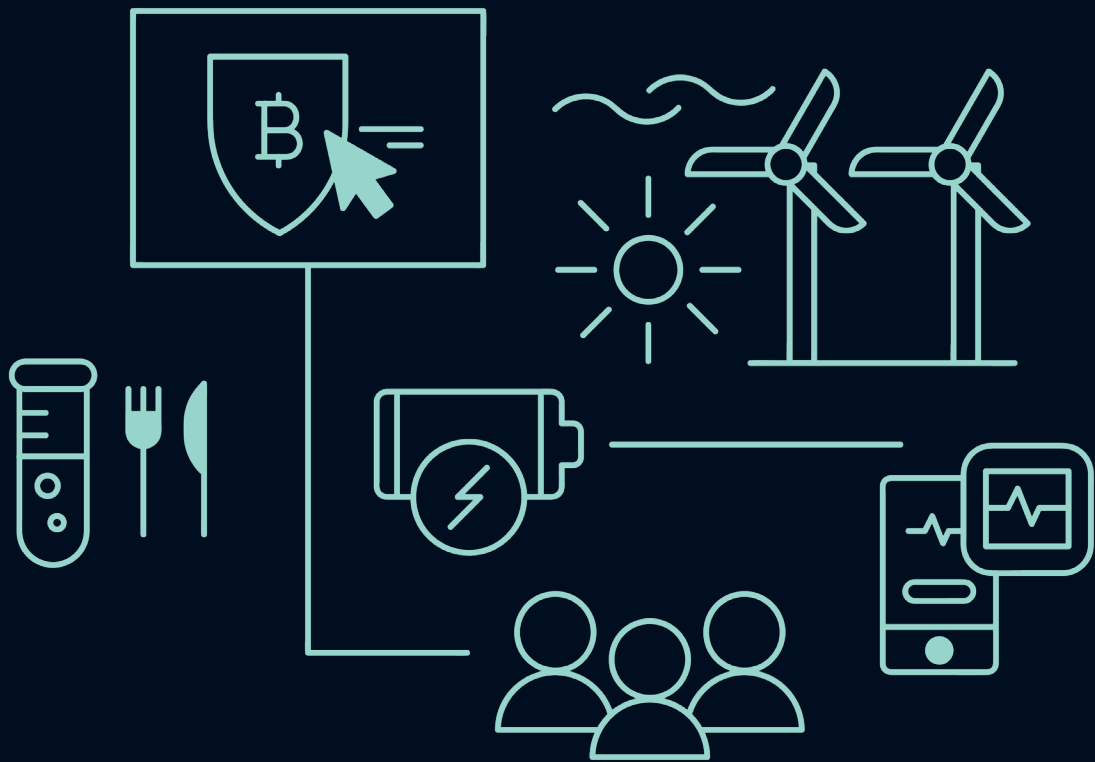




12 Tech Trends To Watch Closely In 2022

2022



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Intro

2021 was a year of push and pull. Between the Covid-19 vaccine rollout and a sharpening focus on innovation, companies across industries increasingly turned to tech for new answers — and new challenges. From supply chain bottlenecks, to escalating weather disasters, to the ongoing battle against disinformation, 2021 was a year of revised expectations.

In 2022, expect to settle into the “new normal,” where disruption is always a possibility. To keep up with the sea change of the past couple years, tech and industry players will rethink what they produce, and how.

This year brings huge opportunities for tech companies to make major, meaningful moves in healthcare — an industry tech leaders have been after for years. As pandemic variants cloud the future and highlight the need for quicker timelines, pharma players will embrace virtual clinical trials as an avenue for faster drug development. In healthcare more broadly, the already hot telehealth sector will see greater emphasis on remote patient monitoring.

Digital identities will also become a lucrative opportunity, as talk of the metaverse and NFTs further accelerates. But plunging deeper into virtual worlds opens up the playing field to more cyber crime: security solutions will become a major priority, especially as crypto hype and data privacy controversies continue to boom.

Climate tech and the pursuit of alternative energy solutions will become top of mind for execs and businesses looking to achieve net-zero emissions, and the push for electrification will continue to gain momentum. But with enormous capital costs, there will be a wide chasm between winners and losers — and between true impact and more greenwashing.

Finally, ultrafast delivery players will rely on partnerships to reach a sustainable scale, while lab-grown meat will vie for a spot in consumers' shopping cart.

Ultimately, expect 2022 to be a year of adaptation, where players across the board will invest in solutions for the new — and increasingly virtual — “normal.”



Next wave of telehealth

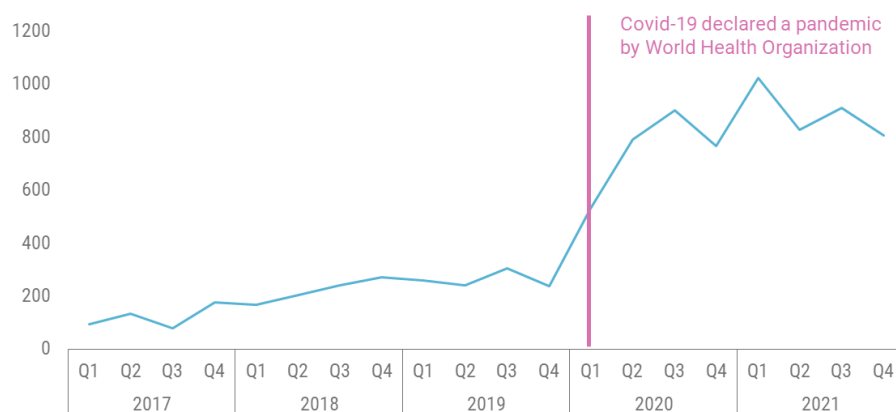
Big tech companies, retailers, and telecoms will compete with existing healthcare players for the \$30B+ remote patient monitoring market.

The Covid-19 pandemic upended healthcare in countless ways, but one outcome showing staying power is the rise of remote patient monitoring (RPM) — tech that tracks key vitals and metrics while patients are away from typical medical settings.

While RPM has been gaining traction for several years as a way to reduce costs and improve the patient experience by enabling a tech-driven “hospital-at-home” model, the approach took off as lockdowns and overburdened hospitals led to an enormous surge in demand.

Interest in RPM has surged during the pandemic

Media mentions of remote patient monitoring, Q1'17 – Q4'21



Source: cbinsights.com

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The tech can be applied to a wide range of medical applications. For example, well-funded startups in the space include:

- [Huma](#), which uses data produced from smartphones to monitor health.
- [Element Science](#), which offers a wearable defibrillator that also continuously monitors for life-threatening heart rhythms.
- [Biofourmis](#), which provides a dedicated vitals measuring device alongside AI tools to help manage patient care for conditions like diabetes.

The role of non-traditional healthcare players will accelerate in the coming year as the RPM market expands and the enabling tech improves.

RPM could lead to earlier diagnoses and better treatments, reduce the cost of care, and even support “decentralized” clinical trials. Healthcare providers like Mayo Clinic and insurers are already enthusiastic about the prospect and are partnering liberally with RPM startups and wearables makers, but big corps from non-healthcare industries are also seeing an opportunity to secure a chunk of the [\\$30B+ RPM market](#) — particularly by leaning into expertise in consumer electronics, data handling & AI, physical retail infrastructure, and connectivity.

Another RPM boon will come from the quickening rollout of 5G services. AT&T and Verizon are due to significantly expand their 5G services by late January. This will open up new possibilities for data-heavy RPM applications, as continuous monitoring of multiple vitals and AI-driven analysis tools can eat up a lot of bandwidth.

Telecoms are eager to showcase this healthcare potential. For instance, in December, AT&T partnered with Samsung and [Qure4u](#), a digital health startup, to launch an initiative to monitor people with high blood pressure.



Meanwhile, RPM software platform [Somatix](#) received backing from T-Mobile's accelerator in September. Expect telecoms to rapidly establish more RPM partnerships and even acquire startups in the space to allow them to directly offer more RPM services.

2. Remote patient monitoring

Hand-in-hand with telemedicine is remote patient monitoring, including administering and adjusting medication based on collecting and analyzing near real-time data. By using IoT devices, healthcare providers can remotely monitor vitals, track medications, and transfer current data to help staff make faster, more informed decisions.

5G will enable better connections on mobile devices, increase data transfer capacity utilizing wider bandwidth, support larger blocks of data transference, and help enable healthcare workers to give improved live and near real-time remote care.

Today, remote monitoring is largely limited by the capacity of the network to handle data; 5G will enable more reliable connections to facilitate the data transfers workers need to make quick healthcare decisions remotely for more patients. This will have an impact in healthcare in ways like unobtrusive monitoring, assisted living for people with chronic conditions, active aging, and more.

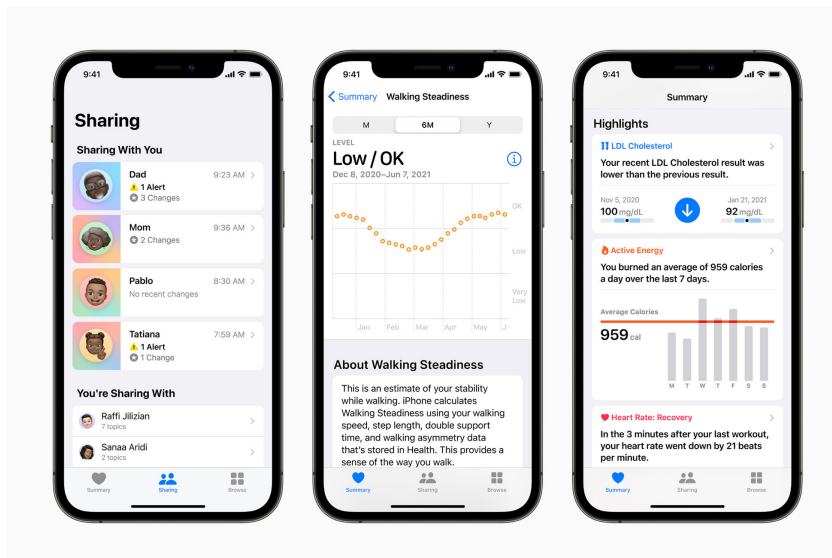


88% of providers say they are researching, piloting, planning, or already remotely monitoring patients with IoMT devices.*

AT&T has been talking up the potential for 5G-enabled RPM for years. Source: AT&T

Big tech will also be key players to watch in the coming months.

Apple, for one, announced tools for securely sharing data gathered from its devices with doctors in June 2021. It is also rumored to soon be launching additional health-tracking Apple Watch features for glucose levels, blood pressure, body temperature, and more. At the same time, a growing number of studies are indicating consumer-focused wearables' potential for helping to monitor patients, including research from Stanford that found Apple Watches were suitable for remotely monitoring the condition of some heart patients. Google, Amazon, and Microsoft are similarly beginning to offer RPM services across their consumer devices, including Fitbit, Nest, Azure Kinect, Halo, and more. (Read more in our [Big Tech In Healthcare report](#).)



Apple announced tools last year to share health-related user data with doctors.
Source: Apple

This shift toward consumer-products-as-medical-devices could create an opening for big tech companies to use their vast ecosystems and AI prowess to go beyond what a typical medical device maker could achieve using RPM. Medical device makers tend to focus on building dedicated RPM devices that would be prescribed to patients by doctors. Meanwhile, big tech companies already have their devices in the hands of hundreds of millions of users and have invested heavily in intuitive UX that could help make RPM services feel more accessible.

For example, big tech companies are well-positioned to use AI to passively screen everyday users for “digital biomarkers” — subtle changes in how users engage with devices (such as text input speed or interactions with certain apps) that may help predict the onset of conditions like anxiety, depression, or even Alzheimer's disease.



Other pieces of tech companies' future healthcare plans may also fall into place in 2022 — especially around VR. Apple, for instance, is widely expected to launch a VR/AR headset this year. This type of device could provide big tech companies with a platform to offer immersive “digital therapeutics” — software-driven treatments often centered around behavioral change and disease management — for conditions that have been diagnosed using RPM on other devices in their ecosystems. Eventually, this approach may even allow big tech companies to create a closed loop that cuts out traditional healthcare providers altogether for certain conditions.

Other big non-healthcare companies are also interested in RPM.

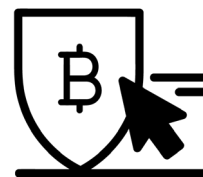
- Salesforce, for instance, is offering a remote patient monitoring tool on its cloud-based platform — aimed at helping providers manage RPM deployments and visualize the vast amount of data being produced.
- Best Buy spent \$400M in October to acquire Current Health, a startup offering RPM devices and a data platform. The retailer wants to tap into its network of stores and consumer electronics experience to offer services across the entire RPM value chain — from turning storefronts into de facto points of care to offering RPM devices to managing the data created.

Watch for more corporations to leverage their current advantages to enter the RPM market, a big prize which — by definition — takes healthcare services out of traditional settings like hospitals where barriers to entry for non-incumbents are high. Success in RPM could also act as a launchpad for new entrants to compete in other lucrative healthcare spaces. Anticipate a potential uptick in tech companies and other non-healthcare corporations partnering with hospitals and insurers to help deliver care.



A key challenge for these corporations will be navigating fiendishly complex healthcare regulations, especially around data. This could slow down newcomers, but is unlikely to stop them. That said, “moving fast and breaking things” is unlikely to be on the table.

This may calm the nerves of healthcare incumbents worried about rapidly losing ground, but one question will likely be keeping more than a few CEOs up at night: can a tech company move into healthcare faster than a healthcare company can move into tech? As more healthcare services become delivered via consumer-focused channels, a growing number of industry giants certainly think they know the answer — and they’re betting that remote patient monitoring is just the tip of the iceberg.



Crypto crime

The crypto security space will expand to address rising cyber crime as hackers continue to evolve in their tactics.

Interest in crypto is higher than ever before. Spending opportunities are increasing as more companies — from Starbucks to Whole Foods to KFC — begin to accept cryptocurrencies like bitcoin as a form of payment.



Interest in crypto is on the rise

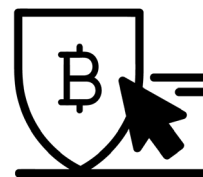
News mentions of “crypto” or “cryptocurrency,” 2017 – 2021



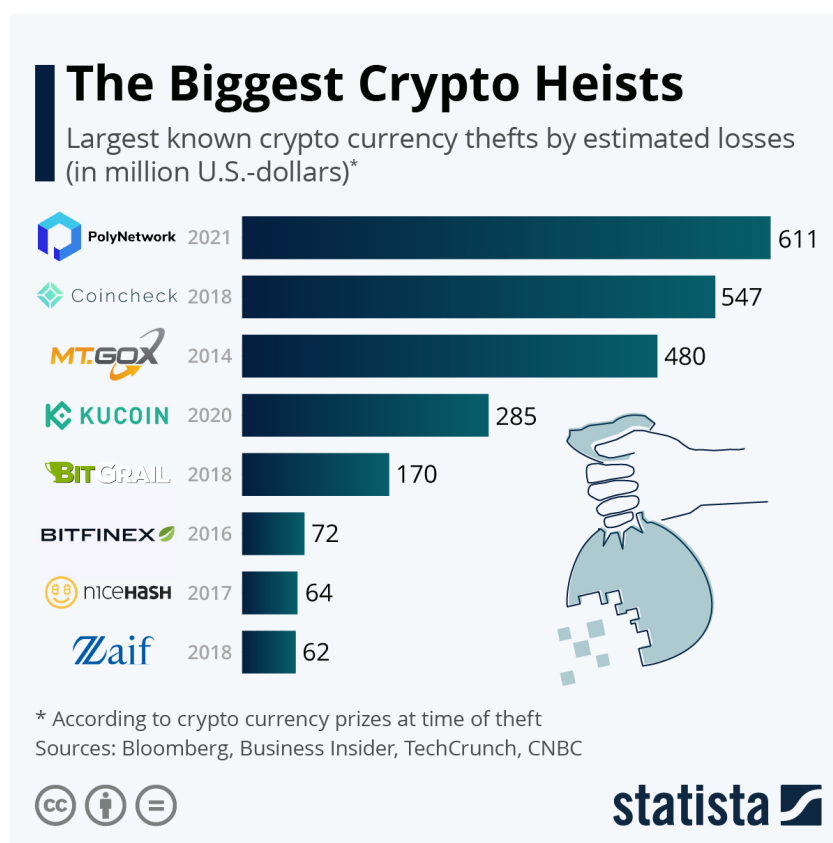
Source: CB Insights

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But as the technology becomes more ubiquitous, so do the associated cybersecurity risks. Though illicit activity reportedly accounts for less than 1% of crypto transactions, reports of crypto crimes have risen an average of 312% every year since 2016. These include hackers stealing coins from investors, individuals falling for crypto investing-related scams, and more.

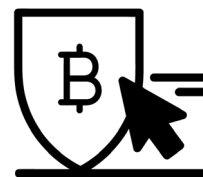


In August 2021, for example, hackers stole over \$600M worth of tokens from decentralized finance (DeFi) platform Poly Network in what was considered the biggest crypto heist to date. Though the funds were ultimately recovered, the attack demonstrates how costly vulnerabilities in crypto security can be – and it's not the only instance.



The largest known cryptocurrency heists, as of August 2021. Source: Statista

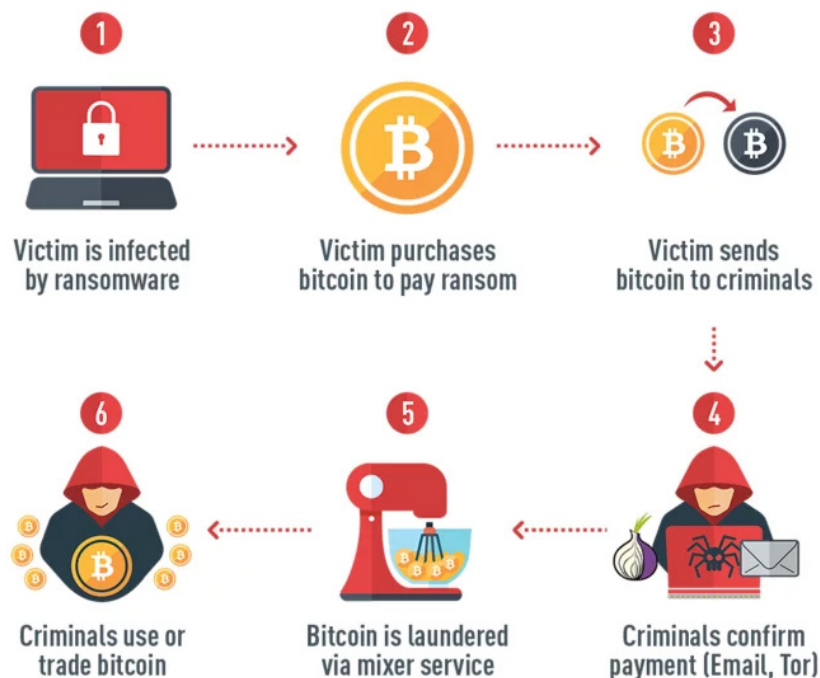
More recently, in December 2021, cybercriminals stole \$150M in cryptocurrency from exchange [BitMart](#) as a result of a security breach involving stolen private keys. Individuals with large amounts of crypto have also fallen victim to hackers. In November 2021, a teenager was arrested for the theft of \$46M CAD – the largest known cryptocurrency theft from a single person.



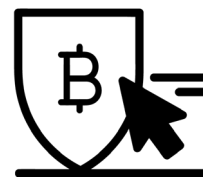
Another way cyber criminals are taking advantage of cryptocurrency is as ransom to pay off ransomware attacks. While cash continues to be the first choice for criminals, that could change as crypto becomes more widely used and accepted. Because cryptocurrency transactions don't involve intermediaries like banks and do not carry personally identifying information, hackers can extort millions of dollars while remaining basically anonymous.

Further, crypto payments are permanent. Like cash, once the money is sent, the sender usually can't get it back unless the recipient returns it. Hackers can also "launder" the money by transferring it through multiple digital wallets so that it's nearly impossible to trace. In short, it's the perfect crime.

How ransom payment transactions work



Source: Emsisoft



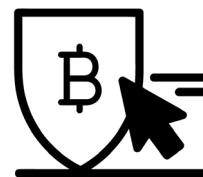
In 2021, cyber attackers halted operations at a major East Coast pipeline, stopped production at one of the US' biggest meatpackers, and breached an IT software vendor that supplied hundreds of other companies. In each of these cases, the hackers demanded a ransom of millions of dollars worth of bitcoin.

Criminals are also targeting bitcoin ATMs as more are being installed around the US in places like Walmart. Scammers drive victims to use a QR code to send funds to the scammer's crypto wallet during their ATM transactions. As with blockchain technology in general, there is little legal oversight of the machines.

All of this sets the stage for the security and compliance space to grow dramatically in 2022. Regulators in the US have voiced the need for guardrails in cryptocurrency markets to mitigate this kind of risk. China has been much more aggressive, banning crypto trading and mining in September 2021 in an effort to limit risk to the country's financial system and minimize financial crime. But without consistent regulations in place, startups are stepping in to try to fill the security void.

Companies like [PassFort](#), [Chainalysis](#), [TRM Labs](#), [Solidus Labs](#), and [Elliptic](#) are working to minimize blockchain-related risks with solutions that range from anti-money laundering (AML) and know your customer (KYC) solutions to transaction visibility to smart contract code security.

Investors are also taking note — funding to the cybersecurity market in general has exploded. In 2021, startups in the space raised \$28B — up 136% year-over-year — across nearly 850 deals.

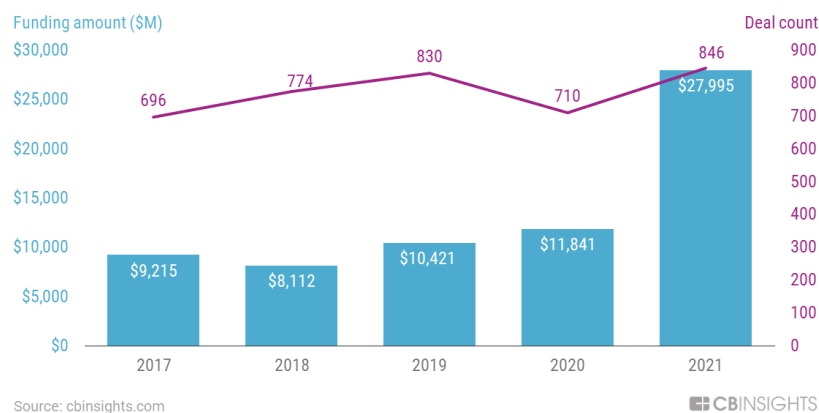


Companies in the cybersecurity space focusing on crypto-specific solutions include:

- [Base Zero](#), which aims to help financial institutions safely self-custody client crypto assets.
- [CryptoPolice](#), which is working to create a decentralized crypto scam verification system.
- [PhishFort](#), which provides an anti-phishing solution for crypto companies.

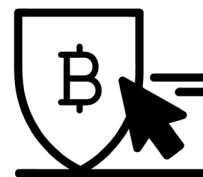
Cybersecurity funding hits record high

Disclosed deals & equity funding (\$M), 2017 – 2021



Crypto exchanges like Coinbase are also investing in security solutions to protect themselves and their customers. The [crypto giant](#) participated in a \$23M seed round to security platform [Forta](#) in September 2021. It also announced plans to acquire crypto security startup [Unbound](#) in December. The announcement came just 1 week after Coinbase's purchase of Switzerland-based [BRD](#).

Financial services companies are jumping in as they increasingly embrace cryptocurrency. In 2021, for example, Mastercard [purchased](#) cryptocurrency AML compliance company [CipherTrace](#) and PayPal acquired cryptocurrency security company [Curv](#).



But many of these security measures focus on protecting crypto exchanges, which leaves personal wallets vulnerable to theft. Further, cyber criminals are expanding their toolkits. For example, cryptocurrencies known as “privacy coins,” such as Monero, let users send and receive coins with total anonymity. Hackers have demanded that victims pay in privacy coins in some recent extortion cases, driving many exchanges to delist the coins.

However, this method can pose challenges for hackers looking to cash out those funds. Kim Grauer, the director of research at Chainalysis, says,

“Privacy coins haven’t been adopted to the extent that one may expect. The primary reason is that they aren’t as liquid as Bitcoin and other cryptocurrencies. Cryptocurrency is only useful if you can buy and sell goods and services or cash out into mainstream money, and that is much more difficult with privacy coins.”

Still, the crypto space changes quickly, and privacy coins could pose a greater risk in 2022.

As of 2021, there are over 300M crypto users around the world and more than 18,000 businesses accepting crypto payments. With more individuals and companies storing wealth in cryptocurrencies and using the coins to conduct transactions, the costs of hacks are rising. This year will bring more scams, hacks, and illicit transactions, but it will also bring well-funded startups seeking to apply their protections to the quickly evolving ecosystem.



Direct-to-avatar

Mass fashion brands will go all in on the avatar economy as the metaverse, NFTs, and digital identities take off, and the low cost of development and huge user bases entice a deluge of entrants.

A \$4,115 Gucci bag in Roblox. A \$50,000 FEWOCiOUS x RTFKT sneaker NFT. An \$8 Balenciaga outfit on Fortnite.

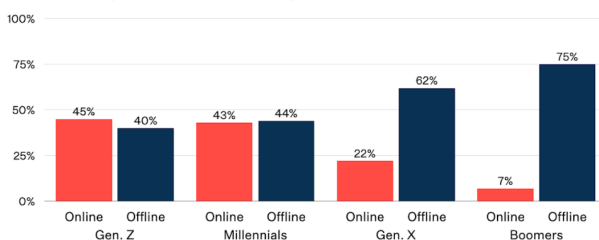
In the last year, the explosion of [NFTs](#) and [metaverse hype](#) — combined with the rise of virtual worlds like Roblox and Fortnite — has spurred fashion brands to further experiment with [virtual goods](#).

In these worlds, users interact in the form of avatars, which they can personalize with clothing, accessories, and other purchases. Alongside their popularity in virtual worlds, avatars have grown more ubiquitous through messaging apps like [Snapchat](#), social platforms like [Zepeto](#) and [VRChat](#), and avatar tech developers like [Genies](#).

These digital identities are becoming increasingly important, especially to Gen Zers, who report feeling more like themselves “online” than “offline,” according to one survey.

More Gen. Z consumers say they feel most like themselves ‘online’ than ‘offline’

Percentage of responses by generation:
Where do you feel most like yourself?



Data: Consumer Trends Survey, powered by toluna*

The New Consumer | Coefficient

Source: *The New Consumer*



As the importance of virtual selves grows, selling to users' digital identities — in other words, going “direct-to-avatar” (D2A) — presents huge branding and monetization opportunities for fashion brands and retailers more broadly. In 2022, we expect the direct-to-avatar business model to take off as brands bet on the future of virtual worlds and compete for relevancy online.

Recent collaborations between fashion brands and virtual platforms — like Gucci’s 2-week virtual “Gucci Garden” space on Roblox — highlight the potential of targeting audiences in virtual worlds. Gucci’s experience reportedly saw around 20M visits from Roblox users, yielding hundreds of thousands of purchases.

But limited-edition collaborations are just one avenue. Brands are also testing out their D2A strategies by:

- Launching digital storefronts or permanent “experiences” in these worlds (e.g., interactive skatepark Vans World in Roblox).
- Targeting blockchain-based worlds like [The Sandbox](#), where Adidas recently bought a plot of virtual land, and [Decentraland](#), where Sotheby’s has opened a virtual gallery.
- Creating their own experiences (which they could monetize directly), such as Off-White’s OFFKAT mobile game or Louis Vuitton’s NFT mobile app Louis: The Game.
- Experimenting with NFTs. For instance, Nike [acquired RTFKT](#), an a16z-backed NFT studio that creates digital collectibles like virtual sneakers, in December 2021.



Source: RTFKT

Non-fungible tokens (NFTs) are a “key enabling technology” for digital goods, per Index Ventures principal Rex Woodbury, as they prove scarcity and authenticity, since users can claim exclusive ownership of digital assets verified on the blockchain. This has important implications for brands looking to get in on the burgeoning resale economy for virtual goods – digital fashion house [The Fabricant](#), for example, takes a 5% royalty when a piece of clothing is resold thanks to NFT tech.

While there is massive potential for brands going D2A, opportunities – via minting NFTs or launching in-game virtual content more broadly – hinge on 1) branding and 2) monetization.

By entering virtual worlds, brands can engage with large, young audiences where they’re spending much of their time – active Roblox users, for instance, average 2.6 hours per day on the platform.



Eventually, brands may work directly with users-turned-creators (like the ~1.3M developers on Roblox) who have the skill sets and gaming experience to develop these goods and installations, predicts Meagan Loyst, Gen Z VCs founder and Lerer Hippeau investor. Gucci, for example, partnered with popular Roblox creators and designers cSapphire and Rook Vanguard to develop its virtual items.

In a virtual environment, brands also have more leeway to customize and test products than in the real world, especially as physical constraints like supply chains, inventory, labor and material costs, and other factors become non-issues. “In theory, the potential is limitless for brands to monetize in the metaverse,” Loyst writes, as it’s much cheaper to create and replicate digital goods vs. physical goods.

For example, between November and December 2018, Epic Games-owned Fortnite reportedly sold 3.3M NFL-branded skins to bring in approximately \$50M in revenue as part of its partnership with the NFL (which was brought back again in 2020 and 2021).



Source: Epic Games



But the potential upside of selling directly to digital identities extends beyond what we're already seeing.

While most virtual goods are currently world-specific (e.g., Balenciaga Outfits are only available in Fortnite) or exist as crypto collectibles (e.g., RTFKT sneakers), the future that brands are betting on looks quite different. Avatar tech companies like Genies and [Wolf3D](#) are currently working on developing avatars that users can "carry" with them across platforms. With interoperability on the horizon, consumers will be even more incentivized to buy goods they can take with them wherever they go, as they do in the physical world.

In the short term, fashion brands will invest heavily in creating items and experiences in virtual worlds with already big audiences — over half of kids in the US use Roblox, and Fortnite and Zepeto count user bases in the hundreds of millions. But as more fashion houses compete for relevancy online, including with fully digital fashion brands like [DressX](#), they will need to experiment with smaller platforms — as well as invest in the tech solutions (e.g., [3D modeling](#)) and skilled workers that will enable them to do so — to keep learning about the space and get ahead of future developments.

Given the [\\$190B market opportunity](#) for virtual goods, we expect the D2A model will be adopted not just by luxury fashion brands, but by all players looking to monetize the metaverse hype, from professional sports teams to restaurant chains. Other areas of opportunity include:

- **Entertainment:** Events marketed to consumers' avatars have the potential to draw far larger crowds (and revenue) than they can in the physical world. A prime example is Ariana Grande's 3-day Fortnite concert series in August 2021, which saw millions of attendees and \$20M+ in revenue including merchandise sales.



- **Real estate:** As more brands and consumers head into virtual worlds, purchasing and owning “virtual land” or properties could become an important market for companies to target.
- **Payments:** Emerging digital financial ecosystems could underpin activities and D2A transactions in the metaverse, disrupting traditional payments systems. Companies offering [financial services that are tailored to virtual currencies](#) (e.g., DeFi applications) are already [seeing strong interest](#).

As more players enter virtual worlds, “creating brand FOMO,” as Decode_M founder Mike Berland puts it, will require increasingly creative and targeted audience approaches. Brands and retailers will need to understand the communities they're trying to engage, otherwise they may risk alienating users or falling short with their campaigns.



Virtualizing the clinical trial

***In silico* techniques will cut the time and money it takes to develop a drug and insulate clinical trials from disruptions like Covid-19.**

For potentially life-saving drugs and treatments, the road to commercialization is steep.

On average, it costs \$2.6B to research and develop a successful drug and takes 10+ years to come to market. It's estimated that *in vivo* testing (testing on animals and humans) accounts for more than 75% of the total cost, with recruitment alone being one of the biggest barriers to drug development — only 6% of clinical trials are ultimately completed on time.

Amid a global health crisis, the challenges only multiply: Covid-19 interrupted an estimated 80% of non-Covid-related clinical trials, a costly setback. At the same time, the accelerated development and approval of Covid vaccines demonstrates the critical value in implementing faster and more effective clinical trials. But how can pharma players succeed?

Enter *in silico* clinical trials.

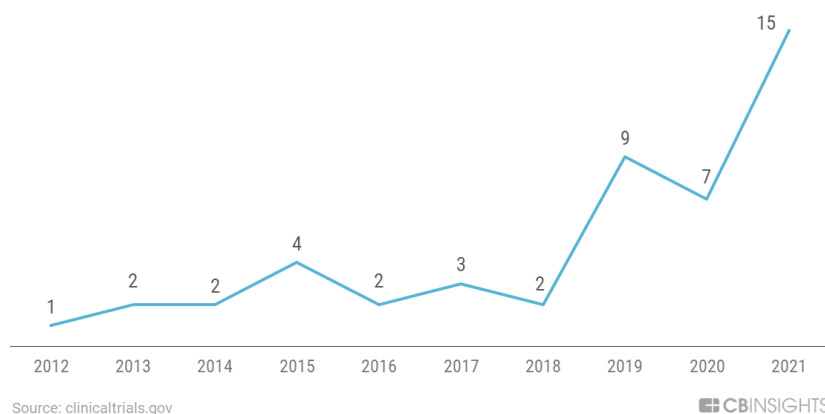
This technology — which uses computational models to simulate how a drug, medical device, or intervention will affect a virtual population — is emerging as a way to cut costs and accelerate timelines while reducing the risk to animal or human test subjects.

In silico trials are unlikely to replace traditional clinical trials entirely, but they could improve their speed and success rates dramatically.



In silico trials see growing adoption

Number of clinical trials that use *in silico* methods, 2012 – 2021



From study design to post-study analysis, clinical trials are notorious for their time-intensive, manual, and error-prone processes. Working with human patients is time-consuming, costly, and in some cases, unfeasible. The average cost per patient per trial is over \$41,000.

Finding patients who even fit the criteria and are willing and able to participate is also challenging. On average, 80% of studies experience delays in enrollment and 20% of trials fail to meet enrollment goals altogether. Bottlenecks at this stage impede the trial and ultimately delay patient access to life-saving therapeutics.

In silico trials, instead, simulate the effects of a new treatment using virtual populations with the goal of supplementing or even partially replacing *in vivo* testing. Benefits include:

- Researchers can use modeling and simulation to predict trial outcomes before advancing to real-world clinical trials and ultimately design studies that are more likely to succeed.
- Virtual populations can diversify the biological variability of traditional trials and enable exploration of irregular phenotypes that would be difficult to recruit for.



- Control or placebo arms in trials can be simulated so that real-life patients who need treatment are guaranteed to receive it. This helps encourage potential subjects to enroll in the first place.
- *In silico* methods can lead to more exploratory research outcomes that might not be feasible with conventional trials. For instance, a recent *in silico* trial looked at the same virtual population twice to see how the presence or absence of a secondary risk factor affected treatment.

“You can run, for instance, an *in silico* Phase II trial on 10,000 virtual subjects, rather than being limited to let’s say 10 or 20 or 50 real human subjects.”

— FRANÇOIS-HENRI BOISSEL, NOVADISCOVERY CEO

The technology is largely early-stage, but it has recently seen increasing adoption from medical device and pharma players.

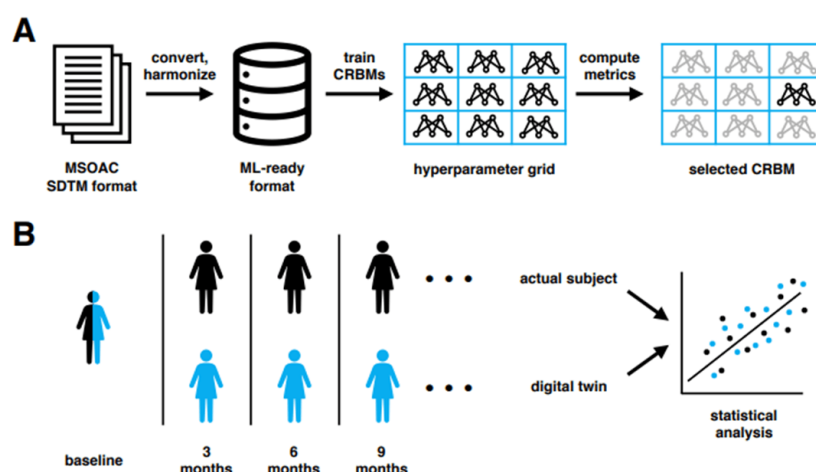
- France-based [Novadiscovery](#), backed by big pharma CVCs Sanofi and Debiopharm, has partnered with pharma players like Janssen and Takeda. The company allows clients to run simulations of different regimens (using real-world data) and identify optimal subgroups for a given treatment before going to clinical trials.
- [GNS Healthcare](#) uses genomic data from partners like Tempus to design virtual patients and simulate individualized drug responses for diseases such as rheumatoid arthritis, multiple myeloma, and colorectal cancer. The company — backed by players including Merck, Amgen, and Celgene — recently



announced a multi-year partnership with Memorial Sloan Kettering Cancer Center to accelerate development of prostate cancer treatments.

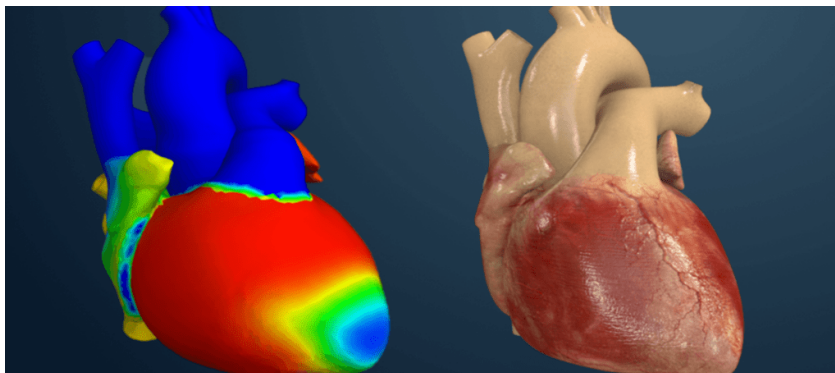
- **Unlearn** develops **digital twins** – virtual copies of a real-life entity, in this case human treatment subjects – to use as control arms in studies. To achieve this, machine learning models create digital representations that possess the same baseline data as human subject counterparts.

Using statistical models of disease progression, researchers can better simulate clinical outcomes for a given cohort of patients, down to the level of how specific traits impact treatment. This could result in a hyper-personalized approach to assessing a patient's fit for a given intervention.



Source: Unlearn

France-based **Dassault Systèmes** is making strides in shaping this space through its multi-year partnership with the FDA, one goal of which is to conduct an in silico trial testing new cardiovascular devices' efficacy and safety. Dassault plans to do this by using its simulated 3D heart model and virtual patients.



Source: Dassault Systèmes

This initiative, known as the Living Heart Project, will set the groundwork for how digital evidence can be used in assessments of cardiovascular devices. The project includes 130 organizations across 24 countries, including pharma giants like Bayer and Pfizer, as well as medical device companies like Medtronic. Given the scope of the project, progress here could encourage coordinated adoption by healthcare stakeholders across the industry.

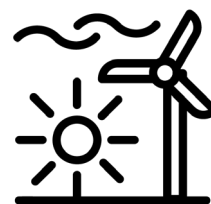
In silico technology, though, is not without its drawbacks. For one, using computer-generated patient populations relies on real-life, historical data for modeling, which can make it tricky to test for unexpected or novel side effects to treatments. Instead, *in silico* trials might be more suited to test a treatment's efficacy (i.e., to validate "expected" results).

Further, these techniques need to build more credibility through proven applications and studies if they are to become a more integral part of clinical trials. And so, in the near future, *in silico* testing will primarily be used to augment or optimize traditional *in vivo* testing, rather than replace it altogether.



In 2022, we're likely to see more pharma players incorporating *in silico* tech into their pipelines as a layered approach to make clinical trials more efficient and resilient. We'll also see more regulators like the FDA and the EU's EMA outlining best practices for collecting and analyzing data like digital evidence.

(Read about other ways technology is transforming clinical trials [here](#).)



Net-zero or bust

Climate tech is becoming a VC darling, but high capital costs and murky claims will pose tough challenges for investors.

Tackling climate change is becoming a massive industry.

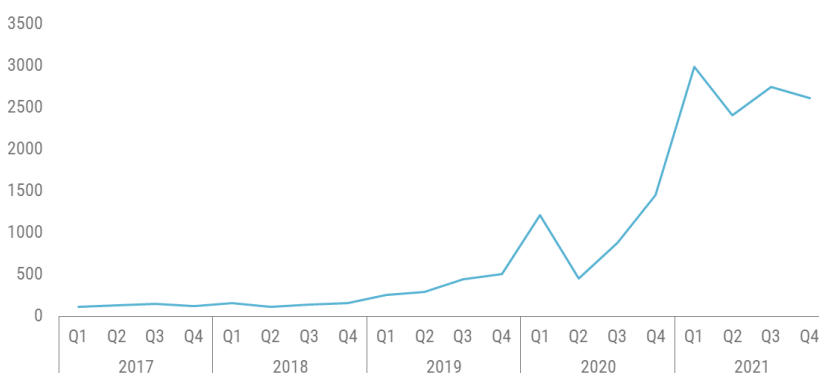
Announcements of net-zero carbon output commitments from companies and governments have picked up momentum. Consumers are more and more eager to spend their money with sustainability-focused brands. Government spending, such as the recently signed infrastructure bill in the US, will push billions into investments that could help combat climate change.

Reflecting this trend, sectors as diverse as [food](#), [energy](#), [fashion](#), [transport](#), and [many more](#) are scrambling for ways to lower their carbon footprint and cater to an increasing appetite from shareholders for better performance across environmental, social, and governance (ESG) standards.

These issues are increasingly top of mind for execs, with earnings call mentions of “climate change,” “global warming,” or “ESG” surging in 2021.

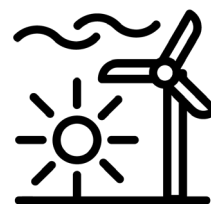
The climate's corporate moment has arrived

Mentions of climate change, global warming, or ESG on earnings calls, Q1'17 – Q4'21



Source: cbinsights.com

 CBINSIGHTS



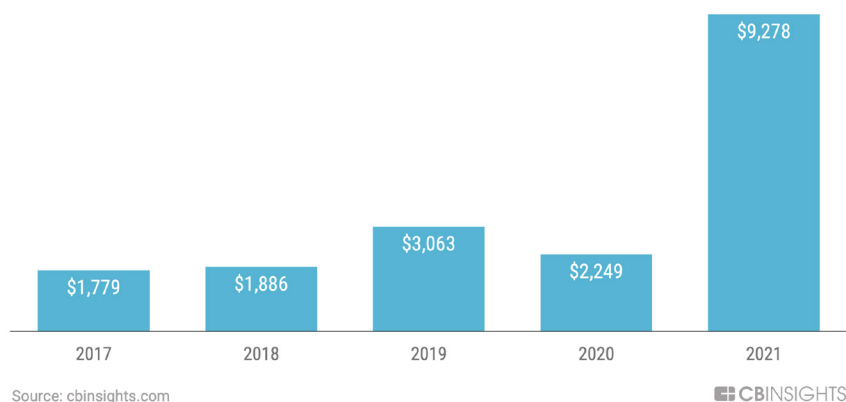
VCs are quickly seizing the opportunity.

Climate tech — a broad term covering technologies that can help tackle climate change, from low-impact protein to carbon-sequestering concrete to emissionless vehicles, and much more — became a hot VC space in 2021 and the trend is set to only accelerate.

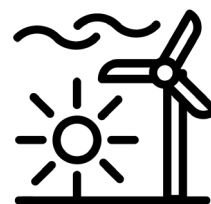
For the renewable energy space alone, funding increased last year **more than 4x** compared to 2020. This momentum is being reflected across other climate tech spaces, with startup funding smashing records in sectors including **energy storage**, **hydrogen**, **carbon capture**, **alternative proteins**, **vertical farming**, **electric vehicle tech**, **smart buildings**, and more. (CB Insights clients can dig into this funding data using our analyst-curated Expert Collections.)

Renewables investment increased 4x in 2021

Renewable energy equity funding (\$M), 2017 – 2021



Last year was also a big year for climate tech-dedicated VC funds. US-based Lowercarbon Capital raised \$800M in “just a few days,” according to its founder Chris Sacca. In Europe, climate tech-focused World Fund launched last year having secured about \$400M, and 2150 said in October that it had raised over \$300M for its sustainability-focused fund.



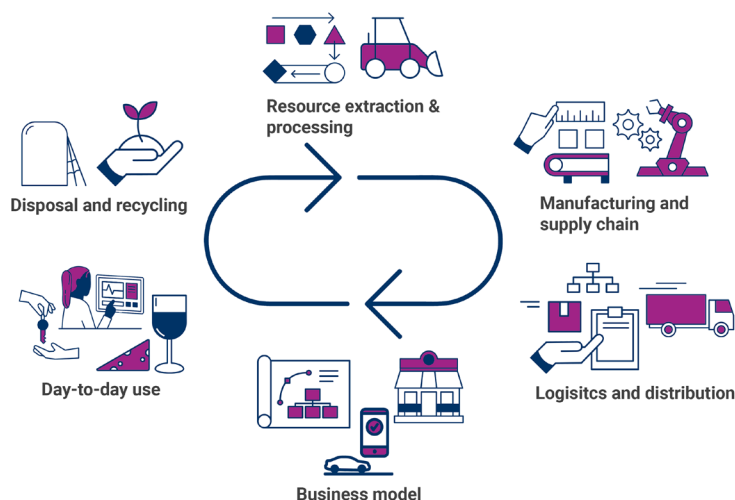
The returns could be sizable. For instance, [sustainable shoemaker Allbirds](#) went public at a \$2B+ valuation in November. Meanwhile, battery recycling company Li-Cycle went public at a \$1.7B valuation in August.

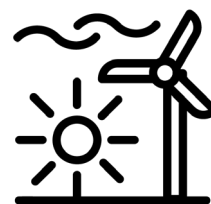
Larry Fink, the CEO of investment management giant BlackRock, even said in October that he thinks the next 1,000 unicorns will come from climate tech. (See *how his prediction pans out using our [real-time unicorn tracker](#).*)

But the path ahead will be difficult. Climate tech competition is heating up, just look at the rising number of [alternative protein contenders](#) and [electric vehicle players](#), and investors have their work cut out for them to weed out “greenwashing” — superficial climate-friendly talk or ill-conceived sustainability projects.

Companies can approach climate tech from a broad array of perspectives — from carbon-sucking products to resource-saving business models to low-impact supply chains and manufacturing — but actually assessing a startup's sustainability credentials requires weighing a product's impact from its raw inputs to eventual disposal.

Assessing sustainability requires looking at all aspects of a product's life



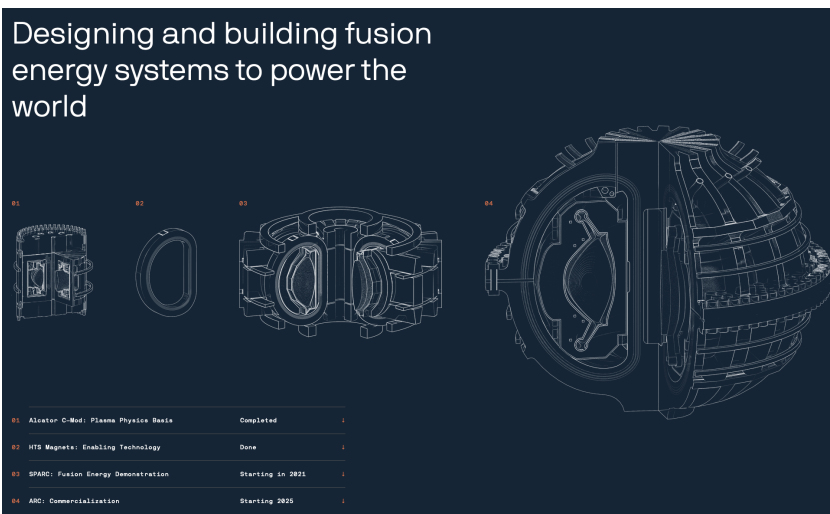


This can be vexing as difficult trade-offs quickly emerge. For instance, the energy needed to manufacture a new “energy-efficient” item may far outweigh any likely gains from day-to-day use.

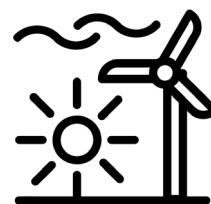
Climate tech also raises the dreaded “[hardware is hard](#)” challenge.

Some of the most potentially impactful — and potentially lucrative — climate tech innovations such as [better electric vehicles](#), [vertical farms](#), [geoengineering tech](#), and [new energy sources](#) can be astoundingly capital intensive to even get prototypes off the ground.

[Fusion energy startups](#), for instance, saw a massive jump in funding this year as climate tech boomed. The approach mimics the reactions powering the sun to produce carbon-free electricity. Get it right and it could provide enough clean power to keep human civilization humming along for eons.



Fusion reactors are very complex and capital intensive — but they could be a key (and lucrative) power source of the future. Source: Commonwealth Fusion Systems



But building a mini-star isn't cheap. [Commonwealth Fusion Systems](#), an MIT-spinout, raised a \$1.8B Series B in December to continue developing its demonstration "SPARC" reactor.

That's a lot of risk to take on. But VCs are built for risk. And [the growing number of enormous mega-rounds \(\\$100M+\)](#) going to startups across the globe indicates that VCs are better placed than ever to move the needle on even capital-intensive climate tech.

With climate-friendly technologies maturing across a broad array of sectors and investor demand booming, the coming year is set to be a breakout moment for sustainability investment. Watch for an increasing number of high-valuation exits and announcements of advances across several climate tech areas. Some high-profile startup failures in the space are inevitable — but, at least for now, don't expect them to do much to dent investor sentiment.



Ultrafast convenience

Retailers will join forces with cash-burning ultrafast delivery companies to help win over consumers.

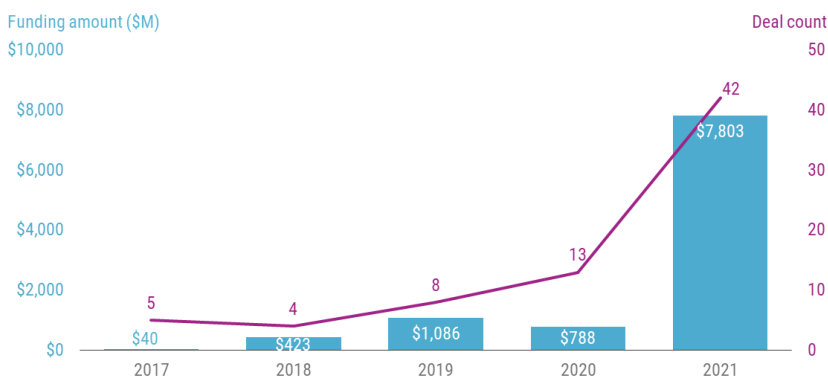
The ultrafast delivery space has never been hotter.

Urban consumers' preferences for instant gratification, combined with a [shift away](#) from physical retail amid the ongoing pandemic, propelled US ultrafast delivery sales to an estimated \$20B to \$25B in 2021, according to Coresight Research.

Now, the e-commerce model of “speed is king” — which Amazon kicked off in 2005 with 2-day free shipping — is being pushed to the limit. Funding to startups offering delivery in 10 to 20 minutes surged nearly 10x year-over-year in 2021 to approach \$8B.

Ultrafast delivery funding surges nearly 10x YoY

Disclosed deals & equity funding (\$M), 2017 – 2021



Source: cbinsights.com

 CBINSIGHTS



But many are still scratching their heads at how these startups — which operate under a “dark” store model — can reach profitability with full-time delivery drivers, little to no delivery minimums or fees, urban real estate rents, and no significant markups on already slim grocery margins. NY-based grocery delivery startup 1520, for example, shut down in late 2021 after failing to acquire customers and running out of funding.

2022 will prove to be a “do or die” year for ultrafast delivery. Players looking to survive — and retailers trying to get in on the future of delivery — will increasingly seek out partnerships with each other to win customers and differentiate their offerings.

Grocery retailers and ultrafast companies have already started to link up, especially in population-dense European cities:

- In October 2021, Carrefour announced “Carrefour Sprint,” a partnership with Paris-based startup Cajoo and Uber Eats to deliver to customers in 15 minutes. The retail giant previously took a minority stake in Cajoo in July 2021.
- Also in October, Tesco announced a partnership with Gorillas to pilot 5 UK-based dark stores using Tesco’s products and Gorillas’ app.
- Aldi Nord partnered with Glovo in April 2021 to test a 30-minute delivery service in Spain and Portugal.
- Meanwhile, Kroger said in September 2021 it would partner with Instacart to launch its “Kroger Delivery Now” service.

But reaching the 10- to 20-minute delivery standard will require continued investment on retailers’ part. Smaller-format convenience-oriented stores like 7-Eleven and Walgreens, for example, have already launched delivery services in partnership with companies like Uber, Instacart, and DoorDash (which also launched ultrafast delivery via its own “digital convenience store” DashMart) in the US.



This kind of interest could signal a ripe partnership opportunity for quick-commerce startups that focus on speed, and even an acquisition avenue as these retailers look to bring ultrafast delivery services in-house.

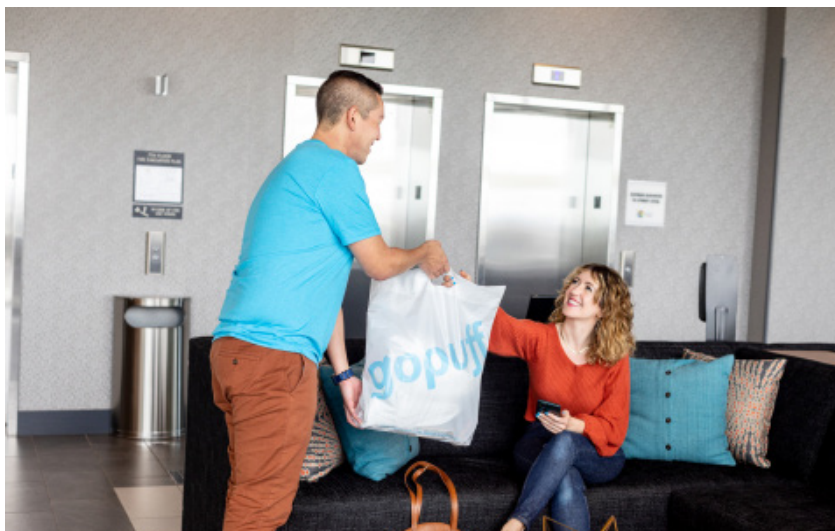
For retailers and ultrafast delivery players, inking business relationships offers mutual benefits:

- **Real estate savings:** The ultrafast delivery model, which relies on warehouse space to house goods for delivery, can entail high real estate rents and set-up costs. Tesco and Gorillas' "co-location" pilot, where dark stores are housed in Tesco supermarkets with extra space, indicates a new avenue for making ultrafast delivery more economical.
- **Tech stack development:** Ultrafast delivery players' proprietary inventory tech – which enables them to accurately track and predict inventory fluctuations – combined with retailers' supply chain expertise will help these startups better respond to customer preferences and even personalize their online grocery experience. Retailers looking to stay on top of trends in online grocery and e-commerce will be keen to up their inventory, warehousing, and customer marketing capabilities – all strengths of ultrafast companies.
- **Customer acquisition:** Partnering with startups will enable retailers, and grocers in particular, to enter new urban markets and capture more small trips in areas with high population density. Whether through co-branding or white-labeling their services for grocers and convenience stores, ultrafast players stand to gain name recognition and a vital customer acquisition avenue with retailers' backing.
- **Diversified product options:** Fast-track delivery apps offer another channel for retailers to get their products in front of their customers, especially as consumers shift more of their spending online. For ultrafast startups, which already sell at



grocery retailer prices, adding private-label items through a retailer partnership would appeal to price-conscious shoppers.

As regional leaders become established and consumer demand proves strong enough to make dark convenience stores successful, even retailers beyond grocers and convenience stores could look to partner with these startups to offer fast-tracked last-mile delivery. Recent partnerships in this vein include Uber and Indigo in Canada to deliver books and gifts, as well as [Gopuff](#) and Hyatt Hotels in the US to deliver travel essentials.



Source: Hyatt

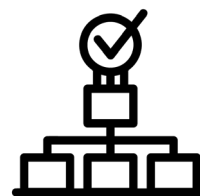


We expect other retailers to experiment with ultrafast delivery through strategic partnerships — and potentially M&A — as the space matures. For example:

- Fashion chain C&A has partnered with Glovo to offer delivery in under 30 minutes in Spain and Portugal for a selection of in-demand clothing items on Glovo's app. Moving forward, more fast fashion retailers will likely explore ultrafast delivery to boost sales.
- Gopuff is piloting a prescription delivery service in Philadelphia for birth control, acne, and erectile dysfunction medication. Gopuff's pharmacy ambitions could extend to drugstore chains like Walgreens or CVS — which currently offer same-day or 1- to 2-day delivery — to deploy more convenient fast-tracked delivery for their customers.

Ultimately, the future of both ultrafast delivery players and brick-and-mortar retailers in the highly competitive online grocery and e-commerce spaces will depend on their ability to differentiate themselves and engage customers over the long term. An increasingly diverse set of partnerships will be key to their success.

For more, clients can check out the "[Ultrafast Delivery](#)" sheet of our [Food & Meal Delivery Collection](#) to compare provider delivery fees, delivery minimums, and geographies served.



De-risking supply chains

Manufacturers, retailers, and other stakeholders will turn to digital twins and the microfactory model to bolster their operations.

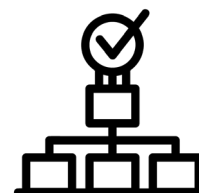
Long-standing cracks in global supply chains came into sharp focus last year, as pressure from forces like the pandemic, weather events, labor shortages, and port congestion mounted.

This has created a swell of demand for tech solutions that can provide a step change in the resiliency, agility, and efficiency of logistics networks — and allow manufacturers, suppliers, and retailers to shift toward more proactive business models.

Key market drivers in [supply chain innovation](#) include:

- **Digitization:** Technologies like digital freight matching and blockchain-based asset-tracking are better matching supply with demand and improving data access and value.
- **Visibility:** Demand forecasting and visibility platforms are helping businesses identify and respond to inefficiencies and potential disruptions.
- **Automation:** Robots are proliferating across the supply chain, enabling capabilities like robotic fulfillment, autonomous ground and drone delivery, and more.

The opportunity is massive. For one, the retail industry lost an estimated \$1.14T to out-of-stock items in 2020. On top of that, being able to deliver a product in 2 days, rather than 7-10, can boost sales by 40%. Making it happen in 1 day leads to sales growth of 70%, according to Deliverr.



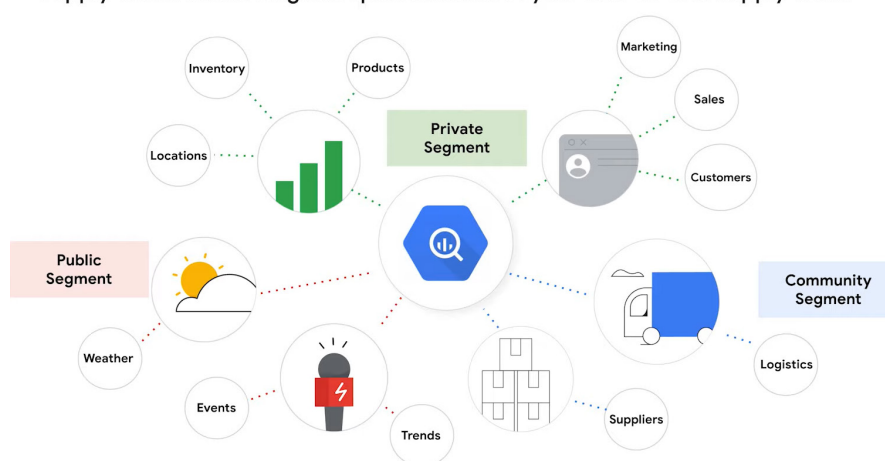
While advancements to mitigate disruptions and enhance efficiencies across supply chain operations are already being made, a few areas are gaining more traction as we move into 2022.

Digital twins are one of the most promising solutions here. The [\\$32.2B market](#) is shaking up supply chain management, enabling simulation of an organization's supply chain, including potentially thousands of vendors, warehouses, logistics processes, and more.

Augmented by AI, the tech can help predict what will happen in a virtual environment if, say, a severe weather event or a labor or parts shortage hits any part of the chain. From there, it could automatically propose and implement a solution, such as procuring a part from elsewhere.

Per a fall 2020 Grant Thornton survey, around 1 in 5 manufacturers are planning to invest in supply chain digital twins, suggesting the tech is still early-stage. But businesses that have already adopted the tech are seeing benefits such as reduced total inventory and capital expenditure, as well as increased throughput, according to BCG.

Supply Chain Twin: A digital representation of your end-to-end supply chain



Source: Google

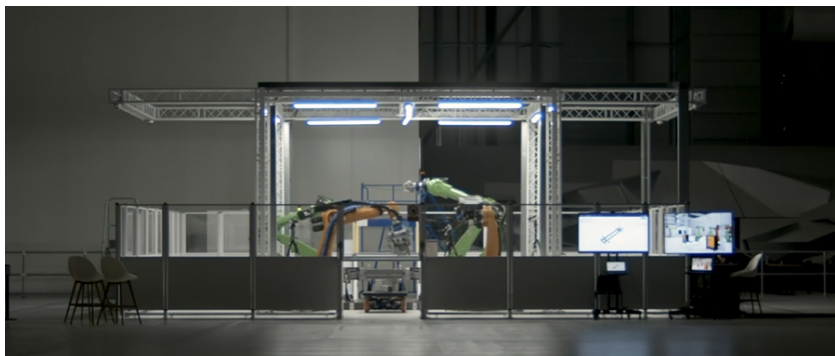
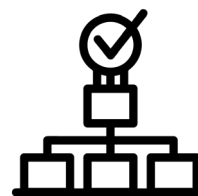


Big tech companies like Google, Microsoft, and Amazon are in a position to lead the market, given their advanced cloud platforms and computing capabilities. In fact, all 3 big tech giants announced digital twin offerings for enterprises in recent months.

- Google announced its Supply Chain Twin cloud offering in September 2021. Customers like Renault are reportedly seeing reductions of up to 95% in the time it takes to analyze data using the platform.
- Microsoft launched a preview of its supply chain digital twin offering in November 2021. Daimler Truck AG is using the solution to reduce downtime and parts shortages as well as accelerate decision-making as, or even before, supply chain issues arise.
- Amazon Web Services (AWS) began rolling out its IoT TwinMaker in November 2021. The solution specifically helps enterprises create digital twins of industrial operations, but Amazon could soon look to expand its scope to the entire supply chain.

Digital twins will take off in 2022 as organizations seek to hedge against supply chain disruption.

Moving from the cloud to the factory floor, some manufacturers are turning to a microfactory model, which relies on automation and robotics to create more flexible manufacturing frameworks that can be deployed in a fraction of the time and at scale.



EV maker Arrival's robotic, cell-based approach to manufacturing can adjust on the fly to changes in product design. Source: Arrival

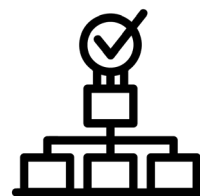
The model has been around for several decades, but a host of forces are making it more viable and attractive — from the urgency of slashing emissions to the decreasing cost of AI and robotics to the growing demand for small-batch and personalized goods.

Startups are pioneering the model. However, corporates and incumbent players are also exploring the technology via investments and partnerships.

- Electric bus and van maker [Arrival](#) is currently building 3 microfactories — each costs around \$50M and will produce 10,000 vans or 1,000 buses a year. To achieve this, the microfactories employ just 200 people, occupy 200,000 square feet, and can be operationalized in as little as 6 months. (For comparison, Tesla's gigafactories can cost billions of dollars and occupy millions of square feet.) The company has received investment from Hyundai and Kia, as well as UPS, which has committed to buying 10,000 of its vans.

**“It’s almost like the model of McDonald’s.
You get as many as needed to fulfill demand.”**

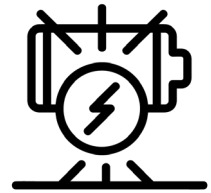
— DENIS SVERDLOV, ARRIVAL FOUNDER AND CEO



- Early-stage food tech startup [Relocalize](#) is developing shipping container-sized microfactories that will be placed near grocery distribution centers, with each microfactory serving 100-200 local grocery stores. It launched its first microfactory — designed to produce ice without any water waste — in November 2021, with the goal of making and storing 1.6M bags of ice annually.
- [Bright Machines](#) offers businesses a microfactory-as-a-service featuring lines of small, intelligent robots. Using Bright Machines' microfactory solution, point-of-care diagnostics developer DRW reportedly increased production output by 10x and reduced unit assembly time from 2 minutes to 20 seconds.

Across current iterations of the microfactory model, automation is key to making operations efficient enough that the cost economics of micro-manufacturing make sense. As technologies like AI and robotics become increasingly advanced, the microfactory approach will become more lucrative — and could have major implications for shoring up the efficiency and resilience of supply chains.

In the coming year, businesses will continue to face disruptive events at every turn. Those that invest in technology to strengthen their supply chains could not only avoid the worst but come out on top.



The electrification of everything

Battery tech will make huge advances this year, bringing the promise of electrification to everything from planes to basketball shoes.

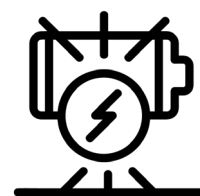
We see the move toward electrification every day. Buses amble past propelled by silent electric engines, homeowners are installing power-generating roof tiles, and some athletes are even wearing electric shoes that adapt to the shape of their feet.

These examples still feel like novelties. But that's not likely to last.

Mainstream electrification is set to reach new heights in 2022 as a growing number of companies, investors, and governments place big bets on the technology and cheap sources of clean energy become more abundant. Meanwhile, a number of corporations and well-funded startups are poised to make leaps in battery technology that will set the stage for mass electrification across countless industries.

Electric vehicles (EVs) are a major driver of this momentum. EV pioneer Tesla is currently worth more than \$1T — more than the rest of the top 10 global automakers combined. The US government pledged in 2021 to electrify its entire federal fleet of about 645,000 vehicles. Many carmakers, including GM, Volvo, Honda, and more, have announced plans to move their entire lineups over to electric.

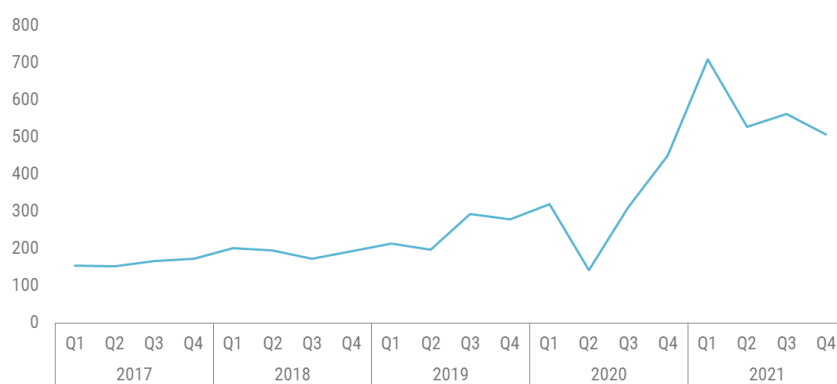
More and more corporations are taking notice of this burgeoning electric revolution and are making their own plans — from airlines edging toward electric planes to logistics incumbents pushing to be carbon-neutral. Today, industrial companies could electrify up to half of their fuel use with existing technology, according to McKinsey.



Mentions of electrification in earnings calls soared to record levels in 2021 as execs talked up sustainability goals and ways to tap into electrification opportunities. Expect a torrent of electrification announcements in 2022.

Electrification is becoming a priority for more corps

Mentions of electrification on earnings calls, Q1'17 – Q4'21



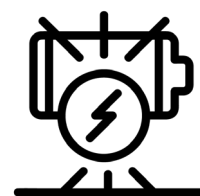
Source: cbinsights.com

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But electrification presents its own challenges. Clean power generation will need to be rapidly scaled up to meet a steep rise in demand, complex processes will have to be rethought to suit electricity's strengths, and far-reaching infrastructure will have to be installed to support it all.

A reliance on batteries can also cause issues. The need for mined metals like lithium and cobalt risks supply chain bottlenecks and raises its own environmental concerns. A shortfall in supply could also set the stage for fresh geopolitical tensions and saber-rattling.

But many would argue that these are manageable problems compared to what electrification offers in return, especially with the ongoing rollout of renewables like solar and wind — leading to some countries enjoying an abundance of clean electricity — disruptive advances in [energy generation](#) on the horizon, and new tech emerging for better supply chain management. A greater arbiter of the electrification trend will likely be how good batteries can get.



The more energy that can be packed into a battery, the more applications it can be applied to. Lighter, longer-lasting batteries could help emission-free planes take to the skies, boost the applicability of commercial electric vehicles, make it cheaper for property owners to install on-premises energy storage, and much more.

Progress in this area has picked up momentum and more big announcements and product launches could be on the way.

Apple is reportedly planning to launch an electric car by 2024 amid rumors that it's achieved a breakthrough in battery tech. Meanwhile, technologies that sprinkle silicon into batteries to boost energy density are moving out of the lab and into consumer products. For example, [Sila Nanotechnologies](#) — a unicorn that has raised nearly \$1B in funding — brought its silicon battery tech to market for the first time in late 2021 via fitness tracking company Whoop. Sila claims that it increased energy density by 20% compared to typical lithium-ion batteries, helping bring the overall size of the wearable down by a third.

Powering innovation today.

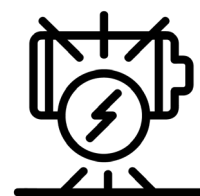
The WHOOP 4.0 is powered with Sila science—a smaller, more powerful battery that unlocked next-gen features and a new apparel-ready form factor.

[Learn more](#)



Nearly a 20% increase in energy density	33% smaller device size	5-day battery life
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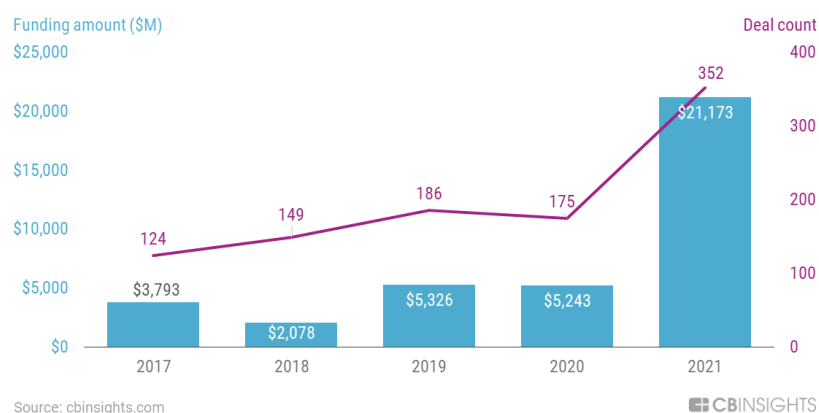
Sila Nanotechnologies' silicon battery tech was used in a commercial product in late 2021. Source: Sila Nanotechnologies



Investors are sensing that a big jump in energy storage demand is approaching — deals to startups in the space doubled in 2021 compared to the previous year, while funding increased 4x. Investments are going to companies working on everything from large-scale storage for power grids to [battery recycling](#) to novel tech like [solid-state batteries](#). (CB Insights clients can see [55+ startups transforming energy storage in this market map](#).)

Energy storage investment was supercharged in 2021

Disclosed deals & equity funding (\$M), 2017 – 2021



As batteries advance in the coming year, we'll see even more parts of the economy go electric. Though a lot hinges on building out capital-intensive infrastructure and pouring money into nascent tech, more and more big players are betting that the shift toward electrification is just getting started.



The consumer privacy battle

Consumer privacy will take off as a strategic business priority in 2022 – which could end up giving big tech an even greater advantage.

Over the past 20 years, tech giants like Amazon, Facebook (aka Meta), Google, and Apple have amassed unfathomable amounts of user data.

While the increasing generation and collection of consumer data has spurred innovation, it has also given rise to security concerns and set off waves of consumer privacy regulation (like the EU's General Data Protection Regulation, or GDPR) over the past few years.

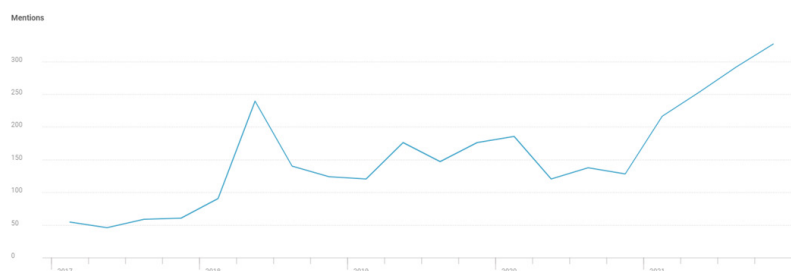
At the same time, consumers have also become more skeptical of how their data is managed and increased their demand for control over its collection, storage, and use. For example, three days after the GDPR went into effect, NGO La Quadrature du Net filed a formal privacy complaint – on the behalf of 12,000 individual consumers – against Google, Apple, Facebook, Amazon, and Microsoft. This resulted in Amazon getting slapped with an \$887M fine in July 2021 – the largest GDPR penalty administered to date.

Action taken by regulators and consumers has not been without consequence. Rising executive interest in privacy and compliance management reveals that the protection of consumer data has increasingly become a priority for businesses across all industries.



Consumer privacy increasingly grabs executive attention

Mentions of consumer privacy on earnings calls, Q1'17 – Q4'21



Source: cbinsights.com

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Investors have also taken note, increasingly backing [consumer privacy startups](#) such as the following in recent years:

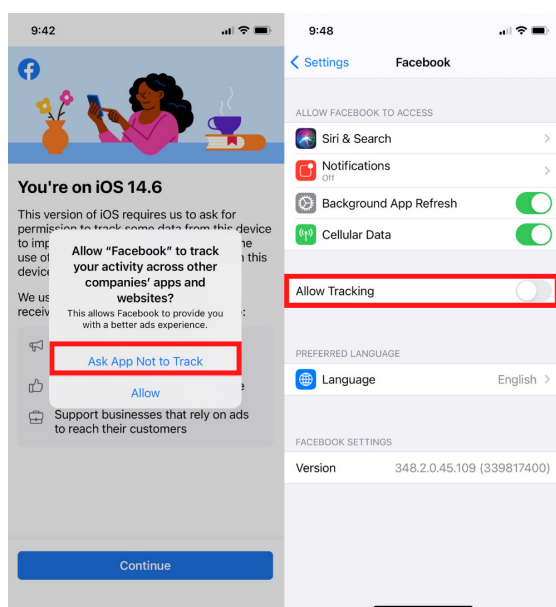
- [OneTrust](#) raised its fourth mega-round to date in 2021. The company's total funding now stands at \$937M, and it was last valued at \$5.1B in December 2020.
- [LogicGate](#) — a provider of GDPR and California Consumer Privacy Act (CCPA) compliance solutions — raised a mega-round in June 2021, bringing its total funding to \$158M.
- Data privacy platform [BigID](#) has raised 10 times since 2018, bringing its total funding to \$246M. It was last valued at \$1.3B following an extended Series D round in 2021.

These rising regulatory, consumer, and startup pressures have elevated the profile and importance of consumer privacy over the past few years, compelling big tech companies to move in two different directions.



Some have moved in step with these pressures. For example:

- Google announced that it aims to phase out third-party cookies and launch a Privacy Sandbox by 2023 in order to enable personalized ad delivery while protecting user privacy.
- In April 2021, Apple launched its App Tracking Transparency feature via its iOS 14.5 update, allowing users to disable ad tracking for certain apps. This update has forced developers to not only allow users to opt out of tracking – which has been possible in the past – but also to explicitly provide users with the choice in a pop-up prompt before the app is even used.



Source: Apple



“At Apple, we believe privacy is a fundamental human right. We work relentlessly to build it into everything we make. It’s fundamental to how we design and engineer every product and service we put into the world.

While others are focused on making customers the product, collecting ever-growing amounts of personal information, we’ve kept the lens focused on how technology can work for people. And that’s meant introducing countless features that give users transparency and choice over how their data is collected, used, and shared.”

— TIM COOK, APPLE CEO

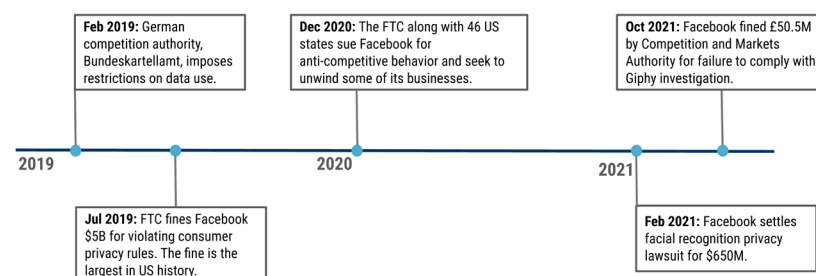
Other big tech companies, like Facebook, have moved against the tide, [drawing investigative scrutiny and penalties](#) over privacy scandals. In July 2019, the company received a \$5B fine from the FTC for violating consumer privacy rules — the largest placed on any company by any regulatory organization in history. Additionally, Facebook CEO Mark Zuckerberg has denounced Apple’s iOS 14.5 privacy update as well as Tim Cook’s post-Cambridge Analytica suggestion that the social media company stop collecting user data outside of its main apps.



THEME #1: A BLEMISHED CYBER & PRIVACY RECORD

...has resulted in regulatory pressure...

Facebook's privacy and security missteps have caught the attention of lawmakers and regulators, resulting in fines and lawsuits that have totaled over \$5B in the past 3 years. Further, its numerous acquisitions have created a moat of personal user data, which contributed to the filing of an antitrust lawsuit in 2020.



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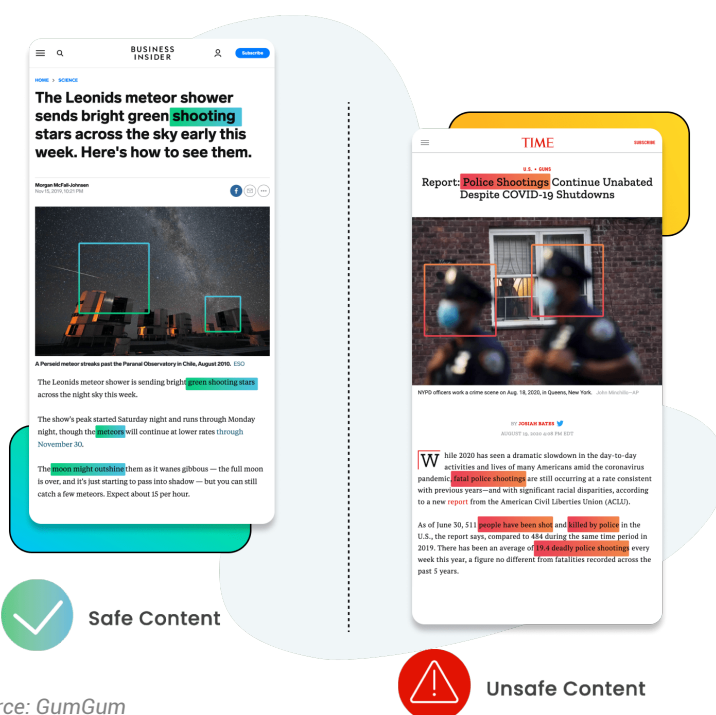
Until now, it has been possible for organizations that rely heavily on consumer data to largely remain neutral on the matter. However, consumer privacy awareness is at an all-time high and regulatory pressure is only set to increase as a deluge of more stringent privacy legislation comes into effect this year. Together, these forces will necessitate that consumer data-dependent organizations – big and small – adjust their strategies and prioritize consumer privacy as we head into 2022.

One of the most immediate effects of this shift will be an acceleration in the abandonment of third-party data collection, as this sits at the core of both Apple's iOS update and Google's move to phase out cookies. The advertising and marketing industry, already battered and beholden to big tech, stands to potentially lose the most, but any B2B or B2C company that relies heavily on third-party targeting to advertise is going to need to adjust dramatically at the risk of facing massive losses. Publishers that don't take mitigative measures stand to lose 50%+ of their total ad revenue, according to Google.



Many organizations will rush to collect first-party data (where consumers provide their information directly to a business) in order to continue targeting ads on third-party sites. However, the use of this data will prove to be far more beneficial for large enterprises and put smaller companies — that don't have as much data or the means to collect it — at a disadvantage.

With this scenario on the horizon, contextual targeting is well-positioned to make a comeback this year, as it allows businesses to deliver relevant and profitable ads without third- or first-party data. For instance, **GumGum** — a contextual intelligence startup — utilizes computer vision and natural language processing technologies to analyze web pages, videos, images, and other digital content to help advertisers place their ads in the most relevant locations without tapping into their first-party data.

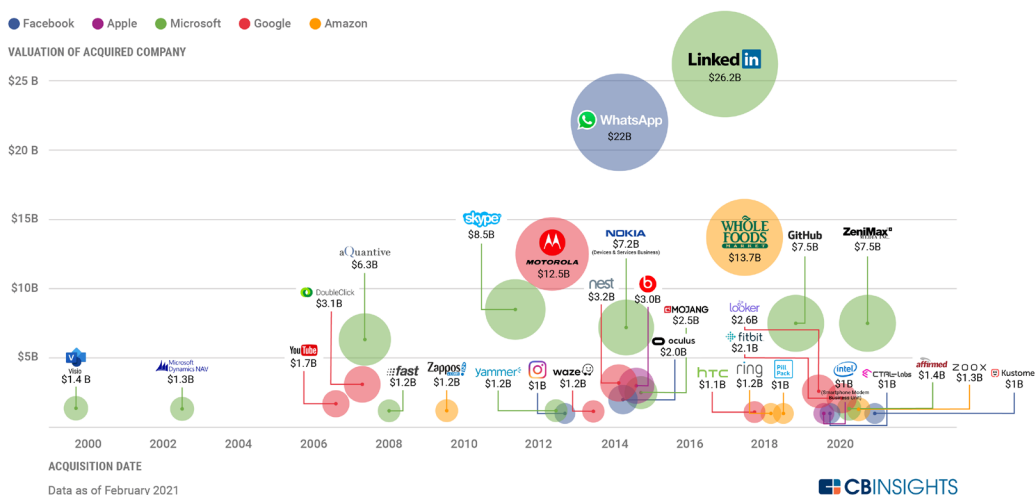




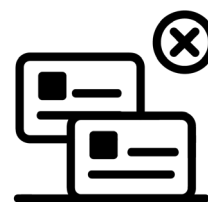
Notably, in the end, this overwhelming rush toward consumer privacy will likely benefit big tech companies the most. Although some currently use third-party data to power their advertising tools, in the long run, their first-party data stockpiles – which they have amassed over 2 decades of high-profile acquisitions – will be a competitive advantage in the advertising landscape. Meanwhile, smaller companies will scramble to adopt new solutions to redesign their advertising operations and adapt to a cookieless environment.

TIMELINE OF TECH GIANTS' BILLION-DOLLAR ACQUISITIONS

Every \$1B+ acquisition made by Facebook, Amazon, Microsoft, Google and Apple. Bubble size represents maximum valuation.



That said, the year of the consumer may simply be a stepping stone to multiple decades of digital giant domination.



Killing the credit card

Buy now, pay later purchases will become more frequent and higher value as millennial and Gen Z shoppers gravitate away from traditional cards.

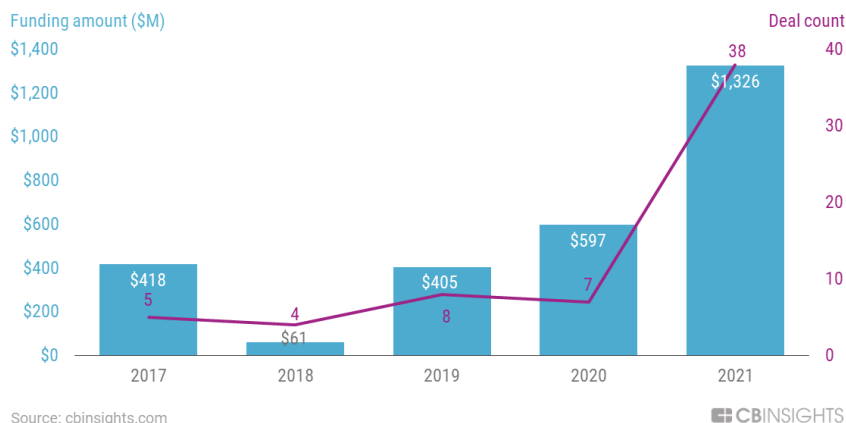
As the Covid-19 pandemic drove unprecedented levels of e-commerce shopping, point-of-sale (POS) financing — or “[buy now, pay later](#)” (BNPL) — saw a huge boost while credit card balances dropped to their lowest point since 2017.

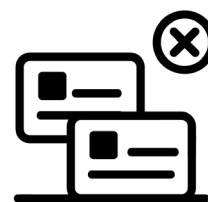
Currently, BNPL still reflects a small portion of the overall spending on payment cards (including credit, debit, and prepaid cards), an industry that sees roughly \$8T in annual spend volume in the US. But this could turn a corner in 2022.

BNPL startups — including [Affirm](#), [Klarna](#), and [Afterpay](#), which was recently acquired by Block (fka Square) — saw record-setting amounts of funding and deals in 2021. The industry is expected to grow [10-15x to top \\$1T](#) in annual gross merchandise volume by 2025.

BNPL startups see record funding

Disclosed deals & equity funding (\$M), 2017 – 2021





Even big tech players are making moves in the space:

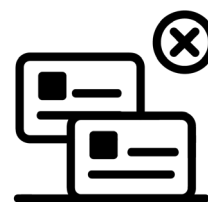
- Amazon partnered with Affirm in August 2021, allowing shoppers to create a payment plan for items over \$50. As of November, Affirm is the exclusive BNPL provider for the e-commerce giant.
- Apple and Goldman Sachs are reportedly working on a BNPL offering called “Apple Pay Later.”
- Google Pay has partnered with Afterpay and Klarna to provide BNPL services for in-store shopping.

Credit-shy millennials and Gen Z shoppers are driving this growth, accounting for nearly 75% of consumers who use BNPL solutions. Wary of debt and hidden fees, consumers in this age group are hesitant to take on the interest and fees associated with credit cards.

With BNPL flexibility, customers can purchase items online through installments (typically 4 payments) with no interest or penalties if paid on time, or through fixed-rate interest-bearing loans at the POS where fees are known upfront.

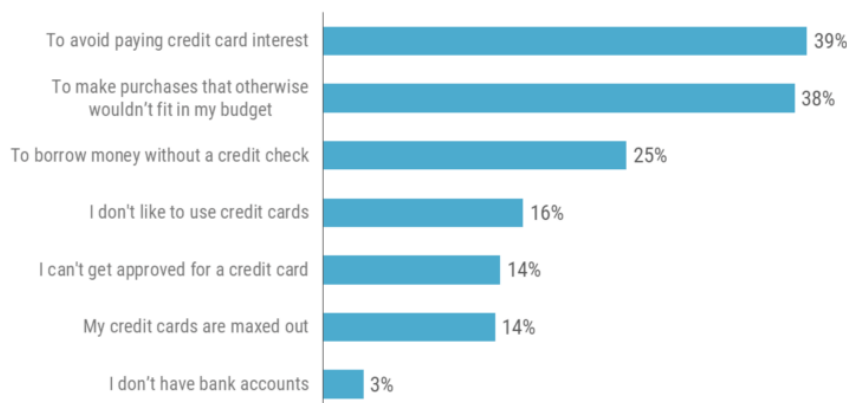
With longer-term financing or missed payments, these may still be a more favorable option to credit cards: Klarna, for example, charges 19.99% APR for month-to-month financing and a missed payment fee of \$7 per month — much lower than the \$25-\$40 that credit card companies can charge.

Also, users often opt in for credit products from BNPL providers because they may have a better chance of getting approved. For example, Affirm's proprietary credit underwriting model approves 20% more customers on average than comparable competitor products. Its recently launched Debit+ card has zero overdraft fees (which typically cost around \$35 each), sign-up fees, annual fees, or late fees — and allows users to convert their purchase into installment payments within 24 hours of buying.



BNPL offers payment term flexibility that cards can't

Reasons shoppers use buy now, pay later



Source: The Ascent Survey

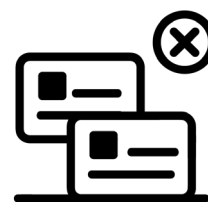
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On the other side of the equation, BNPL providers earn money by charging the retailers who aim to attract more shoppers with convenient payment plans. This gamble seems to be paying off — Klarna now has 20M customers in the US alone, with an average customer age of 33.

BNPL is typically used for smaller purchases, with an average order size around \$140. This is usually spent on apparel and cosmetics products, according to Head of Klarna US David Sykes.

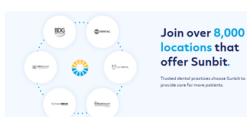
But this could begin to change in 2022.

Customers are already beginning to use BNPL solutions to finance bigger-ticket items like furniture and household appliances. Forty-three percent of adults in the US are interested in using BNPL to pay for goods and services ranging from cars to home remodeling to medical treatment, according to an AWS study. [Sunbit](#) is already making moves here: The California-based startup offers BNPL financing for auto parts, healthcare services, dental services, and more.



BNPL expands beyond retail

Healthcare



HQ: California, US

Wedding planning



HQ: New York, US

Ride-hailing & streaming



HQ: Mexico City, Mexico

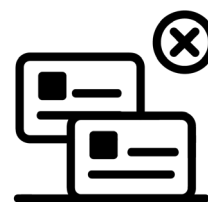
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For now, when it comes to major purchases, the vast majority of customers do their research online and continue to close the deal in person. This is partially because using BNPL services to make big-ticket purchases online is still new, so there is still quite a bit of consumer trust to build. Financing a \$140 clothing purchase with a new service is one thing, but using it to buy a new car is another.

At the same time, some verticals are seeing an increase in customers making big purchases digitally. Online car dealer [Carvana](#) sold 100,000 vehicles in Q2'21, yielding a nearly 200% increase in revenue year-over-year. Similarly, [Vroom](#) reported that its "e-commerce units sold surged by 172% to more than 18,260 units" year-over-year. Both offer financing directly from their websites.

As consumers increasingly rely on digital channels for many interactions, and as BNPL becomes more familiar, it stands to reason that more shoppers will choose these solutions for bigger and bigger items in 2022 and beyond. BNPL providers are already beginning to up their spending limits — Affirm now approves payment plans for as much as \$17,500.



But BNPL is not without risk. Consumers can still rack up a considerable amount of debt. They may also make their BNPL payments using credit cards, which could then be charged the very fees they were trying to avoid. For now, BNPL's debt performance reporting is "opaque," according to a recent Fitch Ratings report.

In 2022 and beyond, consumers will need to track their BNPL spending carefully. Meanwhile, payment networks and credit card issuers will likely partner with BNPL companies or create their own in-house BNPL solutions to stay competitive. For example, players like [Splitit](#) and [Four](#) are already partnering with Visa and Mastercard. Capital One is also testing a beta version of its own BNPL product.

White-label BNPL providers are starting to emerge



CBINSIGHTS Source: CB Insights & FT Partners. The above list of logos is non-exhaustive.

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Finally, watch for more white-label BNPL providers to emerge. These companies — like [Amount](#), [Limepay](#), and [Pledg](#) — help brands build out their own BNPL solutions, enabling them to keep their own branding and have more control over their product.



Lab-to-table

Regulations will finally allow lab-grown meat to hit restaurant tables and grocery store shelves and begin competing against traditional meat and plant alternatives.

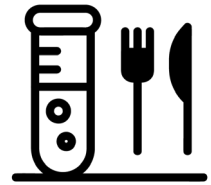
Lab-grown (or “cultivated”) meat companies, which make meat using animal-derived cell cultures, have existed for years — but to eat their products, you’d have to sign a waiver. These companies have been awaiting regulatory approval, and are not yet able to bring their products to market.

But that doesn’t mean the market doesn’t have big potential. Some estimates say cultured meat could account for a third of US meat consumption by 2040, surpassing plant-based alternatives. In the [\\$2.7T global meat market](#), even a fraction of market share could be massive. With regulatory bodies making overtures to bring cultivated meat to the mainstream, traditional meat vendors and leading plant-based alternative companies may soon be facing a new contender.

Currently, only one company has the regulatory approval to sell cultivated meat: [Eat Just](#), which has received approval from Singapore authorities to sell chicken breasts made with cell cultures. Under its brand GOOD Meat, the company made the world’s first sale of cultured meat in December 2020, serving its “no-kill” chicken in Singaporean restaurant 1880.



GOOD Meat's lab-grown chicken in 1880's maple waffle dish. Source: CNBC



Eat Just has raised \$707M to produce its vegan and cell-cultured food products, most recently earning a valuation of \$2.6B in March 2021. The company is part of an expanding market of meat alternatives, which is estimated to hit [\\$140B](#) in the next decade, per CB Insights' Industry Analyst Consensus.

Israel and Singapore have been hotspots for cultivated meat innovation due to favorable regulatory conditions. While most companies can't yet sell their products commercially, they're making strides to develop them. In Israel, startups like [Aleph Farms](#), [SuperMeat](#), and [Future Meat](#) have raised funding to cultivate their lab-grown meat products. SuperMeat has even piloted a test restaurant, though the restaurant is not yet fully open to the public, and requires guests to sign waivers to try their no-kill, lab-grown chicken burgers.

2022 may be the year that US-based players materially enter the game, with the cultivated meat industry poised to see regulatory action and even early approvals in the region.

In the US, lab-grown meat is regulated by both the FDA and USDA, with the FDA overseeing cell growth and the USDA overseeing cell harvest and labeling. In September 2021, the agencies published a public request for comments about labeling meat products containing cultured cells. The USDA also committed to a \$10M investment over the next 5 years to establish the National Institute for Cellular Agriculture, the first-ever US government-funded cultivated protein research center.

A handful of cultivated meat companies have announced that they hope to start selling commercially this year. One of them is [Upside Foods](#) (fka Memphis Meats), a leader in the cultivated meat space. In late 2021, the company opened a 53,000-square-foot processing plant for lab-grown steak and poultry products — the largest-ever cultivated meat facility, with capacity to produce over 50,000 pounds of product annually.

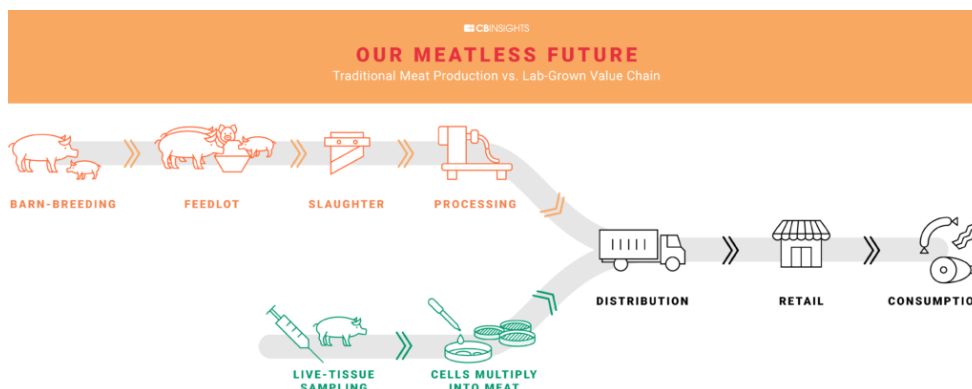


A lab-grown chicken burger. Source: Upside Foods

While awaiting regulatory approval, the company has focused on preparing its facility, packaging, and branding, and offered tastings to staff, journalists, and investors like Richard Branson. Michelin-starred chef Dominique Crenn has partnered with the company to provide “culinary counsel” and eventually serve Upside’s chicken in her restaurant, Atelier Crenn.

Eat Just has also expressed hopes that the Singapore approval will be the first of many, and its cultivated chicken products may soon join other products, like its vegan mayo and egg substitutes, which are already on US grocery store shelves. Other companies to watch in the space include [Wild Type](#), [BlueNalu](#), and [Finless Foods](#), all of which are working on cell-cultured seafood products like salmon and yellowtail.

Benefits of lab-grown meat include that it's less resource-intensive than commercial farming and that it alleviates concerns about animal cruelty and slaughter practices. One Oxford study found that, compared to traditionally farmed meats, cultured meats could require 96% fewer emissions, using 45% less energy and 96% less water.



Lab-grown meat also has the benefit of more familiar flavors, smells, and textures than mainstream plant-based alternatives — potentially making it more appealing to traditional meat eaters. While plant-based alternatives mimic meat (like [Impossible Foods'](#) “bleeding” plant-based burger, which is engineered to look and taste like meat) or offer a substitute (think black bean burgers or tempeh), lab-grown meat is real meat, with the same taste and mouthfeel as traditionally farmed products.

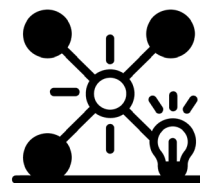
However, the tech is not without its challenges. One major barrier is cost, though prices may be trending down. For example, Singapore-based [Shiok Meats](#) plans to start selling its cell-based shrimp at a cost of about \$37 per kilogram — double the price of real shrimp, though down from the ~\$7,400 price tag of a couple years ago. Estimates by research firm CE Delft suggest cell-cultured meats could reach price parity with some traditionally farmed meats by 2030.

Still, companies will have to majorly fine-tune their technology if they wish to scale operations enough to bring products to a commercially appealing price point. Achieving success will also require education and branding efforts to counteract any “ick factor” associated with foods that may be seen as “fake” or lab-grown.



In any case, 2022 is poised to be the year when leading plant-based meat alternatives like [Impossible Foods](#) and [Beyond Meat](#) could have to seriously contend with lab-grown competitors for the first time. Lab-grown meat startups could also pose a threat to traditional meat suppliers like Tyson, Smithfield, Hormel, and Cargill, although some of these, spotting opportunity, have already become investors in these startups.

While regulatory agencies may move slowly, they're not stagnant — and this year, regulatory changes could have a major impact on what new foods we see in stores and on plates.



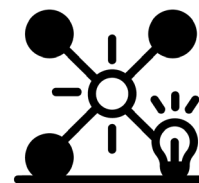
Fusion energy

Advances in AI and a startup funding splurge will push the long-sought clean energy source closer to reality.

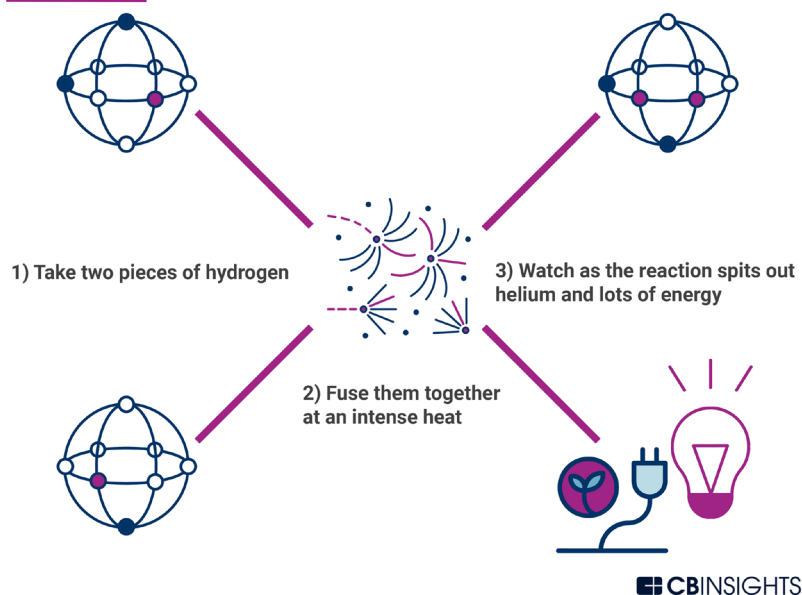
The allure of fusion energy is easy to understand — it could offer an effectively unlimited source of energy that's safe to use and doesn't produce carbon emissions. It also could become a powerful tool to help ward off climate change as a more reliable complement to renewables like wind and solar.

So far, no one has been able to pull fusion off. But a handful of fusion startups — backed by investors including Bill Gates, Jeff Bezos, and Google — have raised billions in the last year off the back of developing novel approaches to fusion. With ample resources, the time has come to prove that their tech can deliver.

Fusion energy works by bringing the nuclei of two atoms together to make a new single nucleus. In the case of hydrogen, the energy holding together the resulting helium nucleus is less than that required for the two originals. The difference is released as energy — a lot of energy. This is the same basic process that powers the sun.



Fusion produces loads of energy, but achieving a net gain has proven gnarly

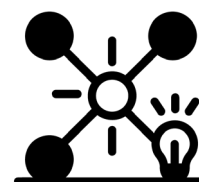


Fusion reactions naturally occur in stars, but mimicking them on Earth is very challenging.

That abundant excess energy is what fusion researchers have been chasing, for the better part of a century, to drive a new form of clean electricity production. The key challenge is getting out significantly more energy than is put in — sparking fusion reactions on Earth is intensive, requiring temperatures many times hotter than the center of the sun and colossal magnetic fields. After decades of toil, meaningful net energy gain from a fusion reactor has never been achieved.

But that could be about to change.

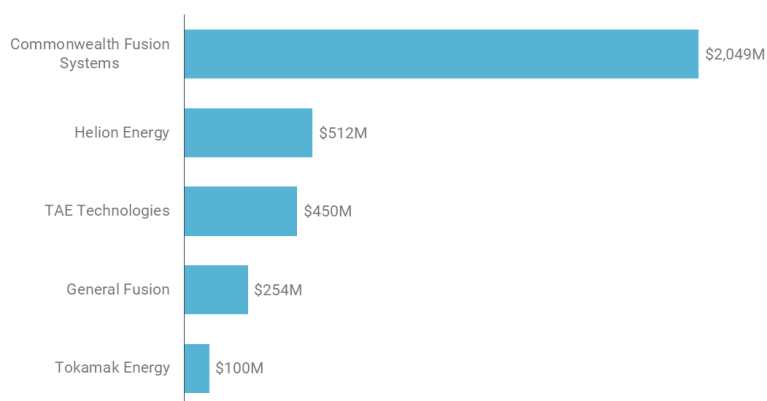
Funding to startups in the space skyrocketed in 2021 as several companies working on novel fusion approaches raised mega-rounds to build demonstrations of net energy gain. If they pass that hurdle, then billions more will likely be needed to scale from there.



That said, if a company can prove that its technology works, then the payoff for investors could be enormous. Electricity is set to become a **\$5T global market** within the next decade, according to CB Insights' Industry Analyst Consensus.

Investors are pouring money into fusion startups

Top-funded fusion startups by disclosed equity funding (as of 01/12/2022)

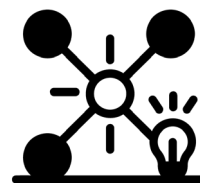


Source: cbinsights.com

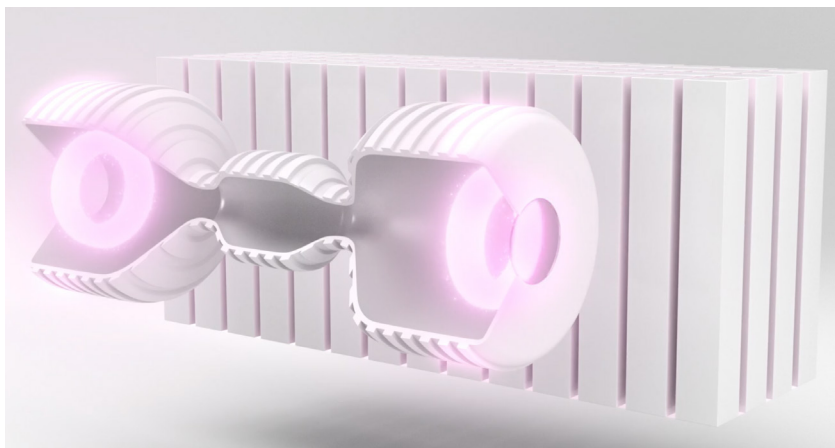
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The biggest round last year went to **Commonwealth Fusion Systems**, an MIT spinout that announced a \$1.8B round in December led by Tiger Global, with other backers including Bill Gates and climate tech-focused Lowercarbon Capital. A few months before, the company said it had completed tests of ultra-powerful new magnets — a key enabling tech for fusion — which would pave the way for it to build a demonstration fusion reactor.

Meanwhile, rival fusion startup **Helion** secured \$500M in November (with commitments for a further \$1.7B if certain milestones are met). The company takes a different approach to fusion by focusing on efficiently converting the released energy to electricity and deploying shipping container-sized reactors with low-power output for use cases like powering individual data centers or factories. This contrasts with approaches that aim to build mega-reactors to make big dents in general demand for electricity.



Other fusion startups [General Fusion](#) (backed by Jeff Bezos) and [TAE](#) (backed by Google Ventures) have also raised hundreds of millions of dollars within the last year.

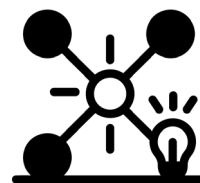


*Startups are working on a variety of new approaches to fusion energy.
Source: Helion Energy*

This surge in funding doesn't mean that commercial fusion is imminent — even bona fide breakthroughs would take several years to scale up. But it signals that fusion technology is entering a new phase of maturity that may even see it contributing power to the grid before the decade is out.

One driver here is the agility of fusion startups compared to nation state-level research projects that can involve years of negotiation and are sometimes hamstrung by changing spending commitments. Another catalyst has been the emergence of new technology.

For instance, advances in AI have made it possible to improve the design of reactors to optimize the conditions needed for fusion to take place and better predict the behavior of the intensely hot, swirling particles. [Quantum computers](#) are also beginning to be applied to help simulate fusion reactions to improve a reactor's performance. AI and quantum computing are both advancing rapidly — expect new modeling capabilities arriving in the coming year to add extra heft to fusion's momentum.



Very soon, as cash-rich startups succeed or fail in overcoming the countless challenges of building demonstration reactors, we may get a good idea of whether the technology is likely to work.

Achieving net energy from fusion would change the future of energy — and 2022 could be a make-or-break year for several promising fusion approaches.