

Metaverse

New horizons for the digital economy

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Executive Summary

The Metaverse is going to involve the building of real-time, 3D, persistent, large-scale virtual worlds and environments, where people are going to be able to work, play, learn, entertain and enjoy real-life experiences. This is about bringing together all the elements of our digital age in an immersive experience, creating a seamless convergence of our digital and physical lives.

The Metaverse represents the next phase of the industrial revolution, the next step in the evolution of the internet – a megatrend that we are only in the first innings of.

To us, the Metaverse investible universe is about so much more than social and gaming platforms with VR headsets. It encompasses a broad range of existing industries and sectors that can help build and populate virtual worlds, creating environments and economies that are truly digital.

Web 3.0 is going to be driven by machine learning, artificial intelligence, blockchain technology and edge computing infrastructure – all of which are essential if we are to unlock the vast potential of an increasingly 3D, real-time and immersive Metaverse. That said, we believe Web 3.0 is likely to complement Web 2.0, not replace it, and that the Metaverse will straddle both.

It's hard to know whether the launch of a new device will speed up its adoption, or what catalyst may speed up the use of accepted standards/protocols. However, we believe that it will be able to draw in trillions of dollars' worth of economic activity, likely forcing businesses to radically rethink their digital strategies again.

Investing in the Metaverse doesn't have to be a rollercoaster ride. We advocate a disciplined approach – one that respects valuation and fundamentals, and doesn't extrapolate the pace of recent pandemic trends into perpetuity. We don't feel it necessary to focus exposure on a few select companies, trying to predict the 'winners' now in a theme that could span decades. Rather, we'd suggest looking for diversified exposure across subsectors in established companies with the expertise and execution track record to benefit from the growth of the Metaverse.

Introduction

The Metaverse was catapulted into the public's imagination last year by the re-naming of Facebook to 'Meta Platforms'. This happened against the backdrop of the pandemic, which accelerated cultural trends and behaviours (including the adoption of virtual technologies) that need to be in place for widespread acceptance of the Metaverse, particularly for Generation Z – the cohort likely to drive its growth.



We believe the Metaverse represents a major economic opportunity for a wide range of innovative companies that can help facilitate, create, or benefit from the growth of immersive virtual worlds.

Technology plays an ever-growing role in our everyday lives, enabled by a combination of Moore's Law¹ and Metcalfe's Law.² This has brought with it significant economic growth in what some have classed as the start of the 'fourth' industrial revolution. In our view, the Metaverse represents the next phase of this revolution, the next step in the evolution of the internet, a megatrend that we are only in the first innings of.

We believe the Metaverse represents a major economic opportunity for a wide range of innovative companies that can help facilitate, create, or benefit from the growth of immersive virtual worlds. McKinsey estimates the Metaverse has the potential to generate up to US\$5 trillion in value by 2030,³ by which time Citi sees the total addressable market reaching US\$8-13 trillion.⁴

At this early stage, we believe that some of the greatest opportunity is for those involved in developing the infrastructure that is required to be in place for the Metaverse to reach its true potential. Then, real-world experiences and assets will be digitised, enabling users to go seamlessly from one experience to another. We believe this is too big an opportunity for companies to ignore. As costs come down and adoption rates climb, there is potential for explosive growth opportunities to emerge, with new competitors likely to be able to enjoy speed to scale that could destroy entire revenue pools for incumbent players over the longer term.

There has been a lot of hype surrounding the theme over the last 12 months, with detractors suggesting that the concept was dreamt up by Big Tech companies to distract investors from slowing revenue growth and declining users. We believe there to be genuine substance to what's probably going to be an important investment theme for the next 10 or 20 years.

This white paper will look to define what the Metaverse is, as well as what it is not, exploring use cases that already exist and the potential of some that are yet to be realised. We suggest an analytical framework for approaching the investment universe, exploring the growth potential that can be found across the Metaverse Value Chain. We do this unapologetically through the lens of an active investor. In our opinion, investing in the Metaverse doesn't have to be a rollercoaster ride. We advocate a disciplined approach, one that respects valuation and fundamentals, and doesn't extrapolate the pace of recent pandemic trends and low discount rates into perpetuity.

As with all exciting new investment themes, there are going to be areas of significant risk as well as opportunity.

What is the Metaverse?

Currently, there are many varying definitions of the Metaverse. However, this isn't surprising, given that it's still in the very early stage of development. What people tend to agree on is that it's going to involve the building of real-time, 3D, persistent, large scale virtual worlds and environments, where people are going to be able to work, play, learn, entertain, and enjoy real-life experiences. This is about bringing together all the elements of our digital age in an immersive experience, creating a seamless convergence of our digital and physical lives. Key words seem to be: immersive, interoperable, and social.

Virtual Reality (VR) and Augmented Reality (AR) are likely to be key enabling technologies for the Metaverse, with huge potential to transform the ways people interact with organizations, their products and services by allowing platforms to make experiences truly immersive. However, in our view, the Metaverse is device agnostic and likely to be primarily accessed through PCs, smartphones and tablets initially.

Web evolution: trying to predict the future is difficult

If we step back and consider the evolution of the internet, and how users and companies have adapted to its potential, we are reminded of how difficult it is to predict the future. Initially, Web 1.0 was limited to text-based content, accessed through a desktop browser. The 90s saw the launch of future e-commerce giants such as Amazon and eBay, but although many companies had an online presence, economic activity was slow to follow.

The introduction of the smartphone heralded the start of Web 2.0, and suddenly millions had access to the internet in a handheld device, on which they could access the internet, watch videos and take photos. Content became much more image/video-based, with 'social' networks growing in importance. Companies suddenly had to have an online presence. Anybody could post a blog or release a song or short film on YouTube. Building apps improved the user experience immeasurably, and developers began to recognise the potential of 3/4G networks and smartphone computing power. Computing became cloud-driven, enabling streaming services, forcing enterprises to radically rethink their digital strategy.

Casting back 20 years, though, few predicted how Web 2.0 would develop with any degree of accuracy. Before the first smartphones were launched, analysts were convinced that Blackberry, Nokia and Ericsson would remain the leaders in the space. The idea of a smartphone without a keyboard was scoffed at by some pundits, but consumers quickly adapted.

Web 3.0 is a vision of the internet of the future, decentralised and permissionless, where users have ownership of their data.

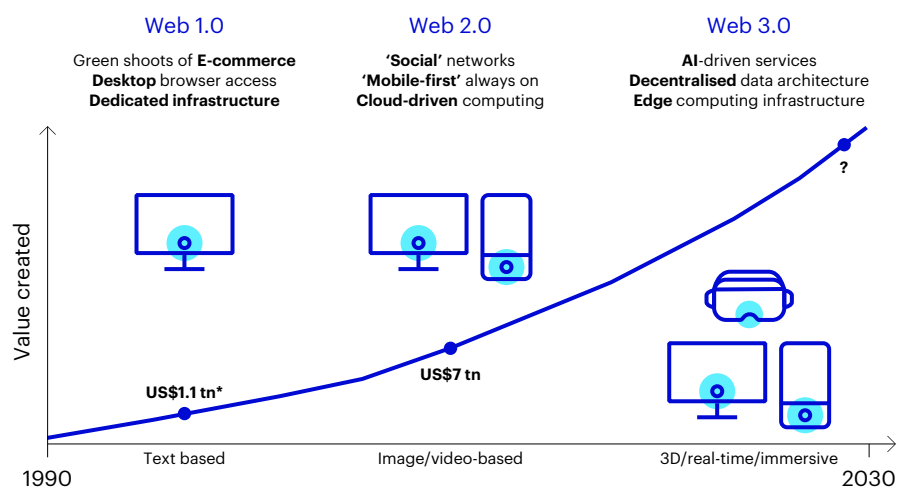
The Metaverse is often cited as being related to Web 3.0, and some enthusiasts insist it must be based on Web 3.0 technologies such as blockchain. We believe it can exist without.

However, if the Metaverse is going to be truly interoperable, Web 3.0 is likely to serve as the basis for connectivity. [Sandbox](#) and [Decentraland](#) are forging ahead with the building and operating Web 3.0 platforms, but closed platforms like [Roblox](#) are operating on Web 2.0. We believe that Web 3.0 is likely to complement Web 2.0, not replace it, and that the Metaverse will straddle both.

Web 3.0 is going to be driven by AI and edge computing infrastructure,⁵ which are essential to unlock the vast potential of an increasingly 3D, real-time and immersive Metaverse.

It's hard to know whether the launch of a new device will accelerate its adoption, or what catalyst may accelerate use of accepted standards/protocols, but we believe it will be able to draw in trillions of dollars' worth of economic activity, forcing businesses to radically rethink their digital strategies again.

Figure 1
Evolution of the web



Source: Invesco. For illustrative purposes only. *Internet companies market cap as of 2000 and March 2022.

Metaverse use cases – for work...

While we're still at a very early stage in the development of the Metaverse, there are use cases live today that give an indication of how further innovation can unlock enormous value in a range of areas from manufacturing, education, gaming development, digital museums to immersive maps.

Firstly, the Metaverse is being used for work. The pandemic saw huge uptake of videoconferencing, but with social distancing restrictions having been lifted in much of the world, hybrid working is the new normal, with technology solutions emerging to ensure employees stay connected, whether they're working from home or the office.

Microsoft's [Mesh for Teams](#) is designed to make online meetings more personal, engaging and fun. Meta Platforms has [Horizon Workrooms](#), its own mixed reality work solution. Roblox have weekly townhalls on their platform, with the whole company encouraged to meet and mingle. Accenture's [Nth floor](#) serves a similar purpose and is used by the company for onboarding new employees.

Companies are increasingly adopting new communications technologies to support remote collaboration, with technological developments continuing apace. The benefits of these changes have the potential to quicken productivity growth and spark new scientific discoveries.

Industrial use cases for the Metaverse are evident, too. Nvidia's Omniverse helps businesses bring together digital assets, irrespective of their formats or engine, into a single virtual environment. Car manufacturer BMW used Omniverse software to design and simulate futuristic state-of-the-art factories in the Metaverse, using a digital twin to push the envelope on smart manufacturing, reducing production planning time by 30%. Amazon is using it to study how robots interact with each other in warehouses, while Ericsson uses the same technology to explore 5G radio propagation in digital twins of real cities.

Digital twins: an area of broad growth across multiple sectors

The ability to build shared virtual environments, where the laws of physics are obeyed and users can work together in real-time with different systems, has uses in architecture, engineering and construction, manufacturing and automotive. For example, Bentley Systems are the leading software provider for designing and maintaining infrastructure. When a bridge is inspected for maintenance, this is now done using a drone and digital twin.

Uses such as those outlined here should help improve product quality, reduce manufacturing costs and unplanned downtime while increasing output, and ensuring worker safety. Other software providers, such as Unity, are understandably bullish on the potential for revenues from digital twin software to scale to multiple billions. Meanwhile, for high-end luxury and retail uses, more immersive customer experiences have exciting potential.



Image courtesy of BMW, NVIDIA.

... and for play

The Metaverse is for play as well. Online gaming was its first real use case. Game developers have been building virtual worlds for decades, making them increasingly immersive.

Massive multiplayer online role-playing games (MMORPG), such as World of Warcraft, have millions of players, while Fortnite support 3-4 million people playing at a time across different platforms. Real-time rendering software, such as Epic Games' Unreal Engine, and Nvidia's Omniverse are key enabling technologies for gaming in the Metaverse.

These games are increasingly free-to-play, not tied to a specific console or device, and have generated billions of dollars for their operators. Game development is also becoming increasingly democratised. Gaming platform Roblox enables users to develop their own games, from which they can earn Robux – the platform's in-game currency that can be converted into US\$. Blockchain gaming takes this to the next level, enabling players to own in-game items as NFTs (non-fungible tokens) and sell/transfer them, or even loan them out.

But the Metaverse is about much more than gaming. Tim Sweeney, CEO of Epic Games, was asked whether Fortnite was a game or a platform. He replied that "Fortnite is a game. But please ask that question again in 12 months."⁶

More and more real-time events are being hosted in the Metaverse. Marshmello and Travis Scott have already held live virtual concerts online attended by millions,⁷ while over 36 million people watched Lil Nas X perform on Roblox.⁸ The monetisation potential for content creators is clear. It's not just concerts, promoters are exploring the viability of hosting football matches and F1 races in the Metaverse. Serie A broadcast a live game between AC Milan and Fiorentina in the Metaverse, hosted on the Nemesis platform with over 7,000 fans from the MENA region tuning in.⁹

Forward-thinking brands already have a presence in the Metaverse, with the corporate title of 'Chief Metaverse Officer' set to become commonplace.

Balenciaga recently announced a collaboration with Fortnite, the game's first luxury brand partnership that has both digital and physical elements. Within the game, skins and outfits are available within a virtual store that replicates physical Balenciaga retail spaces, while a limited-edition line up of physical products spanning apparel and accessories were offered on Balenciaga's website.

Nike's best-in-class marketing team has long made them one of the world's most innovative sportswear brands. The company has already staked a claim in the Metaverse. NIKELAND in Roblox has attracted over 6.7 million visitors from 224 countries since launch¹⁰ to play games, browse virtual stores, choose and design new pairs of Air Max trainers for their avatars, allowing a new level of engagement between brand and consumer. The company's acquisition of NFT sneaker shop RTFKT and the launch of Nike Virtual Studios is further evidence of their commitment to the Metaverse.

Video games, user-generated content and the Metaverse

Much has been made about video games being the new social media. Multiplayer games have a strong social aspect that keeps players coming back. Modern AAA games¹¹ can cost hundreds of millions of dollars and many years to develop. For companies to sustain interest in their games, and become truly persistent worlds, they need to provide content more cheaply and more rapidly. This is where lessons can be learned from social media.



Social media companies have pulled off the remarkable trick of getting their customers to produce content for them without having to pay for it. This keeps other customers on the platform, generating advertising revenue. It's a business model that some games companies have been learning from.

Players like to produce their own content. There's an army of 'modders' on PC games, modifying existing games; creating monsters that are more challenging to fight, look cooler or just changing the user interface to make it more user friendly. This is easier on PCs than consoles, as the source code is more accessible. User-generated content (UGC) like this keeps players engaged. Some companies, like Roblox,

are taking advantage of this and provide tools to help users generate their own content. We have seen other games offer the same, with Grand Theft Auto Online allowing players to set up missions for others to play. Nintendo had a successful game in Super Mario Maker that allowed players to design their own 2D platforming courses and post them online for others to play. Millions of these courses were created. One thing that sets Roblox apart from other games is that they also provide a cut of revenue to in-game developers.

For gaming companies with Metaverse ambitions, UGC is a powerful way to keep users engaged and we can expect more games to provide the tools to allow this in the future.

How big is the potential market?

While we're already able to see extraordinary use cases for the Metaverse, we're only in the early innings of its development. We believe this is a multi-year investment theme – one that relies on building the infrastructure needed for the Metaverse to reach its true potential. At this stage, most of the investment and progress needs to be made in the compute, hardware, networks and platforms segments of the Metaverse Value Chain.

There are exciting developments happening day-to-day in this space, be that news on Meta Platforms new headset R&D or the formation of the Metaverse Standards Forum, but we're still several years away from mass adoption. When the infrastructure is in place, more and more real-world experiences and assets will be digitised in the Metaverse, enabling users to go seamlessly from one experience to another. More use cases will emerge in areas such as travel, real estate, healthcare and education, with exciting opportunities as developer and creator economies emerge.

As technology improves, the speed to scale for new entrants is likely to accelerate, leading to further disruption, and likely winners we probably haven't even heard of yet. Costs will likely come down and adoption rates will probably climb. In our view, this could lead to explosive growth potential that could draw in a massive range of economic activities to the Metaverse.

Just how big is this market going to be? One area you can presumably find consensus on is that it's likely going to be big, with significant potential market growth for the Metaverse. However, it's still too early to make precise predictions, with much depending on your definition of the Metaverse.

Just the components and hardware elements of the Metaverse Value Chain are expected to grow at 43% CAGR over the next decade, reaching c. US\$300 billion by 2025 and US\$830 billion by 2028, with some estimates expecting it to be a trillion-dollar market in the next decade.¹²

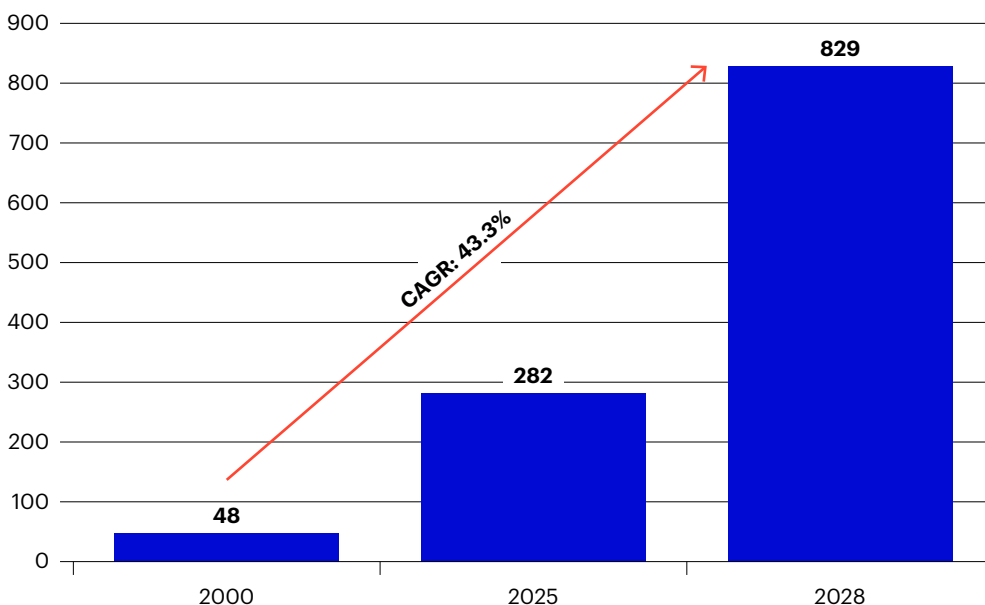
Another way of looking at it is that the global hardware, broadband, and gaming sectors are estimated to be worth around US\$2.6 trillion in 2021, and are expected to grow at 7.4% CAGR to 2025.¹³ We expect that Metaverse-specific applications will continue to take market share in these segments, providing a significant earnings driver for companies in these areas.

Assuming real-world economic activities, experiences and goods will be digitised, one can think about the total addressable market as a very small but growing percentage of global GDP. On this basis, the Metaverse ecosystem would only need to have a 1.2% penetration of the global economy to reach a US\$1 trillion market size. The sheer range of use cases leads us to think this is not an unrealistic estimate.

Analysts at Citi have estimated that the total addressable market (TAM) of the Metaverse could reach US\$8-13 trillion by 2030. This is based on a device agnostic definition, assuming the Metaverse accounts for 30-40% of the digital economy, which itself could account for 20-25% of global GDP by 2030. Their narrower definition based on users with VR/AR devices, gives a TAM of US\$1-2 trillion.¹⁴

Much of the Metaverse's early revenue growth is likely to be from North America due to the higher acceptance of advanced technologies, more start-ups focusing on the Metaverse and a healthy gaming sector, which is generating market opportunities. However, the Asia-Pacific region is also likely to see considerable growth, with early adopters in markets, such as Korea and the Philippines, showcasing some exciting new use cases for platforms.

Figure 2
Components and hardware segments
Market size (revenue, US\$bn)



Sources: Emergen Research (2021)

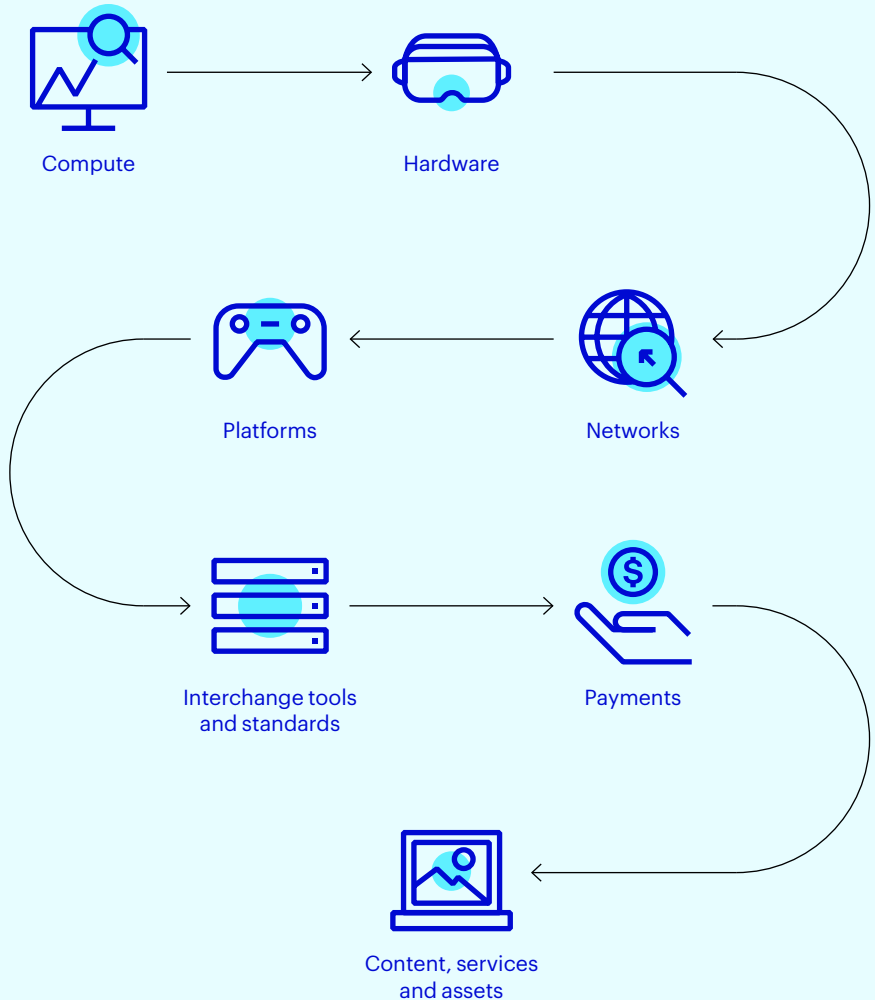
Framework for an investable universe

As an investment theme, the Metaverse encompasses a broad range of industries and applications, with opportunities for companies across the market cap scale. We shouldn't limit opportunities to these areas – as the pace of development quickens, new and exciting opportunities will emerge in different areas.

A useful way of thinking about the opportunity set available is to break down the Metaverse Value Chain (MVC) into seven distinct categories.¹⁵

As mentioned earlier, the first phase of the build-out is likely to see the greatest opportunities for companies in the first four categories: compute, hardware, platforms, and networks.

As the infrastructure is built, interchange tools and standards are likely to become more important, being the source of tools, protocols, and engines that will serve as the standards to allow interoperability between different digital worlds.



As the Metaverse is still in the early stages of development, the greatest opportunities lie within the first four categories: compute, hardware, platforms, and networks.

Compute

There's a reason only 100 players can join a session of Fortnite, and why Serie A only invited 10,000 fans to their first event. For the full potential of an open, fully immersible and interoperable Metaverse to be realised, we're going to need more computing power.



Ever-growing computing power will also help drive down the costs of the Metaverse. In recent years, we've seen a tremendous increase in the computing power a single chip can deliver, with a commensurate decline in monetary and time costs, which ultimately leads to faster and cheaper AI. It's easy to understand how additional computing power has historically spurred further technological advances, which is why demand in this segment has always exceeded supply.

Companies operating here include logic, memory, and equipment manufacturers that support these products. Semiconductor chip design companies, foundries and related equipment companies could all stand to benefit from Metaverse-related demand.

For an idea of the scale of advances required, Nvidia have suggested that the "graphics required to deliver a cinematic VR experience in a massive multi player physically accurate world will likely require three to four orders of magnitude more than the performance of our highest end GPUs, plus continuing advancements in algorithms for rendering, physics AI and animation."¹⁶

Moore's Law is slowing down for CPU performance, meaning GPUs are increasingly required for advanced computing applications, such as AI and rendering virtual worlds. Less than 10% of servers have a GPU installed today – a figure that could rise to over 50% over time.

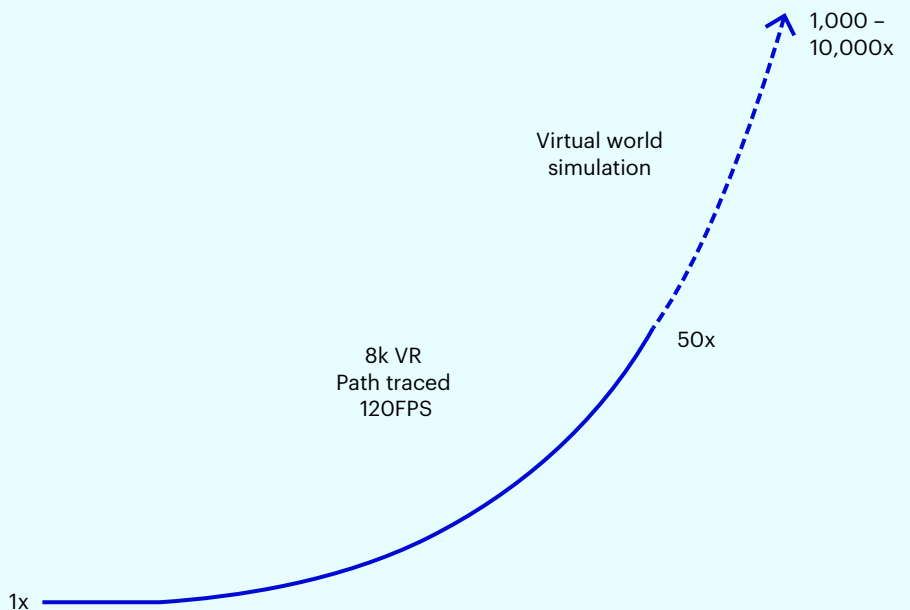
Edge computing is also likely to play an interesting role in powering the Metaverse, enabling data to be captured, stored, and processed locally across smart devices and local networks rather than in the cloud.¹⁷ Removing the need to send data to the cloud to be processed, edge computing helps solve problems of limited bandwidth and latency-critical for an immersive, high-fidelity experience.



Less than 10% of servers have a GPU installed – a figure that could rise to 50% over time.

Figure 3

Virtual world simulation requires more computing power



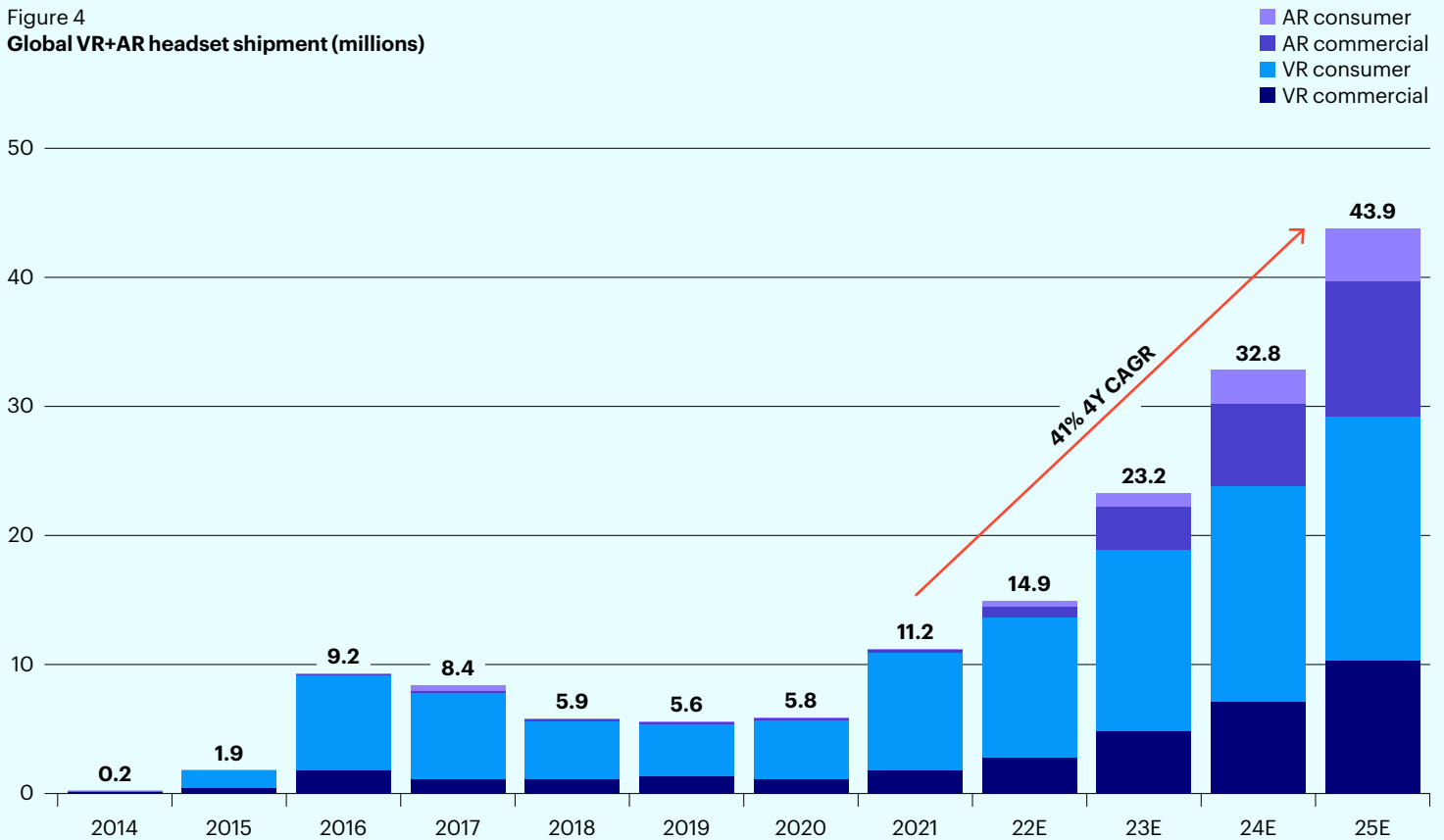
Source: Invesco, NVIDIA as at May 2022.

Hardware



To access and experience the Metaverse, users are going to require a range of physical devices, including VR/AR headsets, haptic accessories, smartphones, PCs and tablets, which will all require technological components such as cameras, sensors and scanners.

Figure 4
Global VR+AR headset shipment (millions)



Source: IDC/CLSA as at 15 June 2022. There is no guarantee that these events will come to pass.

Meta Platforms (formerly Facebook) has already invested heavily in AR and VR, developing its Oculus VR headsets, with AR glasses also in development. In 2021, Mark Zuckerberg predicted that AR glasses will one day be as ubiquitous as smartphones, suggesting that if they manage to deliver the equivalent of 120-inch screens in front of our eyes, we won't need TVs or other displays in future.¹⁸

Admittedly, this is still some way off, with developers still working on the challenge of compact, lightweight headsets that run for a long time on battery power. In 2016, Goldman Sachs predicted there would be almost 100 million VR/AR headsets in use by 2020, with the number today estimated to be closer to 10 million.¹⁹ That said, Meta Platforms shipped 10 million Oculus

Quest 2 headsets in 2021.²⁰ While VR/AR devices aren't yet mainstream, the market is maturing fast. IDC estimates that increasing VR/AR application scenarios, as well as improving hardware and software performance, could see global headset shipments grow at a 41% CAGR to 43.9m by 2025.²¹

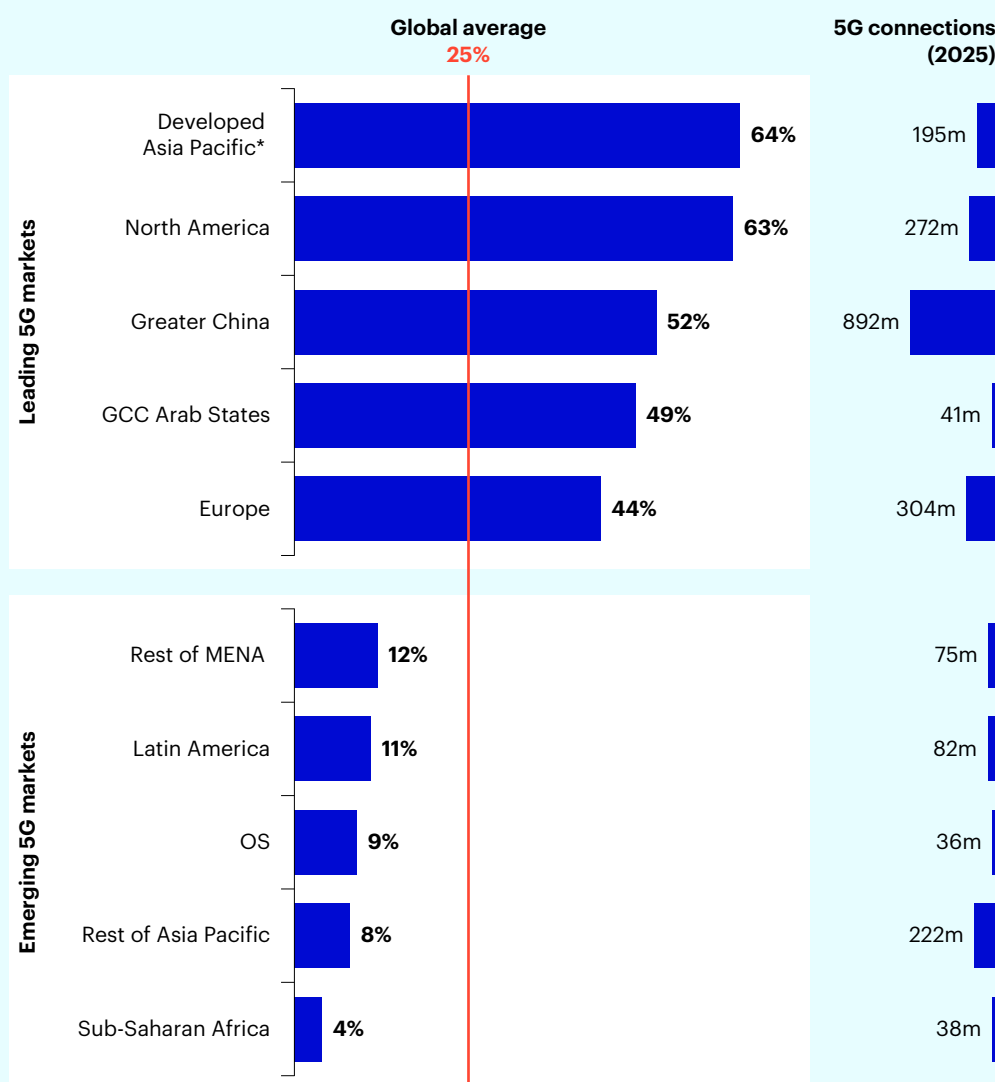
Meta Platforms certainly have first-mover advantage in VR/AR headsets with 80% of the market share, but Apple is strongly rumoured to be preparing a product launch in 2022/23, while other companies are active, including Google, Microsoft and Sony. It's not unrealistic to expect a breakthrough in terms of adoption in the near term, while new devices, such as gloves and bodysuits, are also gaining traction.



Networks

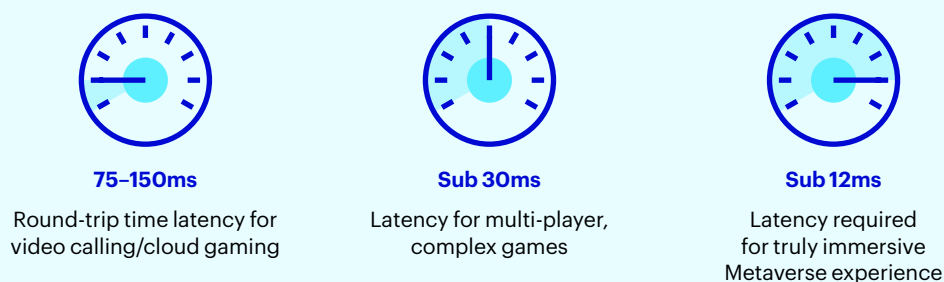
We're going to need faster connectivity speeds too, with latency²² and bandwidth being two key areas where we need to see improvement. The current state of the global internet infrastructure isn't fit to support real-time, persistent Metaverse experiences, due to bandwidth issues resulting in lags, packet drops, and general network unreliability.

Figure 5
The transition to 5G is occurring at varying speeds
5G adoption in 2025 (percentage of connections)



Source: GSMA Intelligence as at 28 February 2022. *Australia, Singapore and South Korea.

Figure 6
Latency needed for a truly immersive Metaverse experience



Source: CitiResearch as at 31 March 2022.

The rollout of 5G networks will help, but only 25% of the global population is expected to have access by 2025, with wider coverage needed in emerging markets across Asia and Africa in particular.²³

Low latency is critical to capture micro-expressions, reduce discomfort with virtual reality (VR) displays, and build a more realistic user experience. We need this for real-time communication in games or other VR settings.

The only way so many people could attend Fortnite's Travis Scott concert (where players were seamlessly transported from the game's core map to other virtual worlds, like outer space and the ocean depths), was for Epic Games to send a standard Fortnite patch to players days before the event. This enabled the game to load the pre-determined set piece in the background. The 12 million attendees were also not sharing the same virtual space, but broken up into numerous worlds, each with 100 players, again to save on bandwidth. The alternative to this requires cloud stream support for users as they make real-time decisions.

Cloud data centres are therefore likely to be a key element of the Metaverse's supporting architecture, given that it will house artificial intelligence (AI) and data-hungry applications that require 5G/6G network speeds. As already mentioned, edge computing will help, reducing the distance between the user and the processing network to reduce latency and lag. This will require significantly more powerful chips and enhanced security solutions to better protect user data.

Digital infrastructure owners are critical for continued development to help deliver on the promise of the Metaverse. The ten largest cloud service providers collectively spent over US\$88 billion on data centre infrastructure in 2021,²⁴ with the scale of investment likely to continue to grow rapidly for years to come. Data centre capex at Amazon, Google, Meta, and Microsoft is projected to increase 25% in 2022, with global data centre capex to reach US\$350 billion by 2026.²⁵

Platforms

Platforms are going to be those companies involved in developing, designing, rendering and operating immersive, digital worlds where we are going to be able to work, play, learn and socialise.



Key to their success will be how they facilitate flourishing digital ecosystems and economies, generating a virtuous circle. As Bill Gates envisioned, a “platform is when the economic value of everybody that uses it exceeds the value of the company that creates it.”²⁶

Metaverse platforms are therefore going to need to have the technical ability to support user-generated content (UGC), the services to support it, and the framework for operating a multifaceted economy. Roblox is the best-known platform in this regard, with its revenue sharing agreement with developers.

It's no coincidence that leading virtual platforms, such as Roblox and Minecraft have their origins in gaming. Game developers have huge experience building varied, large scale, complex simulations,

with few other industries having comparable depth and breadth of building consumer experiences that required so much computing power. As different game platforms open up more of their services, they move closer to becoming Metaverse platforms.

Platforms like Decentraland and The Sandbox are truly decentralised, having set themselves up on blockchain. This has the advantage of providing users with the ability to own in-game items or land, and a meaningful opportunity to generate real-world income. It also provides scope for users to take part in the growth of the platform's overall value, which, if managed correctly, can be a significant attraction. If the Metaverse does become truly interoperable, many platforms are likely to exist and be popular.



Interchange tools & standards

Today, the internet is accessible to billions of people thanks to interoperable standards, such as the HTML language that developers use to build websites, that can be read on all internet browsers.



The promise of a truly interoperable Metaverse largely depends on whether leading developers and platforms can agree on open standards. Not every element of the Metaverse needs to be compatible, but without the right tools, protocols and engines that serve as the standards allowing interoperability between different digital worlds, the Metaverse could end up being a series of experiences in silos or carefully controlled walled gardens. For now, a virtual Gucci handbag bought in Roblox can only be carried by an avatar on that platform.

Enabling people to move seamlessly from one part of the Metaverse to another – with their digital assets – is a big technical challenge that is not likely to be achieved for a long time. In part, that's because the infrastructure (hardware, compute, networks and platforms) still needs to be built. However, without broad agreement on solutions, platforms and developers risk stymieing innovation and slowing adoption. For example, Epic Games argue that Apple's App Store is a walled garden that grants excessive power to the owner, raises costs for developers, and reduces the ultimate value of the metaverse for users.²⁷

An example of an interchange standard is Pixar's open-source Universal Scene Description (USD) technology. NVIDIA, Autodesk, and Apple are amongst the big tech companies that support USD, which allows 3D digital assets to be edited in the same way as an HTML file, where the changes can be seen occurring visually in real-time.

Game development engines like Unity and Unreal from Epic Games offer a suite of products that make creation and development easier and composable for developers, and it is essential that they play an enabling role, making it easier for developers to build products that work across different virtual worlds.

Encouragingly, the formation of the Metaverse Standards Forum was announced in June 2022. This brings together heavy hitters, including Adobe, Alibaba, Epic, Huawei, Ikea, Meta, Microsoft, Nvidia, Qualcomm, Sony, and Unity. They appear committed to ensuring there's interoperability between Metaverses and even a common vision. Notable absentees include Alphabet, Amazon, Apple, Roblox, and Samsung.

While this is only a forum rather than a standards-setting body, it stands out as a serious attempt to grapple some of the theme's biggest challenges, cutting through the hype and plethora of competing visions. The body will focus on "pragmatic, action-based projects such as implementation prototyping, hackathons, plugfests, and open-source tooling to speed up the testing and adoption of Metaverse standards, while also developing consistent terminology and deployment guidelines." Meanwhile, its activities are likely to cover areas such as "3D assets and rendering, human interface and interaction paradigms such as AR and VR, user-created content, avatars, identity management, privacy, and financial transactions."²⁸

Payments

If the Metaverse develops as hoped, more and more economic activity will likely be drawn in, with opportunities for those companies involved in facilitating digital transactions, currencies, exchanges and other financial services providers.



The definition of money in the Metaverse of the future is also likely to differ from our understanding of money today, with a place for in-game tokens, stablecoins, central bank digital currencies (CBDCs) and cryptocurrencies.

Users must be allowed to own, buy and sell virtual assets in the Metaverse. In an ideal world, it is hoped that the digital economy can benefit from payment rails that are fast, inexpensive, flexible, scalable and secure. However, current payment rails tend to compromise on one or more of these values.

In today's Web 2.0 environment, online payment solutions favour closed platforms and largely disadvantage users or developers. For example, Apple is under mounting pressure from regulators around the world due to the dominance of its app store (as is Google). App providers must use Apple's payment system (IAP) for the settlement of payments and have been prevented from linking to payment systems outside the App Store. Not only that, but Apple charges up to 30% on all transactions involving virtual goods and services, most of which is derived from games.

Against this backdrop, it is easy to see why there has been such excitement around the blockchain technology that underpins cryptocurrencies. Blockchain is a proven interchange tool and standard that is likely to provide the fundamental infrastructure for the Metaverse's digital economy, facilitating user-driven digital assets creation and transactions. In this paradigm, controls and decision making are transferred from a centralised body (individual, organization, or group) to a distributed, decentralised network.

Cryptocurrencies are an effective facilitator of online transactions, but their high price volatility and low execution efficiency make them an impractical solution for small, everyday transactions. They are also coming under increasing regulatory scrutiny. The recent bubble and crash in crypto prices also showed that most of the 'value' created was the result of excess liquidity from quantitative easing. For now, they remain objects of speculation rather than stores of value.

New technologies tend to experience hype cycles, with euphoria and speculation followed by a collapse. However, blockchain feels to us like it's here to stay and those that survive will probably continue to use cryptocurrencies.

While the current crypto ecosystem is flooded with competitors and pretenders, the market will likely consolidate, with cryptocurrencies co-existing with fiat currencies, central bank digital currencies (CBDCs) and stablecoins.

In terms of blockchain, Ethereum seems to stick out as the broadest and most functional for now. Its size and the fact that it goes beyond mere transaction settling, allowing the embedding of apps and contracts, for example, suggest it will form the basis of various organisations. The Ethereum blockchain is also host to most Non-Fungible Tokens (NFTs), although other blockchains have implemented their own versions.

Even before the inception of the internet, musicians and other artists have been victims of piracy. This has only increased with the internet where copies are easily made and quickly distributed. NFTs offer transparent ownership authenticity of digital assets, with distributed ledger technology allowing content creators to distribute their work and receive royalties as soon as the creation is being "used". This dynamic disintermediates some centralised parties that were previously in charge of distribution and charging users for these creations.

Blockchain technologies themselves need to be interoperable to offer users a seamless experience, and there are cross chain solutions being adopted to achieve this – most notably Polkadot. This could only further expand the network effects of blockchain technologies and the utility of all cryptocurrencies and NFTs, while reducing fragmentation.

Content, services & assets

The final category is likely to see the most interesting opportunities for 'over the top' service providers, consumer and enterprise-facing companies digitising the real-world economy.



Figure 7
Not just tech and internet

Phase I: Investment in supportive technology required to enable Metaverse capabilities



Phase II: With infrastructure in place, real-world experiences and assets will be digitised, enabling users to go seamlessly from one experience to another

Source: Invesco.

As already described, for the Metaverse to reach its full potential, the relevant technologies and infrastructure need to be developed. However, once those foundations are in place, the architecture is there for more immersive storytelling. Then, content will be king. Owners of existing intellectual property will be in a strong position, with the potential to reach large audiences in new and exciting ways.

Forward-thinking companies are already boosting their presence in the Metaverse. We've already mentioned Nike's acquisition of NFT design company RTFKT, which last year in a collaboration with digital artist Fewocious sold 600 real sneakers paired with virtual ones in just 7 minutes, generating \$3.1 million.²⁹ Fashion brands, such as Gucci and Balenciaga, have also started building a presence, embracing the potential of new customer experiences.

In the gaming sector, Microsoft's US\$75 billion acquisition of Activision has caught the headlines, an accelerant of existing trends towards scale and the owning of proprietary content.³⁰

There will also be an opportunity for new entertainment franchises and consumer-facing brands. New technologies will likely do more than transform how consumers access content. They could move the boundaries of the content itself.

Fitness and healthcare app developers may exploit these new technologies, while education providers might learn how to best harness VR or even extended reality (XR) experiences in the classroom, virtual or otherwise. Field trips to ancient Rome or Constantinople, for example, could be added to tuition programmes of the future.

As well as opportunities for companies involved in designing, selling, re-selling, storing, protecting and managing digital assets and virtual goods, we believe new developer/creator economies will soon emerge, with roles for architects, designers and security staff, to name a few.



Once the foundations are in place, the architecture is there for more immersive storytelling. Then, content will be king.

What counts as a Metaverse stock?

To invest in the Metaverse, we need to try to narrow down the broader market to what we'd consider a superior investment universe focused on capturing opportunities across the Metaverse Value Chain (MVC), rather than purely 'Metaverse revenue'.

Figure 8

What counts as a Metaverse stock?



>10% of revenue exposure to the Metaverse Value Chain



>10% of expected growth coming from Metaverse Value Chain in the next 3 years



>10% of capex of investments going towards the Metaverse Value Chain



A critical supplier/solution provider for the Metaverse Value Chain

Source: Invesco.

This broader scope is necessary, given that the theme is still at a very early stage. It's also difficult to get companies to disclose their exposure to the Metaverse, but any company that meets one of the following criteria warrant inclusion in our investment universe.

For example, TSMC is the largest semiconductor manufacturer globally, and over 90% of the total revenue is from manufacturing semiconductors. We know that over 80% of these semiconductors go into either mobile, PC, consumer devices, servers or other high power computing segments. However, we don't know how much of that goes directly to Metaverse specific applications – and it's unlikely TSMC would know this either. We can say the same for NVIDIA and their GPUs. But to us, these companies are very clearly within an investable universe.

In our view, focusing on an estimate of exposure to the 'Metaverse Value Chain' is therefore more constructive. In the case of TSMC, it could be argued that all leading edge (5nm and 7nm) chips are captured under a broad MVC definition, which accounts for 51% of their revenue.

In the case of a company like Tencent, the MVC definition would arguably include all gaming, social network and cloud revenue, and a gradually increasing share of payments revenue, too. All these segments are key parts of the MVC, and we would expect Tencent's business units to be very much involved in the development of China's Metaverse in the years ahead.³¹

Additionally, we include in our investment universe companies in the 'Interchange tools and standards', 'Payments', and 'Content, Services and Assets' segments that don't meet these criteria, but which are demonstrably and pro-actively investing in Metaverse-related products and capabilities, enabling us to get exposure to parts of the Metaverse Value Chain that are at a more nascent stage of development.

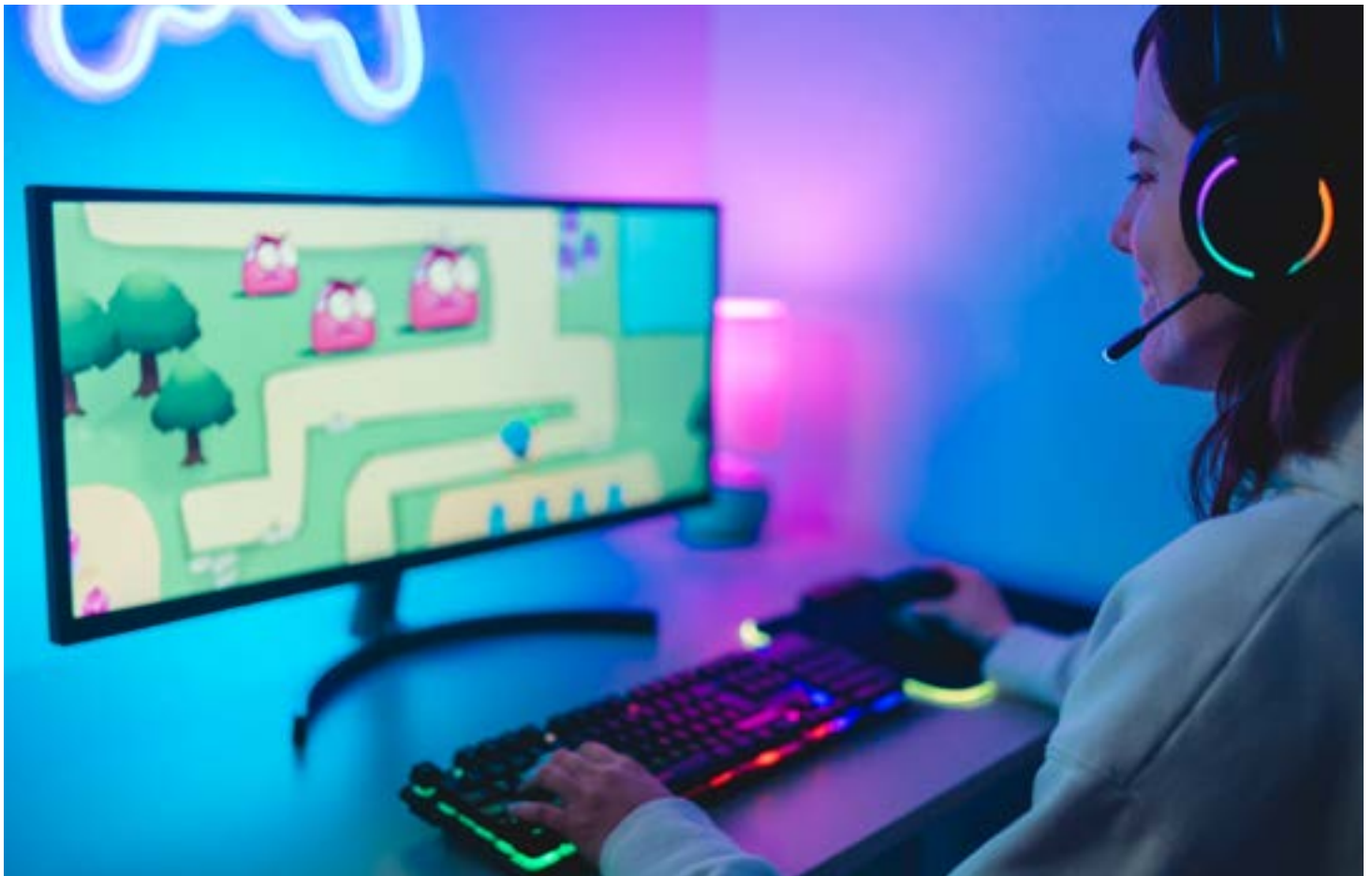
The question of 'thematic purity'

When most people hear 'Metaverse', they think of the existing, scaled Metaverse platforms such as Roblox, Decentraland, The Sandbox, and Horizon Worlds, as well as VR and AR.

To us, Metaverse as a concept expands way beyond these platforms and experiences into a broad range of industries and use cases. The seven subsegments of the MVC show that there are many distinct and interrelated sectors that will help facilitate, create, or benefit from the growth of immersive virtual worlds.

We think there are exciting opportunities for businesses in all seven subsegments – beyond the platforms themselves. This is akin to understanding the importance and value of picks and shovels in the era of the gold rush.

At this early stage, we'd suggest that investors don't focus on trying to predict the 'winners' now in a theme that could span decades. Rather, we'd look for diversified exposure across sub-sectors in established companies with expertise and an execution track record to benefit from the Metaverse.



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Risk warnings

The value of investments and any income will fluctuate (this may partly be the result of exchange rate fluctuations) and investors may not get back the full amount invested.

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