GLOBAL X MODEL PORTFOLIOS

INVESTING IN THEMATICS FROM A PM PERSPECTIVE

As of August 2023

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INTRODUCTION

Expectations for technology are constantly changing. Just a decade ago, accessing the internet via a mobile device was clunky at best. Today, the slightest amount of buffering of HD video draws intense annoyance from smartphone users. As innovation begets innovation, the COVID-19 pandemic accelerated the adoption and use of important technologies spurring even more advancement. While the pandemic encouraged a step up in use, we think of this overarching trend as the continued shift from Innovation to Utility, where new technologies build on ideas that came before, turning the revolutionary into the day-to-day. As workplaces regain normalcy, the technological tools utilized during the pandemic look to have staying power, launching Americans into a "New Normal" of technology.

In this white paper, we seek to detail key themes shaping our world. This iteration of the report is focused exclusively on the Disruptive Themes category, but later this year we will be releasing our analysis into the People & Demographics and Physical Environment categories. This research and analyses support some of the thematic investing decisions made in the Global X ETF Model Portfolios. Used standalone or as satellite strategies, our thematic approach strives to position portfolios for the future. Global X's suite of Model Portfolios contains three strategies that are exclusively focused on thematic equity, and an additional seven model portfolios that include thematic equity in the context of a broader asset allocation. Our portfolios are actively managed (not static) and will enter and exit themes over time. As such, not all themes available will be directly represented at a given time. For more information on Global X Model Portfolios, including allocations, please consult our Advisor Login.

THEMATIC EQUITY ADOPTION

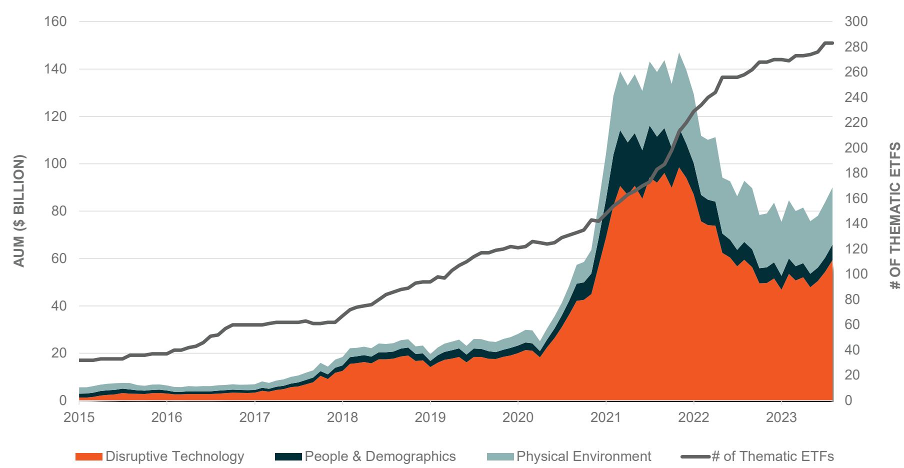
Interest in accessing thematic equity through ETF products increased significantly over the last few years. COVID-19 related lockdown restrictions and shifts in how society engages with technology drove a sharp increase in thematic adoption during 2020. While society is learning how to live with this virus as life is starting to return to normal, the technologies that enabled us to engage during the pandemic could be used as building blocks to the future.

"At the end of July 2023, there were 283 thematic ETFs totaling **$90.0 billion** in assets under management (AUM), up +7.6% from June 2023 and down -3.0% from the same month last year.[1]"

[1] Global X Research as of 7/31/2023

AUM OVER TIME

Source: Global X ETFs, Bloomberg Data as of July 31, 2023.



Note: AUM includes assets of funds closed until the last month of trading activity.

THEMATIC ADOPTION

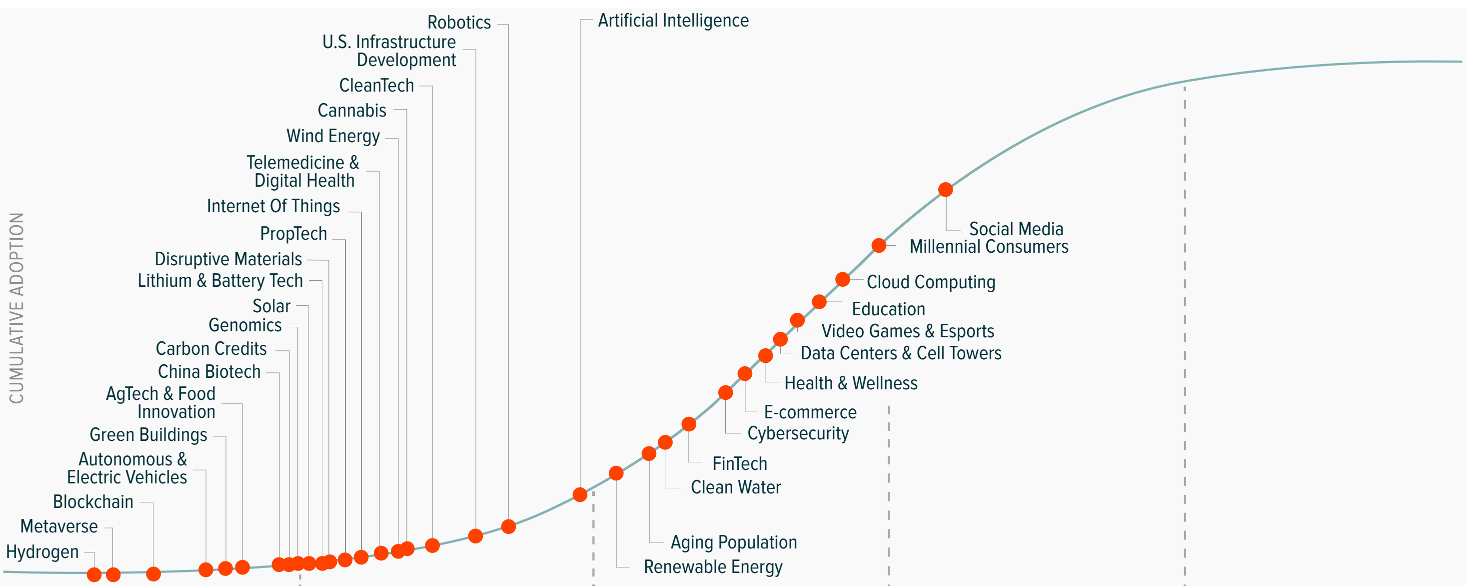
The adoption of new technologies typically follows an S-shaped pattern, with the rate of growth accelerating as the product gains mass acceptance, until eventual deceleration as the technology becomes pervasive (see chart). Our thematic strategies target themes in the Early Adaptors and Early Majority phases, and reduce exposure to themes as they advance into Late Majority territory.

The scalability of key technologies typically rises at higher levels of adoption, boosting revenue and potentially also profitability. While most themes experience gradual improvements in scale along the adoption curve, for themes that rely on interconnectivity, such as Social Media and to a lesser extent Video Games & Esports, monetization opportunities accelerate once the technology has high adoption levels and network effects make it is more difficult to switch to a different service.

In the disruptive technology category, we can currently trace majority of the structural changes to data and connectivity. As we transition to a digital future, this established new frontiers for interconnectivity.

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2022.



Displayed for illustrative purposes. Curve shape not indicative of mathematical transformation.

PHASES OF ADOPTION

INNOVATORS
Adoption starts slowly, as only a small group of Innovators take a chance on a new technology before it is proven or widely accepted.

EARLY ADOPTERS
Early Adopters accelerate and evangelize via word-of-mouth. This is often the tipping point, as Early Adopters convince others that a particular technology is worthwhile.

EARLY MAJORITY
Early Majority, we reach the part of the Adoption S-curve where the slope is the steepest, and hence the rate of adoption is at its fastest. In this phase, sales tends to explode.

LATE MAJORITY
Adoption continues growing at a solid pace as the Late Majority are convinced to participate, and the technology appears seemingly everywhere.

LAGGARDS
Finally, holdouts, begrudgingly acquiesce and accept/adopt a technology.

Note: This is an indication of thematic adoption within society. This analysis is as of April 2022 and is subject to change. The curve does not in any way reflect past or future performance of the ETFs.

THEMATIC CLASSIFICATIONS

Global X Research has developed a holistic Thematic Classification System, designed to help investors better understand, track, and analyze the evolving thematic landscape. Focused on identifying powerful themes and organizing them by common traits and drivers, the system consists of four layers of classifications: Categories, Mega-Themes, Themes and Sub-Themes, with each layer becoming increasingly granular in its focus.

As of publication, the classification system is comprised of 3 categories, 11 mega-themes, and 42 themes. The number of each is expected to change over time as the thematic landscape evolves. The table provides an overview of the Global X Thematic Classification System and our takeaways from each mega theme.

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Category		Mega Theme & Key Takeaway	Theme
DISRUPTIVE TECHNOLOGY	The Infrastructure of the Digital World	**Big Data** Big Data's cloud computing and cybersecurity technologies integrate exceptionally well from a portfolio perspective, as the data-dense cloud necessitates ongoing cybersecurity spending and investment.	Machine / Deep Learning
			Cybersecurity
			Quantum Computing
			Cloud / Edge Computing
		Connectivity If AI is a system's brains, the Internet of Things (IoT) acts as the digital nervous system. Connectivity enables real-time and remote monitoring of autonomous systems.	Digital Infrastructure
			5G / Next Gen Networking
			Emerging Market Internet
			Internet of Things
			Space / Satellite Communication
	How it Relates to the Physical World	**Robotics** The adoption of robotic and AI tools combined with internet of things (IoT)-based sensors and massive scale cloud computing could be sparking the Fourth Industrial Revolution, increasing the efficiency and effectiveness of factory-based production.	AI / Automation
			3D Printing
			Drones
		Mobility We expect the Mobility theme to be boosted by the integration of robotics & AI and internet of things (IoT) technologies that may result in the proliferation of connected, autonomous EVs.	Autonomous Vehicles
			Electric Vehicles
	How it Relates to the Digital World	**Digital Experiences** Improved connectivity opens a world of possibilities for enhanced online engagement. The future is likely to be more interactive with improved cloud computing increasing the potential for video game streaming and increased blurring of physical and digital worlds.	AR / VR
			Video Games
			Social Media
			Streaming
		FinTech We expect continued innovations in mobile payments, online banking, and alternative lending platforms to bring financial services to previously unbanked and underserved populations.	Mobile Payments
			Peer-to-Peer Lending
			Crowd Funding
			Blockchain
PHYSICAL ENVIRONMENT	Infrastructure and a Greener World	**Climate Change** As repercussions of climate change becoming more acute, we expect the transition towards net zero to create opportunities in all themes accross Physical Environment.	CleanTech
			Clean & Renewable Energy
			Resource Scarcity
		Disruptive Materials	Disruptive Materials
		Infrastructure Development	Infrastructure Development
PEOPLE & DEMOGRAPHICS	The Human Side of Innovation	**New Consumer** Consumer preferences are adjusting as populations age, purchasing power shifts, and regulatory changes shape longer-term consumption patterns.	Millennials & Gen Z
			Emerging Market Consumers
			Urbanization
			E-commerce
			Education
			Sharing / Gig Economy
			Safety & Security
			Cannabis
			Sports Betting
			Professional Sports
		UPCOMING	
		Health	Healthcare Innovation
			Aging Population
			Health & Wellness
			Emerging Market Healthcare
			Alternative Medicine

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Infrastructure of the Digital World

We can currently trace majority of the structural changes to data and connectivity. A handful of key themes are foundational, providing the technological backbone for the digital future. Given interconnectivity between technologies and themes, these foundational themes link to both the physical and digital world.

KEY MEGA THEMES:

- Big Data
- Connectivity

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BIG DATA (CLOUD COMPUTING & CYBERSECURITY)

Perhaps no investment theme has been more important to the business world since the COVID-19 outbreak than Big Data. As workplaces went remote, access to key documents, applications, and computing resources made cloud computing essential. We expect the global economy to shift further into the cloud over time, though connectivity can be both a blessing and a curse, as readily accessible files can become an easy target for malicious actors. Fortifying cybersecurity measures are therefore necessary investments to protect remote treasure troves of sensitive data.

KEY TAKEAWAYS

- COVID-19 related pressure boosted the Big Data theme as it increased cloud utilization faster than previous estimates. Now an estimated 92% of enterprises use multiple cloud services, employing 2.6 public and 2.7 private clouds on average.[1]
- Cybersecurity spending is expected to increase significantly with the global economy going digital. Ninety-six percent of organizations increased their cybersecurity spending in 2020, according to a recent survey. And 91% increased their cybersecurity budgets in 2021.[2]
- Big Data's cloud computing and cybersecurity technologies integrate exceptionally well from a portfolio perspective, as the data-dense cloud necessitates ongoing cybersecurity spending and investment.

WHY CLOUD COMPUTING AND CYBERSECURITY ARE SUCH POWERFUL FORCES

Cloud computing offers proven efficiencies that modernize business practices

Of all the investment themes that we track, the Cloud Computing theme likely accelerated the most due to COVID-19 because it became essential to business continuity. In a survey by computer software company Flexera, 29% of respondents said that they increased their cloud usage significantly more than expected during the pandemic, while 61% made slight increases due to pandemic-related operational changes.[3] Today, an estimated 92% of enterprises use multiple cloud services, employing 2.6 public and 2.7 private clouds on average.[4]

With growing demand attributed to lower operating costs, better collaboration, increased flexibility, and improved turnaround times for server expansion, the largest enterprises by revenue accounted for 51% of the cloud market in 2020.[5] These firms were not new to the cloud, having used it to build applications or host corporate infrastructure. The next push looks to modernize core business applications and processes. Technology conglomerate Cisco expects 94% of all corporate workflows to run through some form of cloud infrastructure by 2021, as servers dedicated to individual tasks quickly become relics.[6]

The next stage of the cloud's evolution looks to be omni-cloud solutions that stitch together multiple platforms and services to create more integrated data sharing and access. Managed multi-cloud environments should help assuage security, cost, and governance issues, the top concerns of enterprise cloud decision-makers.[7]

Currently, supply chain constraints, including the ongoing semiconductor shortage, are a challenge. But we believe the shortage can enhance the Cloud Computing theme. Under more normal conditions, corporations have a choice. They can build out their own personalized data centers, spending the time, resources, and expertise to customize servers. Or they can contract a cloud provider that offers a more general but rapid turnkey solution. Currently, high costs and long lead times due to supply constraints disincentivize personalized server builds, forcing organizations into the cloud to avoid the risk of delays.[8]

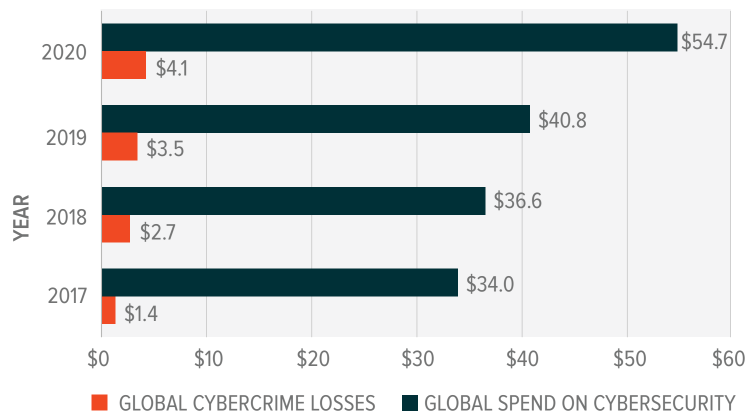
As the value of data increases, it requires more protections

Cloud computing data centers aggregate and concentrate valuable data and processing power, increasing the speed and effectiveness of computing tasks. But that digitization makes protecting this valuable and sensitive data essential. The World Economic Forum marked cyberattacks as the 7th global risk by likelihood and 8th by impact in 2020.[9] It's estimated that global cybercrime costs will grow by 15% per year to $10.5 trillion annually by 2025.[10]

In 2020, ransomware attacks increased by 62% globally and 158% in North America compared to 2019.[11] These malicious attacks have real consequences for business, infrastructure, and end users beyond lost data and operational disruptions. According to FBI data, U.S. economic losses from more than 791,790 reported cybercrime incidents in 2020 exceeded $4.1 billion.[12] The effects of a successful breach, financial and otherwise, can be felt for years after the actual threat ends. As much as 22% of negative effects occur in the second year after the event, and another 11% surface in the third year.[13]

CYBER ATTACKS CONTINUE TO CAUSE DAMAGE EVEN AS SPENDING INCREASES DRAMATICALLY

Source: IC3, March 2021, Canalys, January 2021.

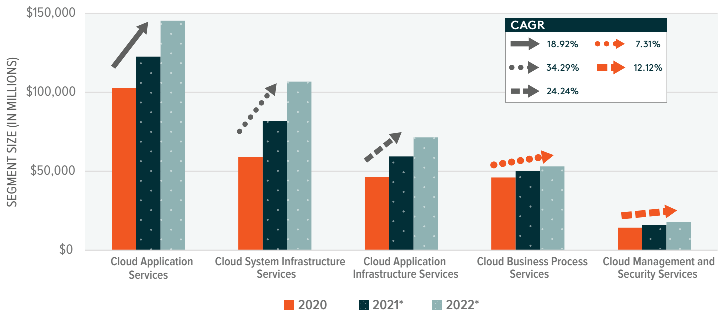


According to solutions provider Insight CDCT (Cloud + Data Center Transformation), 96% of surveyed organizations increased their cybersecurity spending in 2020, and 91% expanded their cybersecurity budgets in 2021. However, current solutions largely focus on closing immediate security gaps and addressing the easiest-to-deploy options first, not the most concerning threats, including state-sponsored corporate espionage, attacks on critical infrastructure, and disinformation campaigns.[14] For example, the Solar Winds hack discovered in December 2020 is believed to be the work of the Russian Foreign Intelligence Service. About 100 companies and a dozen government agencies were compromised, including the U.S. Treasury, Justice, and Energy departments, and the Pentagon.[15]

The increased sophistication of state-sponsored cyber threats requires equally sophisticated state responses. The Biden administration recently issued a new mandate for federal agencies to patch cybersecurity vulnerabilities in government software. This mandate covers about 200 known security flaws, making it one of the most widespread initiatives of its kind.[16] Additionally, the House passed the Small Business Administration (SBA) Cyber Awareness Act, requiring small businesses to notify Congress of cybersecurity breaches. A second component includes the Small Business Development Center Cyber Training Act for cybersecurity counseling certification programs.

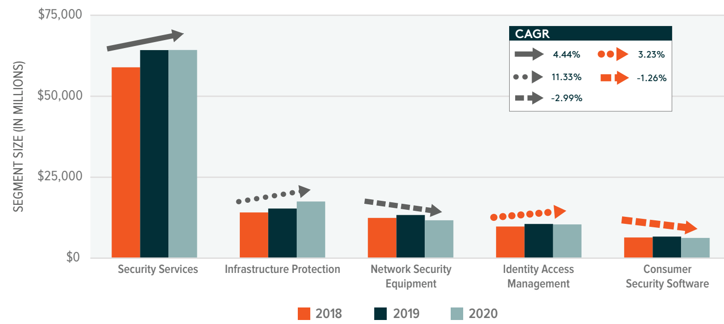
VISUALIZING THE MARKET OPPORTUNITY

GLOBAL CLOUD COMPUTING SPENDING BY LARGEST SEGMENT
Source: Gartner data as of 4/21/2021.



*Predictions as of 4/21/2021

GLOBAL CYBERSECURITY SPENDING BY LARGEST SEGMENT
Source: Embroker data as of 11/2/2021.



RISKS TO THE BIG DATA THEME

Supply chain disruptions could affect development of critical cloud infrastructure

A concern for Big Data and the broader technology space is the supply chain constraints limiting the availability of certain types of semiconductors. This shortage has nuanced effects on the Cloud Competing theme as increased demand from end users is offset by capacity growth restrictions. Data center development is necessary for the continued expansion of service offerings and staying competitive in an industry with regular hardware advancements and data demand increases.

Shortages aren't affecting every type of semiconductor. High-margin microchips, such as the server-level central processing units (CPUs) and graphics processing units (GPUs) that make up the backbone of data centers, are generally available. But other necessary components like power supplies and network switches face lead times in the 40–60 week range, more than double the pre-pandemic norm.[17,18] Semiconductor foundry capacity is growing at 1–3% per year, but that growth is outpaced by the demand for computing power, so constraints are expected to persist. Industry leaders expect tightness through Q2 2022.[19,20]

Cybersecurity is an inherent risk in the digital age

Data is gold today, which means data centers must become virtual fortresses. Concentrating such a valuable resource only increases the interest of malicious actors, and when they see an opening, they take it. For example, attacks on cloud infrastructure providers increased 630% between January and April 2020 compared to the previous four-month period as cyber criminals looked to exploit COVID-related confusion.[21]

Unauthorized access can occur even without malicious activity due to incorrect settings or user and employee errors. In 2019, more than 540 million user records from a large social media company were exposed by a leading cloud provider due to improper data protections.[22] Absolute protection of data is likely impossible because there is a direct trade-off between data security and accessibility, but many risks can be mitigated by adequate cybersecurity spending and security awareness training.

From a risk perspective, the Cybersecurity theme looks well-insulated. Cybersecurity technologies work to proactively shield against possible attacks while mitigating and repairing the damage from attacks that already occurred. As a result, there is little risk at the broad theme level because the factors spurring adoption are unlikely to ever wane. Risk remains acute at the individual company level, where malicious actors constantly stress-test specific cybersecurity approaches and tools.

Should a breach occur under a cybersecurity provider's nose, markets are likely to devalue that company compared to its peers. However, in such instances, interest actually increases for the space overall. Cybersecurity stocks and ETFs have a history of positive price performance following the announcement of large-scale hacks, including the Solar Winds incident. In a situation where a data center or application developer falls victim to a large breach, negative share performance could be offset by broader cybersecurity gains.

THEMATIC INTERSECTION: INTERNET OF THINGS AND ARTIFICIAL INTELLIGENCE

Internet of Things (IoT)

The proliferation and advancement of connected devices driven by IoT technology looks to enhance the opportunities for Big Data themes. The integration of microchips and networking into more products creates more opportunities for data collection, as well as unauthorized access. Distributed sensors require a central data processing location to receive and aggregate collected information. And as the number of connected devices expands alongside increasingly sophisticated data analysis, so does the need for processing power and cloud computing resources.

But sensors are next to useless if they aren't secure, so IoT also positively impacts the Cybersecurity theme. For a malicious actor, the IoT is a cornucopia of opportunities to attack. Ninety-eight percent of all IoT device traffic is unencrypted, which translates to 57% of IoT devices being highly vulnerable to cyberattacks that can expose personal and confidential data.[23] Successful IoT deployments require multi-layered, end-to-end security that ranges from upfront, baked-in security requirements to the ongoing management and protection of sensitive machine-generated data.[24]

Artificial Intelligence (AI)

The cloud and AI and are also a fitting match. The cloud can democratize access to AI, providing turnkey solutions without significant upfront investment or specialized experience. AI can enhance cloud infrastructure through computing resource management, streamlining workloads, and automating repetitive tasks without human interaction. Additionally, growth in AI capability and complexity requires expanded computing resources. In 2018, AI research lab OpenAI reported that the amount of computational power used to train the largest AI models doubled every 3.4 months, an appetite that cloud providers can quickly satisfy.[25]

AI technology is a boon for the Cybersecurity theme, given its use of pattern recognition and predictive intelligence to detect unusual network activity or penetration attempts. As cyberattacks grow in complexity, regularity, and intensity, AI can bolster human-based cyber defenses. Spending on AI cybersecurity tools is expected to grow faster in the coming five years than hardware or services, indicating wholesale adoption of the technology.[26]

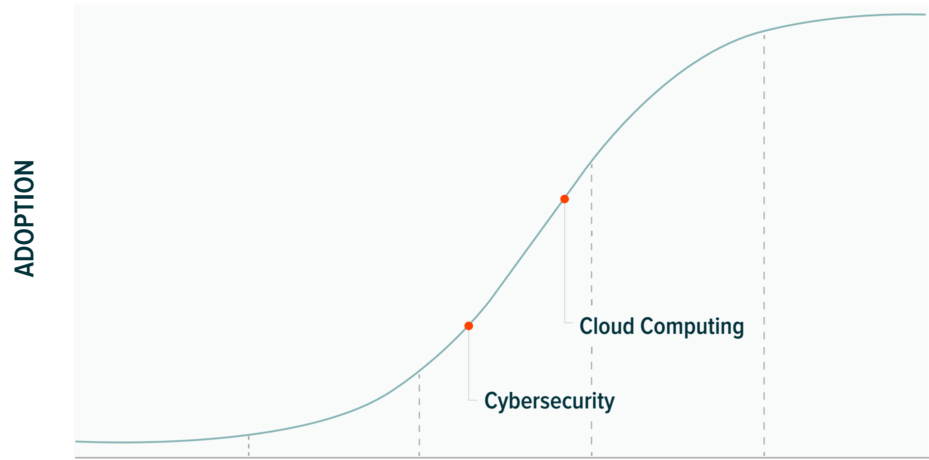
BIG DATA IN A PORTFOLIO CONTEXT

Big Data is foundational to our digital future, and is comprised of core themes that we believe have a place in most thematic portfolios. Both Cloud Computing and Cybersecurity fall squarely into the Early majority phase, indicating that adoption levels are high and rising, and that the market has begun to accept these themes at scale.

The companies that implementing Big Data technologies are global and stand to benefit as thematic adoption rises across the world. The pie charts below breaks down the geographic exposure of the largest Big Data ETF products. We believe there is ample innovation occurring outside of the states, and that limiting exposure to the U.S. will exclude key players to the detriment of investors over the long term.

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021



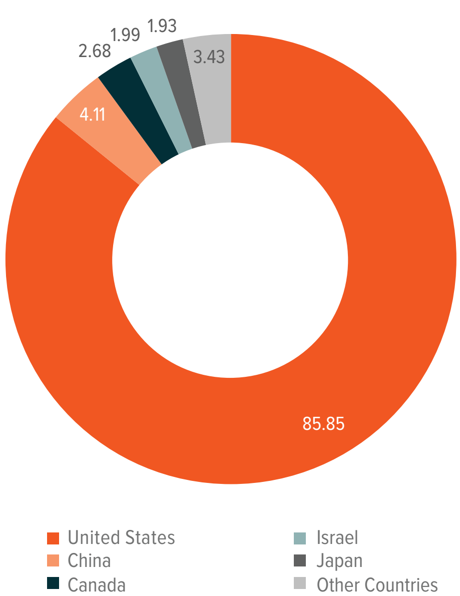
ADOPTION	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
GROWTH	Slow	Medium	High	Medium	Slow

In our view, thematic equity should be targeted, using screens to ensure the underlying companies provide the desired thematic exposure. This pure play exposure minimizes overlap between themes while also differentiating the exposure provided by the theme relative to broad beta products. An overlap analysis between Big Data thematic ETFs and XLK, the Technology Select Sector SPDR Fund, shows that average overlap by weight is 6.4% and 2.5% for cloud computing and cybersecurity funds, respectively.[27] As shown above, cloud computing scores higher on adoption than cybersecurity, and this is reflected in the theme's larger level of inclusion in broad tech sector ETFs. The names that overlap tend to be large, well known and active in many business segments, such as Microsoft and Cisco, while those that don't overlap are smaller and relate specifically to the theme. This highlights a key advantage of thematic investing - gaining exposure to key players early in their business lifecycles before they are included at any significant weight in broader indexes.

We believe both Cloud Computing and Cybersecurity could grow in importance over the next decade. Migrating to cloud-based infrastructure and software affords enterprises greater flexibility, predictability, and scale. While the market nears mass adoption, opportunities remain for firms to expand Software-as-a-Service and Infrastructure-as-a-Service offerings. The cloud's effectiveness has been proven; the next leg will maximize its potential. Helping the cloud reach its potential will be the cybersecurity industry, which seems well-positioned to capitalize as people and economies move further online. Cyber threats continue to increase in occurrence and severity, demonstrating the permanent need for cybersecurity spending. Both these Big Data themes benefit from subscription revenue models, helping establish more stable and predictable income streams.

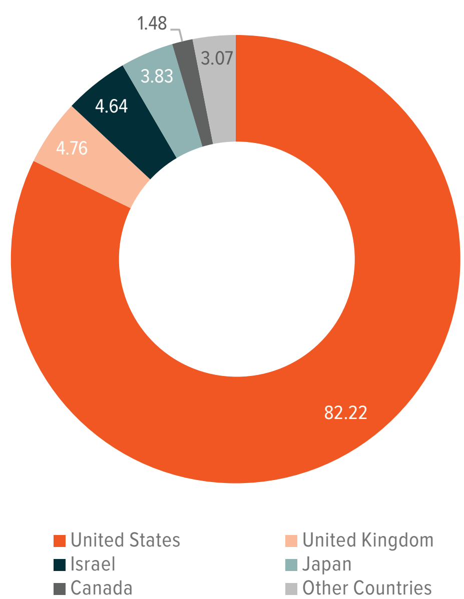
CLOUD COMPUTING: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of 12/31/21.



CYBERSECURITY: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

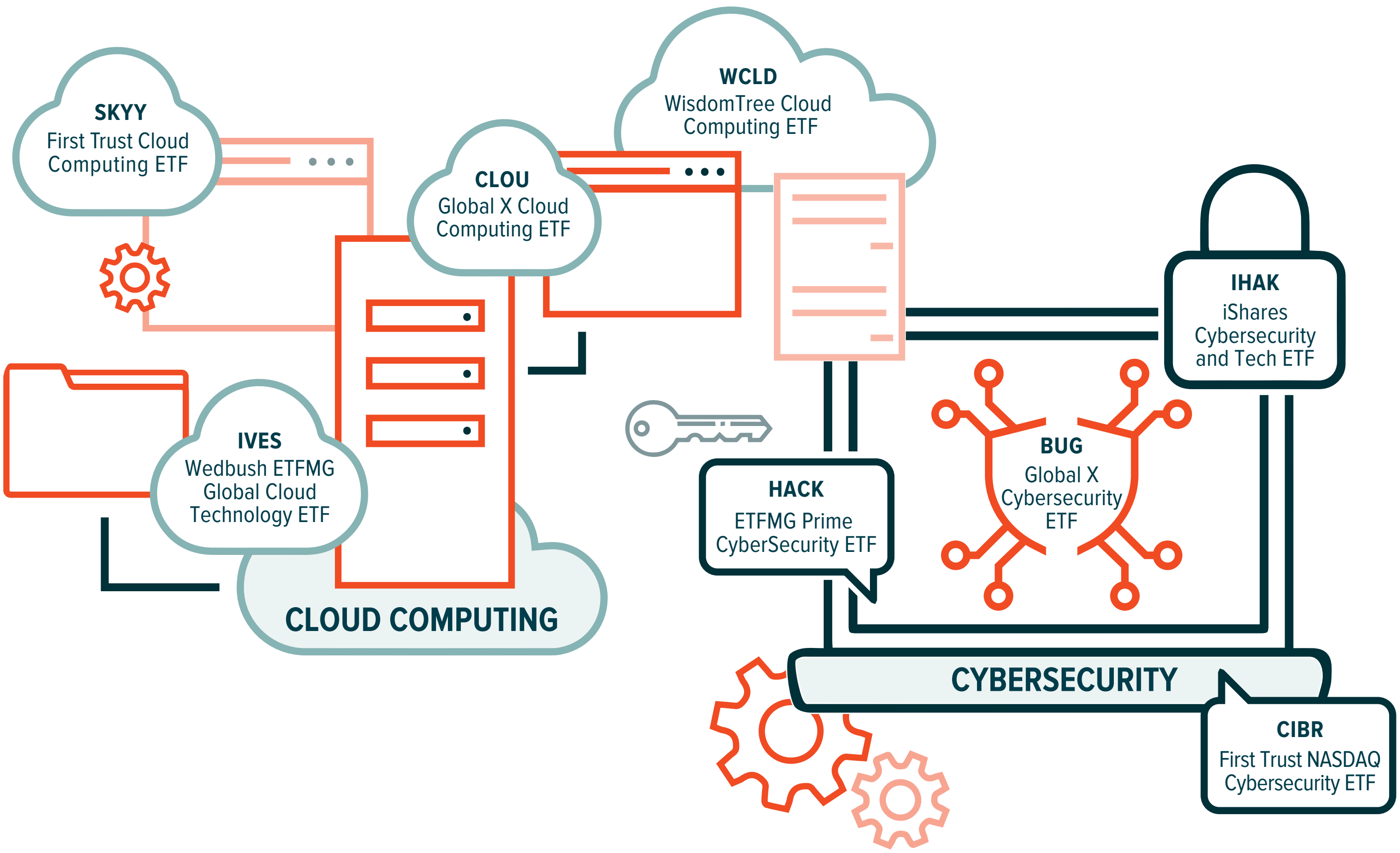
Source: Morningstar data as of 12/31/21.



Note: Pie charts include the largest four cloud computing and the largest four cybersecurity ETFs according to our thematic classification. All Thematic ETFs weighted the same.

HOW TO ACCESS BIG DATA

The graphic below identifies some U.S. listed ETFs that provide direct exposure to the Big Data theme through Cloud Computing and Cybersecurity technology.



BIG DATA FOOTNOTES

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[27] ETF Action data as of 2/9/22

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CONNECTIVITY (INTERNET OF THINGS & DIGITAL INFRASTRUCTURE)

Connectivity creates opportunities, and we expect the Connectivity theme to grow as the internet of things (IoT) connects more devices across sectors. Sparked by the continued miniaturization of microchips and receiving a powerful tailwind from the speed and capacity of 5G networks, IoT sensors and connected devices are set to harness the power of collected data. While these technologies appear to occur effortlessly, they rely on an extensive network of towers and data centers. Core to the Connectivity mega theme's growth potential is the significant investment being made to enhance this digital infrastructure.

KEY TAKEAWAYS

- Industrial IoT (IIoT) could be a key component of the Fourth Industrial Revolution (Industry 4.0), which we expect to transform manufacturing and supply chains. IIoT is expected to account for over 70% of all IoT connections by 2024.[1]
- Increased connectivity increases the need for investment in digital infrastructure. Between 2016 and 2020, the U.S. wireless industry invested $140 billion in infrastructure enhancements, building over 417,000 new cell sites in 2020 alone.[2]
- The Connectivity theme lives up to its name by connecting numerous themes, both innovation-based and physical infrastructure-based. We believe this attribute makes Connectivity particularly dynamic from a portfolio perspective.

WHY THE INTERNET OF THINGS AND DIGITAL INFRASTRUCTURE ARE SUCH POWERFUL FORCES

Connected devices are everywhere and growing more powerful

Connected devices produce an almost unimaginable amount of data. Technology conglomerate Cisco estimates that IoT devices produced 500 zettabytes (1ZB = 1 trillion gigabytes) of data in 2019, and it expects that number to grow exponentially each year as more devices come online.[3]

In 2021, the average American household had 25 connected devices, up substantially from 11 at the end of 2020.[4,5] In total, the U.S. had 468.9 million connected devices online by the end of 2021, including 190.4 million data-only devices such as smartwatches or medical sensors. Data only IoT-focused connections have increased 272% in the U.S. since 2013.[6] Globally, the number of connected IoT devices is expected to grow from 11.3 billion in 2020 to 27.1 billion by 2025 as the chipsets and wireless communication services that enable connectivity become more available.[7]

Cheap and readily accessible sensor and communications chips enhance the capabilities of everyday devices. Microsoft data shows that the average price of an IoT sensor declined from $1.30 in 2004 to $0.44 in 2018.[8] This trend combined with computing power increasing by a factor of 10 roughly every four years has resulted in even basic products such as toasters receiving a digital upgrade.[9]

In the short term, the semiconductor shortage has increased the prices of chips and other electronic components, demonstrated by the semiconductor producer price index rising from 54.1 to 55.3 in 2021.[10] The long-term trend of declining costs per unit compute is expected to resume once manufacturing catches up with demand, further aiding IoT adoption.

Industrial IoT creates dynamic growth opportunities in the manufacturing sector

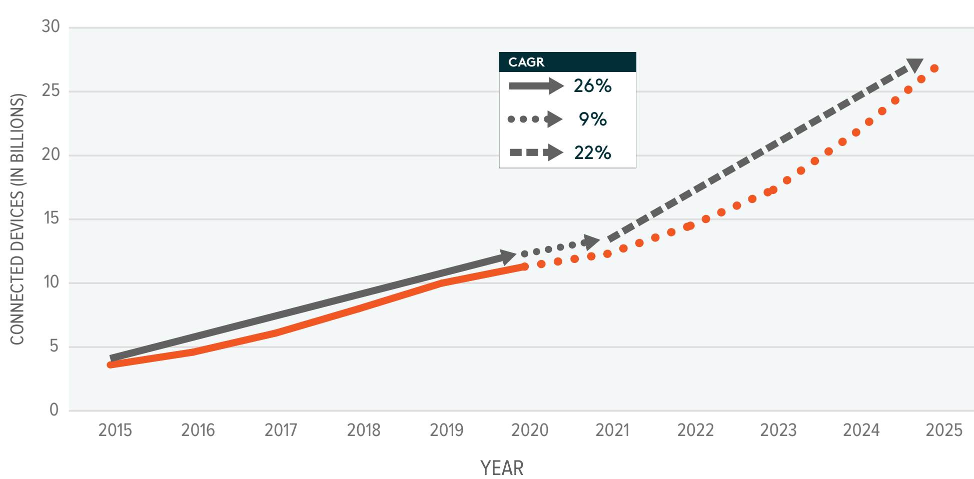
Recent kinks in supply chains indicate that the current production paradigm isn't sufficiently equipped to handle system-wide stress. The solution is to transform traditional and linear manufacturing supply chains into dynamic, interconnected systems. Bringing Industrial Internet of Things (IIoT) technologies into manufacturing facilities will change how products are made and delivered. Adding sensor technology and adaptive control systems to production lines could transform real-time data into actionable insights that may be used to increase manufacturing efficiency.

A key advantage of Industry 4.0 compared to just-in-time manufacturing is a reduction in downtime due to predictive repairs. Production downtime, even for necessary maintenance, can have large costs. By monitoring the current condition of machinery, reacting to warning signs, and cross-checking input and finished good levels, IIoT-enhanced factories can optimally schedule repairs, thereby reducing downtime and increasing facility throughput.

Further efficiency gains can be derived by utilizing IoT for inventory and asset tracking. With GPS technology, complicated logistics can be monitored and simplified. For example, a manufacturer can know in real time when a shipment of raw materials will arrive at a facility or when finished products arrive at a distribution center. This information can help companies maximize profitability by giving them insight on when to replenish inventory or help them locate and recover lost or stolen equipment and goods. McKinsey data shows that firms who implemented Industry 4.0

GLOBAL IoT CONNECTED DEVICES

Source: IoT Analytics data as of September 2021.



> "Globally, the number of connected IoT devices are expected to grow from 11.3 billion in 2020 to 27.1 billion by 2025."

technologies were able to respond to the COVID-19-induced supply chain crisis in 96% of cases, while those firms without these technologies were able to respond just 19% of the time.[11]

Towers and data centers combine innovation and real estate

Communications networks are essential digital infrastructure because they facilitate connections between the massive processing power of data centers and end users. Significantly, towers and data centers marry elements of growth-oriented technology investing and income-oriented real estate. Data centers provide physical space for customized server infrastructure while addressing cooling, power management, and security responsibilities, in exchange for regular fee payments. Data centers also serve a diverse set of clientele, including big tech companies, government agencies, financial services firms, and health care providers.

In 2020, the U.S. accounted for over 80% of new data center construction and expansion projects globally.[12] Investment in this infrastructure totaled more than $700 million.[13] But more is needed, as demands on digital infrastructure will only increase. The vastly improved bandwidth, latency, and speed that 5G networking technologies offer could be required for widespread adoption of advanced IoT-enabled devices like autonomous vehicles. However, current infrastructure is likely to crack under the additional load, [making the need for cell towers greater than ever](#).

Currently, there are approximately 128,000 macro cell towers in the U.S., but each tower only has so much range and capacity. A typical cellphone only has enough power to reach a tower up to 5–7 miles away, and a single Long Term Evolution (LTE) cell can only manage about 200 active device connections per 5 megahertz (MHz) of spectrum before speeds begin to slow.[14,15] The expansion of IoT means a higher demand for towers and wireless spectrum to ensure adequate coverage.

Tower demand is expected to remain robust with 6.37 billion active smartphone users globally.[16] But construction and permitting hurdles often limit expansion, making existing towers increasingly valuable. In the U.S., suppliers of macro cell towers increased tower capacity by about 8% from 2019 to 2020.[17] But over the same period, mobile data per smartphone increased 29%.[18] Taking a longer-term view, U.S. mobile data traffic has increased by 108x over the last decade, which indicates that much more tower capacity will be needed to meet data demand.[19]

Solutions for capacity constraints coming with 5G, continued investment

With more data being collected by sensor-enabled devices than ever, transferring information in a timely manner can be a challenge. 5G networks offer a potential solution. Next-generation wireless networks offer more spectrum over more channels, increasing the number of devices able to actively connect to a tower at once, and allocating additional bandwidth to each device. 5G also uses small cell antennas, which have much shorter ranges than their macro counterparts.

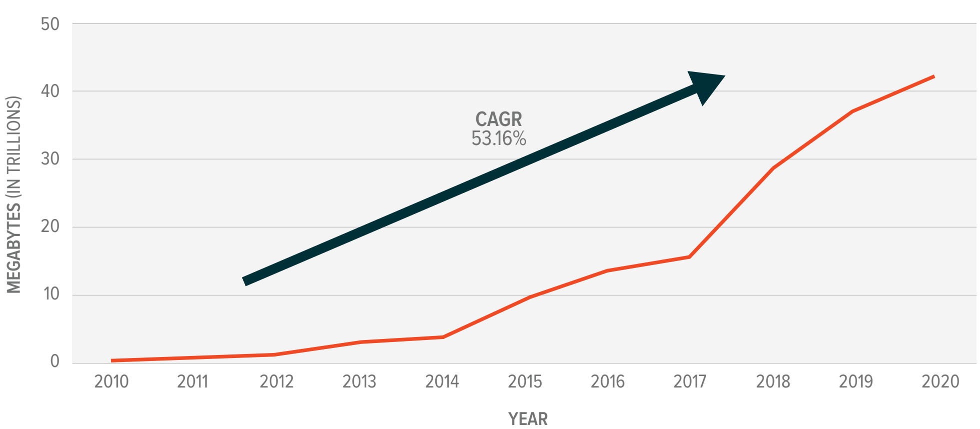
The overlapping coverage areas that small cell antennas create raise wireless coverage density, which improves connections while alleviating pressure on any one tower. Coverage remains spotty compared to the more established 4G networks, but 20% of new smartphone sales in the U.S. were expected to contain 5G chips by the end of 2021, so improvement is inevitable.[20]

Wireless network providers are increasing investment in digital infrastructure. Data from wireless communications trade association CTIA shows that the wireless industry invested $30 billion into infrastructure projects in 2020, the third consecutive year capital expenditures increased, and the largest year of investment in the last five. Between 2016 and 2020, the industry's investment in infrastructure totaled $140 billion. Over 417,000 new cell sites were built in 2020, a 35% increase from 2016.[21] Over the last two years, a lighter regulatory touch facilitated more cell site construction than in the previous seven years combined.

This investment is in addition to the almost $200 billion spent on wireless spectrum auctions over the same period.[22] Spectrum refers to the radio wave frequencies used to transfer wireless signals and is a core component of wireless communications. Auction winners are licensed to transmit on a larger swath of the electromagnetic spectrum, furthering the rollout of 5G technology and increasing the quality of end-user connectivity.

ANNUAL U.S. WIRELESS DATA TRAFFIC

Source: CTIA data as of 7/27/21.



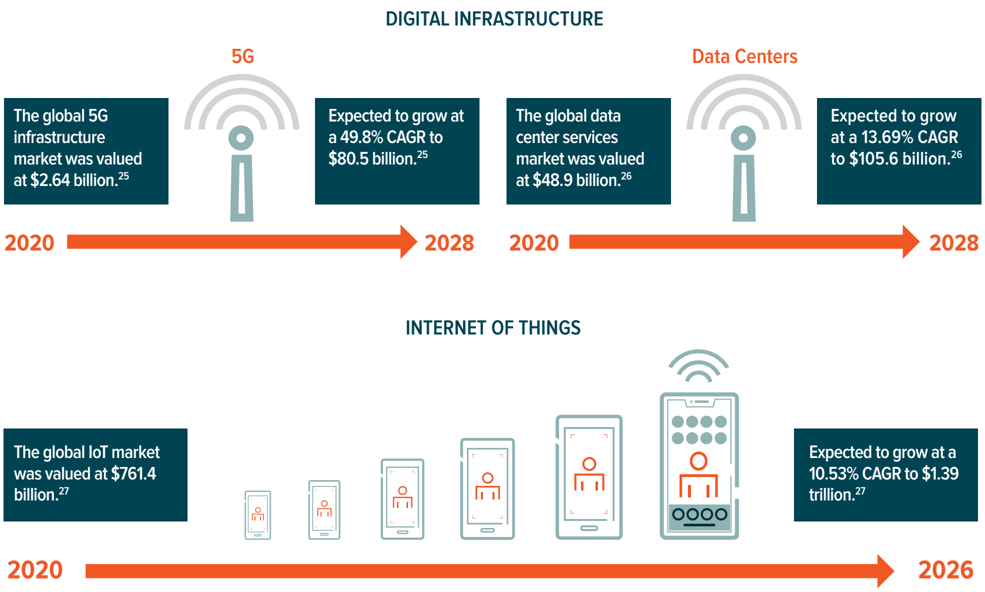
"Taking a longer-term view, U.S. mobile data traffic has increased by 108x over the last decade, indicating that much more tower capacity will be needed as data demand continues to expand."

RISKS TO THE CONNECTIVITY THEME

The semiconductor shortage is a headwind for IoT

Surging demand, including demand from 5G expansion plans, forced foundries to focus on high-margin production, typically the newest and most advanced chips. As a result, the production of lower-tier chips took a backseat. These commodity-type chips are typically used in consumer-focused IoT devices because they generally don't require the fastest networking or processing speeds. An estimated 20 million cellular chipsets will go undelivered due to shortages in 2021, influencing 80% of global manufacturers to report challenges producing digital products and services.[23,24] The result is increased prices and decreased availability of some connected devices, likely negatively affecting sales of consumer goods in the short term.

VISUALIZING THE MARKET OPPORTUNITY



Expanding opportunity that lays the foundation for the digital future.

The chip shortage also affects the 5G rollout because routers, switches, and base stations face longer delivery times. Smaller network providers indicate that equipment delays stalled deployments by 18–24 months.[28] These delays look to be more acute outside of the U.S., given the robust purchasing relationships and financial heft of the large U.S. networks.

IoT devices create more network vulnerabilities

IoT devices can be easy targets for cybercriminals due to the network integration of many endpoint devices. With more points of failure, network maintenance becomes a larger task, increasing the chances of a missed software update or incorrect device setup. Comcast estimates that U.S. households can be exposed to as many as 104 cybersecurity threats per month, with the most vulnerable devices being smart home gadgets.[29] The general market immaturity of connected devices is the main reason, as cybersecurity issues are often addressed after product creation and through firmware updates. Connected ecosystems such as Google's Nest and Apple's HomeKit could provide solutions, but the risk remains.

THEMATIC INTERSECTION WITH CONNECTIVITY

Robotics & AI and Cloud Computing

The Robotics & AI and Cloud Computing themes intersect with IoT, particularly from an industrial perspective. Industrial IoT can take many forms, but it mainly focuses on increasing operational efficiency via sensor-based monitoring. Future growth in the industrial space could stem from the integration of robotics, cloud computing and connected IoT devices to build smart, automated factories. Artificial intelligence (AI) utilities will rely on data gathered by IoT systems and sensors to present real-time insights about the world around them.

If AI is a system's brain, IoT acts as the digital nervous system. Connectivity will be essential, with private 5G and low power wide area (LPWA) networks playing a critical role in manufacturing automation that enables real-time and remote monitoring of autonomous systems. Juniper Research predicts that the industrial sector will account for over 70% of all IoT connections by 2024.[30]

Health & Wellness

Connected fitness trackers record some of the most intimate data an individual can produce. The health and wellness economy is growing, especially after the pandemic inspired many to be more active and conscious about their wellbeing. The global fitness tracker market grew 19.5% year-over-year in 2020, expanding at a faster rate than the overall IoT space.[31] Fifty-eight percent of U.S. consumers now use smartwatches or fitness trackers to quantify their daily steps, workouts, and sleep.[32]

Additional upside stems from clinical settings, where medical grade sensors can provide lifesaving information. For example, blood sugar tracking and advanced heart monitoring are two key growth areas, as they can take readings in real-time and then share and store patient data with their care team.

CONNECTIVITY IN A PORTFOLIO CONTEXT

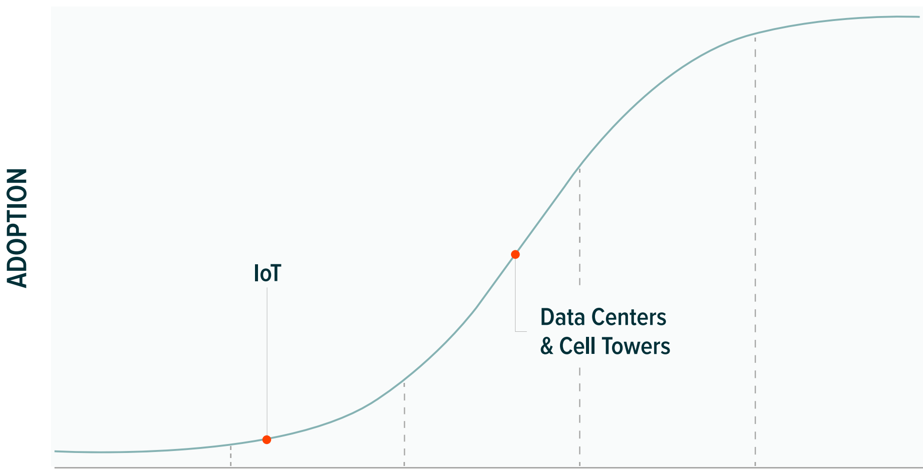
The Connectivity theme lives up to its name by connecting innovative technology and physical infrastructure. We believe this attribute makes the space particularly attractive from a portfolio perspective. Digital infrastructure is further along the adoption curve, falling into the core of the Early Majority phase, and indicating that adoption levels are high and rising. IoT is growing in interest, moving further into the Early Adopters phase, but remaining at a low absolute level.

The companies implementing Connectivity technologies are global and stand to benefit as thematic adoption rises across the world. The pie charts on the next page break down the geographic exposure of the largest Connectivity thematic ETF products. We believe there is ample innovation occurring outside of the states, and that limiting exposure to the U.S. will exclude key players to the detriment of investors over the long term.

In our view, thematic equity should be targeted, using screens to ensure the underlying companies provide the desired exposure. This pure play focus minimizes overlap between themes while also differentiating the exposure provided by the theme relative to broad beta products. We conducted an overlap analysis between Connectivity thematic ETFs, the S&P 500, MSCI ACWI and the most applicable S&P 500 sector ETF for each exposure, XLK

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021



ADOPTION	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
GROWTH	Slow	Medium	High	Medium	Slow

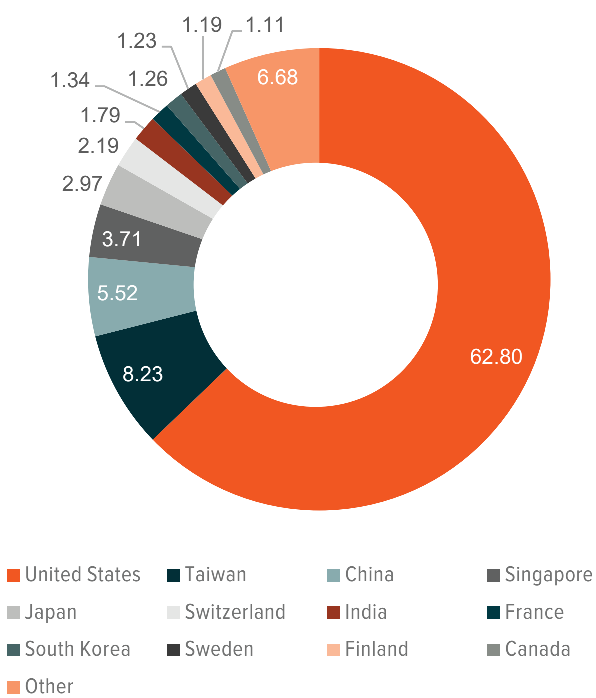
(Technology Select Sector SPDR Fund) for internet of things, and XLRE (Real Estate Select Sector SPDR Fund) for digital infrastructure. We found that average overlap by weight for internet of things was 8.9% when compared to the S&P 500, 7.2% vs. the MSCI ACWI, and 11.7% vs. XLK. Digital Infrastructure scored lower on broad indexes, 2.1% when compared to the S&P 500 and 1.3% vs. the MSCI ACWI, but scored much higher compared to XLRE at 28.0%.[33] These low levels of overlap with broad indexes reflect the benefits of thematic exposure.

The Connectivity theme continues to mature, creating attractive opportunities for long-term investors. The internet of things is now a core technology with connected consumer devices growing in capability and commonality while industrial applications catalyze the Fourth Industrial Revolution. Simultaneously, the digital infrastructure that this connectivity requires continues to advance, including 5G networking technology that provides users with wireless speeds that dwarf those of previous generations.

With data expected to increase exponentially, investment in digital infrastructure has skyrocketed in recent years with wireless providers looking to ensure that their networks can handle the demand. Investment in new and enhanced cell towers and data centers is another sign of the Connectivity theme's maturation, as they can democratize access to the massive processing power of the increasingly connected world.

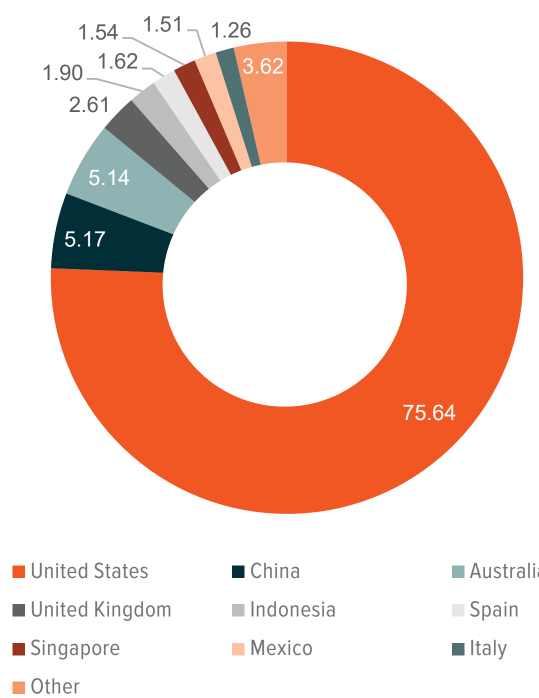
IOT: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of 12/31/21.



DIGITAL INFRASTRUCTURE: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

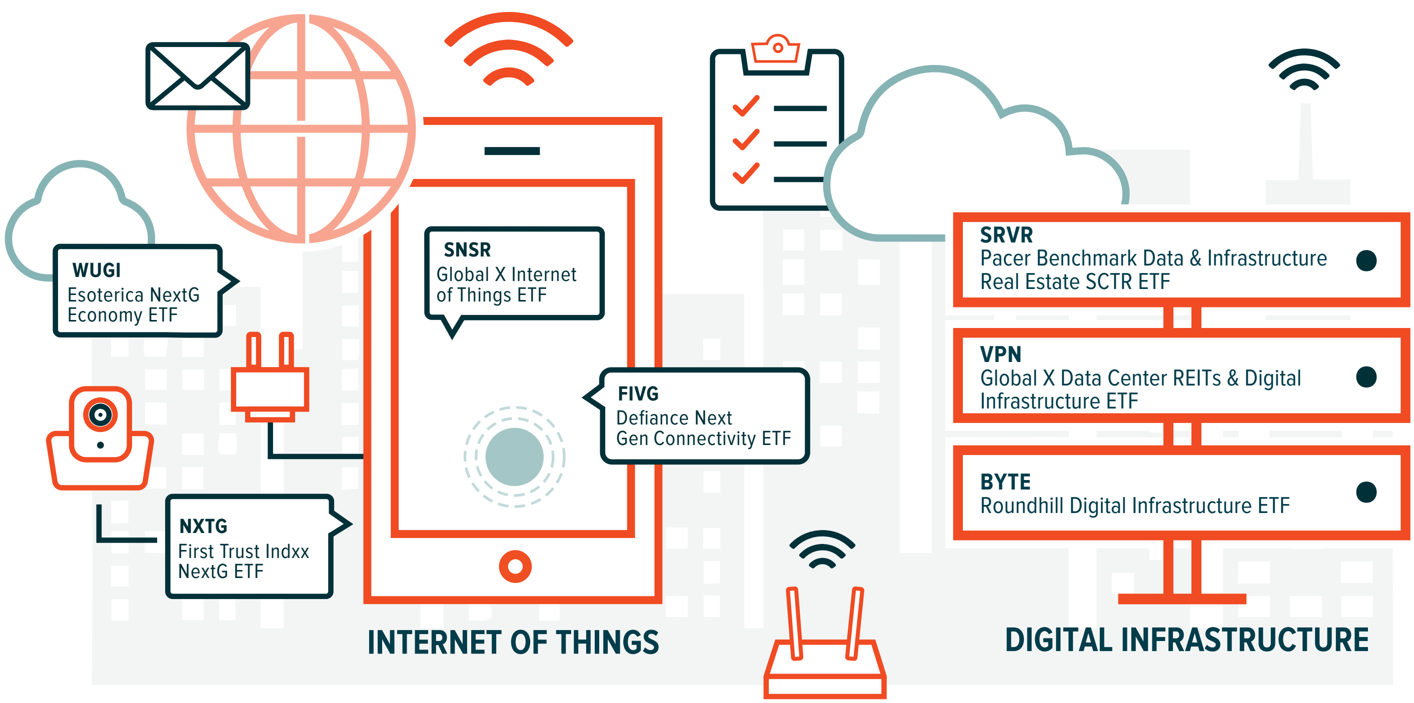
Source: Morningstar data as of 12/31/21.



Note: Pie charts include the largest four internet of things and all three digital infrastructure ETFs according to our thematic classification. All Thematic ETFs weighted the same.

HOW TO ACCESS CONNECTIVITY

The graphic below identifies some U.S. listed ETFs that provide direct exposure to the Digital Infrastructure and Internet of Things themes.



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How Data & Connectivity Relate to the Physical World

In the digital era, everything is becoming more connected and data dependent. Building on the growing pool of data and connections, improved automation systems are changing how processes are run, impacting the future of manufacturing and mobility.

KEY MEGA THEMES:

- Robotics
- Mobility

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ROBOTICS & ARTIFICIAL INTELLIGENCE

A constant throughout history is that humans continually look for ways to make work more efficient. With Robotics & AI themes creeping into everyday life, we believe automation is the next step in society's technological evolution. The adoption of robotic and AI tools combined with internet of things (IoT)-based sensors and massive scale cloud computing is sparking the Fourth Industrial Revolution (Industry 4.0), which we expect to increase the efficiency and effectiveness of factory-based production.

KEY TAKEAWAYS

- Robotics solutions look increasingly appealing as their costs fall while wages rise, populations age, and supply chain pressures persist, the result of which is likely a reshoring of manufacturing.
- By leveraging internet of things and cloud computing technologies, automated production systems can gain in efficiency, capability, and performance.
- The Robotics & AI theme is experiencing accelerating adoption, indicating entrance into the Early Majority stage, and signaling an attractive opportunity for portfolio positioning.

WHY ROBOTICS & AI IS SUCH A POWERFUL FORCE

Robotics and AI are the engines behind an impending Fourth Industrial Revolution

Like previous revolutions, the integration of new technologies could define Industry 4.0, key among them robotics and the internet of things. Together, these technologies are expected to create interconnected manufacturing systems that communicate, analyze, and use data to create positive feedback loops, adapt to changing needs, and increase productivity.

The pinnacle of effective robotic and networking integration is the smart factory — a completely automated production facility that uses data from connected devices to learn and adapt. With this predictive flexibility, smart factories may reduce downtime by auto-scheduling repairs and maintenance when input levels are low or finished product levels are high.

This next-generation production comes as trade wars, supply shocks, and a pandemic reminded the global economy of the fragility and interconnectivity of manufacturing networks. Globalization peaked around 2008, and since then countries have rethought their international trade dependence, reducing the global value of exported goods relative to GDP.[1] COVID-19 only expedited the deglobalization trend. In a 2020 Thomas Industrial survey of 746 manufacturing and industrial companies, 69% of respondents said that they were looking to bring production back to America, and 55% said that they were likely to invest in automation.[2]

Robot economics are becoming more cost-effective

As manufacturers eye domestic production, the significant cost differential between human and robotic labor grows in stature. Higher wages for humans make automated labor more attractive as firms look for ways to maintain price competitiveness. The average yearly U.S. manufacturing wage neared $50,400 in September 2021, up from $46,600 at the beginning of 2020.[3] So, for example, despite an estimated upfront cost of $250,000 for a sophisticated industrial robotic arm, a company could potentially break even in less than two years compared to what traditional labor costs.[4]

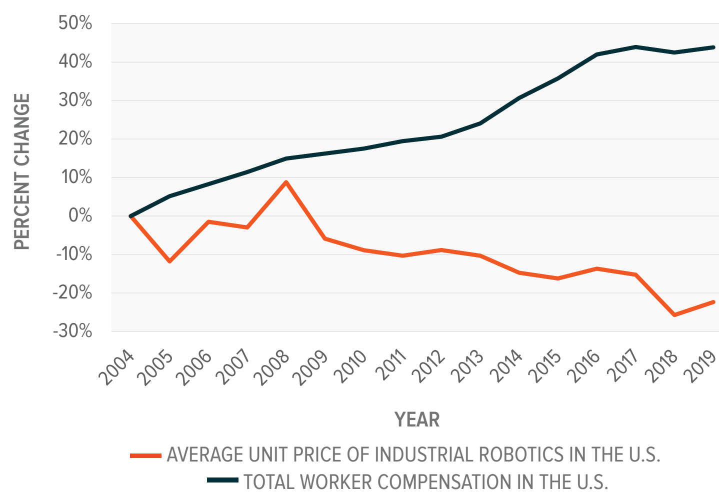
These economics are likely to become more attractive as robotics improve in function and affordability. The average robot price has fallen by more than 50% in real terms over the last 30 years, while labor costs have increased by more than 100%.[5] These cheaper robots are significantly more advanced than older versions. Along with higher dexterity, advanced 3D vision capabilities and swappable end-of-arm tooling create more dynamic robots that are able to perform multiple functions with the capability to improve with software updates.

Robotics can improve human productivity

Collaborative robots, also known as cobots, work alongside humans, taking on repetitive tasks that are prime sources of boredom and injury. This combination approach plays to the strengths of both labor sources because it decreases the error rate while increasing production efficiency.[6]

PRICE OF INDUSTRIAL ROBOTS VS TOTAL WORKER COMPENSATION IN THE US

Source: International Federation of Robotics, May 2021, Economic Policy Institute, February 2020.



An increasingly automated future may be necessary given the world's rapidly aging workforce. The World Health Organization (WHO) predicts that between 2015 and 2030 the proportion of the global population aged over 60 will nearly double from 12% to 22%.[7] Domestically, 65+ age bracket comprises an even larger percentage of the population at 16.3% as of the 2020 census, and it's expected to grow to 20%+ by 2030, surpassing the under 18 age group.[8,9]

This trend is positive overall because it suggests that people are living longer and healthier lives due to advancements in healthcare. However, with age comes metabolic and cellular decline that can compromise physical and mental capacity, which the workplace can expose. This lower productivity at the individual worker level translates into lower GDP growth nationally. A 10% increase in the fraction of the population aged 60+ decreases the growth rate of GDP per capita by 5.5%.[10] Robotics adoption can help offset these declines. A 1-unit increase in robotic density, or the number of robots per 10,000 manufacturing workers, increases labor productivity by 0.04% while potentially freeing up labor for use elsewhere in the economy.[11]

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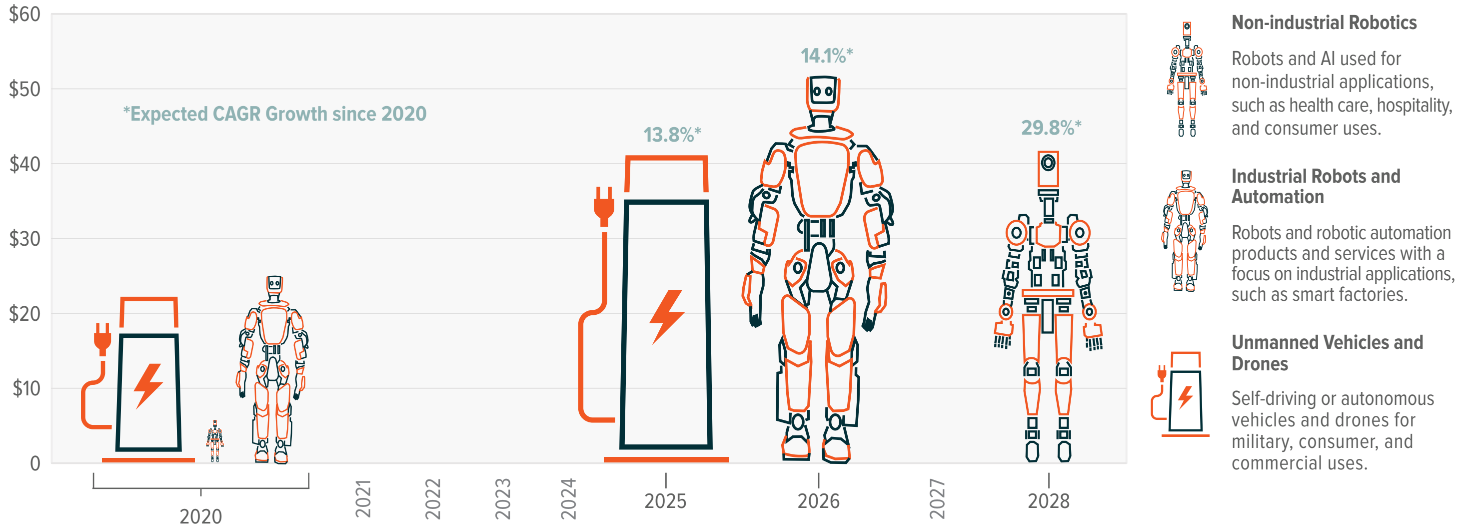
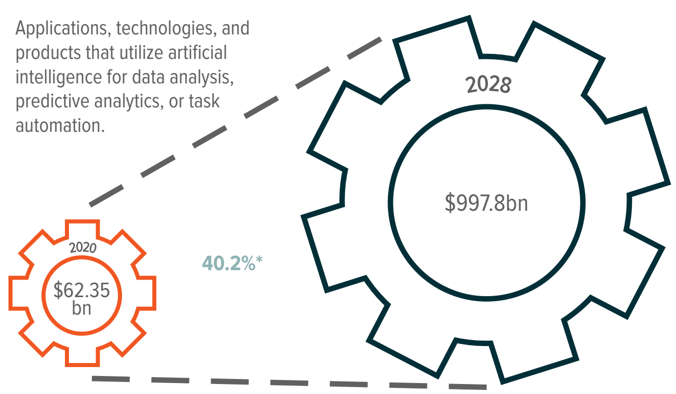
VISUALIZING THE MARKET OPPORTUNITY

ROBOTICS: EXPECTED GROWTH IN BILLIONS[12,13,14]



ARTIFICIAL INTELLIGENCE: EXPECTED GROWTH IN BILLIONS[15]



The global market for Artificial Intelligence applications is expected to expand at an impressive **40.2%** CAGR to reach **almost a trillion dollars in total value by 2028**.

RISKS TO THE ROBOTICS & AI THEME

A China slowdown could have an outsized impact

China is the largest and fastest-growing global market for robotics, having installed more industrial robots than the next four countries combined.[16] In Q1 2020, when Chinese factories were shuddered due to COVID-19, industrial robotic sales there fell by 20% year-over-year, and international suppliers felt the decline.[17] Then, as the rest of the world shut down and China returned to life, it installed more industrial robotics than the next 15 largest markets combined.[18] This surge resulted in the five largest industrial robotics suppliers by revenue deriving roughly 20% of their income on average from Chinese purchases during 2020.[19]

Regulatory risks could dampen U.S. adoption

The U.S. could catch up to China as reshoring of manufacturing continues. However, a risk to large increases in domestic robot density is that it can result in public backlash. We see the potential for robotics adoption to rise alongside income inequality, and we see the potential for policy makers to respond by enacting new taxes and regulations. So-called robot taxes would serve two purposes: To disincentivize firms from replacing workers with robots and to supplement lost payroll tax revenue. By design, these policies would be destructive for the Robotics & AI theme. While not a near-term issue, if such policies were to have any chance of passing in the future, the stock price reaction would likely be dramatic.

Manufacturing is particularly exposed to cyber threats

Like any technology, robotics manufacturers can be hijacked by malicious actors, whether cybercriminals, competing companies, or foreign states. Verizon data shows that the manufacturing industry had the third-highest level of large-scale data breaches in 2020, with system intrusions due to hacking and malware especially common.[20] Unauthorized access is a particular concern because most robotic systems are designed to interact with and manipulate objects in the real world.

However, cybersecurity programs remain underfunded. Manufacturers typically operate on thin margins, leaving cybersecurity a lower priority than capex spending that can increase productivity or output. According to information technology solutions company CDW, just 22% of manufacturing firms who experienced an attack in recent years increased their cybersecurity budgets, while about half did nothing at all.[21] As production continues to automate, securing connected devices will require additional investment.

THEMATIC INTERSECTION WITH ROBOTICS & AI

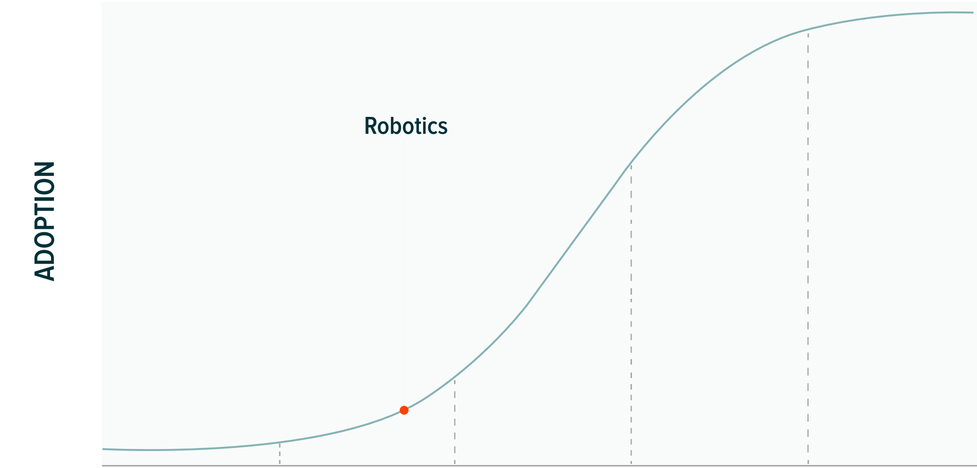
Internet of Things and Cloud Computing

The Robotics & AI, IoT, and Cloud Computing themes fit together perfectly. The IoT theme likely represents the biggest integration opportunity because IoT sensors are core to Industry 4.0 and smart factory trends. As sensor costs continue to fall, the accuracy and availability of data captured from robotic systems may increase. These developments should create a positive feedback loop spurring robotic purchases as updated sensor packages increase the effectiveness of machines young and old.

Cheaper processing power due to further maturation of the Cloud Computing theme allows AI tools to make quicker and more accurate judgements from sensor data. We expect such insights to drive efficiency gains, and increased factory performance could promote expansion via further robotics spending.

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021.



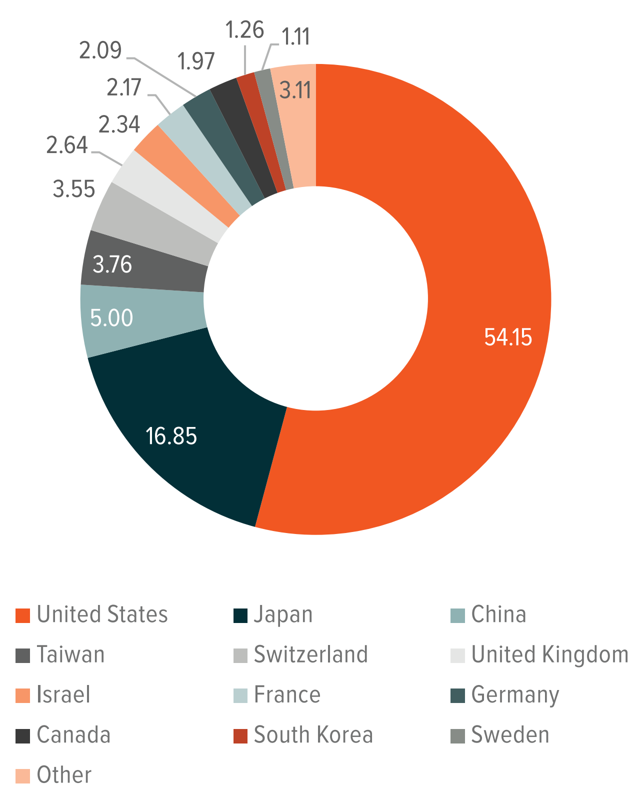
ADOPTION	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
GROWTH	Slow	Medium	High	Medium	Slow

Cybersecurity

The downside of all this connectivity is that manufacturers are regular targets for digital intrusions. We expect their responses to this growing threat to improve significantly due to the increasing cost of malicious activity and the growing integration of technology in production. To this end, increased spending on robotics necessitates increased spending on cybersecurity initiatives. Co-positioning with the Cybersecurity theme may help to lessen cybersecurity risks from the roboticized manufacturing space.

ROBOTICS AND AI: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of 12/31/21.



Note: Pie chart includes the largest five robotics and AI ETFs according to our thematic classification. All Thematic ETFs weighted the same.

ROBOTICS & AI IN A PORTFOLIO CONTEXT

The Robotics & AI theme is quietly humming along, integrating itself into the global economy. Falling squarely into the Early Adopters phase, robotic penetration levels are moderate today, but are accelerating quickly, as technological advancements enable Robotics & AI to play increasingly impactful roles. We believe that adoption levels are set to expand rapidly in the coming years, as firms and individuals leverage robot and AI tech in new and exciting ways.

The companies implementing Robotics and AI technologies are global and stand to benefit as thematic adoption rises across the world. The pie chart breaks down the geographic exposure of the largest Robotics and AI thematic ETF products. We believe there is ample innovation occurring outside of the states, and that limiting exposure to the U.S. will exclude key players to the detriment of investors over the long term.

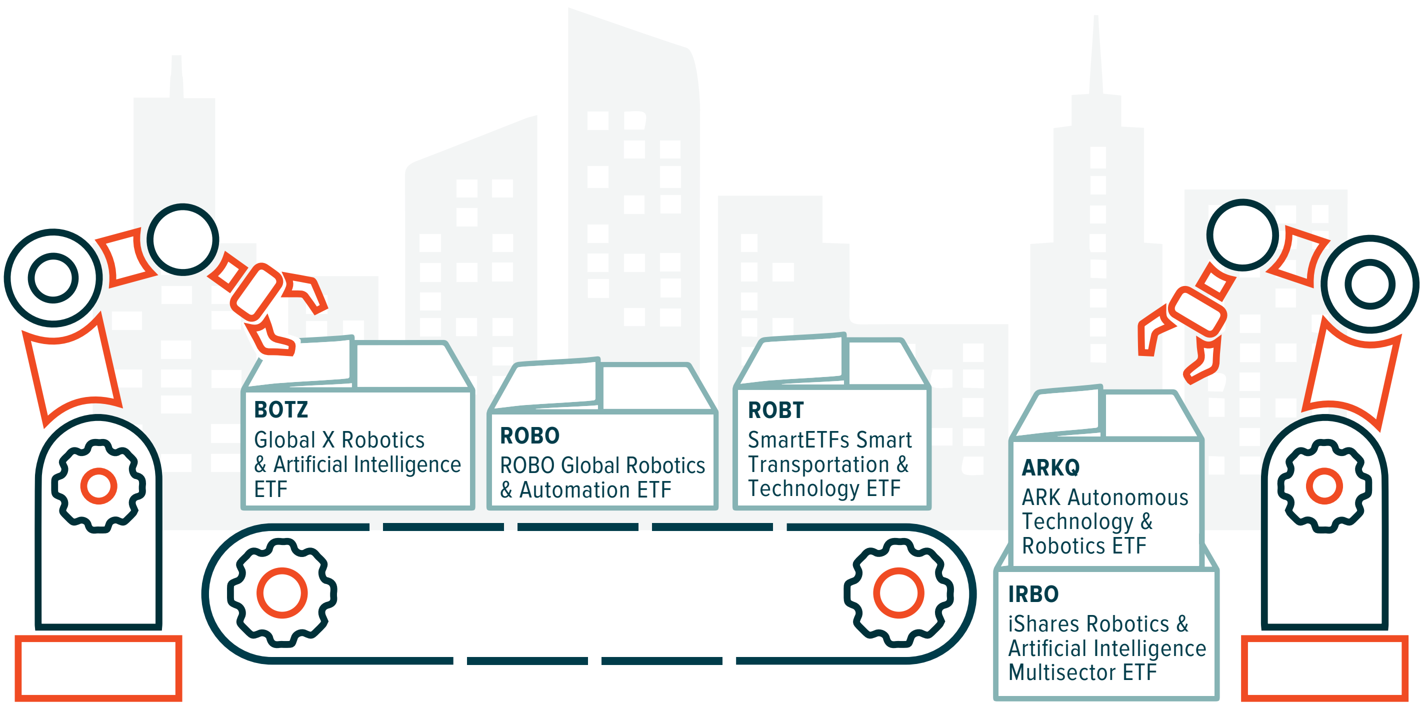
In our view, thematic equity should be targeted, using screens to ensure the underlying companies provide the desired exposure. This pure play focus minimizes overlap between themes, while also differentiating the exposure provided by the theme relative to broad beta products. We conducted an overlap analysis between Robotics and AI thematic ETFs, the S&P 500, MSCI ACWI and the most applicable S&P 500 sector ETF, XLI (Industrial Select Sector SPDR Fund). We found that average overlap by weight for Robotics and AI focused ETFs was 5.7% when compared to the S&P 500, 5.2% vs. the MSCI ACWI, and 2.4% vs. XLI.[22] Common holdings included medically focused robotics producers, semiconductor firms that produce AI chips, and heavy machinery manufacturers, collectively totaling just a handful of individual companies. These low levels of overlap with broad indexes reflect the benefits of thematic exposure.

The Robotics & AI theme sits at the crossroads of multiple structural trends that are expected to increase adoption in the coming years. Rising inflation, supply chain disruptions, deglobalization, and aging populations have firms exploring solutions to enhance manufacturing efficiency and reduce costs. As automation becomes increasingly capable, cheaper, and easier to implement, reshoring will likely accelerate as firms see that the benefits of more localized manufacturing outweigh the risks of producing goods far abroad.

From this perspective, the space looks primed for investment as catalysts drive Robotics and AI adoption into the Early Majority stage. The global average robotic density is at just 126 per 10,000 employees, illustrating the scale of the opportunity as automation begins to answer the problems of today with the machines of tomorrow.[23]

HOW TO ACCESS ROBOTICS & AI

Eleven U.S. listed ETFs provide direct exposure to the Robotics & AI theme, the graphic below identifies the five largest.



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MOBILITY (EV/AVs & LITHIUM/ BATTERY TECHNOLOGY)

Electronic and autonomous vehicles (EV/AVs) highlight the Mobility theme's potential, as they represent an entirely new class of everyday consumer goods and services that use artificial intelligence (AI) for their core functionality. The EV/AV revolution runs parallel to electrification via lithium-based batteries, a similarly influential component of Mobility. As disruption in the transportation sector takes hold, we expect the benefits of EVs, AVs, and lithium battery technologies to proliferate across the global economy.

KEY TAKEAWAYS

- Consumer appetite for EVs is high. A recent survey revealed that 7 out of 10 U.S. drivers would be interested in buying when EV charging infrastructure expand, and EV costs drop.[1]
- Better lithium-ion technology will increase the amount of lithium used in each EV battery. Lithium demand is expected to more than double from 300,000 mt in 2020 to 1 million mt by 2025 and reach 2 million mt by 2030.[2]
- We expect the integration of robotics, AI, and internet of things (IoT) technologies to propel the Mobility theme and eventually the adoption of fully autonomous EVs.

WHY AV AND EVS ARE SUCH POWERFUL FORCES

Mobility is becoming cleaner, smarter, and more autonomous

Using AI to compute billions of data points per second supplied from an array of sensors, cameras, and radar systems, AVs can effectively see the road and respond accordingly to changing conditions. By communicating with and integrating data from neighboring vehicles and even the roadways at large, AVs are expected to reduce accident rates, increase throughput and decrease travel time.

Fully autonomous vehicles remain years away, but it's not too early to project the economic efficiencies they could bring. Trucking company Ryder estimates a fully autonomous truck and transfer hub network could reduce costs by 29–40%, decreasing empty trailer time while increasing flexibility.[3] Such efficiency gains would revolutionize domestic supply chains, increasing the availability of lower-priced goods. Effective AV technology will also allow non-commercial drivers to reclaim hours each day spent commuting, which currently total 70 billion hours per year in the U.S.[4] This found personal time represents a massive opportunity because it creates a distinct space for rest, relaxation, content consumption and productivity.

Regulation remains a key consideration for the development of autonomous vehicles. Recently, the U.S. National Highway Traffic Safety Administration (NHTSA) issued new rules for future fully autonomous vehicles, providing some regulatory clarity to AV OEMs. The new rules eliminate the requirement for driverless vehicles to include manual controls, such as pedals and steering wheels. This change could accelerate the path-to-market for AVs by bringing regulatory policy more in line with the AV development cycle, while ensuring safety standards.

EVs are nearing broad market adoption

With over 1.8 million EVs registered in the U.S. as of the end of 2020, many Americans are already zooming around in emission-free vehicles.[5] U.S. adoption of electric vehicles slowed in 2021 despite increasing in other regions of the globe. Given polls showing that 7 out of 10 U.S. drivers are interested in buying an EV should charging infrastructure proliferate and costs drop, we believe that a confluence of policy changes and technological advancement will spark higher adoption rates.[6]

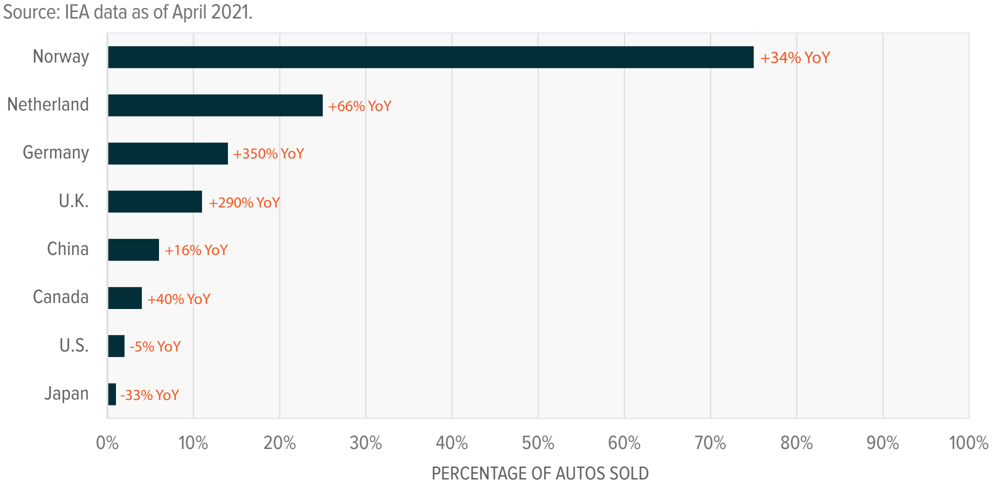
Norway, the global leader in EV adoption, offers a roadmap. In 2020, 75% of cars sold in Norway were electric.[7] The country plans to sell its last internal combustion engine (ICE) vehicle in 2025, a rapid transition sped up by aggressive policy changes. Polices include an exemption of EVs from a value added tax (VAT) and vehicle purchase taxes, which in some cases can lower the purchase cost by nearly 50% compared to an equivalent ICE vehicle. Another perk is EV access to bus lanes, which can shorten travel times.[8] The World Economic Forum believes these polices closed the price gap between EVs and ICE vehicles in Norway.[9]

U.S. to ramp up investment in charging infrastructure

The U.S. lags many European nations due in part to limited EV incentive structures. Forty-five states and D.C. offer some form of incentive, but the federal government hasn't passed any new subsidies since 2009, and many popular EV models are no longer eligible.[10] President Biden's Build Back Better bill may be able to address this relative shortfall by restructuring incentive programs and offering expanded tax credits should vehicles meet a wider set of conditions. The bill's passage remains uncertain, but it indicates that policy makers recognize that an enhanced incentive program is key to spur domestic EV adoption.

EV'S SHARE OF AUTOS SOLD IN 2020

Source: IEA data as of April 2021.



Note: Above reflects select markets. Other markets may have +/- EV share, though Norway leads.

> "Over **1.8 million** EVs registered in the U.S. as of 2020. In the same year, **75%** of cars sold in Norway were electric."

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In the geographically expansive U.S., the build-out of charging infrastructure will take time. The number of public charging stations has more than tripled since 2015, but the U.S. has a long way to go. EV charging stations total roughly 48,400, with just 5,398 classed as DC Fast Chargers, compared to more than 150,000 gas stations.[11,12] More DC Fast Chargers are essential, as less powerful options can take substantial time to recharge, increasing the perceived inconvenience of EVs. The $7.5 billion in grant funding for a national network of charging stations contained in the Infrastructure Investment and Jobs Act will not solve the charger shortage. However, it is the first federally lead investment in charging infrastructure, and it could portend the strategic direction of future funding.

Private investment is following suit with original equipment auto manufacturers and independent charging companies expanding their networks. Tesla and Electrify America, a subsidiary of Volkswagen, pledged to triple and double the size of their charging networks, respectively, over the next two years. Sizable private investment alongside public support will likely be able to address infrastructure shortfalls in the coming years.

Another factor working against large-scale adoption of EVs thus far in the U.S. and elsewhere is their premium cost. Incentives such as tax breaks and rebates may help close this gap, based on the success of such programs in Europe and China. But even without subsidies, EVs are expected to be cheaper than ICE vehicles in only about five years as battery costs continue to fall.[13]

Cheaper batteries are expected to lower EV prices

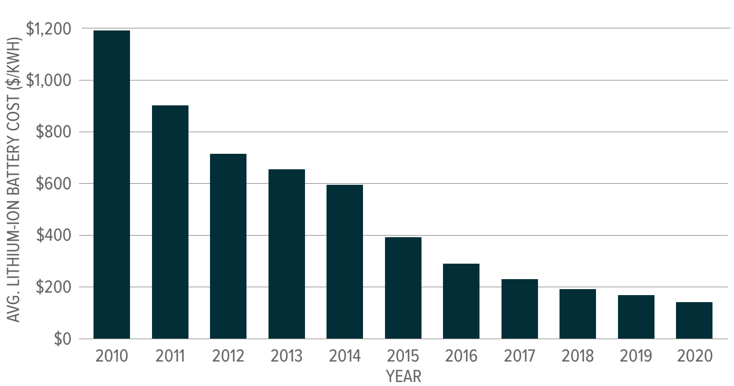
Global X Research estimates that battery costs could be cut in half by 2030.[14] Worldwide, the lithium battery market is expected to grow by a factor of 5–10x over the next decade.[15] As of this writing, supply restrictions and rising demand increased lithium prices by 225% in 2021.[16] Lithium demand is expected to more than double from 300,000 mt in 2020 to 1 million mt by 2025, and then reach 2 million mt by 2030.[17]

At the core of each battery is lithium metal. As demand grows, EVs could use up to 75% of all newly mined lithium by 2025.[18] As the 33rd most common element in the Earth's crust, there is no shortage.[19] But it takes time to bring additional supply online. Improvements to lithium-ion technology will increase per battery lithium utilization. Currently, most batteries use lithium in the cathode component, while next-generation batteries will likely place lithium in the anode as well.

Transitioning to a green energy economy will also require massive capacity of long-duration, grid-scale storage. Lithium-ion batteries are the most common battery storage option today, accounting for more than 90% of global grid battery storage.[20] Lightweight and energy dense, lithium-ion batteries discharge quickly and can be assembled into modular and flexible energy storage systems.

DECLINING BATTERY COSTS SHOULD DRIVE EV & LITHIUM DEMAND

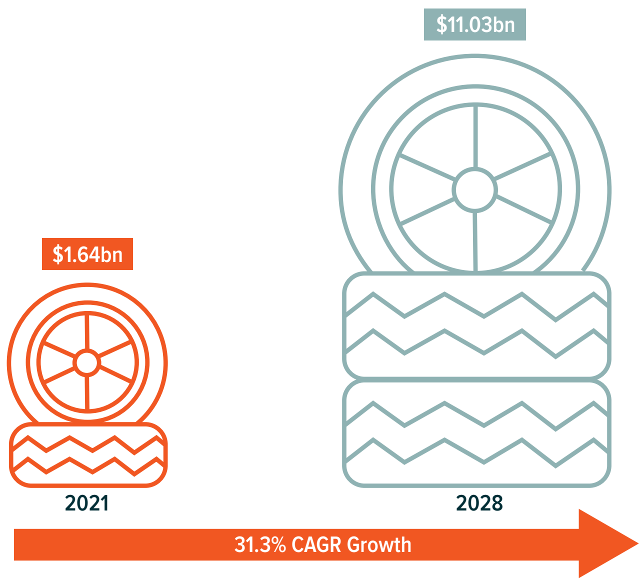
Source: Bloomberg New Energy Finance data as of December 2020.



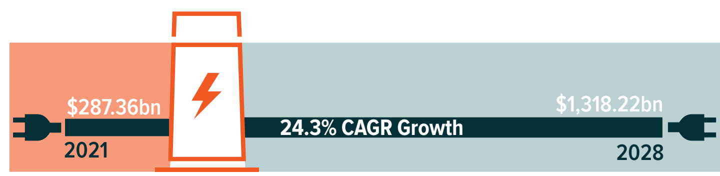
The Hornsdale Power Reserve in Australia, the largest lithium-ion battery installation in the world when built, prevented a cascading blackout in 2017 when a large coal power plant fell offline. The storage system supplied several megawatts of power within milliseconds and supported the grid until another plant came online. This capability demonstrates the benefits of battery storage, even outside of a renewables context.

VISUALIZING THE MARKET OPPORTUNITY

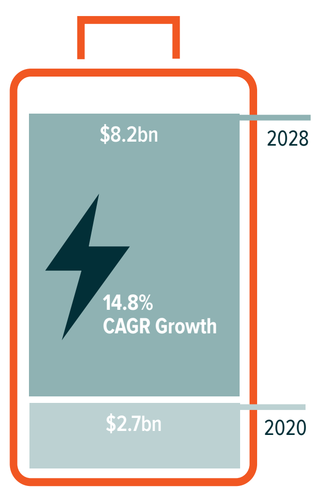
EXPECTED GROWTH IN GLOBAL AUTONOMOUS CARS MARKET[21]



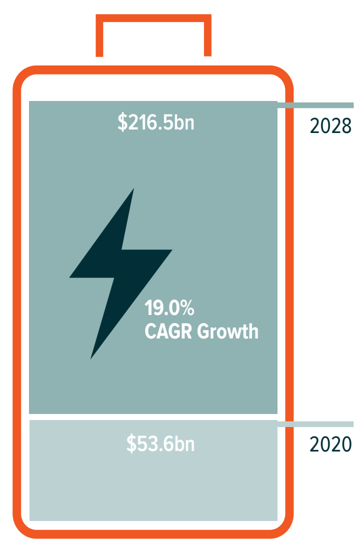
EXPECTED GROWTH IN GLOBAL EV MARKET[22]



EXPECTED GROWTH IN GLOBAL LITHIUM MINING MARKET[23]



EXPECTED GROWTH IN GLOBAL LITHIUM-ION BATTERY MARKET[24]



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RISKS TO THE MOBILITY THEME

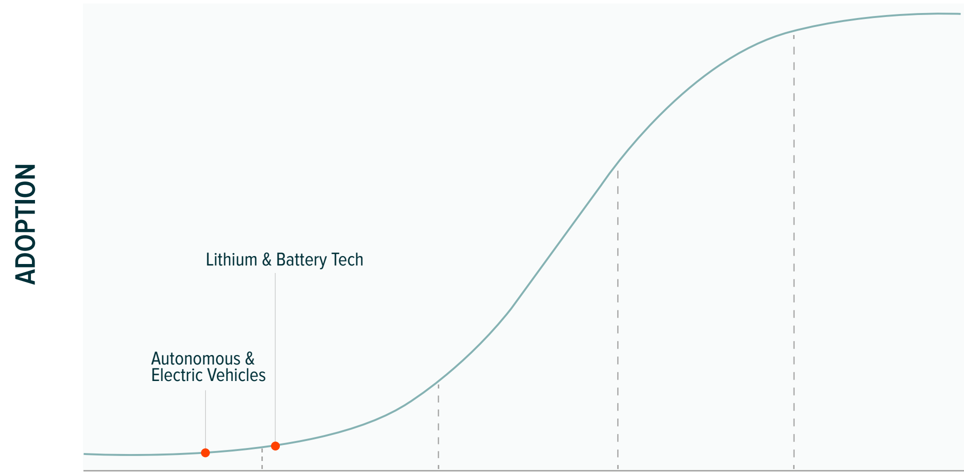
Restrictive regulations could stunt adoption

We believe the main risk to the adoption of fully autonomous vehicles is a mismatch between their technological advancement and consumer expectations. According to the National Highway Traffic Safety Administration (NHTSA), the highest level of autonomous systems currently available in the U.S. is Level 3, where the automated driving system can perform all aspects of driving under some conditions. However, a human driver must be ready to take back control at any time.[25]

Object detection and classification failures by autonomous systems have led to driver and pedestrian fatalities due to driver negligence. Such events are rare but well-publicized, and they can result in state governments restricting autonomous vehicle testing on their roads. For example, California banned a leading ride share company's self-driving cars for nearly two years following a 2018 crash that resulted in the first documented death of a pedestrian.[26]

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021.



ADOPTION	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
GROWTH	Slow	Medium	High	Medium	Slow

Environmental costs can be high

EVs and battery technology represent green tech, but another risk to the Mobility theme is that they have their environmental problems, too. Extraction and processing of any raw material creates externalities, and lithium is no different. The two most common extraction methods source the metal from underground brine reservoirs or mined lithium containing rocks.

Both methods create carbon emissions while using water and land resources. On average, producing a ton of lithium from hard rock sources yields 9 tons of CO2, reducing emissions savings of end-use applications.[27] Newer methods such as brine recovery limit emissions to a third of traditional methods, but they can cause other issues such as watershed contamination.[28] With focus shifting to more holistic supply chains, these issues may grow in stature.

Connected vehicles create opportunities for cybercriminals

Like other themes that rely on connectivity, cybersecurity is a risk for Mobility. In a now-famous story from 2015, Wired magazine worked with a hacker group to demonstrate the vulnerabilities in connected vehicles.[29] Remotely accessing a Jeep while it was traveling 70 mph on a highway, the hackers cut engine power, engaged and then removed access to breaks, and changed radio and climate settings. This specific vulnerability was patched, but it illustrates the potential risks consumers face as vehicles become increasingly computerized and connected. To identify and mitigate similar risks, we expect cybersecurity investments from automobile OEMs to increase.

THEMATIC INTERSECTION WITH MOBILITY

Robotics & AI

At the heart of modern-day vehicles is a digital brain powered by a specifically trained AI, the most advanced of which currently enables driver-assist features such as lane departure monitoring. Eventually, this technology could enable full self-driving capabilities. Improvements in these deep learning-based image recognition systems and EV-specific semiconductors could dramatically increase operations per second performance, boosting the speed and ability with which autos model the road environment. This software layer can be improved more rapidly than hardware, and it can be updated and enhanced after a car rolls off of the lot.

Internet of Things

The Internet of Things theme is central to autonomous driving systems, particularly the use of sensor technology. Aggregating real-time traffic data could allow vehicles to more accurately model the world, planning out routes to increase traffic flow and improve safety. Connected sensor-based EV charging stations could monitor the number of EVs in route for a recharge, reducing downtime by automatically scheduling charger maintenance when expected vehicle demand is low. Sensors could also help route incoming vehicles to ideal charging locations with current availability.

MOBILITY IN A PORTFOLIO CONTEXT

The Mobility theme is earlier on in its life cycle than others within our coverage. While adoption of electric vehicles is gaining steam, the theme remains in the Innovators phase, held back by today's self-driving limitations. There are few pure-play EV/AV companies and even fewer are publicly traded. The space is dominated by a large pioneer, while more classical auto OEMs play catchup. Lithium and battery technology is slightly farther along, entering the Early Adopters phase as commercial uses grow and begin to scale. Over the coming years we expect both Mobility themes to progress further into the Early Adopters stage where growth accelerates while remaining at a low absolute level.

Mobility technologies are global and stand to benefit as thematic adoption rises across the world. The pie charts, on the next page, break down the geographic exposure of the largest Mobility thematic ETF products. We believe there is ample innovation occurring outside of the states, and that limiting exposure to the U.S. will exclude key players to the detriment of investors over the long term.

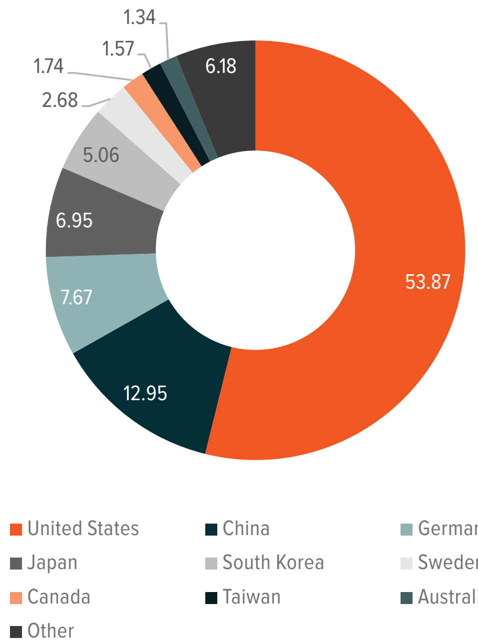
In our view, thematic equity should be targeted, using screens to ensure the underlying companies provide the desired exposure. This pure play focus minimizes overlap between themes while also differentiating the exposure provided by the theme relative to broad beta products. We conducted an overlap analysis between Mobility thematic ETFs, the S&P 500, MSCI

ACWI and the most applicable S&P 500 sector ETFs for each exposure, XLY & XLK (Consumer Discretionary and Technology Select Sector SPDR Funds) for electric and autonomous vehicles, and XLB (Materials Select Sector SPDR Fund) for lithium and battery technology. We found that average overlap by weight for EV/AVs was 8.3% when compared to the S&P 500, 6.7% vs. the MSCI ACWI, 7.4% vs. XLY and 8.3% vs XLK. Much of this overlap stems from traditional vehicle OEMs and large technology companies innovating in the space. Lithium and battery technology scored lower across the board, 2.0% when compared to the S&P 500, 1.6% vs. the MSCI ACWI and 1.9% compared to XLB.[30] These low levels of overlap with broad indexes reflect the benefits of thematic exposure, as sector indexes have yet to include substantial exposures towards Mobility themes.

Mobility innovation represents one of the most tangible areas of technological advancement for the average consumer. Battery costs are falling, while technology and performance are improving dramatically. Soon, EVs won't be a luxury choice, but an economical one. Over the next decade, electrification and automation technologies may merge to forever alter nearly all forms of transportation. The ways we commute, travel and trade could receive an upgrade, powered by a new generation of lithium-based batteries and artificial intelligence. Electric vehicles are at the precipice of transforming the automobile market, and look to be an attractive investment opportunity for years to come.

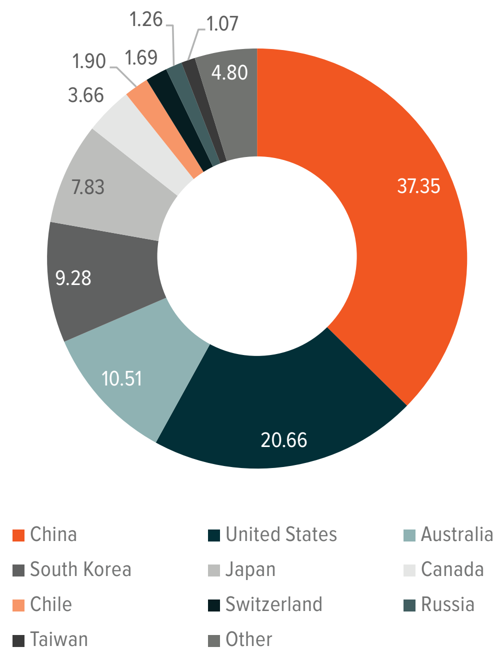
ELECTRIC & AUTONOMOUS VEHICLES: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of 12/31/21.



LITHIUM & BATTERY TECHNOLOGY: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

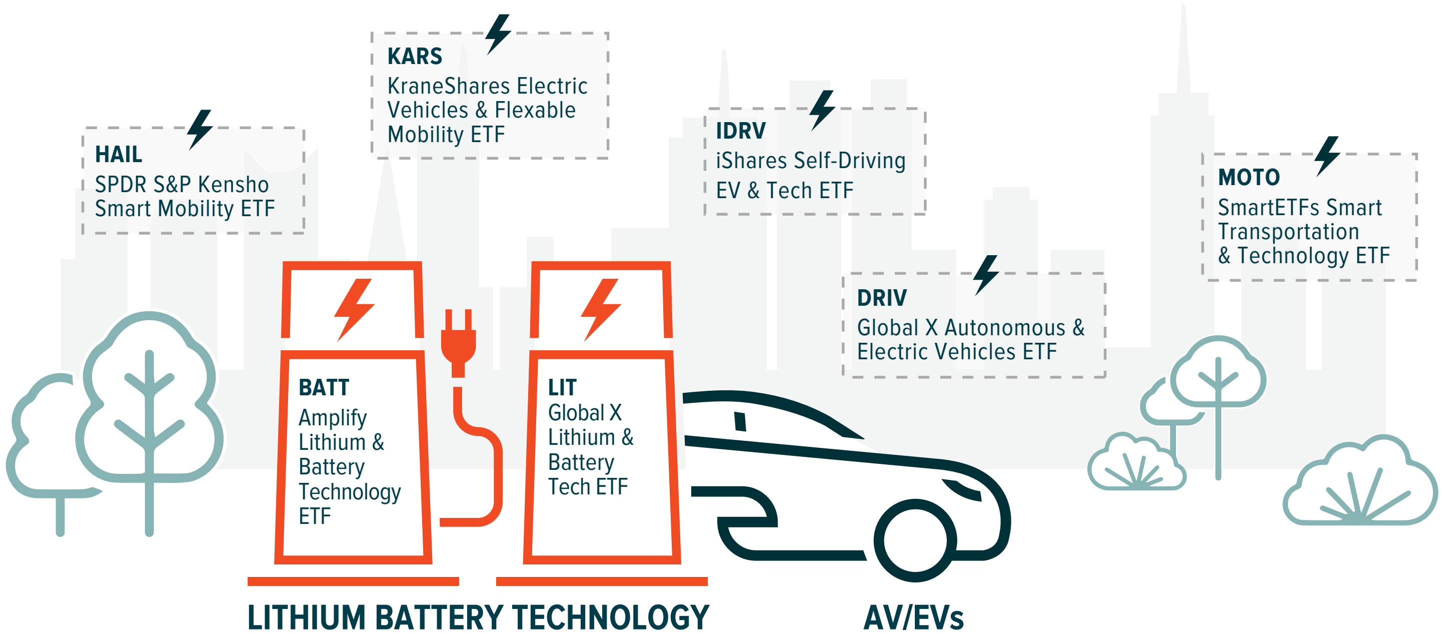
Source: Morningstar data as of 12/31/21.



Note: Pie charts include the largest five electric and autonomous vehicles and all two lithium and battery technology ETFs according to our thematic classification. All Thematic ETFs weighted the same.

HOW TO ACCESS MOBILITY

The graphic below identifies some U.S. listed ETFs that provide direct exposure to the Mobility theme through AV/EVs & lithium/battery technology.



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How Data & Connectivity Relate to the Digital World

As the world becomes more digital, themes naturally converge. The metaverse, which some consider the next iteration of the internet, will transform interactions between humans and computers which could transform social interactions, commerce and so much more. Experiences in the digital world are expanding, and so too are ways to monetize engagement.

KEY MEGA THEMES:

- Digital Experiences
- FinTech

DIGITAL EXPERIENCES (SOCIAL MEDIA AND VIDEO GAMES & ESPORTS)

In 1996, Bill Gates published an essay entitled "Content is King" in which he detailed how content would capture the lion's share of profits created by the burgeoning internet. His view hinged on users becoming personally involved with the content that they consume. Gates proved prophetic, as digital experiences grew to influence all walks of life economically, politically, and, of course, socially. As an investment theme, we believe Digital Experiences, including Social Media and Video Games & Esports, offers compelling opportunities because of the ongoing quest to monetize the attention of content consumers as the world becomes increasingly digital.

KEY TAKEAWAYS

- Social media and video game technology combine to increase user retention and engagement across social and gaming platforms. As competition in the digital economy intensifies, we expect investment in the Digital Experiences theme to grow alongside it.
- Total social media advertisement spending is expected to reach $177 billion in 2022, overtaking television as the largest advertising market.[1]
- Mobile gaming is the largest and fastest growing video game segment, boosted by widespread smartphones adoption and readily accessible casual, free-to-play games. Revenues increased 7.3% in 2021 to reach $93.2 billion[2] and is expected to grow to $218.7 billion by 2024.[3]

WHY SOCIAL MEDIA AND VIDEO GAMES & ESPORTS ARE SUCH POWERFUL FORCES

Digital Experience platforms boast large user bases. Today, more than half of the global population (7.87 billion people) use social media.[4,5] Video games reach a slightly smaller portion of the global population, with over 40% playing video games in some form.[6] Historically, user growth was the main method of expansion for Digital Experience firms, but now they're shifting towards increased engagement and monetization.

Maximizing monetization

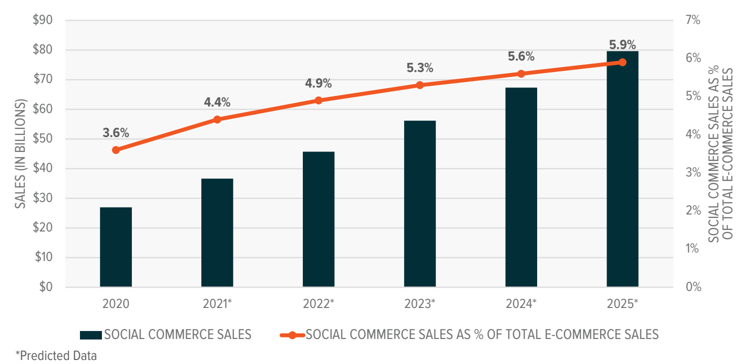
Social media platforms now focus on maximizing the revenue generated from each user. One way they do that is by selling more ads for more dollars. In 2021, global social media advertising revenue reached $148.8 billion, equivalent to 20% of total global ad spending, or about a third of all online ad expenditures.[7] Also, platforms are developing innovative new technologies, such as integrating in-app purchases and cash transfers, enabling augmented and virtual reality experiences (AR/VR), and more as they search for additional revenue streams. The metaverse, which is more of an emersion experience, and may eventually become a fully formed digital economy, could be the next digital frontier.

Advertisement services company Zenith Media predicts that social media will be the fastest growing advertising channel between 2021 and 2024. Total social media ad spend is expected to reach $177 billion in 2022, overtaking television as the largest advertising market as brands leverage social media to spur further growth in ecommerce.[8]

Using social networks for commerce

Combining the visual and curated nature of social media with the ease of in-app purchases, social commerce can help capture customers' attention and reduce friction in the purchasing process. Eighty-three percent of Instagram users say they discover new products on the platform, indicating the size and scope of the opportunity.[9] Social commerce excels alongside influencer partnerships, as adding a known face to marketing efforts can sway consumer purchasing decisions. Among internet users in the U.S. and UK, influencers directly impact the purchases of nearly 1 in 5 social media users.[10]

SOCIAL COMMERCE SALES IN THE UNITED STATES
Source: eMarketer data as of February 2021, Global X Research



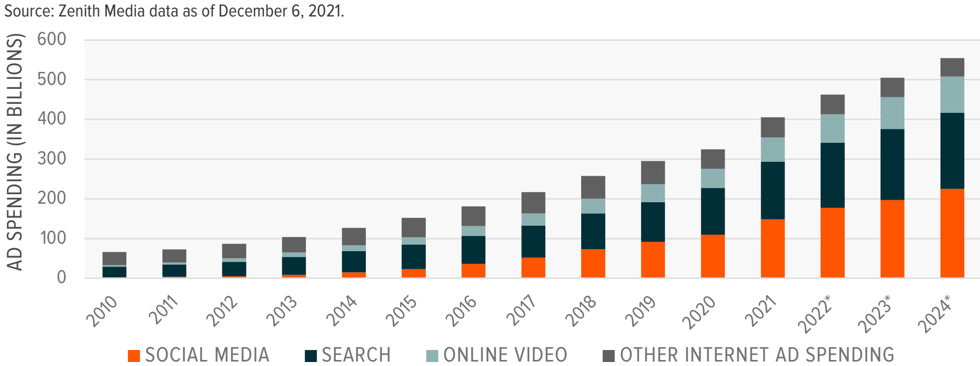
*Predicted Data

Moving into the metaverse

The metaverse, where the virtual world becomes a place to meet, work, and transact, is the next major step for social media. The company formerly known as Facebook, now Meta Platforms, is betting its future on the metaverse. Accessed via virtual reality headsets, such as Meta's Oculus, the rise of the digital economy within the metaverse is likely to feature new methods of shopping, socializing, and gaming that leverage the latest technologies to create exciting new digital experiences.

Many of today's metaverse platforms draw inspiration from the video games of the past. Debuting in 2003, Second Life was a virtual world where players could replicate much of their day-to-day lives, designing avatars, communicating, designing virtual objects, and conducting commerce. The game even coined the metaverse's first millionaire in 2006, an avatar named Anshe Chung belonging to virtual real estate developer Ailin Graef.[11] By integrating concepts first explored by video games, the metaverse can optimize features favored by users.

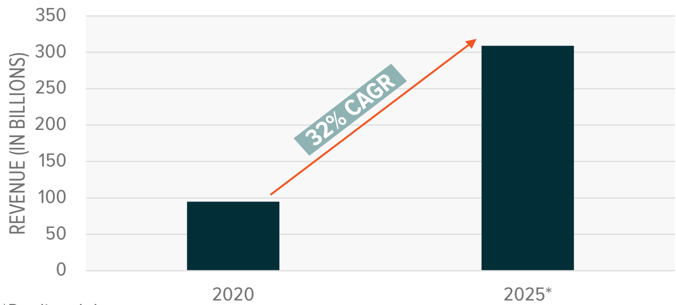
INTERNET ADVERTISING EXPENDITURES
Source: Zenith Media data as of December 6, 2021.



*Predictions as of 12/6/2021

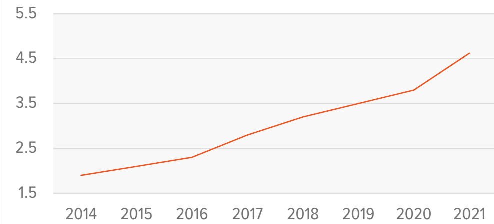
VISUALIZING THE MARKET OPPORTUNITY

GLOBAL SOCIAL MEDIA REVENUE
Source: The Business Research Company data as of February 2022.

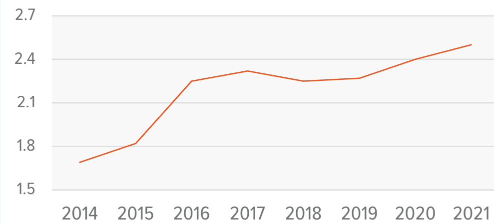


*Predicted data

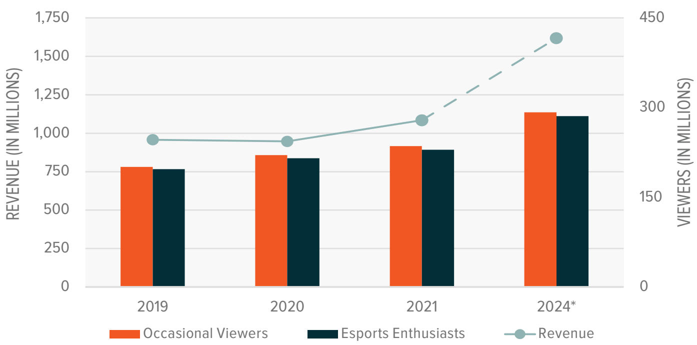
TOTAL GLOBAL SOCIAL MEDIA USERS (IN BILLIONS)
Source: The Business Research Company data as of February 2022.



GLOBAL AVE. DAILY SOCIAL MEDIA USA (HOURS PER DAY)
Source: The Business Research Company data as of February 2022.



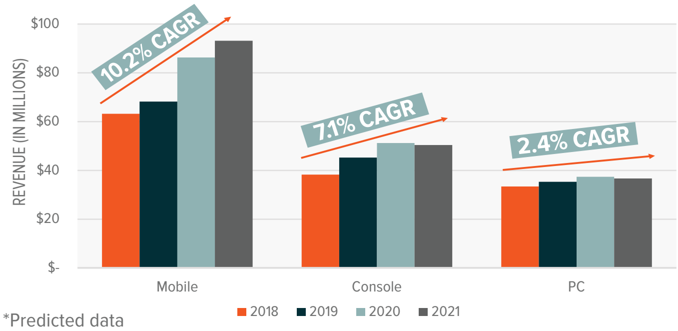
GLOBAL ESPORTS REVENUE & AUDIENCE GROWTH
Source: Newzoo data as of September 2021.



*Predicted data

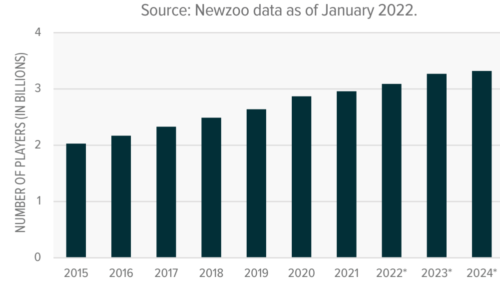
Companies engaged in digital experiences are shifting focus from building user growth and engagement to monetizing their networks.

GLOBAL VIDEO GAMES REVENUE BY SEGMENT
Source: Newzoo data as of January 2022.



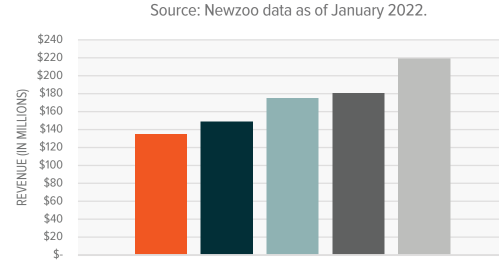
*Predicted data

GLOBAL VIDEO GAME PLAYERS COUNT
Source: Newzoo data as of January 2022.



*Predicted data

GLOBAL VIDEO GAME REVENUE
Source: Newzoo data as of January 2022.



*Predicted data

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Recurring revenue - downloads, subscriptions and microtransactions

Advancements in graphical technology, such as virtual reality and raytracing, make the digital world richer than ever, enticing more people to become regular consumers of video games. As opportunities for recurring revenue streams attract larger user bases and games reach new levels of emersion, we believe the industry can generate outsized returns over the long run.

In the early 2000s, buying a video game required gamers (or their parents) to go to the nearest retail store. Today, near ubiquitous access to high speed internet means that 83% of total video games sales are digital.[12] Digital delivery provides convenient access for consumers with cost benefits to the publisher. Physical distribution requires manufacturing, shipping, packaging, and wholesaling, factors that negatively impact margins. Digital distribution brings the storefront into the living room and puts games just a click away.

Digital distribution also facilitates subscription services. For a low monthly fee, gamers can access hundreds of game titles, ready to play after a quick download. Even though current offerings are largely older intellectual properties, publishers benefit from introducing players to their content.

> Revenues from video games service platforms reached an estimated $6.6 billion in 2020, and are expected to grow at a faster rate than the industry at large over the next five years.[13]

Just as Netflix disrupted the distribution model for movies and TV shows, cloud gaming could have a similar impact on the video game industry. Cloud games are streamed rather than downloaded locally. The cloud provides access to a broad library of games, playable on a variety of compatible devices, without the need to build out an expensive PC or buy a next-gen console. Newzoo, a games market insights and analytics company, estimates 164.6 million players have already switched to the cloud, paying a collective $1.6 billion to take their games wherever they go. Over 90% of players familiar with cloud gaming have tried it or want to, indicating the size and stickiness of the opportunity.[14] The transition to gaming-as-a-service can drive recurring revenue and allow for valuable usage data to be tracked more easily, resulting in targeted ads to big spending players.

For players who want to play games but don't want to pay, the free-to-play (F2P) video game market is now one of the most popular gaming segments. In F2P, publishers generate revenue via microtransactions that offer players the opportunity to buy skins, weapons, and other digital accoutrements while in the game. By purchasing these aesthetics, players can stand out from their friends and enemies. And these microtransactions add up and are a large revenue driver for the video game industry.

RISKS TO THE DIGITAL EXPERIENCES THEME

Social media regulation - mental health, data privacy and censorship

Regulatory risk is a consideration for the Social Media theme owing to concerns about children and teens who spend a significant amount of their time online. A large study of Ontario elementary and middle school students reported "poor mental health" in half of respondents who used social media for five or more hours per day. The effects were even stronger among girls, who reported a 29% rate of suicidal ideation.[15] At the end of 2021, leaked internal research at Facebook drew similar conclusions. Facebook's data showed that 32% of teen girls said that when they feel bad about their bodies, the platform made them feel worse. Teens also reported increased rates of anxiety and depression. [16]

Another risk to platforms is curbs on data privacy. True to their core value of privacy, in April 2021, Apple updated their on-device privacy controls to limit the tracking capabilities of digital advertisers and encourage users to opt out of data sharing.[17] The change decreases the accuracy of targeted advertisements while also limiting the ability of advertisers to measure the clickthrough and conversion rates of their campaigns. Consequences of the change were dramatic for social media firms, many of which described substantial negative revenue effects on subsequent earnings calls.

Users generally view online ads as annoying, in that ads get in the way of users and the content that they want to consume. But platforms generate revenue from ads, so finding a balanced level of monetization opportunities is critical. From a video game perspective, games that keep too much content behind paywalls or use microtransactions heavily can frustrate players, and either one can lead to lower platform interaction and revenue generation.

Digital experience platform users keep coming back to these platforms because they enjoy the access to content and the community. As a result, platforms must walk a fine line between monetization and the user experience. Platforms also must consider how censorship, and the perception of censorship, can affect the community and their bottom line. For example, social media websites commonly restrict the reach of unsavory content while while promoting content suitable for general audiences. This practice can particularly affect user perceptions of how platforms present political content.

Pew survey data showed that 73% of adults believe it is likely to somewhat likely that social media sensors objectionable political viewpoints.[18] The intended effect of content restriction is a more harmonious experience for users, but it can come at the cost of broader user participation on the platform.

Supply chain disruptions affecting next-gen hardware sales

Historically, the Video Games & Esports theme has been limited by hardware and graphics, or the elements that combine to make a game visually appealing: detail, resolution, and framerate. Today, the video game console space is in transition as a new generation of devices bring enhanced features and more realistic experiences. However, supply of this hardware has yet to meet demand, mainly due to the continuing semiconductor shortage.

Component availability prompted manufactures to reduce sales expectations for the newest consoles while increasing production of last-generation hardware.[19,20] These legacy devices use older chip designs and are easier to manufacture, but they lack many of the advanced graphical features that gamers want. The result is extended technological limitations on game developers and new titles. For the newer consoles, the industry continues to be challenged with supply constraints from component shortages and logistics disruptions, which may pose challenges for growth in the near-term.

THEMATIC INTERSECTION WITH DIGITAL EXPERIENCES

Social Media and Video Games

Video games are now effectively social media platforms that let gamers play and collaborate with one another. Gaming alongside real world and digital friends positively impacts retention rates, especially for max level players who've completed a game's achievement-based content. Higher levels of in-game communication and social relationships are also correlated with player retention levels.[21] For companies, social gaming translates into greater engagement and greater monetization opportunities, as peer pressure can prompt additional title purchases.

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Video game content can also be a boon for social media companies. Browser-based social network games leverage the communication prowess of social media to prompt users to reach out to their real-world friends for help in the game. Social network games extend a user's average session duration while directly generating additional revenue by prompting users to view advertisements.

Fintech & Blockchain

The combination of social media and fintech results in new funding solutions that democratize access to capital, such as crowdfunding platforms. Compared to traditional financing methods, crowdfunding, powered by social media network effects, offers a low-fee way to access and raise capital quickly for business ventures or charitable causes. By democratizing access to capital, crowdfunding platforms could help spur innovation and bring disruption to the market.

For video games, the rise in user participation and monetization has been facilitated by digital payments. Using fintech solutions, game titles and microtransactions can be bought with the press of a button, simplifying purchase decisions and increasing sales volumes. Content publishers and platforms will likely reap additional benefit as digital payments become further integrated into virtual worlds. A culmination of fintech integration looks to be non-fungible token (NFT) marketplaces, where blockchain ensures tradable ownership of virtual goods. Such online economies would create earning potential for users, connecting economies and linking digital goods to real-world currency.

Cloud Computing & Data Centers

At the intersection of cloud computing, data centers, and video games is cloud gaming, or the use of remote computing resources to render virtual gaming worlds. Gone are the days when an expensive, high-powered computer or console was necessary for high resolution graphics. With cloud gaming, games can be streamed to a mobile device.

Continued development of cloud computing and the proliferation of data centers will enhance remote gaming experiences. Colocated servers shorten the real-world distance between processing and end users, decreasing latency and lag when split second reactions matter most. Increased compute power enhances the graphical quality available on the go, boosting visual fidelity and user experience. We expect cloud gaming can realize its potential with the continued progression of the Cloud Computing and Data Center themes.

Cybersecurity

As with all digitally focused themes, digital experiences and the platforms hosting such content may be targets for cybercrime. For most websites, a data breach would include personal identifying information such as name, email address, or payment details. Social media is an entirely different animal, as a breach could reveal the most intimate details of a user's life. A malicious actor gaining access to a user's files and personal data can have drastic consequences, but add social media access, and that actor can now impersonate the original account. In line with this, robust cybersecurity is essential to moving digital experiences forward, potentially even into the metaverse.

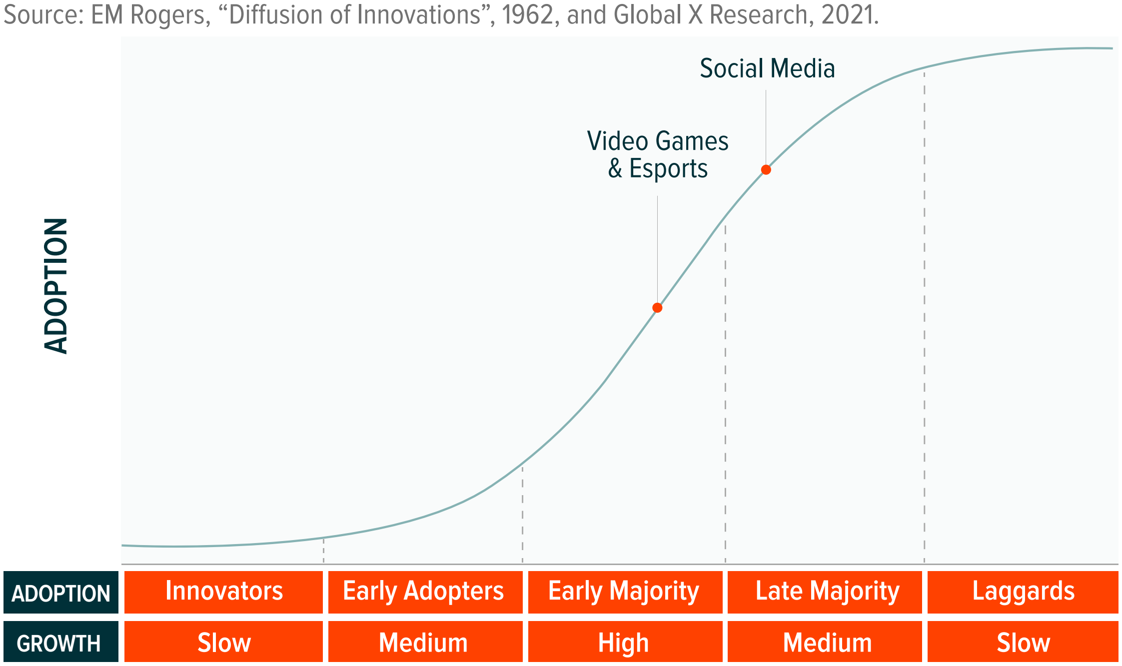
DIGITAL EXPERIENCES IN A PORTFOLIO CONTEXT

The Digital Experiences theme represents the attention economy and the various forms of new media vying for user engagement. Social Media is the most mature theme within our coverage, as its widescale global adoption places it within the Late Majority phase. Social media's growth is not at an end stage, rather it's shifting from account growth to user monetization. Conversely, the Video Games & Esports theme is shifting into the latter half of the Early Majority phase as user adoption increases and consumption of digital experiences deepens.

The companies that comprise the Digital Experiences theme are global and positioned to benefit as thematic adoption rises across the world. The charts below break down the geographic exposure of the largest Digital Experiences thematic ETF products. We believe there is ample innovation occurring outside of the U.S. and that limiting exposure to the U.S. will exclude key players, to the detriment of investors over the long term.

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021.



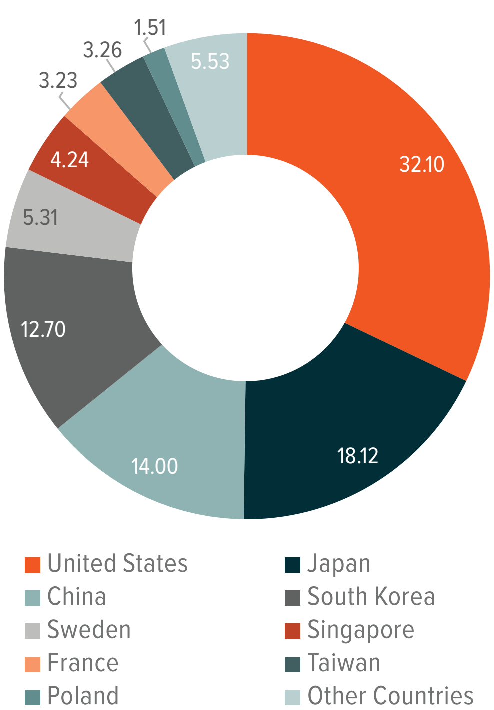
In our view, thematic equity should be targeted, using screens to ensure that the underlying companies provide the desired exposure. This pure play focus minimizes overlap between themes while also differentiating the exposure provided by the theme relative to broad beta products.

We conducted an overlap analysis between Digital Experiences thematic ETFs, the S&P 500, MSCI ACWI, and XLC, the Communication Services Select Sector SPDR Fund. We found that overlap by weight for Social Media was 3.6% when compared to the S&P 500, 2.9% vs. the MSCI ACWI, and 21.3% vs. XLC. Higher sector fund overlap levels would be expected for a theme in the Late Majority phase, as Social Media firms have grown to dominate their segment of the economy. Video Games & Esports scored lower on broad beta and sector indexes, 2.4% when compared to the S&P 500, 2.4% vs. the MSCI ACWI, and 8.8% compared to XLC.[22] These low levels of overlap with broad indexes reflect the benefits of thematic exposure, as accessing the Video Games & Esports theme requires intentional positioning.

Digital experiences are ubiquitous today. Social media has become a core segment, influencing conversations, culture, politics, and many other facets of society. And video games are mainstream, with more than two-thirds of Americans playing.[23] Now that adoption levels are high, Digital Experience-focused companies are targeting monetization, leveraging the network effects of their platforms and communities to maximize their growth potential. They say that "content is king," and as we expect digital experiences to reign long into the future, we believe that it is important to position portfolios to capture the growing benefit of this maturing theme.

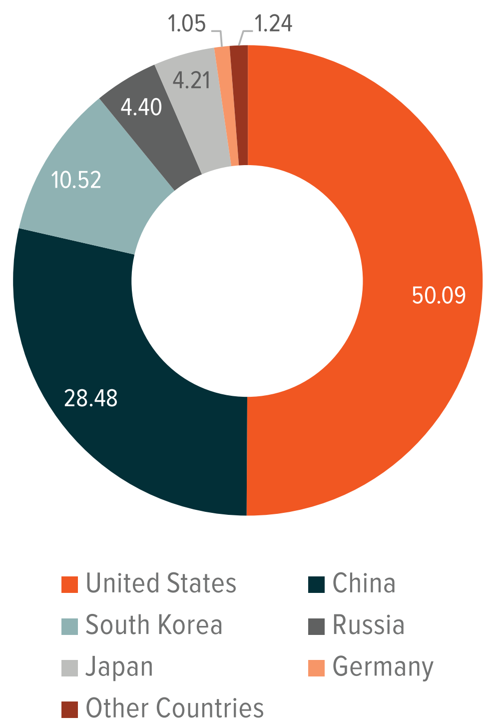
VIDEO GAMES & ESPORTS: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of 12/31/21.



SOCIAL MEDIA: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

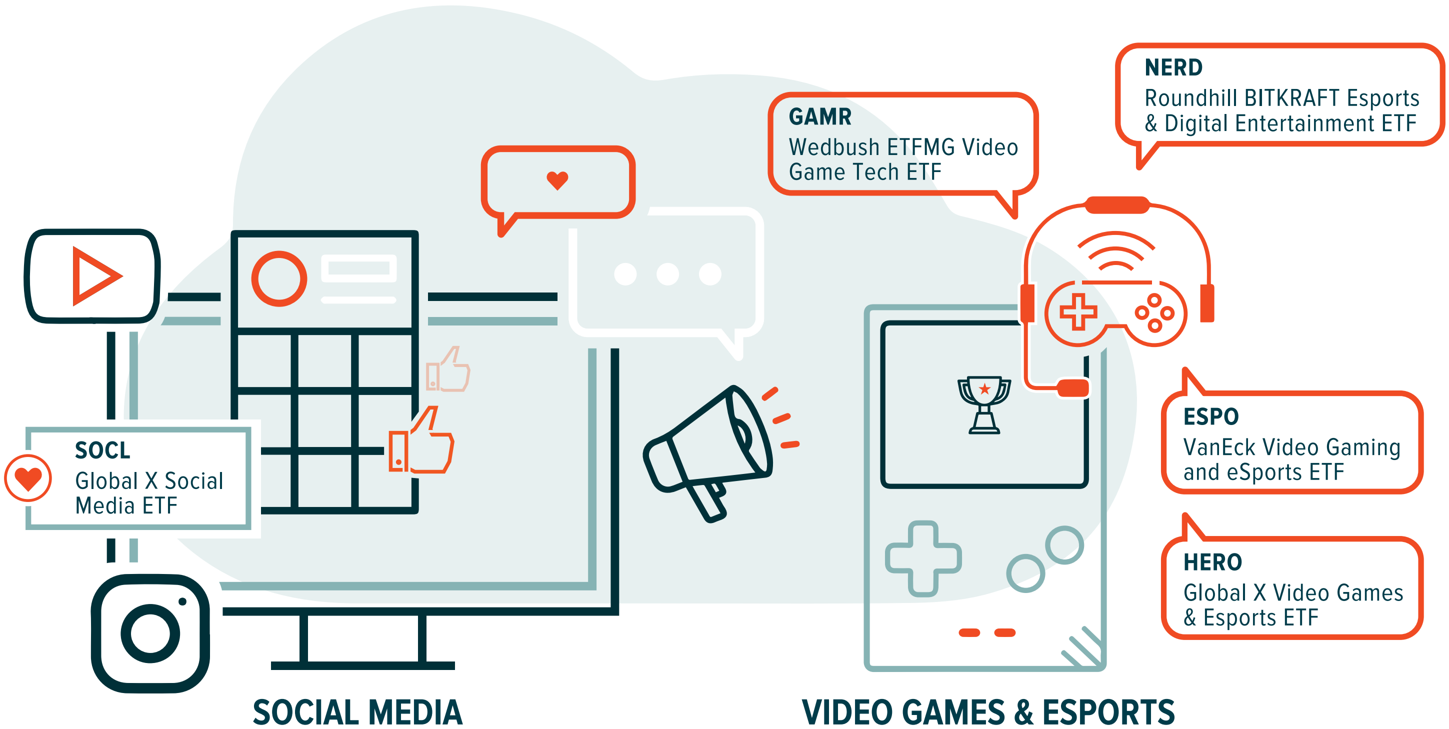
Source: Morningstar data as of 12/31/21.



Note: Includes the sole social media ETF and the largest four video games & esports ETFs according to our thematic classification. All Thematic ETFs weighted the same.

HOW TO ACCESS DIGITAL EXPERIENCES

The graphic below identifies U.S. listed ETFs that provide direct exposure to the Digital Experiences theme through Social Media and Video Games & Esports technology. There is only one U.S. listed ETF that provides direct exposure through Social Media technology. Pure play ETF exposure to Social Media is unique due to large overlap with the Communication Services sector.



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FINTECH (FINTECH & BLOCKCHAIN)

Paper currency is dying a fast death as technology shifts how people access and interact with their money. Fintech solutions are expanding access and improving the efficiency of financial services. And user interfaces are fast becoming all-digital through online banking, digital wallets, crowdfunding, and buy now, pay later (BNPL) services. But digital disruption remains a work in progress at traditional financial firms. For example, transfers between banks or across borders can still take multiple days to settle. Over time, we expect fintech and blockchain solutions to become more integral across the financial services ecosystem resolving some of these inefficiencies. And as user adoption rises, so too will its prominence in portfolios.

KEY TAKEAWAYS

- We expect the digital transformation to bring financial services,including mobile payments, online banking, and alternative lending platforms to previously unbanked and underserved populations.
- The pandemic put Fintech's adoption into overdrive, with digital payments moving into mass adoption. But the Fintech market continues to expand with emerging segments such as BNPL, alternative financing, and blockchain solutions are key avenues for future growth.
- Necessity will likely encourage more traditional financial services companies to incorporate cloud banking and blockchain solutions.

WHY FINTECH AND BLOCKCHAIN ARE SUCH POWERFUL FORCES

The intersection of financial services and technology, or fintech, is where people go to spend, lend, borrow, invest, and trade. Fintech makes financial services more personal and inclusive. Over the last two years, fintech adoption has increased dramatically, and we expect innovation in the space will continue to increase access to the global financial ecosystem.

Importantly, traditional financial institutions are integrating fintech in their business models. Firms are under pressure to reduce their reliance on legacy infrastructure while strengthening core banking systems to create better consumer experiences. Additionally, the increased focus on data connectivity and analysis to improve corporate decision-making has increased interest in fintech. Global investment activity in fintech, including through venture capital, private equity, and M&A, increased from $124.9 billion in 2020 and $148.6 billion in 2019 to $210 billion in 2021.[1]

The rise of the digital payments segment illustrates consumer willingness to adopt new technologies and the enormous growth potential for fintech applications. For consumers, the ease and convenience of buying goods or services by tapping a device on a point-of-sale makes digital payments Fintech's most recognizable segment. For companies, beyond the upfront costs of developing the program and infrastructure to conduct transactions, mobile payment technology is a consumer-friendly way to keep ongoing and variable costs low. With consumers more adept and willing to shop online, more integrated shopping ecosystems are developing.

Emerging segments like BNPL, cloud banking, blockchain-based solutions, and alternative financing solutions like equity crowdfunding and peer-to-peer (P2P) lending will likely be part of the next stage of the industry's evolution.

FINTECH'S KEY GROWTH AREAS

BUY NOW, PAY LATER: Fintech's Fastest Growing Segments Widening it's Appeal

BNPL's growing popularity is a result of continued growth in online shopping. The share of e-commerce transactions paid via BNPL has risen rapidly the last few years with strong U.S. growth.[2]

- BNPL comprised 1.6% of global e-commerce sales in 2019, rising to 2.1% in 2020 and 3% in 2021.
- Scandinavian countries currently have the highest proportion of their e-commerce sales through BNPL at 12–25%.
- The U.S. BNPL share of e-commerce sales rose from 1% in 2019 and 2% in 2020 to 4% in 2021.

BNPL firms allows consumers to make one upfront payment and settle the remaining balance in installments. BNPL is an alternative to credit cards, with many BNPL plans having 0% APR and no fees unless there are missed payments. BNPL provides credit access to consumers with weak credit scores.

ALTERNATIVE FINANCING: Equity Crowdfunding and P2P Lending Opening Doors

Alternative financing found an audience amid the online investing boom in 2020. Capital raised on equity crowdfunding platforms more than doubled in 2020, jumping to $214.9 million.[3] On the debt side, the $115.6 billion peer-to-peer lending market is expected to become an $802 billion market by 2028, rising at a 27.4% CAGR since 2021.[4]

Crowdfunding and P2P lending make it easier to connect investors with those who need capital. They create opportunities for investors to participate in a market that is typically limited to high net worth and institutional investors.

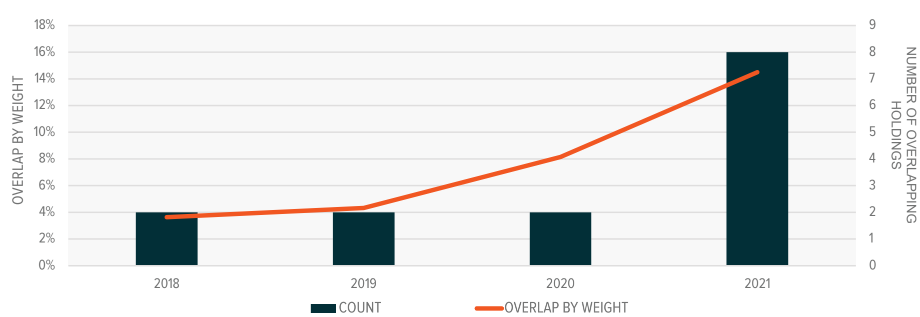
- Equity crowdfunding makes it easier for private startups and small and medium-sized enterprises (SMEs) to raise capital.
- P2P lending helps borrowers find more competitive rates while offering competitive yields for investors.

BLOCKCHAIN-BASED SOLUTIONS: Improved Efficiency

As technology advances and new fintech applications emerge, we believe that blockchain-based digital ledgers will likely become the dominant way people send, manage, invest, and lend their money. To illustrate the growing overlap between blockchain and fintech, we can compare the holdings of two ETFs over time: Amplify Transformational Data Sharing ETF (BLOK) and the Global X Fintech ETF (FINX). The chart shows that in 2021 there was a meaningful increase in their overlapping holdings by weight and number.

HOLDINGS OVERLAP OVERTIME: BLOK & FINX

Source: Bloomberg data as of 4/12/22.



Fintech: Growing adoption across generations and geographies

Fintech adoption remains most prevalent among younger generations. Ninety-five percent of U.S. millennials say that they use fintech applications. Adoption of new technology typically begins with younger generations, but older generations are increasingly adept with these technologies as well. Baby Boomers are the fastest growing demographic for Fintech, with use among individuals 56 and older doubling year-on-year to 79% in 2021.[5]

The global adoption rate of fintech solutions reached 64% in 2019.[6] Particularly exciting for the industry is its growth potential in emerging markets (EMs) and economies with limited traditional financial infrastructure and unbanked populations. China and India have the widest adoption thus far, reaching 87% in 2019.[7] Innovations in mobile payments, online banking, and alternative lending platforms bring financial services to previously unbanked and underserved populations. Without existing infrastructure in place, like traditional bank branches and credit cards, EMs can adopt the latest technology without forcing an old business model into obsolescence.

The chart shows the trend in fintech adoption globally across different traditional financial services prior to the pandemic. Since the pandemic, adoption has increased across categories.

Blockchain: A new avenue for growth

In its most basic sense, a blockchain is a type of database focused on recording and maintaining data. Its unique properties stem from its decentralized approach. In a centralized system, a singular authority controls all aspects of transaction verification and documentation. With blockchain's decentralized approach, data is recorded in "blocks" on a digital ledger. Participants, called nodes, are the computers and devices connected to the network that distribute and validate the ledger on a peer-to-peer (P2P) network. While anyone can create data on public blockchains by creating a new block and chaining it to a previous block, the consensus-based approach to validation means nobody can edit or falsify the data after it's received a sufficient number of block confirmations. The result is a structure that generates trust without the need for a third party.

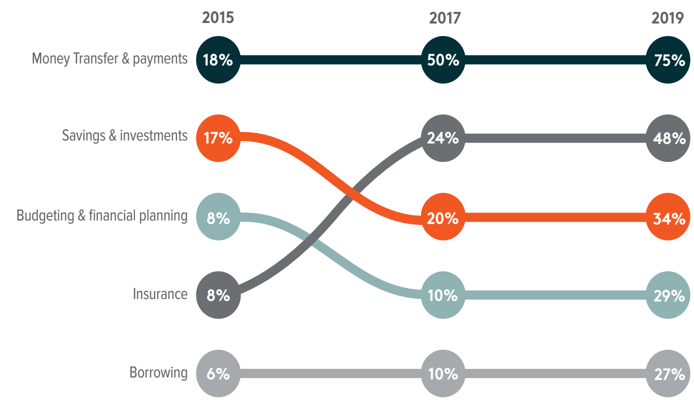
It's conceivable that blockchain networks eventually become embedded in the financial ecosystem because of this key feature: participants don't need to trust a government to back a currency or to responsibly manage the money supply. For the developed world, the significance of this feature may be difficult to understand, though recent economic crises may facilitate comprehension. Trusted financial institutions operating within strong regulatory frameworks that protect investors is not a privilege enjoyed equally around the globe.

The blockchain network provides a mechanism for financial inclusion for unbanked and underbanked populations, particularly in countries struggling with political instability, corruption, or severe inflation. The onset of the war in Ukraine illustrated the benefits of a decentralized form of currency, as people with cryptocurrency wallets continued to have access to currency.

A February 2021 survey by market and consumer data firm Statista indicated that the top 10 countries with the highest frequency of cryptocurrency usage among their populace were all emerging market countries. Nigeria led the way with 32% of respondents indicating that they use bitcoin or cryptocurrency more broadly, followed by Vietnam at 21% and the Philippines at 20%.[8] The U.S. reported an estimated 16% of adults own cryptocurrency. [9] The average age of these potential buyers is 44, which suggests digital assets continue to gain acceptance in the mass market.[10]

FINTECH CATEGORIES RANKED BY ADOPTION RATE: 2015-2019

Source: EY data as of 8/30/20.

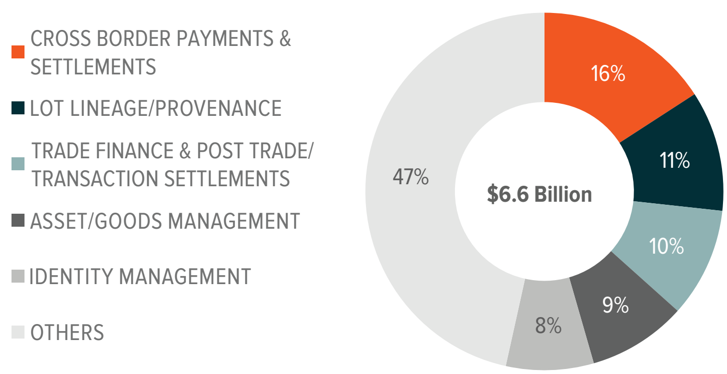


Broad use cases for blockchain

In the short term, blockchain use cases will likely cluster in the banking industry, where financial institutions use the technology to facilitate cross-border payments and transaction settlement. Banking-related use cases accounted for nearly 30% of global blockchain spending in 2021.[11] Beyond financial institutions, applications of blockchain technology are vast, touching supply chains, healthcare tracking, and smart contracts.

TOP USE CASES FOR BLOCKCHAIN TECHNOLOGY: GLOBAL MARKET SHARE 2021

Source: IDC data as of April 2021.



Blockchain's secure ledger creates efficiencies for firms keeping tabs on their international supply chains. For example, firms can easily identify and track tainted or tampered products. Health records can be stored in a blockchain by using a unique patient identifier, allowing patients to access their own records and authorize health service providers to access their information in real time. Smart contracts can increase the efficiency of transactions because there is no paperwork involved and no time spent reconciling errors. Secured by encryption mechanisms, participants can trust smart contracts because they're decentralized and transparent.

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CRYPTOCURRENCY USE CASES

BLOCKCHAIN-BASED SOLUTIONS:
Crypto's Rise Creating New Opportunities

Blockchain technology is closely linked with cryptocurrencies and other digital assets. Cryptocurrencies are designed to serve as mediums of exchange that use encryption techniques to control the creation of monetary units and to verify transactions. As of this writing, 19,406 cryptocurrencies trade on 526 crypto exchanges. Total market capitalization is $1.37 trillion.[12]

Growing merchant and financial institution acceptance continues to solidify crypto's foothold in the mainstream. Cryptocurrency price volatility remains high, potentially making blockchain solutions like digital wallets a less volatile way for firms to capitalize on crypto's growth potential.

EL SALVADOR: A Real World Bitcoin Stress Test

In a world first, El Salvador declared bitcoin to be an official currency alongside the U.S. dollar in September 2021. This step was an important trial of a real world transactional use case for cryptocurrencies, and it provided the token with a new measure of legitimacy. But the experiment has had its growing pains. Chivo, El Salvador's official bitcoin wallet, is notoriously unreliable and transactions take time to verify, resulting in businesses losing much of their initial enthusiasm.

According to a poll conducted by El Salvador's Chamber of Commerce, only 14% of responding business reported that they conducted a bitcoin transaction since it became legal tender. Seventy-one percent of those businesses are micro or small businesses.[13] In our view, it's likely that businesses with less access to traditional banking platforms and payment processors have begun to integrate bitcoin, while larger businesses view the current operational difficulties as a reason to wait. Despite mixed results, we believe that these types of steps are notable on the road to mass adoption.

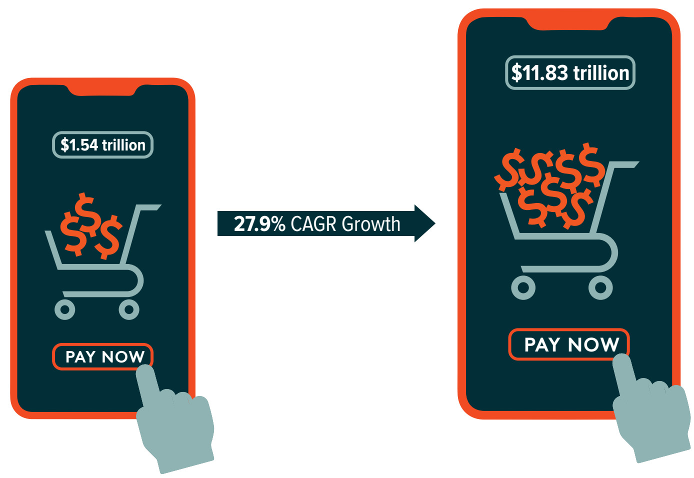
Reaching for Crypto in Times of Crisis

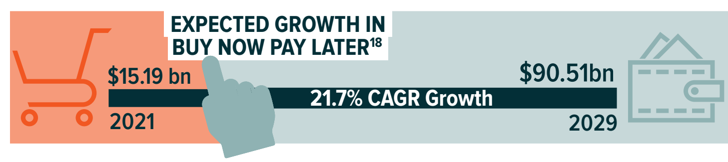
The Russia-Ukraine war has been dubbed the world's first crypto conflict, as both sides have sought to use digital currencies to their advantage. The Ukrainian central bank temporarily halted foreign currency withdrawals and limited daily cash withdrawal in the days following the Russia's invasion. These restrictions resulted in a surge in demand for bitcoin, as Ukrainian hryvnia-denominated trading volume reached a five-month high and the token traded at a 6% premium on Binance's bitcoin marketplace.[14] Crypto is also playing a key role in Ukraine's defense, allowing donations to easily move across international borders. As of this writing, Ukraine's government has received over $60 million in small donations via various tokens.[15]

Russians also turned to crypto in an attempt to shield their finances from the devaluation of the ruble as a result of international sanctions. Ruble-denominated Tether transactions hit $29.4 million in volume on February 28, three times more than a week earlier and the highest daily volume in over a year.[16] This spike occurred on the same day that the U.S. froze Russian central bank assets.

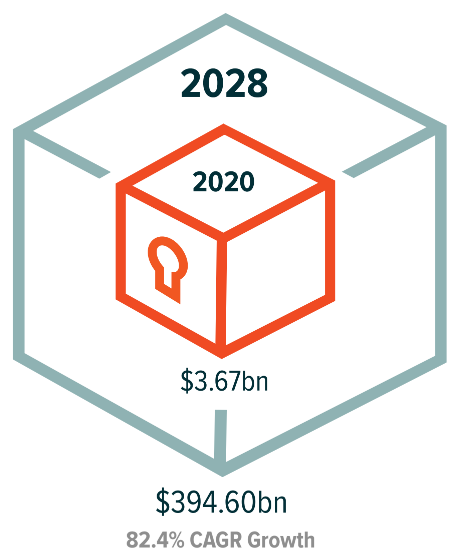
VISUALIZING THE MARKET OPPORTUNITY

EXPECTED GROWTH IN MOBILE PAYMENTS[17]





EXPECTED GROWTH IN BLOCKCHAIN[19]



RISK TO THE FINTECH THEME

Consumer risks: Unsuitable products, scams, and market declines

Fintech platforms commonly remove the middlemen from transactions, democratizing finance. However, there are downsides. In traditional finance, industry employees are commonly held to a fiduciary standard, bound to act in the best interests of their clients. Before they make recommendations, they screen investment opportunities and products for individual customer suitability. Fintech platforms automate much of this work, simplifying suitability and risk tolerance conversations to questionnaires and prescreening options for a wide range of clients before allowing users to make their own decisions. Easy access to risky or complex financial products can lead to harm if investors lack the knowledge or experience to assess them properly.

Consumer risk is also rife within the cryptocurrency market. Scams, defunct coins, and volatility are common, making the space a metaphorical minefield for investors. In 2021 alone, $7.8 billion in value was scammed, typically via rug pulls, where "developers" build what appear to be legitimate cryptocurrency projects before taking investors' money and disappearing.[20]

Cryptocurrency theft is also common, with roughly $3.2 billion worth of cryptocurrency stolen in 2021.[21]

Even legitimate tokens bear risk. Data from token tracking website Coinopsy shows that 2,399 coins are now dead.[22] Investors need to be cautious in the crypto space, as regulation remains light and illicit activity common.

Cryptocurrency bans, regulation, and federal centralization

China and eight other nations curbed their crypto markets considerably.[23] China enforced crypto restrictions in stages, first prohibiting financial institutions from engaging in any crypto transactions, then banning all domestic crypto mining activity, and finally declaring all financial transactions involving cryptocurrencies illegal. Previously, China was the undisputed world leader in bitcoin-related activities. The country's three largest exchanges accounted for over 45% of global market transactions, and Chinese miners controlled about 65% of the Bitcoin network's collective hash rate.[24,25] Market reactions to each successive restriction were initially negative, indicating the risk to investors should other nations implement similar policies.

A maximum regulation scenario would likely entail governments co-opting cryptocurrencies, as central banks will be hard pressed to relinquish the centralized control they currently have over currencies. Instead, they would issue Central Bank Digital Currencies (CBDC) that modernize fiat for the digital age. China implemented a digital yuan, which as of this writing has been used to settle over $13.78 billion in transactions.[26]

Currently, the Federal Reserve ("Fed") has no concrete plans to implement a CBDC, but it has studied the feasibility of such a currency. Partnering with MIT, the Fed worked to "build and test a hypothetical digital currency oriented to central bank uses."[27] These tokens would be backed by real dollars, which would clearly define their value. Crypto enthusiasts would view this hybrid model as blasphemy because it splits trust between governments and cryptographic proofs, but it would likely view the concept more approachable to the average consumer. A successful CBDC implementation would likely draw demand away from traditional crypto assets, decreasing their value.

Digital asset blockchains require significant energy

The majority of today's blockchains, including Bitcoin's, use Proof of Work (PoW) cryptographic proofs to integrate new information and transactions into the chain. This approach relies on competing miners expending significant amounts of energy to solve computationally-intensive math problems. Miners that guess correctly are compensated for their time, processing power, and energy spent with a block reward and transaction fee. Currently, the Bitcoin network consumes an estimated 204.5 terawatt hours (TWh) of electricity a year to function, comparable to the annual power consumption of Thailand. In the process, the Bitcoin network releases 114.06 million tons of CO_2 in the environment, comparable to the average annual greenhouse emissions of more than 20 million gas powered passenger vehicles.[28,29]

We expect governments to eventually place limitations on mining as part of the global effort to reduce carbon emissions. Such a change would likely force cryptocurrencies to adapt, or risk declining adoption. An alternative cryptographic proof gaining favor is Proof of Stake (PoS), which allows blockchain participants to validate new blocks based on their ownership stake in the network. With a validator selected at random and no proof to solve, energy consumption plumets.

The Ethereum network is expected to make the switch in Q2 2022, which could lead to a 99.95% reduction in total energy use, as Proof-of-Stake is roughly 2000x more energy-efficient than Proof-of-Work.[30]

THEMATIC INTERSECTION WITH FINTECH AND BLOCKCHAIN

Fintech and Blockchain

A key advantage of fintech platforms compared to their more classically minded financial competitors is their ability and willingness to integrate new approaches at scale. Fintech platforms can shift their business models over time as new technologies are adopted. The fusion of blockchain and fintech to form decentralized finance (DeFi) is a perfect example.

Together fintech and blockchain leapfrog middleman and bring much needed competition to the banking and finance space. Blockchain implementations can produce substantial savings, up to a 70% cost reduction on financial reporting, and up to 50% across compliance, onboarding, and operations.[31]

Fintech and Internet of Things (IoT)

Fintech platforms and Internet of Things technologies can transform everyday services. For example, insurance underwriters typically operate with incomplete information, which increases the cost of property and casualty insurance policies. Historically, driving record, demographics, and vehicle information determine the price of their auto insurance. While these data points provide a reasonably accurate estimation of future insurance risk, they rely on risk bucketing and generalizations.

However, by using telematic sensors to track GPS and onboard diagnostic information such as speed, acceleration, and breaking behaviors, insurers can form true-to-life risk models based on individualized driver behavior. Privacy focused individuals may view such tracking as invasive, but telematic data collection gives consumers the ability to control their premium costs by incentivizing the adoption of safer driving habits. This integration can increase affordability for lower-risk drivers and coach more aggressive drivers to reduce their incidence of risky behaviors. Such incentives have resulted in accident rate reductions of 10–40%.[32]

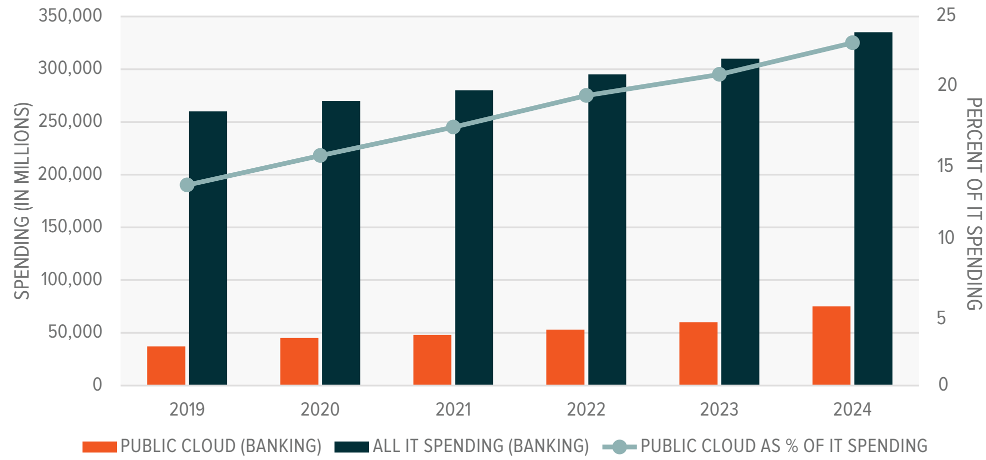
Sensor data can also assist in fault determination, demonstrating directly whether a driver caused an accident or was the victim of one. For underwriters, that means fewer claims, lower administrative costs, and faster resolutions.

Fintech and Cloud Computing

Fintech is viewed as a disruptor of traditional financial services, a well-deserved reputation, but one that doesn't tell the whole story. Fintech firms also offer technologies that help traditional financial services companies enhance their services. Cloud banking is one such growing vertical. Globally, banking industry IT cloud spending is forecast to increase at a CAGR of 16.2% between 2019 and 2024, increasing to roughly 25% of IT budgets.[33]

WORLDWIDE BANKING IT SPENDING & PUBLIC CLOUD SHARE: 2019-2024

Source: IDC, Banking on the Cloud: Results from the 2021 CloudPath Survey, August 2021.



Cloud technology can streamline previously cumbersome processes for banks, such as onboarding new clients, opening accounts, and managing regulatory compliance. Commercial bankers using cloud solutions can see reductions in underwriting times by as much as 81%.[34] Other cloud-based approaches can help banks respond to shifting market trends and bring new products to the market up to 16 times faster than the average.[35] Importantly, these solutions aren't just more efficient operationally, they also shift expenditures away from significant upfront investments in IT infrastructure to lower-cost, subscription-based software-as-a-service (SaaS) models.

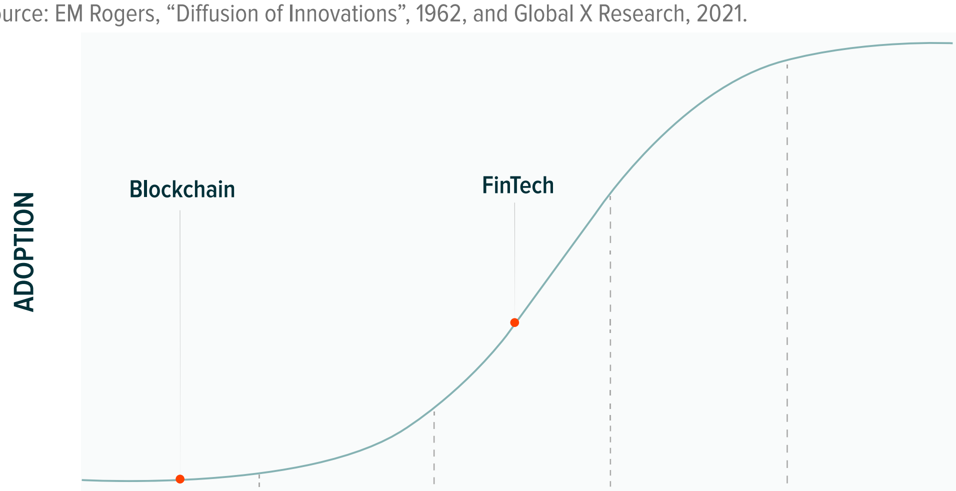
Capital One Bank is a leader in cloud adoption, having shuttered all their internally operated data centers in 2020 to run exclusively on the AWS cloud. Over 80% of their 2,000 applications and software tools were rebuilt to run on the cloud from the ground up, and the migration is already paying dividends. Application updates are much more frequent, improving from a quarterly or monthly cadence to multiple times a day. Disaster recovery tests show downtime falling by up to 70%. These efficiencies and performance improvements from the cloud environment can differentiate the bank from its peers and serve as a model for the advantages of a cloud banking transformation.[36]

Blockchain and Video Games

Play-to-earn is a new frontier for gaming and non-fungible tokens (NFTs). According to a report on NFT tracking site DappRadar, more than 1 million digital wallets connected to decentralized gaming apps per day in October 2021, representing 55% of the blockchain industry's overall activity.[37] Players can earn NFTs from a variety of blockchain games. In Q3 2021, game NFTs accounted for more than 20% of the $10.6 billion in NFT volumes.[38] A key differentiator between blockchain games and other traditional games is the ownership of playable items, and therefore the ability to sell, trade, use, and lend these tokens.

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021.



ADOPTION	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
GROWTH	Slow	Medium	High	Medium	Slow

FINTECH AND BLOCKCHAIN IN A PORTFOLIO CONTEXT

Fintech will continue to make financial services more digital and scalable. This transformation is well underway, but it's one that still has significant room to run globally, particularly in EM, where demand for broader access to financial services is generations in the making. In the U.S., consumers increasingly want and expect digital banking experiences, encouraging traditional financial services firms to pivot to keep up with Fintech trailblazers.

Fintech's digital payment revolution has reached the point where GICS sector changes are being reviewed. Transaction and payment processing companies are currently classified as a part of the Information Technology sector. In the proposed GICS classification, which is due to be implemented in Q1 2023, these companies will be reclassified as Financials Services.[39] Based on current market capitalization, should this sector change occur, the largest payment processing companies will be among the largest companies in the Financial Services sector.[40]

For investors, a risk is not having exposure to the continued adoption and integration of this innovative sector. Gaining exposure through an ETF provides access to a group of companies that continue to disrupt how people interact with their finances.

The companies operating in the Fintech space are global and positioned to benefit as thematic adoption increases across the world. The charts, to the right, break down the geographic exposure of the largest Fintech thematic ETF products. We believe that there is ample innovation occurring outside of the U.S. and that limiting exposure to the U.S. may exclude key players, to the detriment of investors over the long term.

In our view, thematic equity should be targeted, using screens to ensure that the underlying companies provide the desired exposure. This pure play focus minimizes overlap between themes while also differentiating the exposure provided by the theme relative to broad beta products. We conducted an overlap analysis between Fintech thematic ETFs, the S&P 500, MSCI ACWI, and the two most applicable S&P 500 sector ETFs, the Financial Select Sector SPDR Fund (XLF) and Technology Select Sector SPDR Fund (XLK). We found that average overlap by weight for Fintech was 2.6% vs. the S&P 500, 2.3% vs. the MSCI ACWI, 2.0% vs. XLK, and 0.8% vs. XLF.[41]

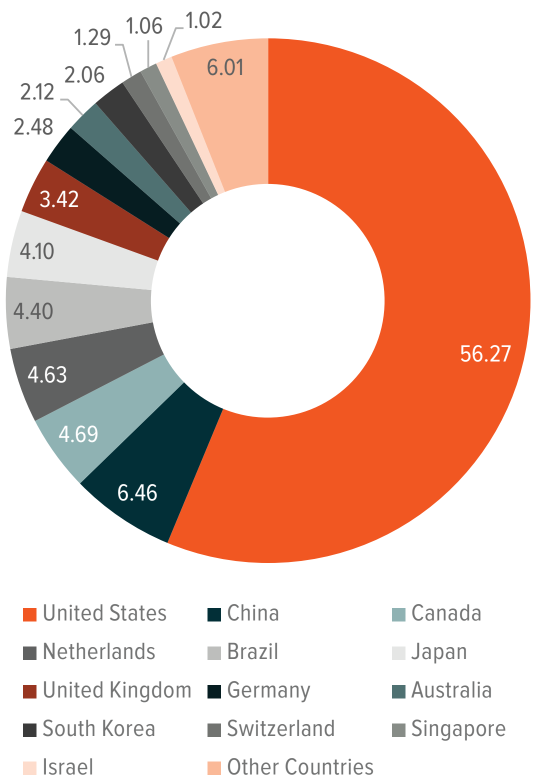
The overlap between broad beta and sector indexes was higher for the blockchain theme. The average overlap between the largest five blockchain ETFs and the S&P 500 and MSCI ACWI indexes was 8.5% and 6.8%, respectively. The overlap with XLK was 11.6% and 4.2% with XLF.[42]

Because blockchain remains in the innovation phase, the number of pure play blockchain companies is limited. Therefore, many ETFs include large semiconductor manufacturers that design and build crypto mining infrastructure. These companies are also included at a relatively high level in market cap weighted broad beta and technology sector ETFs. Over time, we expect overlap levels to decline as the space matures and the number of pure play companies grow.

Technology continues to extend its reach into the financial industry, rapidly changing how people spend, lend, borrow, and invest. In our view, legacy business models that do not adapt will be left in the dust as the Financial Services sector moves into its digital future. As blockchain technology grows out of its infancy, we expect the scope of end-user and institutional applications to grow exponentially and potentially upend traditional finance.

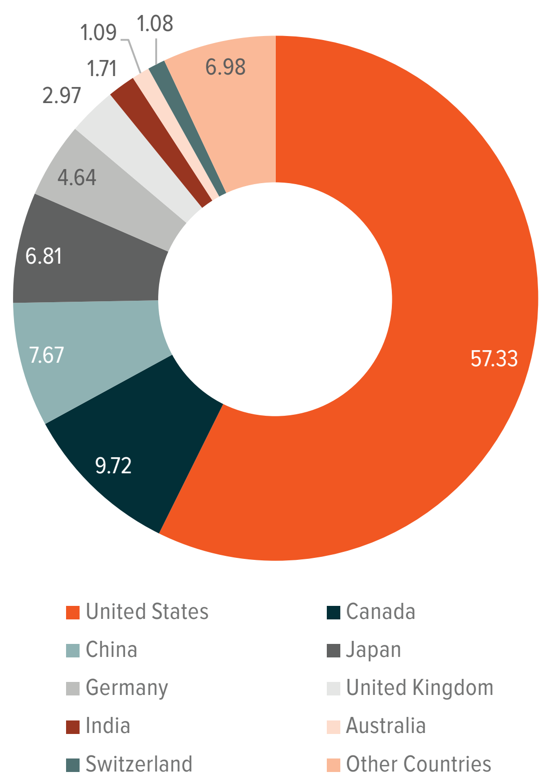
FINTECH: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of 12/31/21.



BLOCKCHAIN: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

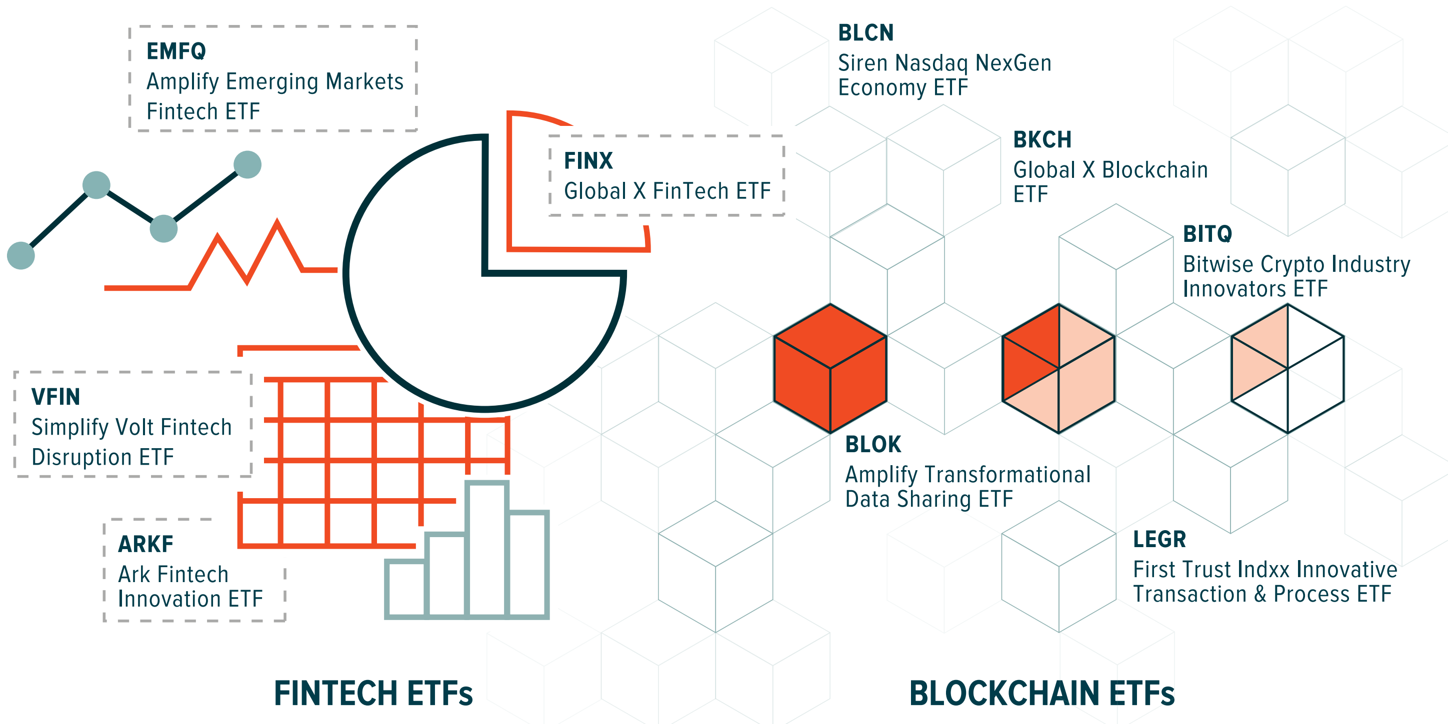
Source: Morningstar data as of 12/31/21.



Note: Includes the five broad Fintech ETFs and the largest five blockchain ETFs according to our thematic classification. All Thematic ETFs weighted the same.

HOW TO ACCESS FINTECH

The graphic below identifies the largest U.S. listed ETFs that provide direct exposure to the Fintech theme through FinTech and Blockchain technology.



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Infrastructure and a Greener World

Good for business continuity and good for the planet are starting to become more closely related. Investment in clean and renewable energy technology and distribution infrastructure can improve energy independence at a time when resource scarcity is a growing concern. This is likely to increase demand for key resources during a period where the Western world is expected to accelerate investment in hard infrastructure.

KEY MEGA THEMES:

- Climate Change
- Infrastructure

CLIMATE CHANGE (CLEAN ENERGY & RESOURCE SCARCITY)

Climate change threatens every walk of life, jeopardizing clean air, safe drinking water, sufficient food, and secure shelter.[1] It is also responsible for an acceleration of the melting of polar ice caps, longer and more severe wildfire seasons and more forceful hurricanes which threaten these basic human needs. To avert the worst impacts of climate change and preserve a livable planet, global temperature increases must be limited to 1.5°C, which requires the world to reduce greenhouse gas emissions 45% by 2030 and achieve net zero by 2050.[2] Reaching these ambitious targets, is a massive undertaking that requires the adoption of green technology and renewable energy, both of which require massive, recurrent investment.

KEY TAKEAWAYS

- The Russia-Ukraine War will likely accelerate the transition to clean energy as Europe moves toward energy independence from Russian fossil fuels, which now represent a threat to national security.
- Global investment in clean energy is far below where it needs to be for the world to reach net zero greenhouse gas emissions (GHG) by 2050. Annual investment in clean energy projects and infrastructure for the rest of this decade must increase from $750 billion in 2021 to over $4 trillion, well above the $2.3 trillion that is expected.[3]
- The Physical Environment mega theme affects all other themes. We highlight the theme's intersection with and potential investment opportunities across the Disruptive Materials and the Mobility mega themes and their associated themes, such as Electronic and Autonomous Vehicles (EVs/AVs). These technologies are core to combatting the negative impacts of climate change.

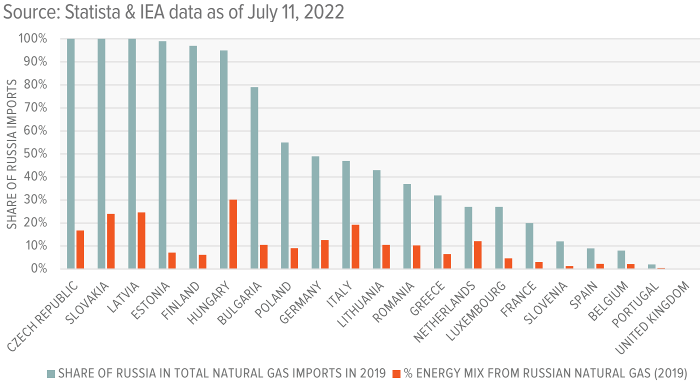
WHY CLIMATE CHANGE IS SUCH A POWERFUL FORCE

Geopolitical factors can accelerate the opportunity for the clean energy and AgTech markets.

Russia's invasion of Ukraine brought to light the role geopolitics can play in addressing climate change. The war served as a reminder that transitioning to renewable energy is not only good for the climate, but also for national security. For example, relying on authoritarian regimes for something as crucial as energy carries significant risk. In 2021, the European Union (EU) imported roughly 40% of its gas and 25% of its oil from Russia. In response to the war, the EU now plans to reduce Russian gas imports by two-thirds by the end of the year, and to eliminate them altogether by 2030. Global energy prices, which were already high before the war due to pandemic-related supply and demand issues, skyrocketed following the invasion.[4]

RUSSIA GAS IMPORTS IN EUROPE

Source: Statista & IEA data as of July 11, 2022



The geopolitical and price pressures stoked by the war will likely accelerate the transition away from oil, gas, and coal. The White House said that greater energy efficiency can be immediately achieved by increasing the use of smart thermostats and heat pumps.[5] The EU said that energy conservation actions by its citizens could save enough oil to fill 120 super tankers and enough natural gas to heat almost 20 million homes.[6]

The agricultural market is also in the war's crosshairs with food production reduced and supply disruptions expected to keep agriculture prices elevated.[7] Combined, Russia and Ukraine are responsible for about 25% of the world's wheat exports, 65% of its sunflower oil exports, 20% of barley exports, and 18% of corn exports.[8] Also, Western sanctions on Russia are expected to continue to affect the fertilizer supply, given that Russia is the world's largest fertilizer exporter.

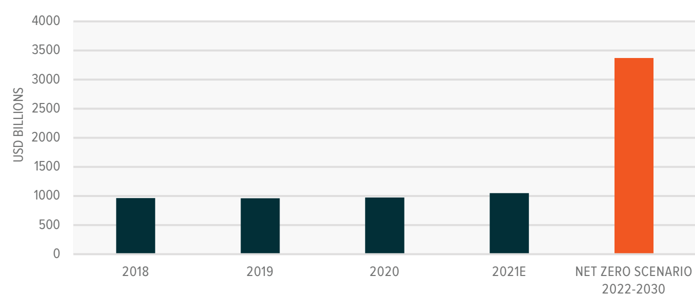
AgTech can help stave off long-term food insecurity and counter geopolitical consequences. This market is expected to grow from $20B in 2022 to over $40B in 2030.[9] Precision agriculture and agricultural robots are two examples in which improve efficiencies in the agricultural market by reducing the use of traditional inputs. AgTech could facilitate more intelligent decisions about how to protect the world's dwindling resources, which ultimately could mean feeding millions more people. The war exacerbated a vulnerable food system that was already experiencing the impact of labor shortages, increasing input costs and supply chain disruptions. However, it is evident that AgTech will likely continue to play a larger and more vital part in the food system of the future.

Investments in green technology and renewables must increase significantly to reach net zero by 2050.

The global economy is expected to be nearly 40% larger in 2030 than it is today, but the International Energy Agency (IEA) estimates that it needs to use 7% less energy to meet net zero emissions by 2050. This target requires a major push to increase energy efficiency. The annual rate of energy improvements must average 4% to 2030.[10] However, global investment in clean energy projects and infrastructure is far below where it needs to be. To close the gap, annual investment for the rest of this decade needs to be three times higher than it was in 2021, as the chart below illustrates.[11]

CLEAN ENERGY & INFRASTRUCTURE INVESTMENT 2018-2030

Source: IEA data as of October 26, 2022



Last year, the U.S. took a major step in combatting climate change with the passage of the Inflation Reduction Act. The act directs nearly $370 billion toward bolstering U.S. climate change mitigation and adaption, increasing energy security, and lowering energy costs.[12] This effort along with various other initiatives globally will be essential to put the world on track to hitting net zero targets by 2050. With these measures, economy-wide emissions are forecast to decline 37% to 41% below 2005 levels by 2030.[13] Without it, U.S. emissions were forecast to fall well short of the goal, declining just 24% by 2030.[14]

Renewable energy use is central to meeting net zero targets. Two-thirds of the total energy supply in 2050 is expected to come from wind, solar, bioenergy, geothermal and hydro energy. Solar energy is expected be the largest segment and accounts for a fifth of all energy.[15] For perspective on the growth required, in 2021, about 61% of the electricity generated in the U.S. was from fossil fuels, about 19% was from nuclear energy, and 20% came from renewable sources. Wind and hydropower were the largest renewable sources at 9.5% and 6.3%, respectively.[16]

Globally, progress is slightly better, as renewables comprised 29% of electricity generation in 2020, much of it from hydropower. However, despite the significant growth of renewable energy over the last decade, the global rate of renewable energy generation will need to double in order to hit net zero.

The acceleration to net-zero can create opportunities in areas of scarcity.

The world's push for net zero will put numerous resources in high demand, likely leading to shortages. For example, food systems currently generate about one-third of GHG emissions to feed roughly 8 billion people. But by 2050, the world will need to feed up to 10 billion people while producing significantly less emissions.[17] With climate change, loss of farmland, loss of habitats, and freshwater depletion and pollution are longer-term, existential risks to humanity's food supply. Currently, only 15 crop types and five livestock species provide about 80% of our global food supply. To survive, the world must adapt, with technology like precision agriculture, agriculture robots (AgRobots), and controlled environment agriculture (CEA) playing a central role.[18]

Also intertwined with food scarcity is the lack of clean water. Currently, 1 in 10 people lack access to a basic drinking water service, and 1 in 4 people have no access to basic sanitation/toilets. As 2050 approaches, demand for water is set to increase 20–30%, driven by megatrends including population growth, urbanization, and industrialization, compounded by increases in food and energy demand. Additionally, degradation of water sources is a growing risk with 80% of wastewater currently released untreated. For example, 40% of Beijing's water sources is "unfit for human contact."[19]

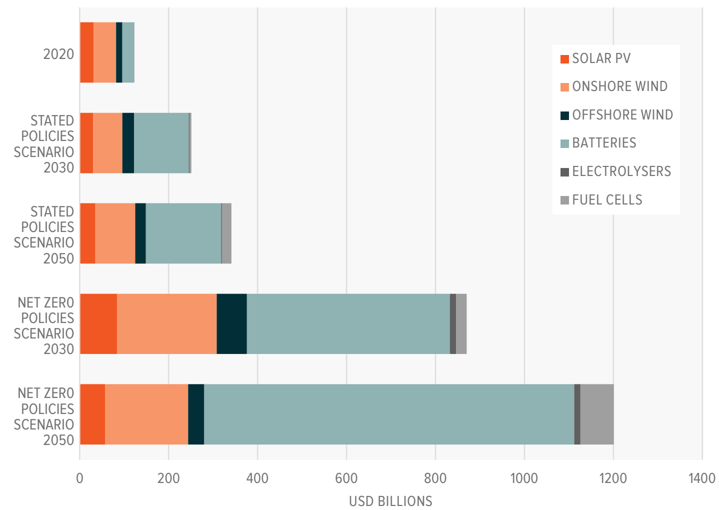
Resource scarcity will also impact the materials needed to produce the technologies required for greener solutions. According to the IEA's Net Zero by 2050 Scenario, the accelerated transition from fossil fuel to clean energy sources could increase mineral demand by six times between 2020 and 2050. The majority of the increase in volume is attributable to electric vehicles and battery storage. Since 2015, EVs and battery storage have surpassed consumer electronics to become the largest consumers of lithium, together accounting for 30% of total current demand. This demand is expected to accelerate as the need for stronger batteries is expected. Recently the IEA estimated that battery demand from EVs will be 40 times greater by 2040 compared to 2020. Demand for nickel, cobalt, and other rare earths are expected to increase significantly relative to what is mined today. A related concern is that China controls 90% of rare earth mineral processing, which could lead to a climate trade war.[20] As countries step up their climate action goals, clean energy technologies are set to become the fastest-growing segment of demand for most minerals. Their share of total demand edges up to over 40% for copper and rare earth elements, 60-70% for nickel and cobalt and almost 90% for lithium by 2040.[21]

VISUALIZING THE MARKET OPPORTUNITY

The path to net zero emissions requires annual investment in clean energy to rise to $4 trillion by 2030, triple current levels. Such investment would create opportunities for equipment manufacturers, service providers, developers and engineering, procurement, and construction companies along with the entire clean energy supply chain. For perspective, the combined market opportunity for wind turbines, solar panels, lithium-ion batteries, electrolyser, and fuel cells is an estimated $27 trillion. In this scenario, EV batteries comprise over 60% of the opportunity.

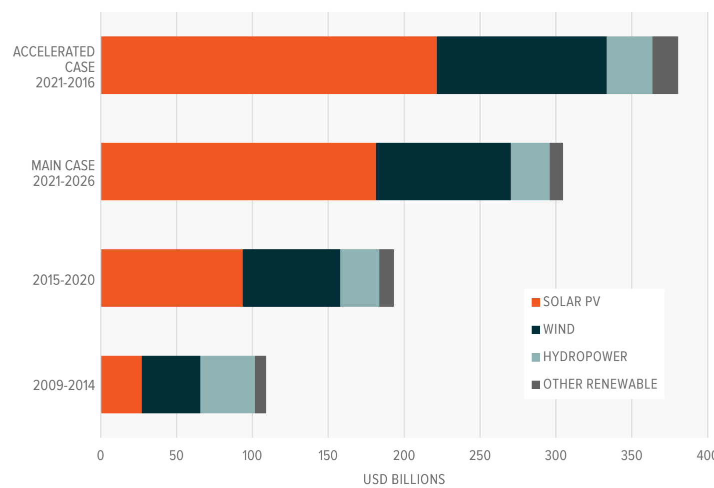
ESTIMATED MARKET SIZES FOR SELECTED CLEAN ENERGY TECHNOLOGIES BY TECHNOLOGY & REGIONS

Source: IEA data as of October 26, 2022



RENEWABLE ELECTRICITY CAPACITY GROWTH BY TECHNOLOGY

Source: IEA data as of November 30, 2021



Solar photovoltaic (PV) is the growth powerhouse in renewable electricity, with its capacity additions forecasted to increase by 17% in 2021 to a new record of almost 160 gigawatts (GW). Total offshore wind capacity is forecasted to more than triple by 2026.[22]

RISKS TO THE CLIMATE CHANGE THEME

Cost pressures may impact the adoption of renewable energy sources.

With improvements in technology, renewable energy sources are now cost-competitive with oil, coal, and gas-fired power. Utility-scale solar PV costs are 85% lower than in 2010, and onshore and offshore wind power are 48% and 68% lower, respectively.[23]

However, to build the infrastructure to facilitate the transition also requires significant expenditure. For the U.S. to reach 100% renewable energy by 2050 requires a $7.8 trillion investment. Among other infrastructure, the U.S. must build 288,000 new 5-megawatt (MW) wind turbines and 16,000 100-MW solar farms on 1.08% of U.S. land, a meaningful percentage. The decarbonization plan would also reduce energy costs by $1.3 trillion per year, because renewable energy is cheaper to generate over time than fossil fuels. In addition, the plan would cut health and climate costs by $700 billion and $3.1 trillion annually, respectively, compared to current fossil fuel infrastructure.[24]

Economic recovery from the pandemic complicates the transition. Pandemic-induced supply chain bottlenecks put significant pressure on prices, and the war in Ukraine added pressure. Demand for sustainable sources such as wind and solar now significantly outpace supply.[25] Post-invasion, renewable energy projects face soaring prices for key materials such as aluminum and steel, as well as higher transportation costs owing to oil prices surging by more than 50% this year. Also, in almost every competitive power market in the U.S., long-term contracts for wind and solar-power purchases, which are used to finance new projects, are substantially higher.[26]

In the near term, cost pressures like these can cause a hiccup in renewable energy production. However, we believe that the war brought the importance of long-term energy security to the forefront on individual country and global levels. With increased recognition that renewable energy sources are effective solutions, we expect them to accelerate the energy transition.

Emerging markets and developing economies make up a large part of underfunding.

An estimated 70% of the additional investment in clean energy required to hit the $4 trillion target by 2030 must come from emerging market and developing economies. Notable examples of developing economies mobilizing capital for clean energy projects include India's success in financing a rapid expansion of solar photovoltaic (PV) in pursuit of its 450 GW target for renewables by 2030.[27]

However, funds to support sustainable economic recovery for developing nations from COVID-19 are scarce. Also, financing capital remains up to seven times more expensive than in advanced economies.[28] The pandemic broke the trend of steady progress towards universal access to electricity and clean cooking.[29] In Africa, the number of people without electricity increased in 2020 after declining over the previous six years. In developing African and Asian countries, basic electricity services are now unaffordable for more than 25 million people due to population growth and increasing levels of poverty. An additional 85 million people, mainly in developing Asia, may be forced to scale back to basic electricity access because of an inability to pay for an extended bundle of services.[30]

It is essential to accelerate funding from international sources to allow developing economies to chart a new lower emissions path. Alongside the necessary policy and regulatory reforms, public financial institutions – led by international development banks and larger climate finance commitments from advanced economies – play crucial roles to bring forward investment in areas where private players do not yet see the right balance of risk and reward. We expect climate concerns to continue to play a large role within global policies and the affects will have to trickle down to developing nations if we are going to strive for global net-zero emissions.

THEMATIC INTERSECTION WITH CLIMATE CHANGE

Disruptive Materials

Disruptive materials are vital to the world's efforts to address climate change. These metals, minerals, and elements provide the backbone to the various game-changing climate technologies. Demand is expected to increase 2–6x from today, depending on the level of climate change adaption achieved. The low end considers a conservative scenario where adaptation does not go significantly beyond current policy, while the high end assumes net zero is hit by 2050.[31]

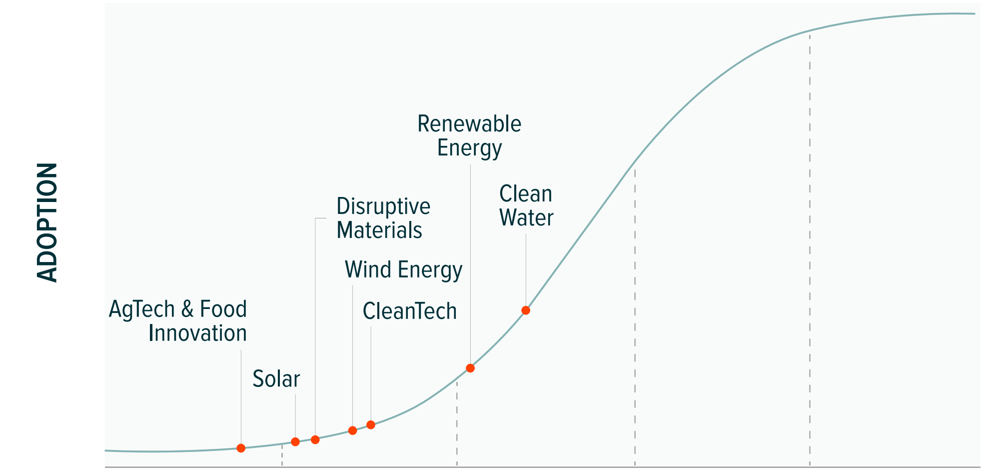
Global X Research expects the transition from internal combustion engine (ICE) vehicles to EVs to be a significant driver of demand for materials like lithium, graphite, copper, nickel, cobalt, and manganese. For example, an EV requires six times more of these materials than a transitional ICE. Elsewhere, the growth of renewable energy sources like wind and solar will rely heavily on disruptive materials. Solar power generation requires about 5 kilograms (KG) of copper per kilowatt (KW), roughly twice that of conventional power generation.

Mobility

Mobility continues to become cleaner, smarter, and more autonomous as the world tries to mitigate climate change. In 2021, 6.5 million electric vehicles were sold worldwide, up 109% on 2020. EV sales accounted for 9% of all passenger vehicles sold. Nearly 85% of the EVs sold were to customers in Mainland China and Europe.[32]

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021.



ADOPTION	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
GROWTH	Slow	Medium	High	Medium	Slow

Demand continues to increase. A recent survey revealed that 7 out of 10 U.S. drivers would be interested in buying an EV when charging infrastructure expands and EV costs drop.[33] To meet this demand, one estimate says automakers and suppliers need to invest at least $526 billion in EVs and batteries between 2022 and 2026, more than double the five-year EV investment forecast of $234 billion for 2020–2024.[34] Net zero by 2050 requires global EV sales to increase to 60% of total car sales by 2030.[35]

CLIMATE CHANGE IN A PORTFOLIO CONTEXT

It is always important to look to tailwinds. The Inflation Reduction Act recently signed into law will provide much needed funding to assist in meeting climate action targets. We expect the Climate Change theme to become increasingly prominent in investment portfolios. Given the scope and magnitude of the crisis, the Climate Change theme is diverse, spanning numerous sectors and specializations. On the adoption curve, Clean Water and Renewable Energy are in the Early Majority phase, indicating adoption levels are high and rising. CleanTech, Solar, Disruptive Materials, and Wind are in the Early Adoption phase. As countries prioritize clean energy and energy security, we expect their adoption to accelerate. Subsets of the Climate Change theme will continue to accelerate as well.

The pie charts break down the geographic exposure of the largest Climate Change thematic ETF products. We believe that there is ample innovation occurring outside the U.S., and that limiting exposure to the U.S. could exclude key players to the detriment of investors over the long term.

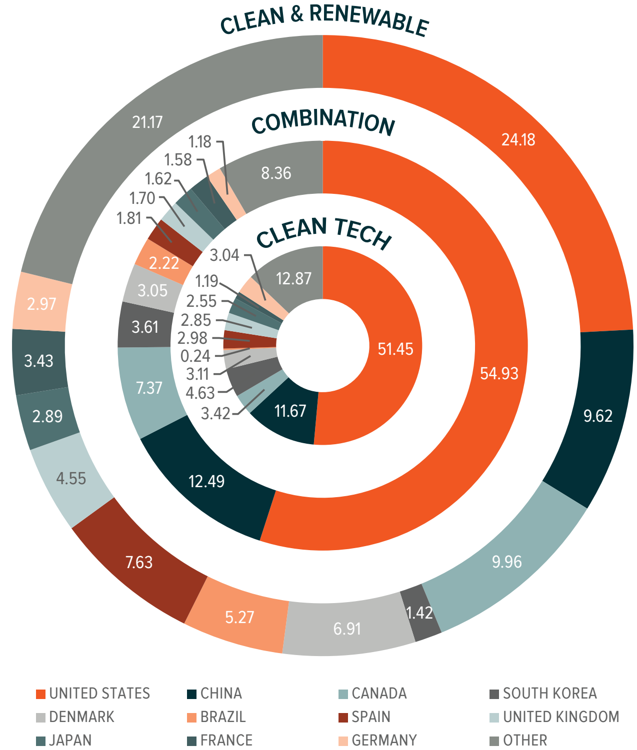
In our view, thematic equity should be targeted, using screens to ensure that the underlying companies provide the desired exposure. This pure play focus minimizes overlap between themes while also differentiating the exposure provided by the theme relative to broad beta products. We conducted an overlap analysis between various Climate Change subthemes ETFs, the S&P 500, MSCI ACWI and the most applicable S&P 500 sector ETFs for each exposure. For the latter, we used the Technology Select Sector SPDR Fund (XLK) and Industrial Select Sector SPDR Fund (XLI) for CleanTech, the Utilities Select Sector SPDR Fund (XLU) for Renewable Energy, and the Materials Select Sector SPDR Fund (XLB) for Disruptive Materials.

We found that average overlap by weight for CleanTech was 1.3% when compared to the S&P 500, 1.2% vs. the MSCI ACWI, 0.6% vs. XLK, and 1.8% vs. XLI.[36] Similarly, the overlap for Renewable Energy was a low 0.05% when compared to the S&P 500, 0.15% vs. the MSCI ACWI, and 0.0% vs. XLU.[37] The overlap for Disruptive Materials was 0.1% compared to the S&P 500, 0.2% vs. the MSCI ACWI, and 5.4% vs. XLB.[38] The low overlap with broad indexes reflects the benefits of thematic exposure, as sector indexes have yet to include substantial exposures towards these Climate Change themes.

Climate change affects the most critical aspects of life, including food, shelter, safety, and work. Many communities are already experiencing the negative impacts, especially those that are more vulnerable. With the repercussions becoming more acute, we expect progress toward net zero to create opportunities across themes like Clean & Renewable Energy and Disruptive Materials. Many climate change-related themes are in the earlier phases on the adoption curve; however, we expect their adoption and growth to accelerate as public and private sector investment ramps up. Climate change requires significant capital expenditure, but inaction will be vastly more expensive.

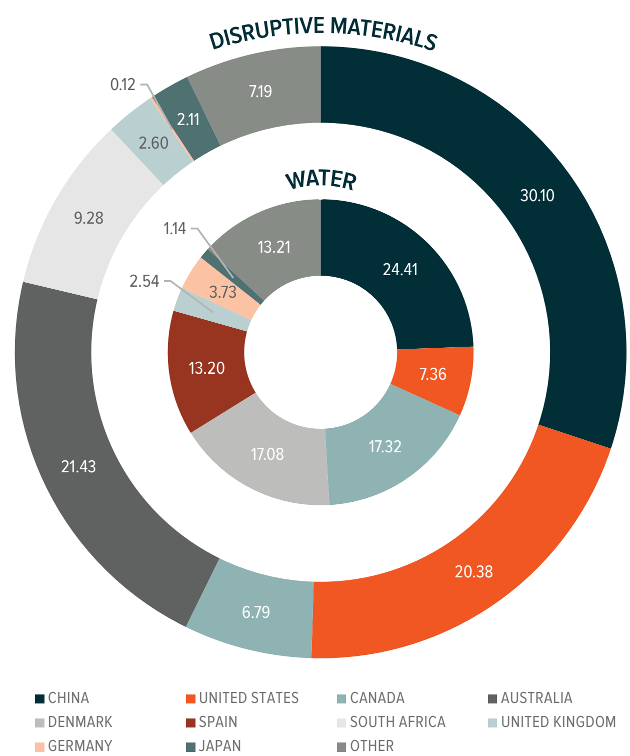
CLEAN ENERGY: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of June 30, 2022



RESOURCE SCARCITY: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

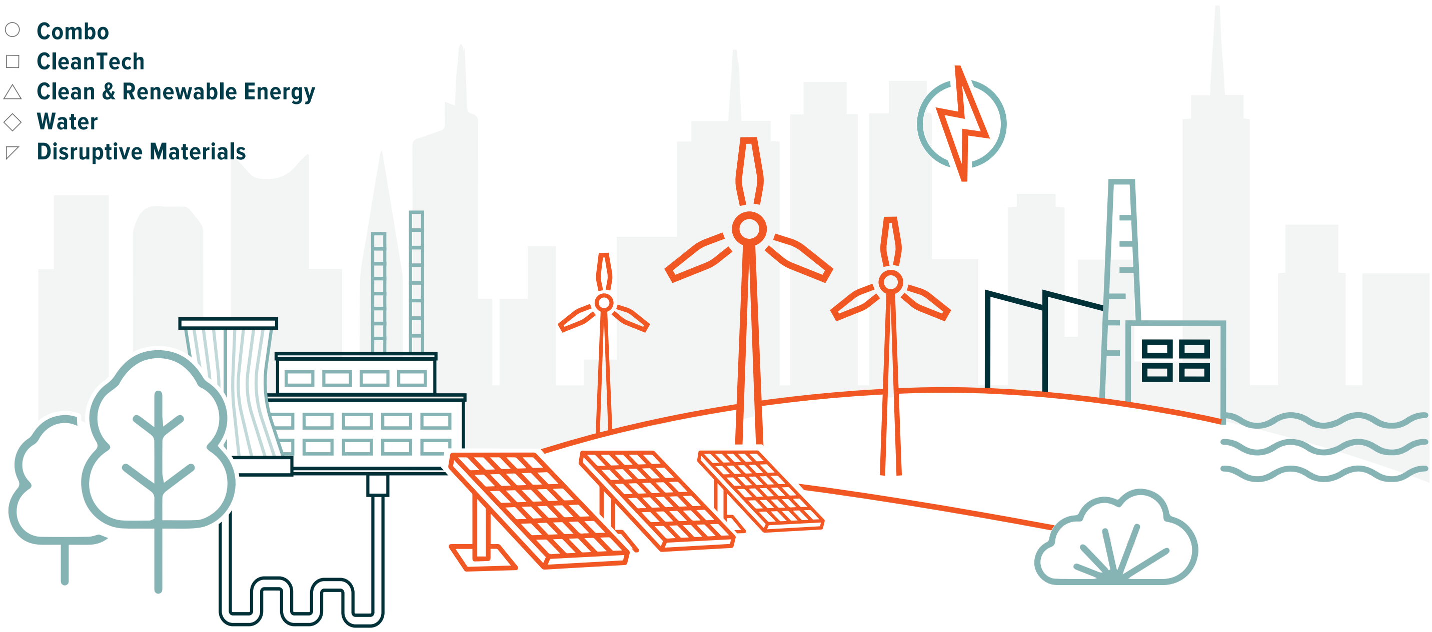
Source: Morningstar data as of June 30, 2022



HOW TO ACCESS CLIMATE CHANGE

The graphic below identifies the largest U.S. listed ETFs that provide direct exposure to the Climate Change theme through Clean Energy and Resource Scarcity.

- ○ **Combo**
- □ **CleanTech**
- △ **Clean & Renewable Energy**
- ◇ **Water**
- ◸ **Disruptive Materials**



CLEAN ENERGY

○ **ICLN**
iShares Global Clean Energy ETF

○ **ACES**
ALPS Clean Energy ETF

○ **CNRG**
SPDR S&P Kensho Clean Power ETF

○ **GCLN**
Goldman Sachs Bloomberg Clean Energy Equity ETF

○ **BNE**
Blue Horizon BNE ETF

□ **QCLN**
First Trust NASDAQ Clean Edge Green Energy Idx Fd

□ **PBW**
Invesco WilderHill Clean Energy ETF

□ **PBD**
Invesco Global Clean Energy ETF

□ **GSFP**
Goldman Sachs Future Planet Equity ETF

□ **CTEC**
Global X CleanTech ETF

△ **RNRG**
Global X Renewable Energy Producers ETF

△ **FRNW**
Fidelity Clean Energy ETF

RESOURCE SCARCITY

◇ **PHO**
Invesco Water Resources ETF

◇ **FIW**
First Trust Water ETF

◇ **CGW**
Invesco S&P Global Water Index ETF

◸ **REMX**
VanEck Rare Earth/ Strategic Metals ETF

◸ **DMAT**
Global X Disruptive Materials ETF

◸ **CRIT**
Optica Rare Earths & Critical Materials ETF

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[38] ETF Action data as of September 2, 2022. Overlap data focuses on the largest three U.S. listed ETFs for the theme.

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INFRASTRUCTURE DEVELOPMENT

Infrastructure provides connection. All infrastructure, whether physical or digital, functions to connect people with people, goods, information, places, markets, or resources. Access to roads, the internet, power lines, and waterpipes connect people to the things that they need to live, not just what they want. After decades of underfunding, infrastructure investment must accelerate to meet these needs, made more urgent by the effects of climate change. And when investment addresses need, opportunities from a portfolio perspective are likely to emerge.

KEY TAKEAWAYS

- Infrastructure investment is severely underfunded and requires a significant global push to close the $15 trillion investment gap by 2040.[1]
- The transition to a more sustainable future with climate change more acute and energy security a priority accelerated the demand for green infrastructure, particularly clean energy.
- The Infrastructure Development theme connects numerous rapidly growing mega themes, including Connectivity, New Consumer, and Mobility, which offer compelling investment potential.

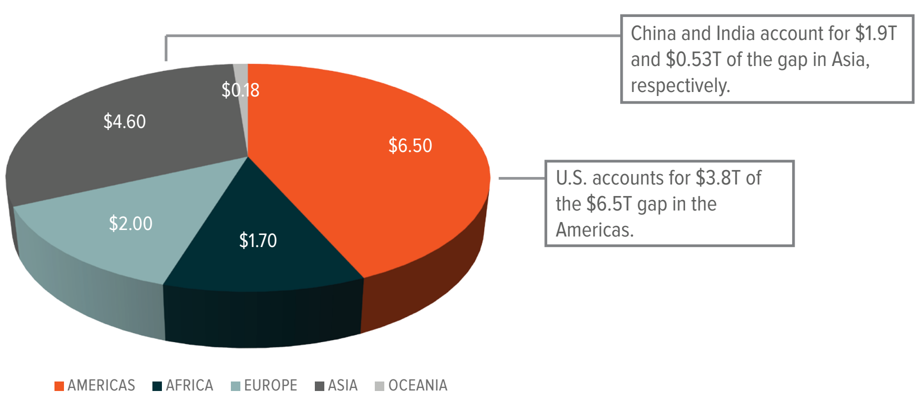
WHY INFRASTRUCTURE DEVELOPMENT IS SUCH A POWERFUL FORCE

A $15 trillion infrastructure gap by 2040 creates an urgent need for investment.

Governments across the globe have mobilized to close the infrastructure gap with various funding programs. We expect investments in infrastructure will continue to grow, creating tailwinds for the Infrastructure Development theme and beyond. The opportunity varies across the globe, but the largest investment gaps are in the Americas and Asia. As the chart below shows, the investment gap in the Americas is the largest at $6.5 trillion.

INFRASTRUCTURE SPENDING GAP (TRILLION)

Source: Global Infrastructure Hub, 2021

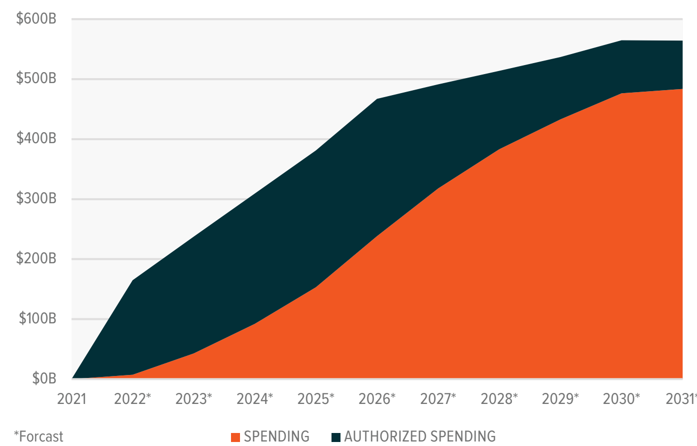


The U.S. accounts for nearly 60% of the total gap and has the greatest investment need in the Americas. Much of the shortfall in the U.S. is attributed to the expansive nature of the country combined with the cumulative lack of investment. Airports, ports, roads, and bridges require significant enhancements. The American Society of Civil Engineers grades U.S. roads a “D,” bridges a “C,” airports a “D+,” and ports a “B-,” noting that the U.S. is “badly in need of greater investment in infrastructure.”[2]

The U.S. took a major step toward enhancing its infrastructure with the $1.2 trillion Infrastructure Investment and Jobs Act (IIJA) in November 2021. The IIJA will direct $550 billion over the next 10 years to rebuild roads, bridges, airports, and rails, expand access to clean drinking water and broadband internet, and advance environmental justice.[3] Congressional Budget Office (CBO) forecasts suggest the federal government will disburse 51% of authorized IIJA funding by 2026 and 86% by 2031. In 2023, infrastructure spending is likely to accelerate as federal agencies build out logistical frameworks for new infrastructure programs, streamline approval processes, and engage with states on competitive grants.

INFRASTRUCTURE INVESTMENT & JOBS ACT IMPLEMENTATION LIKELY TO ACCELERATE IN COMING YEARS

Source: Congressional Budget Office, 2021



Asia has the second largest investment gap at $4.6 trillion, with China and India making up half the gap. China has spent a trillion dollars through its Belt and Road Initiative (BRI). The project intends to build railways, ports, roads, dams, pipelines, and industrial corridors across dozens of countries in Asia, Europe, and Africa. The global economic slowdown forced Chinese banks to sharply reduce lending for new projects as they focus on cleaning up their existing loan portfolios.[4] It will be important to monitor the BRI’s progress, given its significance to infrastructure development across China and developing nations. In 2019, India committed to spending $1.5 trillion over the next 5 years toward infrastructure, including rail, roads, and waterway connectivity.[5]

Europe is responsible for $2.0 trillion of the investment gap.[6] In 2022, the European Union (EU) committed to invest €5.4 billion to support post-pandemic economic recovery in all EU Member States while contributing to the construction of missing transport links and other infrastructure projects across the continent.[7] Investments at the individual country level includes Germany’s plan to invest about $55 billion in the development of quantum computing, artificial intelligence, offshore wind, hydrogen energy, and electric vehicles. Italy recently announced a plan to invest 3.9 billion euro to improve water infrastructure and reduced leaks in cities and agriculture areas.[8]

INFRASTRUCTURE AND A GREENER WORLD

Energy infrastructure is now a priority after years of underfunding.

Energy infrastructure can be broken down to three components: generation, transmission, and distribution. The U.S. national grid is aging, with components over a century old, far past their 50-year life expectancy. To meet the latest state-driven Renewable Portfolio Standards, the country's energy infrastructure gap is projected to grow to $197 billion by 2029.[9] Globally, the energy investment need totals $34.9 trillion and the gap $2.92 trillion through 2040.[10]

Despite the large gap, spending has increased significantly over the past decade. In the U.S., annual spending on high voltage transmission lines grew from $15.6 billion in 2012 to $21.9 billion in 2017, while annual spending on distribution systems—the "last mile" of the electricity network—increased 54% over the past two decades.[11] Government funding from the IIJA will direct $73 billion toward power infrastructure and clean energy, including the deployment of smart grid technologies and battery storage, green hydrogen, carbon capture technology, and renewable power.[12] Utilities are strengthening the electric grid through resilience measures.[13]

Weather is an increasing threat with climate change exacerbating the frequency and intensity of severe weather events and their associated costs. Severe weather was the predominant cause of the 638 reported transmission outages reported from 2014 to 2018. Another issue is distribution infrastructure's struggles with reliability, with 92% of all outages occurring along this segment resulting from a range of issues including aging infrastructure, weather events and vandalism. In the coming years, additional transmission and distribution infrastructure, smart planning, and improved reliability are needed to accommodate the changing energy landscape as delivery becomes distributed and renewables grow.[14]

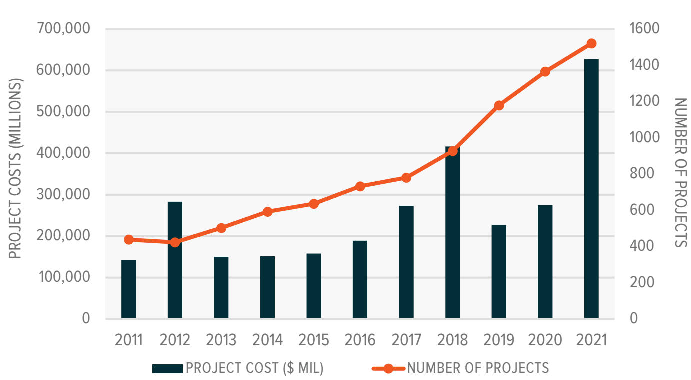
Renewables' share of generating capacity is expected to accelerate as the world progresses toward net zero emissions. Electricity generation from renewable energy sources in the U.S. rose from 18% in 2019 to 25% during the first half of 2022, with about 50% of the generation coming from wind and 30% from hydropower.[15] In *Climate Change*, we highlight the key segments within renewable energy that can benefit from the transition to cleaner energy.

Greening Infrastructure

Infrastructure is responsible for more than 60% of global greenhouse gas emissions, so it's no wonder why a vast majority of today's infrastructure investment focuses on sustainability.[16] As the chart below shows, in 2021, a record US$627 billion in sustainable infrastructure projects were announced in the renewable energy and nuclear sectors across categories including wind, solar, nuclear, and clean waste. That total includes 1,521 individual projects in the Americas, Asia-Pacific, Europe, and Japan, more than 3.5x the total number of sustainable infrastructure projects launched a decade earlier and more than 4x the total dollar value.[17]

SURGE IN SUSTAINABLE INFRASTRUCTURE PROJECTS

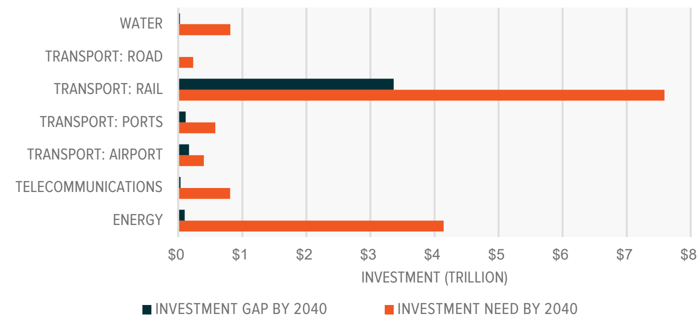
Source: Refinitiv Infrastructure 360 data as of December 31, 2021



VISUALIZING THE MARKET OPPORTUNITY

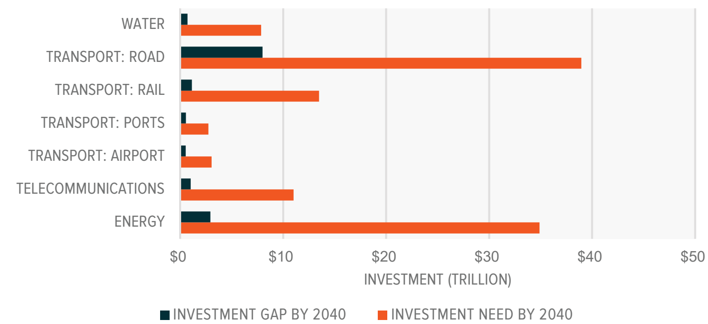
U.S. INFRASTRUCTURE INVESTMENT BY SECTOR

Source: Global Infrastructure Hub data as of December 31, 2021



GLOBAL INFRASTRUCTURE INVESTMENT BY SECTOR

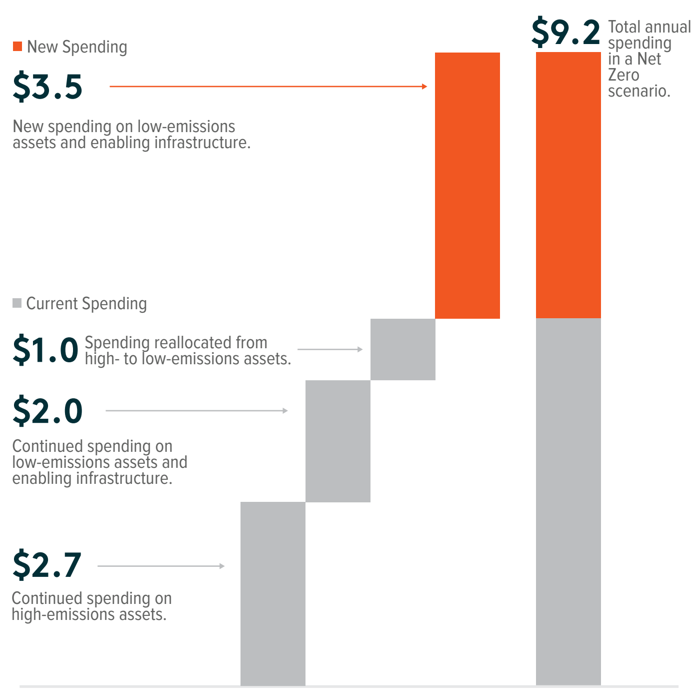
Source: Global Infrastructure Hub data as of December 31, 2021



CONSIDERING LEGACY ASSETS/INFRASTRUCTURE COULD DOUBLE COST

Net Zero costs could reach $9tn a year average ($275tn cumulative to 2050) when considering legacy assets and reallocating capital per McKinsey.

Source: McKinsey data as of December 31, 2021



Green infrastructure is also a focus for private investors, which is good news because private investment is essential for the future of infrastructure development and to help close the gap. In 2021, global private investment was greener than ever with a 60% share.[18] The renewable energy sector, with a heavy emphasis on solar and wind, continues to attract the most investment, tallying almost half of the total. Investment in battery storage skyrocketed, almost quadrupling from 2020. Encouragingly, the increase in green investment in 2021 was mostly outside renewable energy, such as waste, which historically has not been the case and these areas are in dire need of investment.[19]

The trend toward green investments was consistent across all income groups, with the higher income levels having higher percentages. However, the sectors that attracted the most investment by region varied. Within developing areas such as Latin America, Africa, and Oceania, the transport sector garnered much of the investment, in line with the regions' investment needs and gaps.[20] Renewables received a large portion of the investment within developed nations.

RISKS TO THE INFRASTRUCTURE DEVELOPMENT THEME

Capital needs are high and projects may take longer than expected.

Infrastructure projects are costly and rely heavily on government sponsorships. The IIJA is a massive step for the U.S., but the future of infrastructure will require much more funding. Elevated global inflation will likely impede the ability to raise more capital as fiscal spending becomes harder.

Moving infrastructure funds from federal coffers to state and then local governments is time-consuming, and construction projects are seldom known for their brevity. Infrastructure investing can be perceived as riskier because the timeline is longer, projects are unclear, and the costs tend to be higher. Between pandemic-related worker shortages and construction delays, rising geopolitical tensions, and growing macroeconomic uncertainty, hundreds of projects have been sidelined. These setbacks could increase the cost of the various projects.

While the total number of announced projects suggest that 2021 was a record year for new solar and wind projects, setbacks kept many announced projects from getting under way as quickly as anticipated. Just 47 (3.8%) of the 1,232 solar and wind projects announced in 2020 are complete. Likewise, only 89 (8.3%) of the 1,069 solar and wind projects announced in 2019 are complete.[21]

Developing countries require significant investment and will likely rely on private investment.

The investment gap between high-income and middle- and low-income widened in 2021. Private investment in infrastructure projects continued to grow in high-income countries, where 80% of all private infrastructure investment occurred. Conversely, private investment continued to trend lower in middle- and low-income countries. The declining trend in infrastructure investment for these countries began before the pandemic, but the crisis exacerbated it.[22]

This trend is particularly worrying because the infrastructure need is the greatest in these countries and they have the largest financing gaps. Almost two-thirds of the world's infrastructure needs to 2035 are in emerging economies.[23] Not only do many of these countries lack the basic infrastructure to support economic growth and development, but they are also the ones most vulnerable to the adverse impacts of climate change.[24]

Heightened political risk and a lack of adequate mechanisms to mitigate financial risk, including exchange rate risk, can be barriers to investment in these markets. As the global economic backdrop continues to wane, the hurdle rates for these investments will continue to climb, further widening the gap.

Labor shortages can be a challenge.

Government and private sector leaders ranked talent and expertise shortages as one the biggest obstacles to implementing infrastructure projects over the next three years.[25] In April 2022, the U.S. construction industry had roughly 440,000 job openings and the U.S. manufacturing industry had over 1 million. And the IIJA is expected to create hundreds of thousands of additional jobs over the next decade.[26] These labor shortages can have severe economic ramifications, as any delay across the supply chain can lead to delays in project completions and increase costs. It will be essential to close the widening gap between labor demand and supply in order to minimize these potential negative consequences.

THEMATIC INTERSECTION WITH INFRASTRUCTURE DEVELOPMENT

Connectivity

The pandemic accelerated consumer appetite for ease, convenience, and connectivity. For example, 80% of American workers now expect to work from home at least 3 day a week, compared to the 6% of workers who primarily worked from home prior to the pandemic.[27] This transition significantly expands the importance and use of big data. The total amount of data created, captured, copied, and consumed globally is forecast to increase exponentially with big data becoming a $100 billion market by 2027.[28]

To support this rapid growth, digital infrastructure will need to create more capacity. It is estimated to grow at a compound annual growth rate (CAGR) of 19.2% from 2020 to 2025.[29] The IIJA allocated $65 billion to communication.[30] With more investment to build capacity, communication infrastructure owners and operators should be able to service more customers.

E-Commerce

Shopping on a mobile device is now more accessible and the preferred method of purchase for many consumers, a byproduct of the pandemic shifting life online. In 2020, U.S. e-commerce sales increased 42.4% year-over-year (YoY) to $811.6 billion. In 2021, the trend continued, as U.S. e-commerce sales increased 14.2% YoY to $959.9 billion.[31] These figures make the e-commerce sales of $199.3 billion in 2011 seem tiny, and they illustrate this segment's rapid growth.

The runway for additional e-commerce sales growth is significant, as e-commerce represented only 13.2% of total U.S. retail sales in 2021.[32] Globally, the picture looks the same, with e-commerce sales rising 17.1% in 2021, representing only about 19% of total retail sales.[33] As consumers continue to shop online and demand quick delivery, the need for investment in the infrastructure systems that support e-commerce, such as roads and bridges, will likely grow.

Electric Vehicles

The appetite for electric vehicles (EV) surged in recent years, and sales numbers in 2022 reflect this appetite. During Q2 2022, EV sales in the U.S. jumped to over 440,000, a nearly 13% YoY increase.[34] A recent survey revealed that 7 out of 10 U.S. drivers would be interested in buying an EV when charging infrastructure expands and EV costs drop.[35] The number of public charging stations in the geographically expansive U.S. has more than tripled since 2015, but it has a long way to go.[36] By one estimate, the U.S. needs 20 times more public charging stations than it has today.[37]

Europe continues to be a global frontrunner in EVs. In 2021, the continent already had about 375,000 charging stations, but even in one analysis' most conservative scenario, the EU-27 will need at least 3.4 million operational public charging points by 2030. Extensive utility grid upgrades are required to increase Europe's renewable energy capacity and to distribute electricity to these new charging stations. In all, the buildout of EV charging infrastructure may cost €240 billion by 2030.[38]

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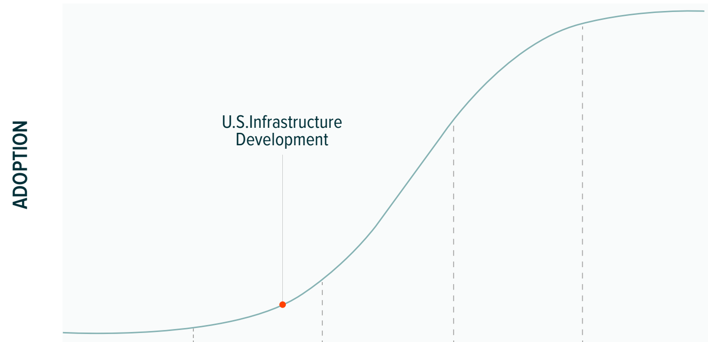
INFRASTRUCTURE DEVELOPMENT IN A PORTFOLIO CONTEXT

The future of infrastructure is dynamic, spanning various industries and themes. On the adoption curve, U.S. Infrastructure sits in the Early Adopters phase. As investments toward improving the infrastructure continue to be prioritized over the next decade, we expect adoption to accelerate.

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021.

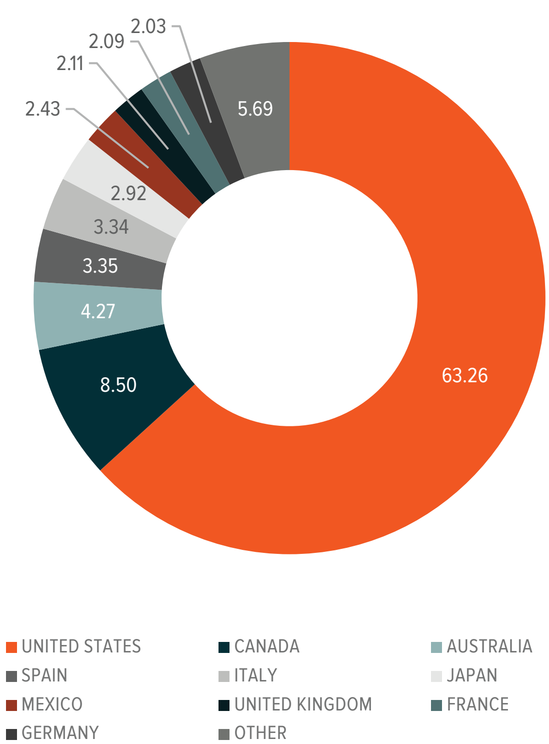


ADOPTION	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
GROWTH	Slow	Medium	High	Medium	Slow

The pie chart breaks down the geographic exposure of the largest Infrastructure Development thematic ETF products. We believe that there is ample innovation occurring outside the U.S., and that limiting exposure to the U.S. could exclude key players to the detriment of investors over the long term.

INFRASTRUCTURE DEVELOPMENT: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of October 31, 2022



In our view, thematic equity should be targeted, using screens to ensure that the underlying companies provide the desired exposure. This pure play focus minimizes overlap between themes while also differentiating the exposure provided by the theme relative to broad beta products. We conducted an overlap analysis between Infrastructure Development ETFs, the S&P 500, MSCI ACWI and the most applicable S&P 500 sector ETF, the Industrial Sector SPDR Fund (XLI). We found that average overlap by weight was 3.7% when compared to the S&P 500, 3.0% vs. the MSCI ACWI, 6.7% vs. XLI.[39] The low overlap with broad indexes reflects the benefits of thematic exposure, as sector indexes have yet to include substantial exposures towards the Infrastructure Development theme.

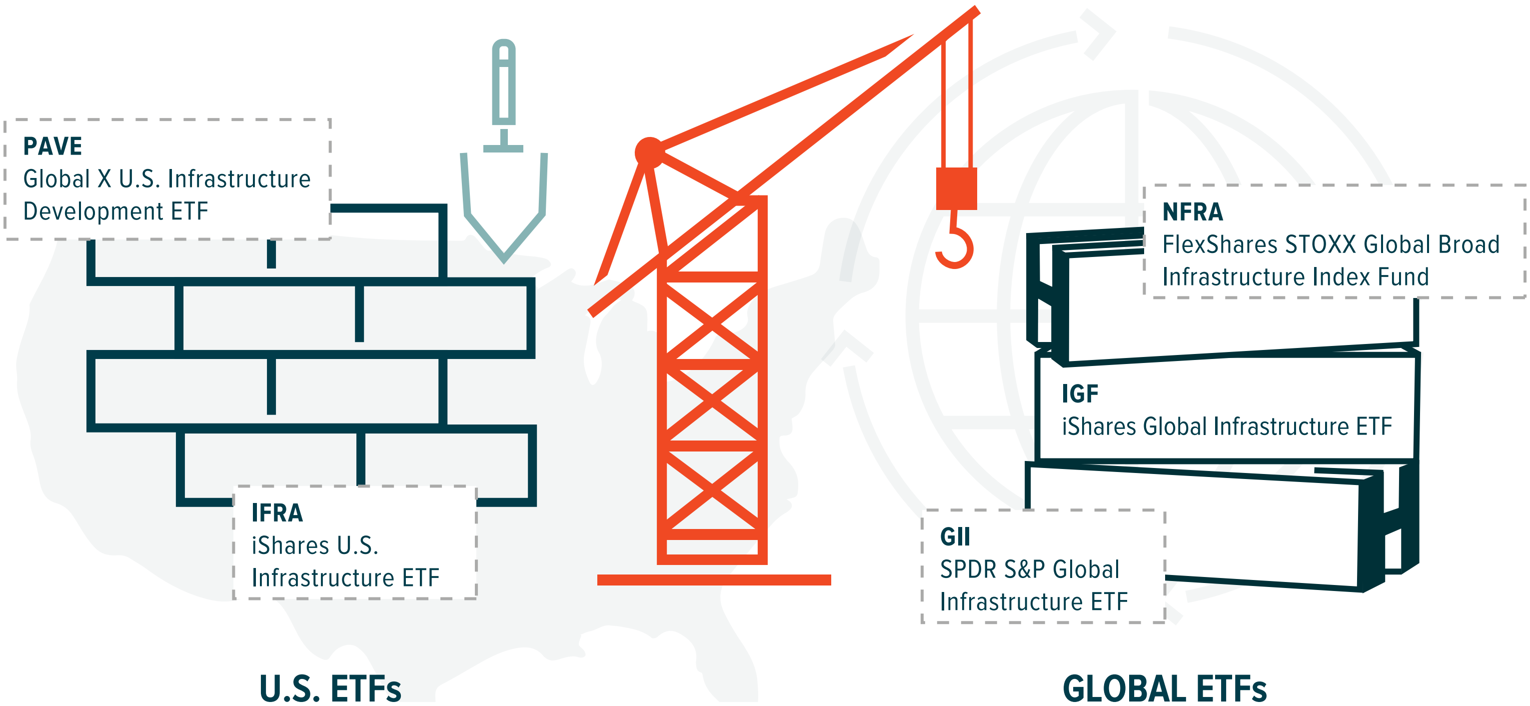
Accelerating infrastructure investment is crucial over the next decade. The American Society of Civil Engineers estimates that the U.S. needs to invest over $2 trillion by 2025 to address critical deficiencies in the nation's roads, railroads, waterways, water systems, dams, airports, electrical grids, waste management systems, park systems and educational infrastructure. Failure to repair and update these systems by 2025 could result in nearly $4 trillion in lost GDP, $7 trillion in lost business revenue, and 2.5 million lost jobs.[40] Globally, the lack of investment to fix deficiencies would be exponentially worse.

Infrastructure Development may not seem as dynamic as other themes, but it is the means by which people and economies connect on local, national, and international levels. And it can't be ignored any longer. After decades of underfunding, urgent enhancements, overhauls, and innovation are needed. Aside from normal wear and tear, in its current state, the world's infrastructure is not equipped to withstand the impact of climate change.

We expect public and private sector investment will continue to increase, both in size and scope, to address these needs. Emerging from these investments are likely to be compelling investment opportunities, exposure to which can provide portfolios meaningful return potential.

HOW TO ACCESS INFRASTRUCTURE DEVELOPMENT

The graphic below identifies the largest U.S. listed ETFs that provide direct exposure to the Infrastructure Development theme.



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INFRASTRUCTURE DEVELOPMENT FOOTNOTES

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The Human Side of Innovation

Demographic shifts have economic, social, and market implications. Longevity is creating new market areas, encouraging R&D into innovative medical areas that may extend life expectancy and quality. Conversely, generational wealth transfer is shifting purchasing power to younger generations who have different purchasing patterns and priorities. The shifting consumer and workforce composition have implications across the thematic universe, with challenges and opportunities going hand in hand.

KEY MEGA THEMES:

- New Consumer
- Health Innovation

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NEW CONSUMER

Consumer trends are shifting as demographic changes alter who consumes, how they consume, and what they want to consume. New pools of consumers with growing discretionary spending power include younger generations and the middle class in emerging markets (EMs). Also, a changing regulatory backdrop may facilitate new demand and opportunities for goods and services that were previously illegal or highly restricted. We believe these demographic and regulatory shifts form the backbone of a new consumer that will shape longer-term consumption patterns and create compelling portfolio positioning opportunities.

KEY TAKEAWAYS

- An estimated $84.4 trillion is expected to be transferred from Baby Boomers to younger generations, who have very different preferences than their older counterparts, including a values-driven approach to purchasing.[1]
- China and India represent a compelling opportunity to tap into consumers coming into wealth. China and India accounted for roughly 35% of the world's population in 2020 and are expected to account for more than one billion first-time consumers over the next decade.[2]
- New areas of consumer growth include markets that capture changing consumer attitudes and preferences, including the cannabis and legalized sports gambling markets.

WHY NEW CONSUMER IS SUCH A POWERFUL FORCE

A YOUNGER, MORE DIVERSE CONSUMER IS EMERGING AMID A MASSIVE GENERATIONAL WEALTH TRANSFER.

Growing consumer diversity creates a complex mosaic of new wants and needs, and opportunities and risks, across the global economy. In the U.S., for example, the racial makeup of Baby Boomers is roughly 75% white, while Generation Z is only 52% white and 25% identify as Hispanic.[3] Also, people are living longer while birth rates have declined. In 2020, the average age in the United States was 38, up from 27 in 1970.[4] An aging population coupled with a more diverse younger population presents different spending priorities and patterns, particularly as older generations transfer their wealth.

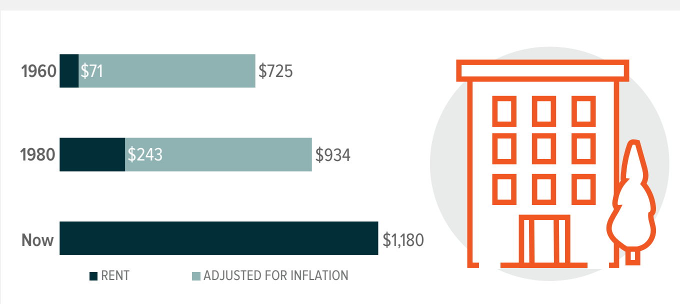
Baby Boomers are no longer the largest U.S. generation, yet they continue to hold more wealth than any other. Baby Boomers' share of wealth peaked at 55.9% in Q3 2016 before declining to 52.1% in Q3 2022.[5] In 2022, research and consulting firm Cerulli Associates forecast wealth transfers through 2045 to total roughly $84.4 trillion, with about $72.6 trillion of that total going to heirs. Cerulli expects the majority of this wealth transfer to come from Baby Boomers.[6] Cerulli estimates that Generation X, ages 40 to 55, will inherit nearly $30 trillion over the next 25 years, while Millennials, ages 24 to 39, will inherit over $27 trillion.[7]

THEN vs NOW COMPARISONS

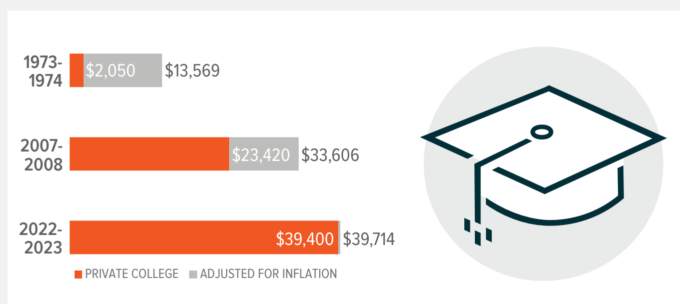
Differences between Baby Boomers (born 1946-1964) and Millennials (born 1981-1996)

Source: McKinsey data as of December 31, 2021

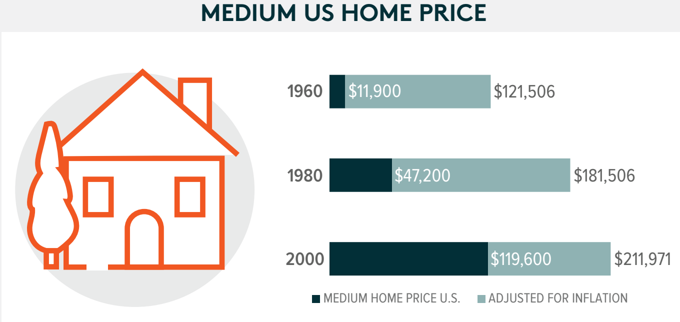
RENT



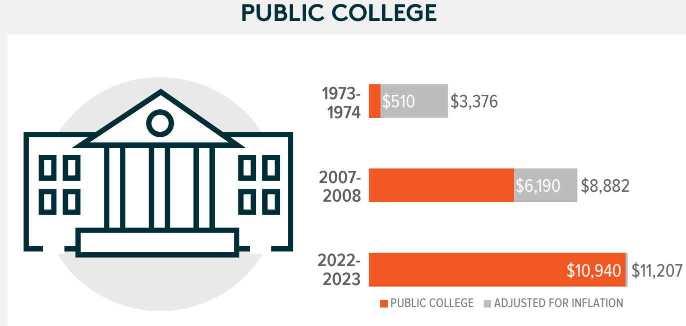
PRIVATE COLLEGE



MEDIUM US HOME PRICE



PUBLIC COLLEGE



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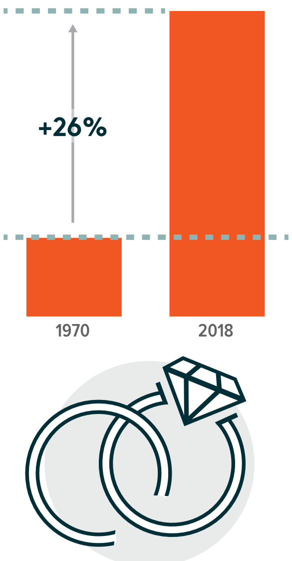
THEN vs NOW COMPARISONS CONTINUED

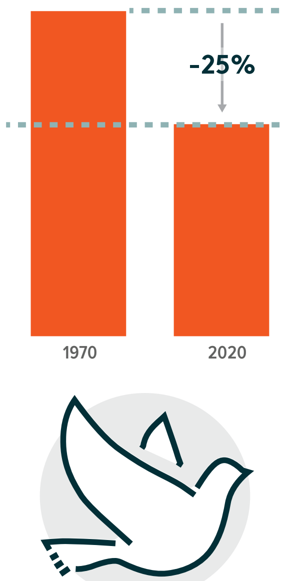
Differences between Baby Boomers (born 1946-1964) and Millennials (born 1981-1996)
Source: McKinsey data as of December 31, 2021

MARRIAGE



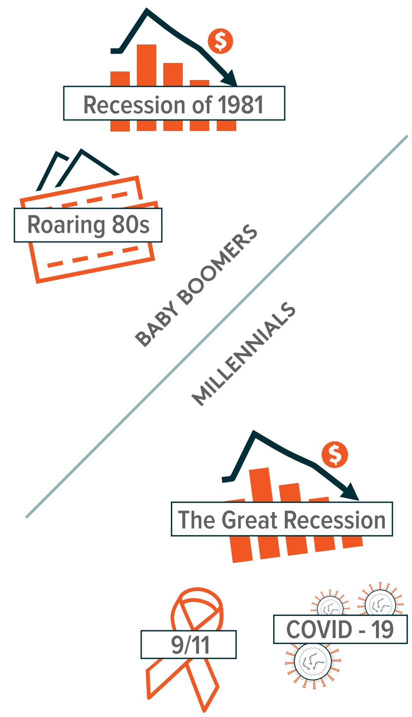
Unmarried US population aged 25-50 increased from **9% to 35%** between 1970 and 2018.

RELIGION



Church and synagogue membership dropped from **72% to 47%** between 1970 and 2020.

MAJOR EVENTS EARLY IN CAREER

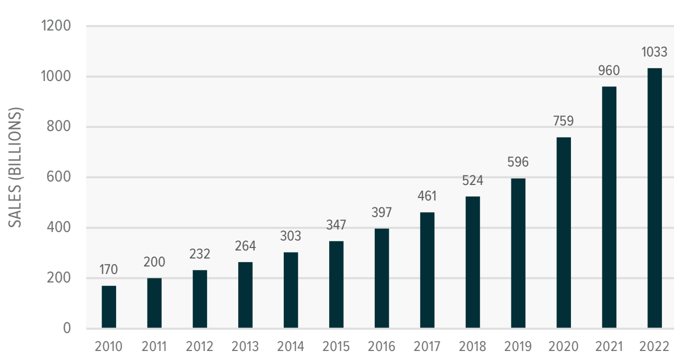


Connectivity establishes new methods for consumption.

New technology-driven consumer anchors are emerging, especially among younger generations that reflect who they are and their priorities through how they spend their time and money. This connectivity means that geography is no longer a limit. The ease of connection through devices like the smartphone increases the demand for convenience, contributing to the continued rise in online shopping. In 2022, U.S. e-commerce sales increased 7.6% year-over-year (YoY) to top $1 trillion for the first time.[8]

E-COMMERCE SALES IN THE U.S.

Source: US Census Bureau as of February 17, 2023



Younger generations prioritize societal good.

Growing visibility of climate change, including droughts, wildfires, hurricanes, and rising sea levels, largely settled the debate that human actions negatively affect the environment. A result of this understanding and growth in climate-related concerns is that consumers are more compelled to act through their purchasing decisions, especially younger generations. Millennials and Gen Z are far more likely to purchase from companies that make sustainability and social justice a focus. More than 60% of Millennials are willing to pay a premium for sustainable products, while 73% of Gen Z survey respondents say the same.[9,10] At the same time, 78% of Millennials evaluated their portfolios for sustainability considerations in 2018, compared to just 20% of Baby Boomers.[11]

GROWING OPPORTUNITIES AS EMERGING MARKET DISPOSABLE INCOME RISES.

Consumption in fast growing markets such as China and India can reshape consumer trends. These consumers are experiencing increasing purchasing power and driving demand for a wide range of products. While the bulk of Chinese consumers have moved from lower-income into the middle class, this large consumer group remains an important area of growth as they continue their trajectory from middle income to upper-middle income. On the other hand, India is a market of new consumers who are experiencing an increase in discretionary disposable income.

Chinese consumers are becoming more affluent.

Over the past two decades, Chinese economic growth brought billions of its consumers out of poverty and into the middle class. China's middle-income population rose from 391 million people in 2000 to roughly 707 million in 2018.[12] Per capita disposable income also rose, reaching CNY 35,100 in 2021, an increase of more than 8x compared to CNY 3,700 in 2000. The upward mobility is set to continue. By 2030, consumer economic conditions are expected to strengthen and result in a larger upper-middle income tier. As the chart to the right shows, this tier is estimated to account for 56% of households and 60% of urban consumption. Lower-middle income households are expected to shrink to 29% of households and 18% of consumption. Also encouraging is that another 20% of consumption could come from affluent populations, more than double the current 10% share.[13]

Higher middle-class income has enabled Chinese consumers to be better connected. China's internet penetration rate skyrocketed from just 1.8% of the population in 2000 to over 54% of the population in 2017. The penetration rate among urban residents is a robust 76%.[14] Consumers are no longer limited to traditional shopping channels and are willing to explore different ways of shopping, a behavioral change that has led to the expansion of live streaming and instant retail shopping.[15] China's e-commerce market is now the largest in the world, with e-commerce sales estimated at $2,879 billion in 2022, more than double U.S. e-commerce sales. By 2026, e-commerce sales are expected to approach $4 trillion in China.[16]

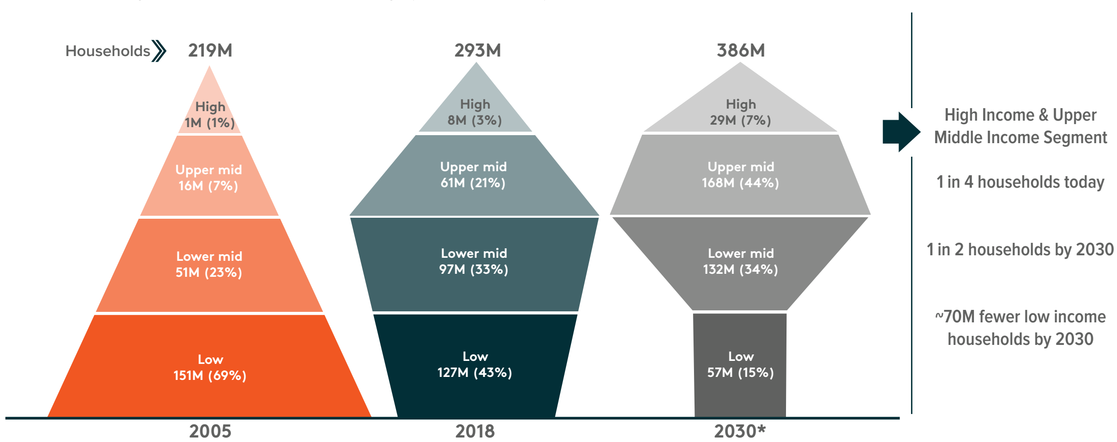
India's consumers are a growing economic power.

Tremendous growth over the last decade now makes India the world's fifth largest economy.[17] Domestic consumption, which comprises 60% of the country's GDP, is expected to grow 4x from $1.5 trillion in 2018 to $6 trillion by 2030, supported by a population of 1.4 billion that is younger than that of any other major economy.[18] Historically, household savings are high in India, with families putting away more than a fifth of their income. This buffer provides support to domestic consumption expenditure even through challenging cycles in economic activity.

Like China, the growth of middle-income and high-income households in India provides an economic anchor. The chart below shows that nearly 80% of households are expected to be middle-income by 2030, climbing from 50% in 2018. This class of consumers is expected to comprise 75% of consumer spending, with the high-income segment responsible for another 14%.[19] Concurrently, there is a government push to reduce the percentage of households below the poverty line from 15% to 5%.[20]

EVOLUTION OF THE HOUSEHOLD-INCOME PROFILE IN INDIA

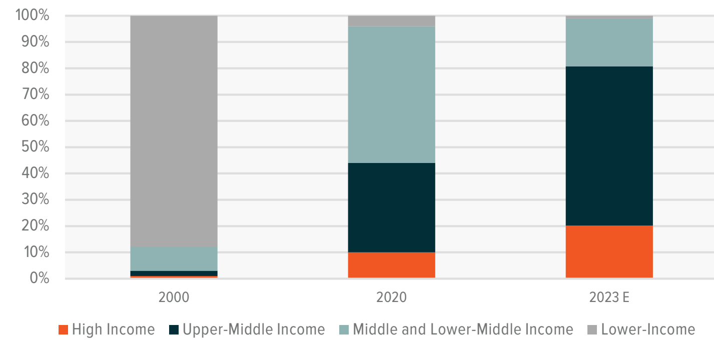
Source: PRICE Projections based on ICE 360° Surveys (2014, 2016, 2018)



*Forcasted data
Note: Low income: <$4,000, Lower-mid: $4,000-8,5000, Upper-mid: $8,500-40,000, High income: >$40,000 basis income per household in real terms; Projections with annual GDP growth assumed at 7.5%

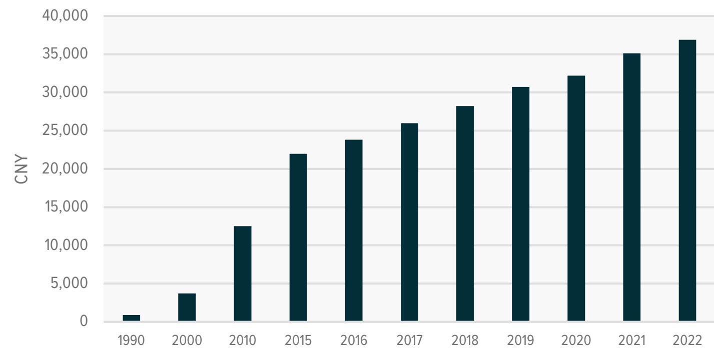
CHINA URBAN CONSUMPTION BY INCOME GROUP

Source: McKinsey data as of November 2021



CHINESE CITIZENS' PER CAPITA DISPONSABLE INCOME

Source: Deloitte Research as of January 18, 2023



A big factor in the Indian consumer's growing influence is that the information divide between rural and urban consumers continues to shrink with the expansion of the internet and devices like smartphones. Metro areas and emerging boom towns are expected to continue to drive economic growth, but there is opportunity for rural per capita consumption to grow faster than in urban areas. Infrastructure improvements should help the gap narrow further.[21]

The relative youth of India's population is another factor. The median age in India is about 29 years old, significantly younger than the U.S. population and China's.[22] The 370 million people who comprise India's Gen Z population will grow up in a significantly different India than older generations. Gen Z's India features ubiquitous access to the internet, smartphones, digital media, and digital consumption platforms. This connectivity is expected to reshape consumer preferences. At the same income levels, the more connected consumer is more likely to spend freely, own durables, and have more brand awareness. Their less connected counterparts are more likely to spend frugally, own few durables, and continue buying more of the same.[23]

DEREGULATION MAKES CANNABIS AND SPORTS BETTING NEW CONSUMPTION SEGMENTS.

The global legal cannabis market size was valued at $22.1 billion in 2022 and is expected to expand at a compound annual growth rate (CAGR) of 25.5% from 2023 to 2030.[24] Forecasts suggest that the market could surpass $100 billion by 2030 with over 70 countries having legalized some form of cannabis for medical use in recent years.[25] Previously, as a restricted substance, medical use cases of cannabis were challenging to study. With restrictions eased, medical studies are likely to increase, potentially creating new opportunities for market expansion. In the U.S., 37 states currently allow cannabis for medical use and 22 states permit its sale for recreational use.[26]

Like many segments of the new consumer economy, the cannabis market's integration with technology, including online ordering and delivery services, can help meet consumer demand. Cannabis delivery among Gen Z consumers increased by 125% YoY in 2022 and overall cannabis delivery increased by 97%.[27]

Legalized sports betting is another booming new consumer segment. The pivotal moment came in 2018 when the Professional Athlete and Amateur Sports Protection Act (PASPA), which restricted sports betting, was overturned in the U.S..[28] Over the next four years, 36 states moved to legalize gambling on sports. In 2022, nearly $80 billion was wagered within the U.S. and the global sports gambling market was valued at $83.6 billion. By 2030, this market is expected to grow to $180 billion, a compound annual growth rate (CAGR) of 10.3%.[29] Tailwinds for this market include the penetration of connected devices and the development of digital infrastructure. Connectivity is particularly consequential to this market, as over 70% of online betting revenue in 2020 came from mobile devices.[30]

RISKS TO THE NEW CONSUMER THEME

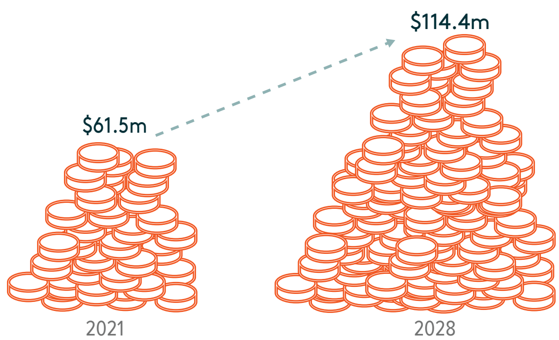
China's aging population could dampen consumption.

Although China softened its one-child policy in 2016, the country's fertility rate remains well below the replacement rate.[31] An aging population adds pressure on younger generations, given that they are usually the ones to take care of the elderly. When generations expand sequentially, this issue is not as acute. However, China's one-child policy created an inverted pyramid known as "4-2-1," or four grandparents and two parents dependent on one child.

In the next 10 years, 123.9 million more people will age into the 55 and above segment in China, the largest demographic increase among all ages.[32] More people will be needed to care for the elderly, and demand for retirement communities and other infrastructure tailored to an older population will increase. Care for the elderly may require more savings from a nation that historically saves more than other countries, potentially dampening future consumption.

VISUALIZING THE MARKET OPPORTUNITY

MARKET SIZE OF THE ONLINE GAMBLING & BETTING INDUSTRY WORLDWIDE IN 2021 AND FORCAST FOR 2028 [33]



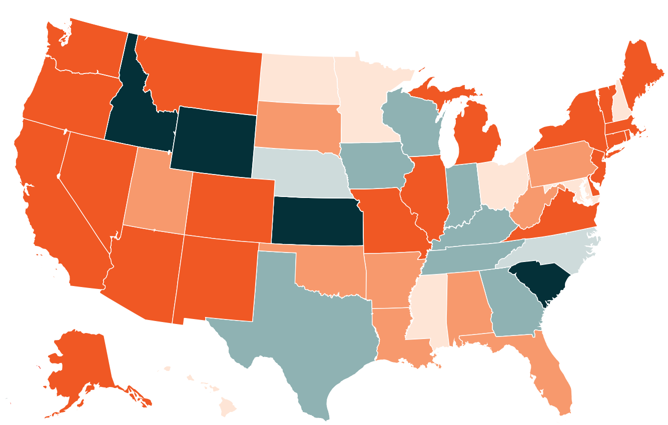
EMERGING MARKETS WILL DOMINATE THE WORLD'S TOP 10 ECONOMIES IN 2050 (GDP AT PPPs) [34]

	2016	2050	
China	1	1	China
U.S.	2	2	India
India	3	3	U.S.
Japan	4	4	Indonesia
Germany	5	5	Brazil
Russia	6	6	Russia
Brazil	7	7	Mexico
Indonesia	8	8	Japan
U.K.	9	9	Germany
France	10	10	U.K.

E7 ECONOMIES G7 ECONOMIES

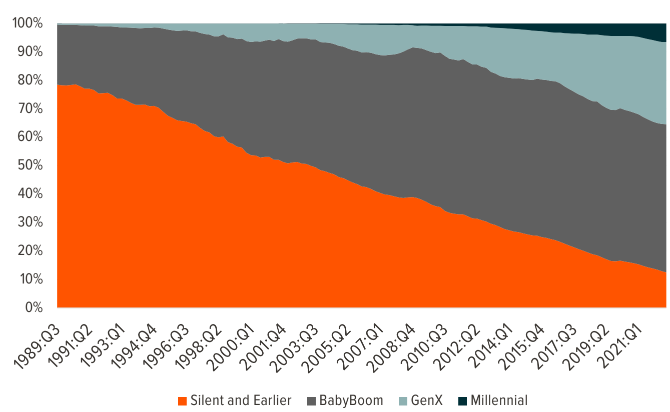
CANNABIS LEGALITY BY STATE [35]

FULLY ILLEGAL CBD WITH THC ONLY DECRIMINALIZED
LEGALIZED MEDICAL MEDICINAL AND DECRIMINALIZED



Note: CBD (Cannabidiol), THC (Tetrahydrocannabinol).

PROPORTION OF NET WORTH BY GENERATION (US) [36]



Increased focus on sustainability could change consumption patterns.

A growing majority of consumers have an interest in sustainable products, and they increasingly ask companies how they incorporate sustainable practices in their business models. In a recent survey, 85% of respondents indicated that they have shifted their purchase behavior towards being more sustainable in the past five years.[37] About 40% of millennials will choose a sustainable alternative when available, whereas older generations are slightly less likely (26-31%). Overall, European consumers report major shifts in their purchasing decisions towards sustainability, notably in Austria (42%) and Italy (41%), more so than U.S. consumers (22%).

The increased desire for sustainable products may shift consumption to longer-lasting items that don't need to be replaced as frequently, which is already the case with goods such as paper towels and recycled clothing.[38] Growing interest in sustainability could stifle demand for many "dirtier" legacy industries while increasing the demand for those perceived as "cleaner."

THEMATIC INTERSECTION WITH THE NEW CONSUMER

Mobility

Younger generations' desire for sustainability cuts across many facets of their life, including how they get around. As these generations come into wealth over the coming years, this desire will likely accelerate the adoption of electric vehicles (EVs).

A recent survey revealed that seven out of 10 U.S. drivers would be interested in buying an EV when charging infrastructure expands and EV costs drop.[39] To meet this demand, one estimate says automakers and suppliers need to invest at least $526 billion in EVs and batteries between 2022 and 2026, more than double the five-year EV investment forecast of $234 billion for 2020–2024.[40] To achieve the International Energy Agency's (IEA) net zero emissions by 2050 goal, global EV sales would likely need to increase to 60% of total car sales by 2030.[41]

Fintech

The intersection of financial services and technology, or fintech, is where many people now go to spend, lend, borrow, invest, and trade. Fintech makes financial services more personal and inclusive. Over the last two years, fintech adoption has increased dramatically around the world, with smartphone access and usage a primary driver.

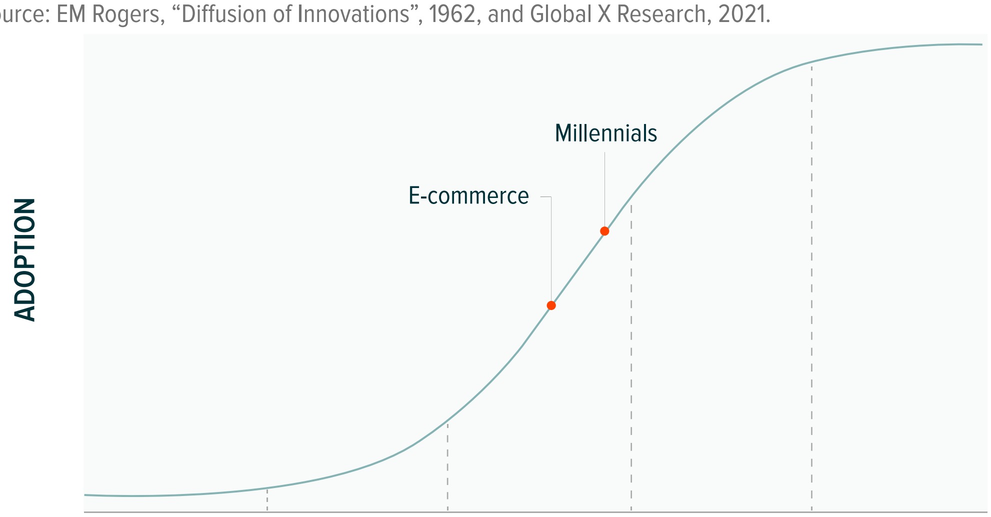
Demographic divergence across different fintech applications is vast, but adoption among younger generations is much more prevalent. They are highly comfortable using technology for financial transactions, including using mobile payment apps for peer-to-peer (P2P) payments. Seventy-two percent of mobile payments users are Millennials or Gen X.[42] For older generations, concern about loss of funds is the biggest obstacle to adoption. As trust grows across generations, we expect digital payments markets to accelerate.

NEW CONSUMER IN A PORTFOLIO CONTEXT

Consumers are the engine for economic growth across the globe. Understanding generational preferences and dynamics will be essential to drive corporate growth. We expect the Millennial Consumer theme to become increasingly prominent in investment portfolios. On the adoption curve, both the Millennial Consumer and E-commerce themes land squarely in the early majority phase, indicating that adoption levels are high and rising.

THEMATIC ADOPTION

Source: EM Rogers, "Diffusion of Innovations", 1962, and Global X Research, 2021.



ADOPTION	Innovators	Early Adopters	Early Majority	Late Majority	Laggards
GROWTH	Slow	Medium	High	Medium	Slow

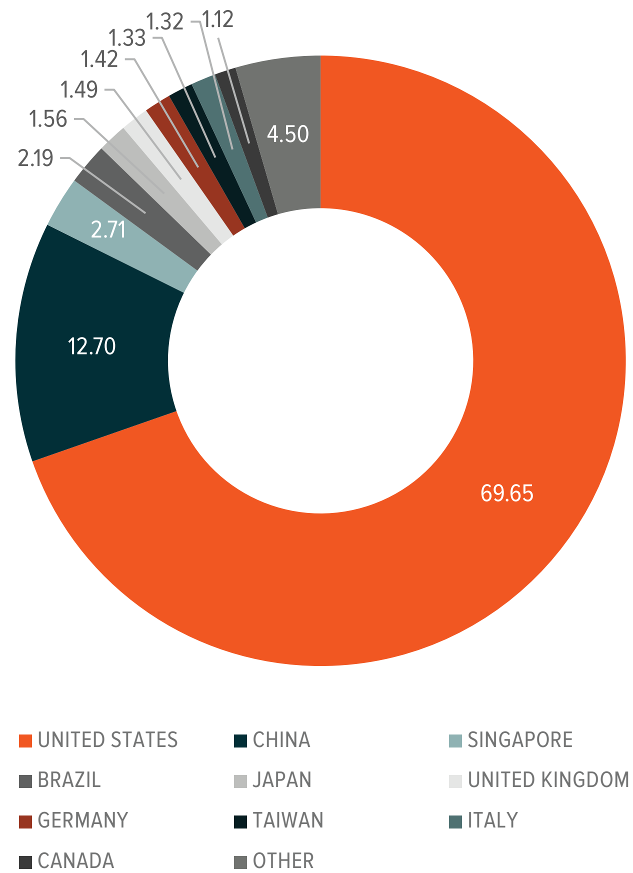
The pie chart breaks down the geographic exposure of the largest Millennial and E-commerce thematic ETF products. We believe that there is ample innovation occurring outside the U.S., and that limiting exposure to the States will exclude key players to the detriment of investors over the long term.

In our view, thematic equity should be targeted using screens to ensure that the underlying companies provide the desired exposure. This pure play focus minimizes overlap between themes while also differentiating the exposure provided by the theme relative to broad beta products. We conducted an overlap analysis between Millennial and E-commerce ETFs, the S&P 500, MSCI All Country World Index (ACWI), and the most applicable S&P 500 sector ETFs: the Consumer Discretionary Select Sector SPDR Fund (XLY) and the Technology Select Sector SPDR Fund (XLK). We found that the average overlap by weight for the Millennial and E-commerce themes was 7.5% when compared to the S&P 500, 5.7% vs. the MSCI ACWI, 15.14% vs. XLY, and 3.5% vs. XLK.[43] The low overlap with broad indexes reflects the benefits of thematic exposure, as sector indexes have yet to include substantial exposures towards these targeted consumer themes.

New Consumer reflects the rapidly changing consumption landscape in the U.S. and around the world. As the Baby Boomer generation continues to retire and transfer wealth to younger generations, we expect shifts in consumer behavior and preferences. In EMs, the growing middle classes in China and India create access to a new consumer that is gaining purchasing power and becoming more interested in quality goods and services. In our view, it is essential for companies to anticipate and adapt to these shifts to be better positioned to build long-term relationships with consumers and shareholders.

NEW CONSUMER: AVERAGE GEOGRAPHIC EXPOSURE BY THEME

Source: Morningstar data as of February 28, 2023



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HOW TO ACCESS NEW CONSUMER

The graphic below identifies the largest U.S. listed ETFs that provide direct exposure to the New Consumer theme.

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