (not listed), Veeam (not listed), Virgin Galactic (SPCE US)

SUSTAINABLE FUTURE – ACCELERATING THE TRANSITION

Ready For Inflection

Theme's fundamentals remain unchanged

Since the launch of our Sustainable Future theme in October 2018, we highlighted a number of trends that are still unfolding.

- Solar & wind technology costs keep on declining.
- The transport sector is entering its "cleanup" phase with the growing integration of clean technologies, including electric vehicles (EVs), biofuels, etc.
- Energy storage is a crucial link to enable the deployment of renewables and EVs.
- Variable & decentralized energy generation fosters the need for power grid upgrades and the integration of smart grid technologies.

2020 reinforced our convictions on key sub-sectors

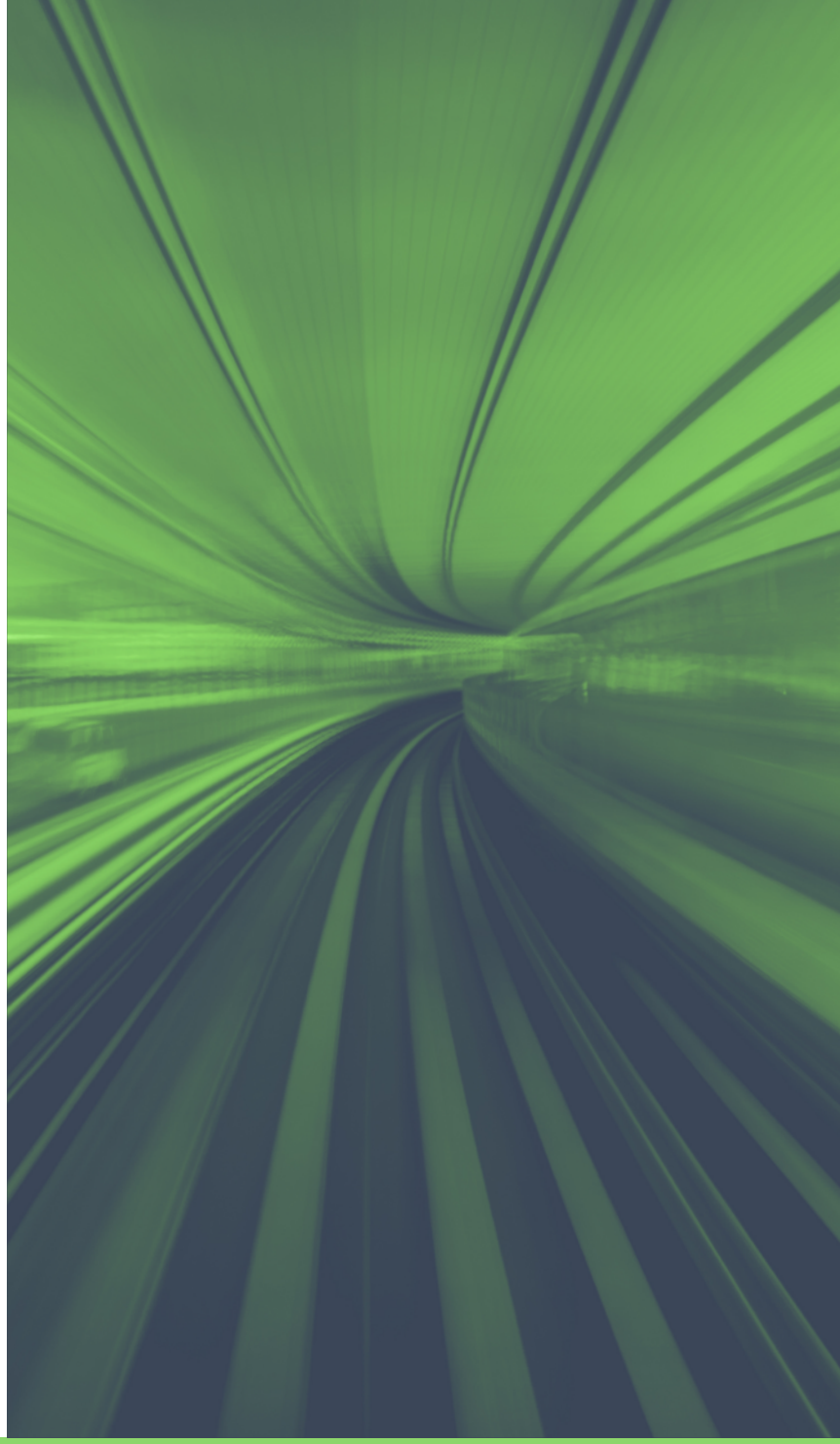
In retrospect, EVs (including innovative automakers as well as key battery manufacturers), as well as the solar industry (notably residential power inverter providers and panels installers), registered impressive performances which drove the theme in 2020 and proved the strong resilience of such industries.

- While Covid-19 impacted the global passenger vehicle industry with YoY –15% in total sales, the electric vehicle segment managed to hold 2019 levels.
- U.S. solar installations are expected to reach 16GW in 2020 (+37% annual growth).

Some major infrastructure spending delayed

Covid-19 has delayed many non-critical infrastructure spending with companies prioritizing urgent measures to secure survival over high capex technology upgrades. The theme's most impacted actors are active in the railway & shipping industries.

- Investments in modern & clean technologies for the rail & maritime transport were postponed due to the near halt in transportation activity during the pandemic.
- With a declining electricity demand, investments in grid infrastructures were not a priority in 2020.



Covid-19 – Impact

2020 was supposed to be a record year for renewables

Before the pandemic, experts were predicting 2020 to be a record year for global renewable capacity addition, notably driven by costs & policies.

- Due to the production tax credit (PTC) phase-out in the U.S., new onshore wind installations were expected to peak in 2020.
- Changes in China's feed-in tariffs (FITs) policy were supposed to drive a rush in solar & wind projects willing to complete in 2020 to benefit from the full tariffs.

Strong resiliency despite supply & demand challenges

Clean technologies have certainly not been immune from the global downturn, with lockdowns, confinement measures, social distancing and travel restrictions triggering supply chain disruptions, construction delays and impacting demand.

- With global electricity demand dropping by 5% in 2020, renewables were the only power source to experience higher demand with 7% of annual growth.
- Lower operating costs, along with priority access to the grid and new projects coming online, have enabled renewables to maintain growth.

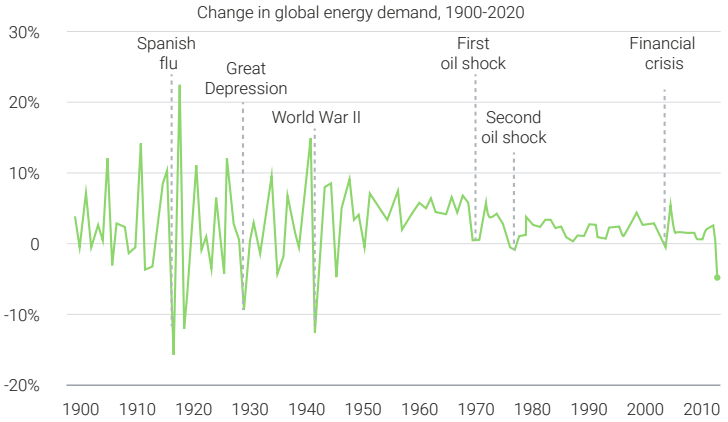
Reinforcing our investment thesis

The sharp collapse in oil prices was supposed to harm clean technologies, with for instance renewables or EV becoming less attractive with access to cheap fuel. Reality showed quite the opposite and the biggest losers ended up being oil companies.

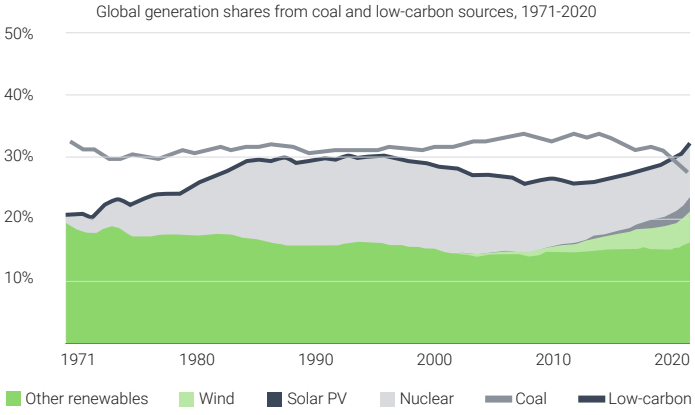
- EV adoption depends more on model availability, driving range, and environmental concerns rather than oil price impact on total cost of ownership.
- Renewables do not compete head-to-head with oil in the power generation market as oil-fired power plants are marginal and more expensive to operate.
- Oil price volatility is in fact boosting utility-scale renewables as such projects deliver more stable & predictable returns with a lower cost of capital.

SOURCE:
Global Energy Review 2020

CORONAVIRUS: A ONCE IN A CENTURY EVENT FOR ENERGY DEMAND



LOW-CARBON SOURCES EXTENDED THEIR LEAD IN THE POWER MIX



Outlook – Electric Vehicles

Policymakers drive the EVs uptake

An accelerated adoption of EVs (both battery and fuel-cell) is expected in the coming years, driven notably by increased commitments at policy level.

- China New Energy Vehicles "NEVs" (incl. battery, fuel-cell and plug-in hybrid) is to reach 20% of new sales by 2025 and 50% by 2035 (vs. 5% today), and many countries (incl. France, Norway, UK, etc.) plan to ban ICE cars within 10–20 years.
- The E.U. passenger car standards of 95g CO2/km (phased-in for 95% vehicles in 2020 and for 100% in 2021) leave automakers with no choice but electrification.

Charging infrastructure and new models' rollout

Countries are scaling-up charging infrastructures while most automakers are accelerating their transition away from ICE by increasing their EV offer. Lack of charging infrastructure and EV models won't anymore be barriers to EV uptake.

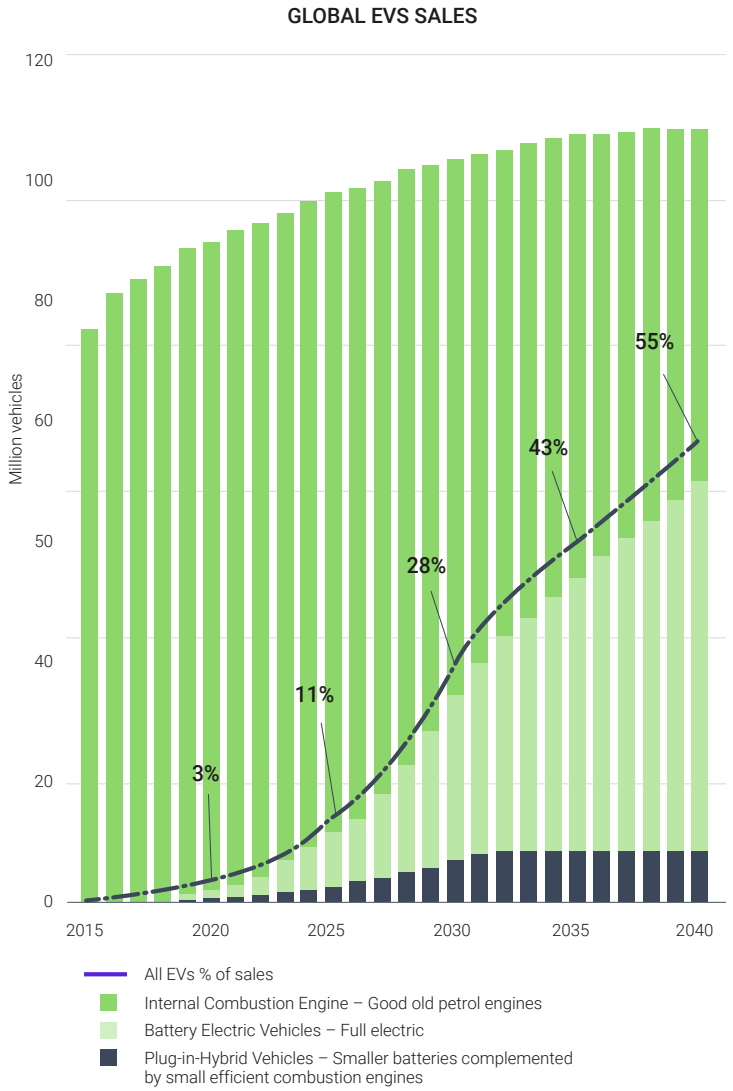
- Automakers have already announced +$300bn of investments in EV over the next 10 years; almost all new car models will be electrified.
- The charging infrastructure market is to grow at a 24% CAGR and reach $40bn by 2030, driven by various support policies (purchase incentives, rebates, etc.).

Prices reach parity

Price competitiveness of EVs keeps improving notably thanks to advances in battery technology (falling costs, improved energy density & lifetime). Price parity with ICE cars is to be reached within the next 3-5 years, and adoption will be driven by model availability, vehicles' performances and infrastructure availability.

- Battery pack cost fell 87% since 2010 and is to reach $100/kWh by 2023 (vs. $156/kWh today), and current driving ranges are reaching 300-500km.
- Batteries' end-of-life management could further enhance EVs value, by either repurposing batteries for a second-life (in stationary storage) or recycling.

SOURCE:
http://www.gov.cn/zhengce/content/2020-11/02/content_5556716.htm
Fuel cell vehicle pilot to reward initiatives by city clusters



Outlook – Solar PhotoVoltaic (PV)

Over-production drove solar module prices down

Despite a production slowdown amid the Covid-19 outbreak, project developers and equipment traders took advantage of their existing stocks to compensate for supply chain delays. At the moment, manufacturing overcapacity is reaching all-time highs, and this is increasing the downward pressure on PV module prices.

- Cheaper PV modules could boost the adoption post-Covid.
- With no innovation breakthrough, PV demand growth is mostly driven by continuous costs decline (in terms of $ per kWh of electricity produced).

Solar to replace existing conventional plants

Latest levelized cost of energy (LCOE) metrics show that solar PV is not only cheaper than conventional generation on a new-build basis, but is also becoming competitive with the cost of operation of some fossil-based power generation plants.

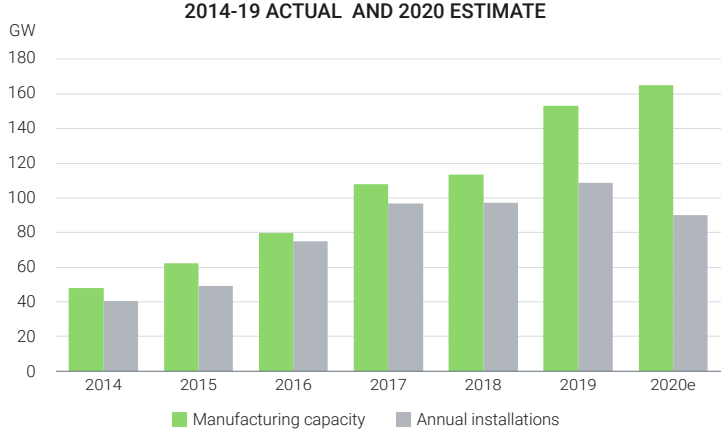
- According to experts, about 1'200 GW of existing coal capacity costs more to operate than building a new utility-scale solar plant.
- Solar power plants are quite popular capex for Big-Tech companies (e.g., Apple, Facebook, Microsoft, etc.) willing to decarbonize their operations.

Residential segment to maintain its fast growth

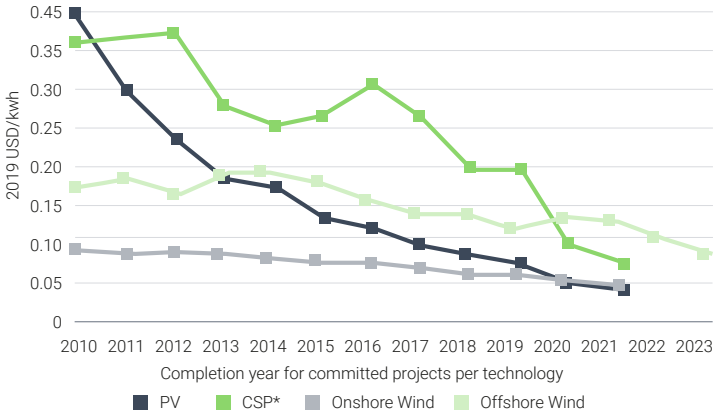
While many utility-scale projects will be postponed, we believe that the residential segment could experience an even-greater unexpected rebound as many private customers, relying on face-to-face sales, were unable to procure solar systems.

- Strong recovery is to be expected in the residential segment, with door-to-door sales being re-authorized and people benefiting from lower PV prices.
- Improved policy support (such as U.S. tax credit extension) could provide an additional boost to the sector.

SOLAR PV MODULE MANUFACTURING AND DEMAND, 2014-19 ACTUAL AND 2020 ESTIMATE



COSTS CONTINUE TO FALL FOR SOLAR AND WIND POWER TECHNOLOGIES



**Concentrated Solar Power*

SOURCE:
Renewable Energy Market Update, IEA 2020
Renewables Increasingly Beat Even Cheapest Coal Competitors on Cost

Outlook – Offshore Wind

A resilient lower-volatility industry

While other renewables experienced project delays due to supply & demand disruptions, Covid-19 impact on the offshore wind segment was very limited.

- With longer construction periods, ongoing offshore wind projects only experienced negligible delays and the industry showed strong resilience during the outbreak.
- 2020 growth in the offshore wind segment is in-line with pre-Covid forecasts, thanks to the completion of many large-scale projects, notably in the UK.

Technology is ready for takeoff

Offshore wind technology has experienced significant scale-up & cost reduction over the past few years, notably thanks to technological improvements in turbine foundations, blade lengths, and power transmission systems.

- The power captured by the wind turbine is proportional to the square of its blade-length, pushing makers to develop larger, ever-longer turbine blades.
- Leading wind turbines makers are developing more powerful offshore wind turbines - e.g., GE and its upcoming Haliade-X of 14MW, Vestas and its V164 10MW, and Siemens Gamesa with its new 14MW model.

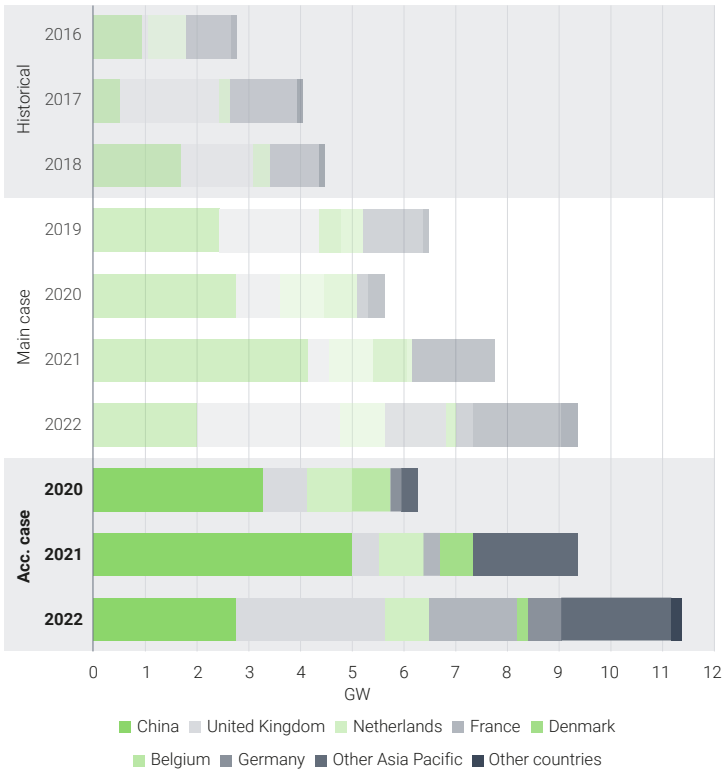
Strong national commitments drive the uptake

Many countries start to envision offshore wind as an attractive way to decarbonize the power sector, such as the UK targeting 40GW by 2030 (from current 10GW) or, more recently, Biden's goal to reach 100% carbon-free electricity by 2035.

- In 2021, new offshore wind additions are expected to reach a record of 7.3GW, notably driven by China where feed-in-tariffs are to expire as of 2022.
- The share of offshore wind (in total wind capacity installations) is expected to rise from 7.5% in 2019, to 15% in 2022 and 20% by 2025.

SOURCE:
Renewable Energy Market Update, IEA 2020
Renewables 2020, IEA

OFFSHORE WIND NET CAPACITY ADDITIONS BY COUNTRY/REGION



Note: Acc. = accelerated.

Outlook – Power Grid (1/2)

Covid-19 gaveU.S.a glimpse of future power markets

Lower operating costs as well as priority dispatch, allowed renewables to increase their share in the power mix. While electricity demand decreased, growing wind & solar penetration drove wholesale electricity prices down in U.S. and Europe. Future power markets will feature both higher demand and a higher share of renewables.

- In Germany, the share of variable renewable energy (VRE) in the power generation mix reached a record of 50% in April.

Grid reliability is becoming a major concern

VRE's higher penetration was a good reliability test for power systems, with intermittent renewables challenging the continuity of electricity supply.

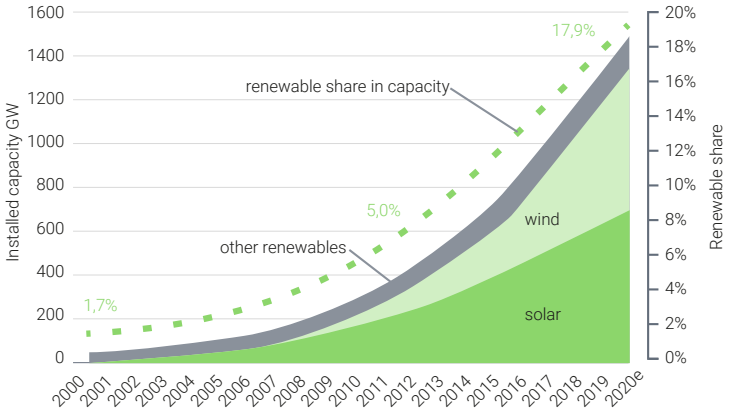
- Smart Grid investments improve grid reliability and resilience. The electric utility industry is expected to make a total infrastructure investment >$1tn by 2030.
- In August, a heatwave in California spurred electricity demand for power air-conditioning units at a time when the share of renewables was already at its highest, causing rolling blackouts across the state.

Spurring demand for energy storage solutions

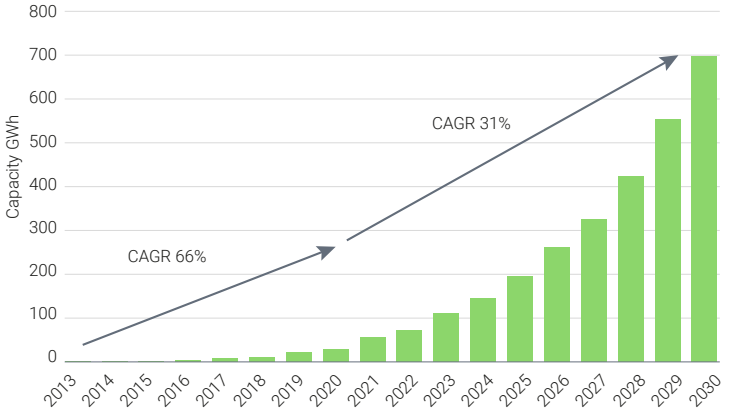
The upcoming growth in renewable-based power generation has now to be accompanied by system flexibility. Storage systems include large-scale batteries and pumped-storage hydro (front-of-the-meter), but also distributed batteries (behind-the-meter) used to store energy generated by distributed solar installation for later use.

- Global cumulative energy storage capacity is to grow from 50GWh today to above 700GWh by 2030, growing at a CAGR of 31% over the next decade.

SHARE OF RENEWABLES IN GLOBAL POWER INSTALLED CAPACITY HAS RISEN RAPIDLY



CUMULATIVE GLOBAL ENERGY STORAGE DEPLOYMENTS



SOURCE:
Renewable Energy Market Update, IEA 2020
Coal, gas, or renewables: Electricity supply responding to lower demand during COVID-19,
Global energy storage capacity to grow at CAGR of 31% to 2030

Outlook – Power Grid (2/2)

Smart grid and demand response

Power grid flexibility can be enhanced by integrating digital technologies into every network steps: from generation, transmission, distribution and on the consumption side. Improving connectivity between generation and consumption is key.

- Satellites can be used to predict weather conditions and better anticipate solar & wind generation.
- AI & ML are increasingly being used in demand response tools, to analyze the data generated by connected devices (IoT, smart meters, etc.), forecast power demand & generation, optimize the use of energy assets, etc.

Utility-scale storage

Grid-scale storage, used to help maintain stability in electricity supply, has for long been dominated by pumped-storage hydroelectricity. However, due to the lack of flexibility of such options, other solutions are being explored, e.g., the use of large-scale batteries providing both geographical & sizing flexibility.

- Tesla is partnering with Neoen to install the world's largest Li-ion battery system in Victoria (Australia), totaling 300MW, and helping stabilize the grid.
- Other future large-scale storage technologies may include flow batteries, hydrogen or thermal storage (using molten salt).

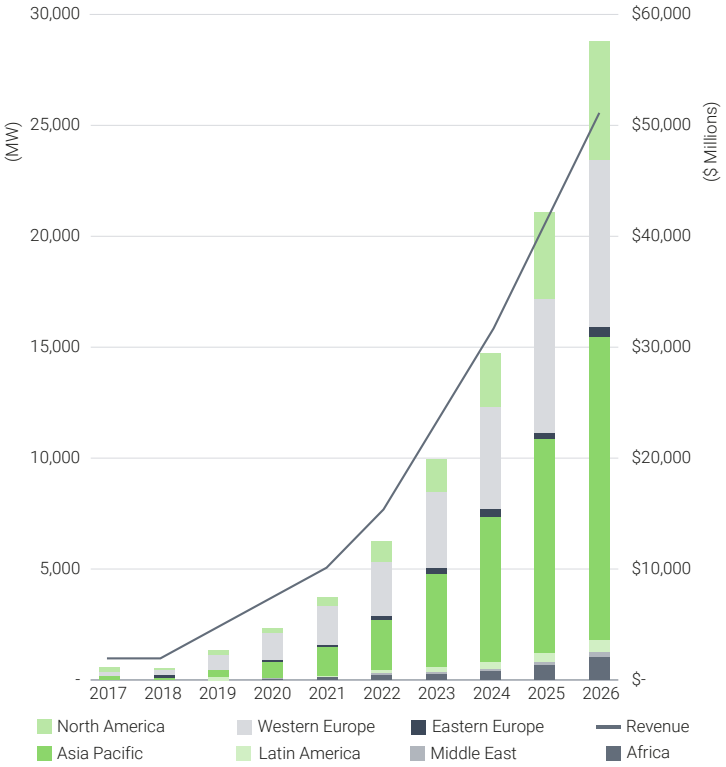
Small-scale storage

A growing number of residential solar installations are now being combined with home battery solutions, which allow prosumers (consumers that also produces electricity) to store the electricity they generate and actively manage the amount of electricity used, stored, and sent to the grid.

- In the U.S., a growing number of residential solar projects are combining battery storage, with ~46% of all new storage capacity addition in 2020 being solar+storage.

SOURCE:
Renewable Energy Market Update, IEA 2020
Renewables Increasingly Beat Even Cheapest Coal Competitors on Cost

ESTIMATED ANNUAL DISTRIBUTED GRID AND OFF-GRID PV-PLUS-STORAGE POWER CAPACITY AND EXPECTED VENDOR REVENUE BY REGION, WORLD MARKETS: 2017-2026



Source: Tokash and Dehamma 2017

Outlook – Hydrogen

A renewed wave of interest

While there have been several waves of interest in hydrogen over the past 50 years, none of them translating into measurable technology adoption, 2020 marked the start of a new hydrogen era. Falling renewables costs & recent focus on decarbonization has brought green hydrogen (done via renewable-powered electrolysis) back to life.

- Hydrogen to represent 13%–14% of Europe's energy mix by 2050 (vs. current 2%).
- Germany unveiled this year a €9bn budget for the development of 5GW of hydrogen production by 2030 and another 5GW by 2040.

A nascent industry with big potential

Green hydrogen has the potential to decarbonize some of the most challenging sectors, including long-haul transport, chemicals & fertilizers, steel production, and heating. It can also be used for the long-term storage of renewable power.

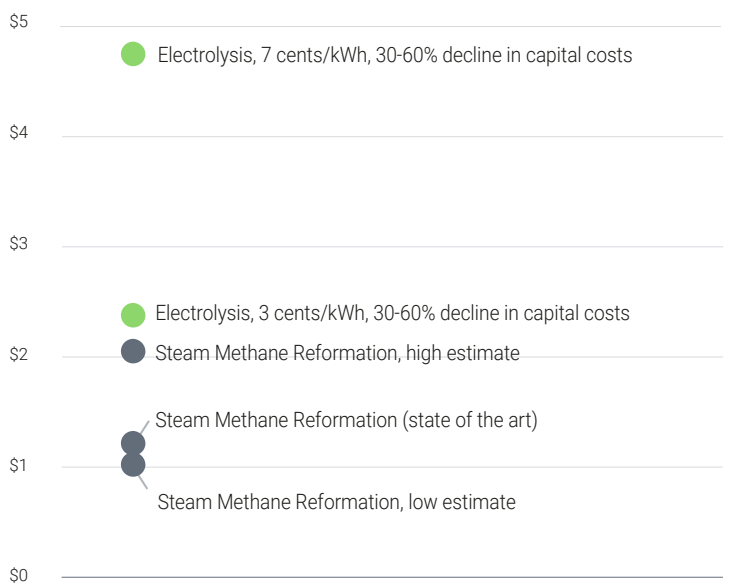
- Many U.S. & European makers of hydrogen components registered impressive price rallies that do not always reflect the current slow market adoption.
- Hydrogen is also catching the interest of oil majors looking to clean-up their activities, and who possess strong know-how and capital power.

Don't count your chickens before they're hatched.

The ongoing hype does not reflect current technology state. There's still a long way to go before green hydrogen becomes cost-competitive with fossil-based hydrogen. Mass adoption can't happen without the combination of falling capital cost of renewable electricity costs, and substantial carbon tax.

- For green hydrogen to become competitive with grey hydrogen (done through steam methane reforming), upfront capital costs must fall by 75% and renewable electricity cost should be at $2 cts/kWh (vs. current $7-8 cts/kWh).

ELECTROLYSIS VS STEAM METHANE REFORMATION AS A MEANS OF PRODUCING HYDROGEN, $/KG



Source: US Department of Energy. February 2020.

SOURCE:
Energy Outlook 2020, J.P.Morgan

Outlook – Green Infrastructures

Clean transition is core to economic recovery plans

Around the world, many governments have announced economic recovery packages with some of them specifically targeting energy-related industries. While a large portion of the help is to relieve some of the most affected sectors (e.g., airline bailouts), a good slice will be directed towards clean technologies.

- After an initial "rescue" phase, governments are now moving to support a "green recovery" phase with stimulus packages targeting clean technologies.
- Such long-term public commitments are to boost investors' confidence and accelerate private investments into the sector.

Europe wants to lead the green recovery

Through its "Next Generation E.U." recovery fund, Europe did arguably unveil the biggest green stimulus plan in history, with 37% of the announced EUR750bn to be spent on climate-related expenditures.

- The plan is in line with EU's Green Deal targeting net zero emissions by 2050.
- Most of the climate-related spending will be dedicated to infrastructure and transport ($126bn), followed by energy efficiency in buildings & industry ($86bn), and new renewable electricity capacity ($30bn).

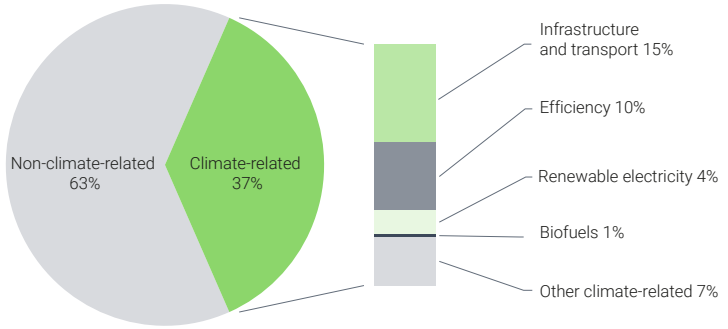
Creating opportunities to boost jobs and growth

Beyond the obvious economic benefits to cleantech industries, directing recovery investments toward climate-related infrastructures could create millions of jobs. Such a positive impact on unemployment is a key driver for governments.

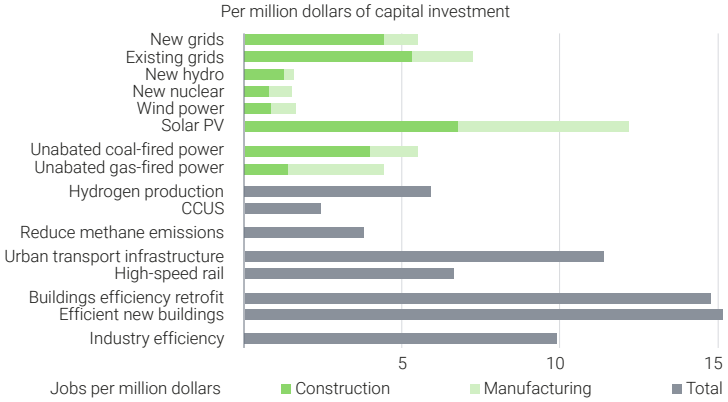
- Globally, it is estimated that about 8% of the 40mn energy-related jobs are at risk or have already been lost during the pandemic.
- New jobs can be created, especially in retrofitting buildings, modernizing power grids, or building new solar PV, where every $1mn invested creates 10–15 jobs.

SOURCE:
Renewable Energy Market Update, IEA 2020
Renewables Increasingly Beat Even Cheapest Coal Competitors on Cost

NEXT GENERATION EU TOTAL AND EXPECTED CLIMATE - AND ENERGY - RELATED SPENDING 2021-23



CONSTRUCTION AND MANUFACTURING JOBS CREATED PER MILLION DOLLARS OF CAPITAL INVESTMENT AND SPENDING BY MEASURE



2020 – A Glance In The Rear-View Mirror (1/2)

IMO 2020 came into force

The International Maritime Organization (IMO) introduced its new regulation capping sulfur content in marine fuels to 0.5% (from previous 3.5%).

- This left ship-owners with basically two main options: either use very low Sulphur fuel oil (VLSF) or keep using cheaper high sulfur fuel oil (HSFO) along with a scrubber capturing sulfur oxides from the exhaust.

Record-low solar PV tender bid by EDF & JinkoPower

Despite Covid-19, new solar projects continued to emerge with large tenders in the Middle East reaching record levels thanks to great solar resources, large and flat sites, cheap land costs and massive scale.

- Abu Dhabi 1.5GW tender received a record-low bid of $13.5/MWh submitted by EDF and JinkoPower.

China easing green rules for petrol-electric hybrid vehicles

Re-classification of such hybrid vehicles into "low fuel consumption passenger vehicles", reducing the number of "negative points" incurred for manufacturing them.

- The new policy allows automakers to make more petrol-electric hybrid vehicles and less all-EV from 2021 to 2023.

IMPACT

H1 2020

IMPACT

Covid-19 Outbreak

Covid-19 outbreak, first identified in China, started to spread to other Asian countries, Europe, the U.S. and ultimately impacting the entire world.

- During the first few months of the pandemic spread, major economies were consecutively hurt, with lockdowns, confinement and social distancing measures slowing-down the supply and demand of most cleantech industries.

Oil Majors cutting their dividends and E&P capital spending

Many oil majors started to cut their dividends as well as capital spending for exploration & production in order to preserve cash, while maintaining investments for the development of clean energy activities.

- As of April 2020, combined capex cuts announced by nine oil majors (incl. Aramco, Exxon, Shell, etc.) reached $38bn or a 22% drop from initial spending budget.

Oil prices collapse

U.S. oil prices fell below zero for the first time in history, challenging shale oil operation and the entire industry. The Covid-19 pandemic created a supply/demand imbalance resulting in a lack of storage capacity.

- The WTI May 2020 contracts tumbled to –37.63 $/barrel.

Hydrogen push from government & industry

Positive momentum in the clean hydrogen industry with several governments unveiling supportive plans and industrial actors consolidating their position.

- E.g., E.U.'s €470bn green hydrogen strategy, or Germany's plan to invest €9bn in the hydrogen economy.

2020 – A Glance In The Rear-View Mirror (2/2)

Europe's €1.8tn rescue plan with large parts dedicated to green stimulus

The E.U. unveiled its green recovery plan in line with its goal to become carbon neutral by 2050. The plan includes financial support for key areas of renewables, EV, energy efficiency and hydrogen.

- Out of the €1.8tn, €572bn is to be spent on climate-related actions.

California heatwave challenging renewable adoption

A heat wave caused rolling blackouts in California this summer due to unusual high electricity demand for air-conditioning and high shares of renewables in the power generation mix.

- Up to 4mn people were affected by the blackouts.

Asian green wave

Major Asian economies announced new commitments for zero carbon emissions in the coming 30-40 years – a general goal that has to be followed by a set of specific supportive measures to clean technologies.

- China is to become carbon neutral by 2060, while South Korea and Japan set their carbon neutrality goal to 2050.

IMPACT

H2 2020

IMPACT

Sunrun & Vivint Solar merger

Consolidation in the U.S. solar residential sector with Sunrun in an all-stock swap transaction, creating a U.S. solar superpower.

- The combined company is to represent roughly 20% of the U.S. residential market.

Release of BP's annual energy outlook

In its 2020 energy outlook, BP concludes for the first time ever that oil demand has already peaked in 2019 and foresees a fast decline for the coming years.

- It predicts oil demand to fall by at least 10% within the next decade and 50% by 2040.

California setting new rules on ICE car sales

Governor announced its plan to ban the sale of new gasoline-powered vehicles by 2035.

- The most aggressive move so far in the U.S. with California accounting for 11% of all new vehicle sales in the country.

Biden Election

Bringing hopes for further support to the cleantech industry and an accelerated transition towards clean energy sources.

- Biden's plan includes a $2tn green stimulus package, 100% carbon-free electricity by 2035, and net-zero carbon by 2050.

2020 – Capital Markets

M&As remain attractive

Given the market uncertainty several deals were canceled or differed because of the pandemic. However, M&A remained an attractive option for companies seeking market consolidation & process optimizations, or for corporations willing to decarbonize their business activity.

- The U.S., saw the merger of the two largest solar residential installers, Sunrun and Vivint Solar, creating a solar superpower with 20% market share in the residential segment.
- BP sold its petrochemical business while entering the offshore wind industry through a deal with Equinor on two U.S. projects.

Challenging time for IPOs with some stunning exceptions

2020 was a challenging year for cleantech companies aiming to go public through standard IPOs. Nevertheless, a few companies made sensational debut on public markets, notably in the best-performing sectors of solar and EVs.

- U.S.-based maker of solar tracking systems, Array Technologies, raised >$1bn, one of the biggest U.S. renewable energy IPOs in recent years.
- New Chinese EV makers Li Auto and Xpeng made their debut on the U.S. stock market, both raising >$1bn in their respective IPOs.

SPACs craze year

2020 saw a surge of Special Purpose Acquisition Companies (SPACs) hitting the stock market, with many pre-mature actors willing to go public without coping with the hurdles and delays of traditional IPOs.

- 2020 is to produce more SPACs than all previous five years together.
- Recent cleantech SPACs include: Luminar and Velodyne (LiDAR), Quantumscape, EOS and Romeo Power (battery), ChargePoint and Blink Charging (EV charging), as well as Desktop Metal (additive).

Structural Trends – Climate Change

Climate change and its consequences are the primary trends

An intensification of extreme weather events e.g., flooding, droughts, and heatwaves and associated wildfires, result in huge human and economic losses.

- Carbon dioxide (CO2) level in the atmosphere keeps increasing and has reached an all-time high above 414 ppm (up 150% from the pre-industrial level).
- 2016–2020 is on track to be the warmest five-year period ever recorded, with 2020 being the warmest year for the Earth's surface.

Global warming mitigation calls for more technology

Global CO2 emissions reduction strategies are all based on the adoption of key technologies, each having its specific contribution depending on the sector. According to experts, the largest area of reduction is the power industry which is to deliver >300Gt CO2 of cumulative emissions reductions by 2060.

- On the technology side, energy efficiency makes the largest contribution at 39%, followed by renewables accounting for 36% of the emission reductions.
- Emerging technologies will contribute to a third of future emission reductions.

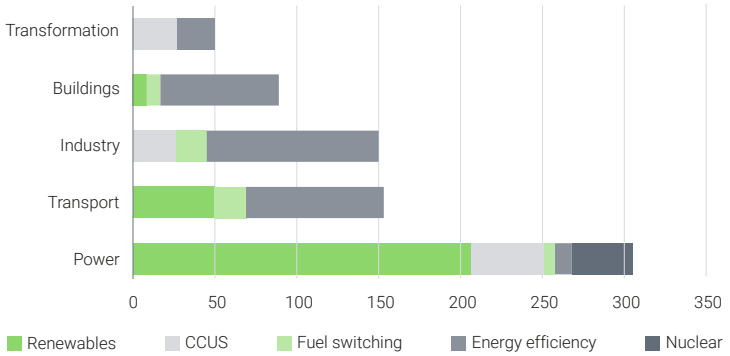
Energy efficiency is just beginning

Beyond expanding the use of energy sources, another way to mitigate carbon emissions is to improve energy efficiency at all levels. This can be done by adapting human behaviors (ask people to simply consume less) or through technologies optimizing the uses of energy and reducing waste (e.g., smart building / agriculture).

- Wide-bandgap semiconductors (e.g., silicon carbide) used in power electronics are to provide a more efficient usage of electric power.
- Innovative technologies or advanced insulation materials are being used to maximize energy savings while guaranteeing similar (or enhanced) functionalities.

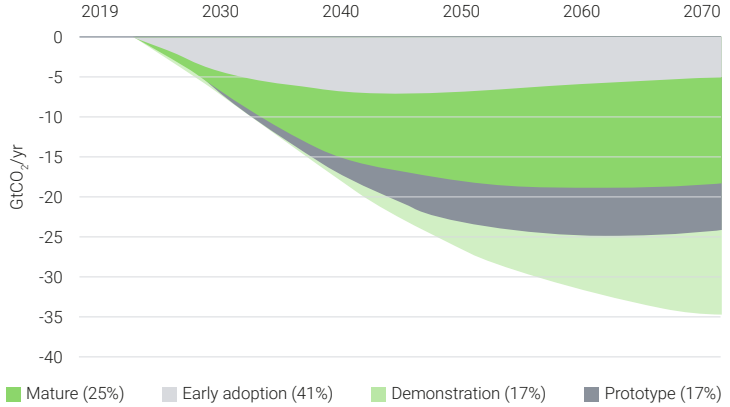
SOURCE:
World Meteorological Organization , The Global Climate 2015-2019 | National Centers for Environmental
New Energy Technology Perspective, IEA 2020, Exploring Clean Energy pathways, IEA 2020

GLOBAL CO_2 EMISSIONS REDUCTIONS BY TECHNOLOGY AREA AND SECTOR, RTS TO CTS



Note: Analysis above uses the Energy Technology Perspectives modeling framework. In the CTS, CCUS delivers 13% of the cumulative emissions reductions to 2060.

CO_2 EMISSIONS REDUCTIONS BY TECHNOLOGY READINESS CATEGORY IN THE SUSTAINABLE DEVELOPMENT SCENARIO



Notes: Percentages refer to cumulative emissions reductions by 2070 between the Sustainable Development Scenario and baseline trends enabled by technologies at a given level of maturity today. Technologies that are at the prototype or demonstration stage today contribute more than one-third of the cumulative emissions reductions in the IEA Sustainable Development Scenario.

Structural Trends – Energy Transition

Global electrification is continuing

Despite a 5% drop in power demand amid the Covid-19 pandemic, electricity demand is expected to bounce back and rise 60% by 2050. Key drivers of rising electricity demand are changing weather conditions and demographics.

- Hotter summers and colder winters result in the increased need for heating and cooling equipment.
- Population growth and increased urbanization drive electricity needs, notably electrification of transport, which is to represent 11.5% of total power demand by 2050.

Peak oil might already be behind us

The latest BP energy outlook suggests that we might have already passed the oil demand peak while others see it happening within the next decade. Whether this is true or not, what is certain is that the oil industry is to decline in the coming years.

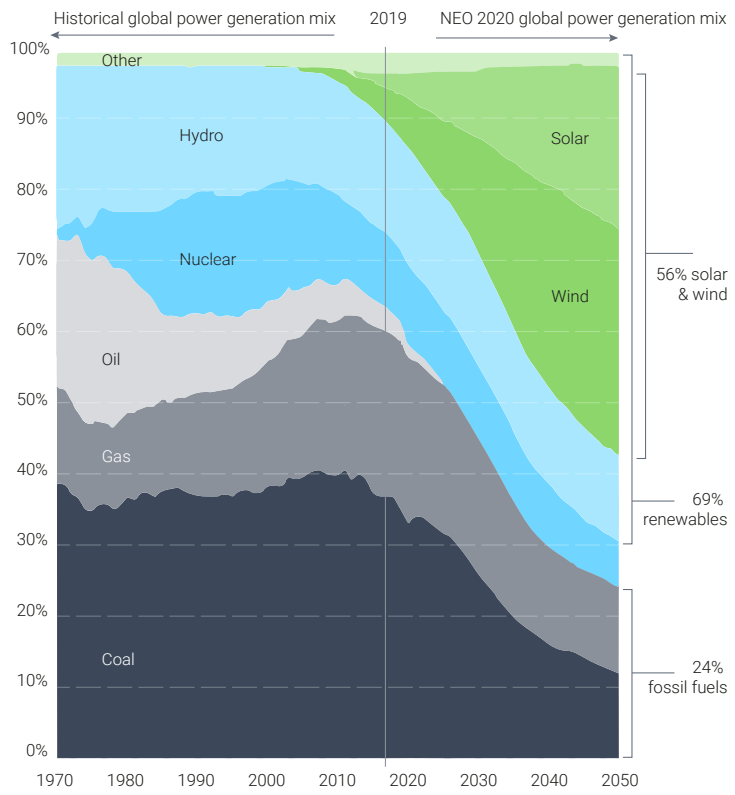
- While oil demand will not fall to zero, new investments in the oil industry are fundamentally challenged.
- In 2021, renewable power is to represent the largest part of energy investments for the first time ever, above oil & gas investments.

Solar and wind will grow their lead

The biggest winners of the growing electricity demand are solar and wind, which are expected to grow from 9% to 20% of the power mix by 2025. On the other hand, the share of nuclear is to remain stable globally, with some countries phasing-out and others extending lifetime of existing nuclear plants or building new capacity.

- In 2020, solar and wind accounted for 90% of new power capacity installed globally.
- This trend is expected to last as promising technologies (like nuclear fusion) will not be available before the second half of the century.

GLOBAL ELECTRICITY GENERATION MIX



SOURCE:
New Energy Outlook, BNEF 2020

Structural Trends – Grid Parity

Measuring the competitiveness of renewables

The price of major renewable technologies, measured in "Levelized Cost of Energy" (the metric used to compare the present value of different power sources), has been on a constant decrease over the past decade.

- Grid parity is reached when electricity generated from renewable sources becomes cheaper than electricity generated from conventional sources (such as coal, gas, etc.) and has already been attained in most parts of the world.
- Solar PV costs dropped globally by 82% over the last decade while onshore wind went down 40% and offshore wind 29%.

Going beyond the simple grid parity

Renewables (solar and wind) have become not only cost-competitive with conventional generation technologies on a new-build basis, but also tend to become competitive with the marginal cost of operation of existing conventional plants.

- When including U.S. government subsidies, utility-scale solar and wind energies are already competitive with the marginal cost of combined-cycle gas, nuclear, and coal.
- Assuming the very low cost of financing will continue, we believe this will help accelerate older power plants' replacement .

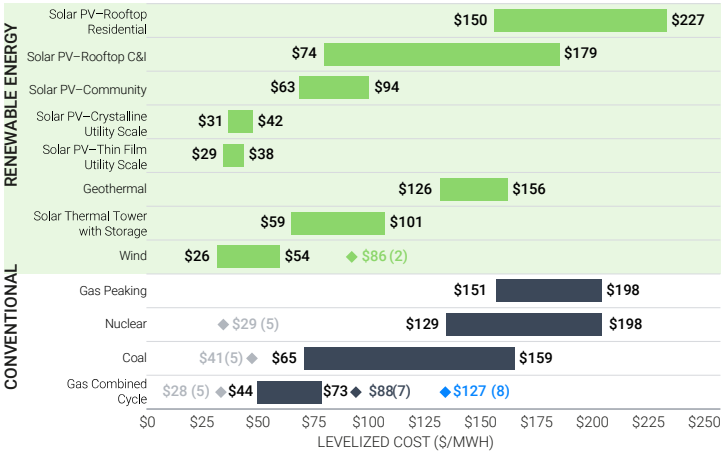
Next step is to reach parity with storage

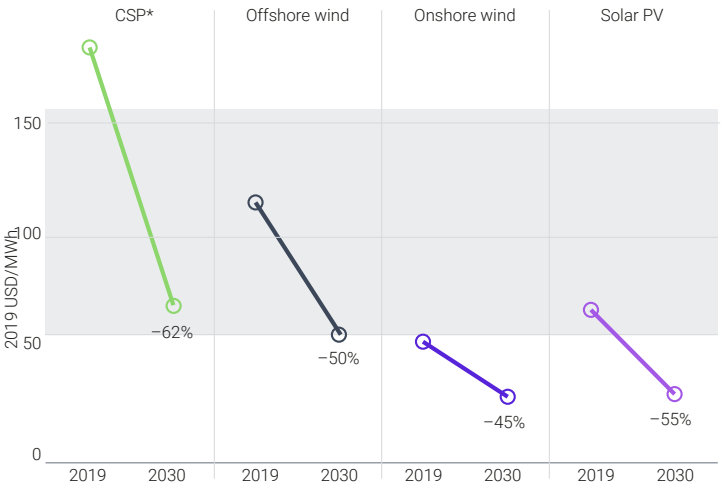
The next milestone for renewables is to become competitive with conventional generation when factoring in the costs of energy storage. At the current cost-decline pace, "renewables + batteries" will soon be competitive with fossil-based power.

- Solar-plus-storage wholesale costs fell from $102–139/MWh in 2019 to $81–140/MWh.
- Storage is a game-changer as it solves the intermittency challenge.

SOURCE:
Solar PV costs fall 82% over the last decade, says IRENA,
Levelized Cost of Energy and Levelized Cost of Storage – 2020

ELECTRICITY GENERATION SOURCES COST COMPETITIVENESS





Concentrated Solar Power

Structural Trends – Responsible Investing

Increased investor pressure

Investors are increasingly challenging companies on climate-related issues, forcing them to make resolutions and take actions to clean-up their business activities.

- 216 companies have already signed the RE100 initiative, a commitment to use 100% renewable electricity by 2050, among them: Google, Amazon, AT&T, Microsoft, Facebook, etc.

Integrating climate risk is a must

Climate change is impacting our society at all levels, and hence must be integrated into companies' financial risks. Disclosing environmental data related to companies' activity is to become the norm in the coming years.

- While reported data remain incomplete and inconsistent, a growing number of companies start to disclose data related to previous environmental metrics and future targets.

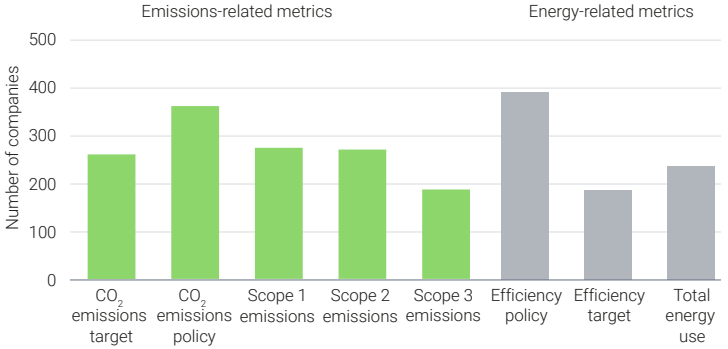
Efforts for better classification

To avoid greenwashing, significant effort is being put to better classify sustainable investments and homogenize all the existing approaches and interpretations. Such initiative should impact both investors and companies that will need to adapt their activities if they want to retain investments.

- The E.U. Taxonomy of Sustainable Economic Activities, a classification tool for sustainable activities, will be applicable from 2022.

SOURCE:
World Energy Investment, IEA 2020

NUMBER OF COMPANIES IN THE S&P 500 REPORTING ENERGY-AND EMISSIONS-RELATED METRICS



Notes: S&P 500 is a stock market index of 500 large companies listed in the United States. Scope 1 greenhouse gas emissions come directly from company operations; scope 2 emissions arise from the generation of energy that is purchased by companies; scope 3 emissions occur during the use of a company's products and are more challenging to estimate. Source: IEA calculations based on Thomson Reuters Eikon (2020).

Initiative	Reporting compliance	Effective
Canada Green Taxonomy	Voluntary	Under development
China Green Industry Guidance Catalogue	Voluntary	2020
EU Taxonomy of Sustainable Economic Activities	Mandatory	2022
Malaysia Green Taxonomy	Voluntary	Under development
MDB Common Principles for Climate Mitigation Finance Tracking	Mandatory	2012
ISO Technical Committee 322 on Sustainable Finance	Voluntary	Under development

Sustainable Future For Dummies

Megatrends driving the theme

Climate change, a growing world's population, and increasing global electrification have started to spark major changes in our living habits and the adoption of sustainable behaviors.

- Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Technology is the only way forward

To grow sustainably, and as a response to the climate change threat, our society has no choice but to develop technologies aimed to adapt to and mitigate climate risk.

- Clean technologies must be deployed to cope with upcoming challenges including air pollution, rising temperatures, fossil fuel scarcity, growing water needs, increasing electricity demand, etc.

A diversified investment universe

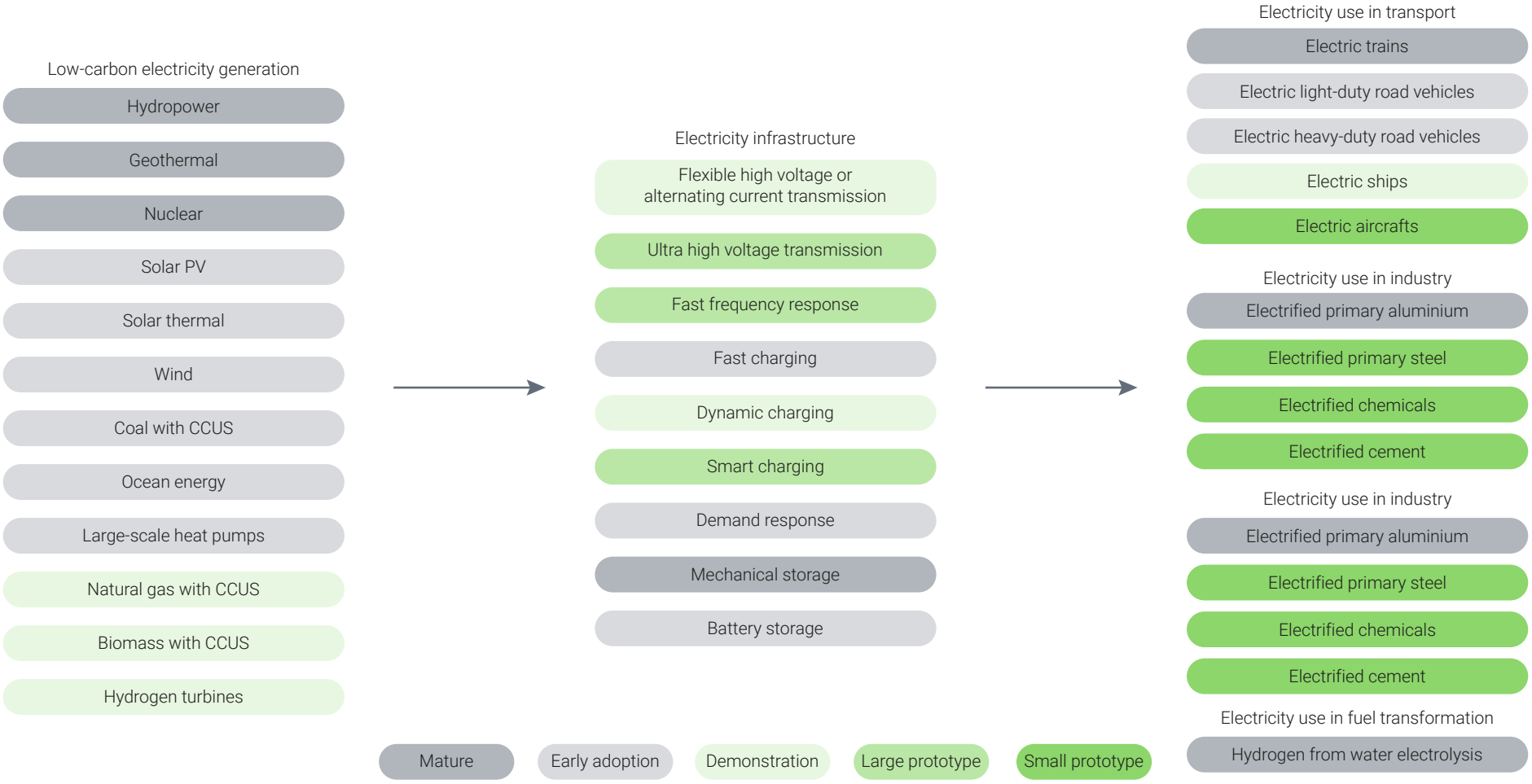
Our Sustainable Future theme captures the growth (estimated above 20% on average) in all industries benefiting from the sustainable development of our planet.

- We invest in pure players in renewable energies, energy storage, clean & smart transportation, water & wastewater treatment, the digitalization of energy systems, and the integration of smart technologies aiming to improve energy efficiency.

SOURCE:
AtonRâ Partners

Positioning Clean Technologies On The Maturity Curve

TECHNOLOGY-READINESS LEVEL OF TECHNOLOGIES ALONG THE LOW-CARBON ELECTRICITY VALUE CHAIN



Catalysts

- **Green Recovery.** Many governments are emphasizing a green recovery post-Covid, by ramping-up commitments and investments in clean technologies.
- **Beyond grid parity.** Renewables becoming competitive with conventional power sources not only on a new-build basis but also with marginal cost of operation.
- **Cheap access to capital.** Clean technologies (incl. solar, wind and EVs) can benefit from current low interest rates to secure initial investments and better finance faster-than-expected deployment.

Risks

- **China's dominance.** China's stronghold on clean technologies and notably on critical raw materials could become a risk, should the government decide to impose higher export taxes.
- **Government's subsidies slowdown.** The reduction and expiration of government's subsidies on key technologies can potentially impact the growth forecasts in the short-term.
- **International tensions.** Escalating tensions result in higher import tariffs and therefore reduce the affordability of cleaner technologies.

Bottom Line

- Following a challenging year where clean industries demonstrated their strong resilience despite the Covid-19 pandemic, many projects were delayed to 2021, which is expected to be a year of sharp rebound in term of technology deployment. The synergies between political support, technology readiness and people's climate awareness have never been so strong. The financial sector is starting to align with climate objectives and past years have proved that many clean industries are already strong enough to withstand crisis and sustain growth.
- In our Sustainable Future team, we seek to maintain a well-balanced portfolio comprising a diversified range of technologies across various clean industries with different maturity levels.

Companies mentioned in this article:

Amazon (AMZN US), Aramco (Aramco AB), AT&T (T US), Blink Charging (BLNK US), BP (BP US), ChargePoint (SBE US), Cree (CREE US), Desktop Metals (not listed), EDF (EDF FP), EOS Energy (EOSE US), Facebook (FB US), GE (GE US), Google (GOOG US), Luminar Technologies (LAZR US), Microsoft (MSFT US), Neoen (NEOEN FP), QuantumScape (QS US), Siemens Gamesa (SGRE SM), Sunrun (RUN US), Tesla (TSLA US), Velodyne Lidar (VLDR US), Vestas (VWS DC)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AtonRâ Partners is a conviction-driven asset manager combining industrial and scientific research with financial analysis. AtonRâ Partners focuses on long-term trends powerful enough to be turned into thematic equity portfolios.

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