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### **BMO Global Asset Management**

# The Internet is Transforming Every Sector of the Global Economy

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## MARKET**INSIGHTS**



#### TODAY'S SPEAKERS



Nick Grous

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Ark Invest



Sa'ad Rana Senior Associate, BMO ETFs



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Artificial Intelligence **Cloud Computing** 

**Digital Media** 

Mobile Payments

Autonomous Technology

#### Convergence

The converging innovation platforms involve 14 investable technologies undergoing steep cost declines, impacting multiple sectors, and serving as launching pads for more innovation.

ARK's Convergence Scoring Framework And Network Graph:

- Technology scores are a function of their potential to generate super-exponential growth as they catalyze other technologies.
- The thickest lines correspond to expectations for an order of magnitude increase in another technology's potential.
- Edges are directional. Neural networks should catalyze autonomous mobility (thick purple line), for example, and the data generated by autonomous mobility systems should improve neural network capability (thin teal line).
- Node size corresponds to estimate of 2030 enterprise value attributable to the technology on a log scale.
- · The innovation platform taxonomy emerges organically from this network graph.

Node size: Log prospective 2030 Market Capitalization Edge size:: Estimated catalyzing impact Edge color coded to the catalyzing technology

Digital Wallets Precision Smart Therapies Contracts Intelligent Multiomic Devices **Technologies** Cryptocurrencies Next Gen Neural Cloud Networks Programmable Advanced Battery Biology Reusable Technology Rockets Adaptive Autonomous Robotics Mobility 3D Printing

Sources: ARK Investment Management LLC, 2023. Information provided on this slide is based on ARK's research and views and subject to change. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security or cryptocurrency. Past performance is not indicative of future results.







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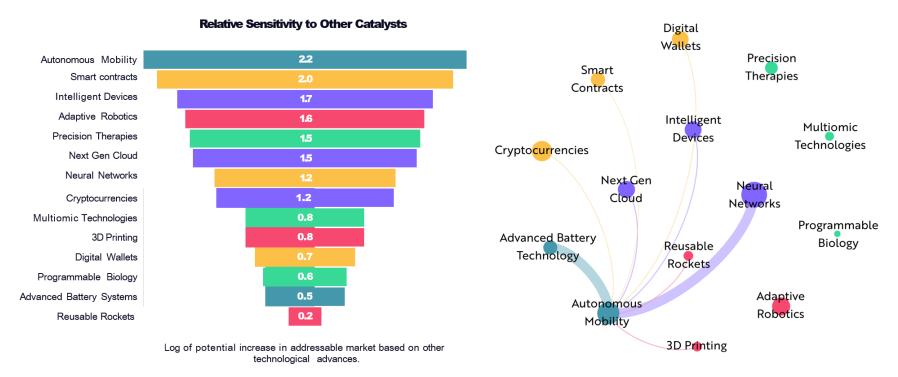
THIS WEEK'S TOPIC:

NEXT GEN INTERNET ARK

WEDNESDAY, DECEMBER 20TH, 2023



#### Autonomous Mobility Epitomizes The Convergence Among Technologies



Sources: ARK Investment Management LLC, 2023. ARK's convergence scoring framework measures the scale of impact that advances in one technology are likely to have on the potential market value of another. "Relative sensitivity to other catalysts" measures the inbound sum of convergence scores for each technology. Scoring is tuned such that a score of 1 corresponds to an order of magnitude potential increase in the technology's market value. Scores are subject to ARK's views and research and are subject to change. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security or cryptocurrency. Past performance is not indicative of future results.







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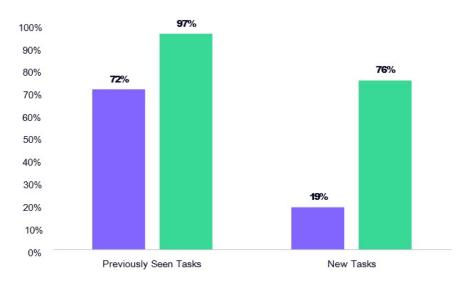
DIGITAL ENTERTAINMENT EVOLVING





#### Robots Learn From Experience Thanks To Advances In Al Language Models

#### **General Task Completion Success Rate** Robot without Al language model architecture (2021) Robot with Al language model architecture (2022)



Already useful for language generation, the advanced transformer Al architecture now is controlling robots, instructing and enabling them to encode complex actions into discrete tasks.

Transformer architecture also helps robots generalize from examples and perform never-seen tasks.

> Neural Networks

> > Adaptive Robotics

Sources: ARK Investment Management LLC, 2023. Gopalakrishnan, K. et al. 2022; Brohan, A. et al. 2022; Jang, E. et al. 2022. Compares performance of RT-1, the robotics transformer architecture to BC-Z, based on a recurrent neural net architecture. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security or cryptocurrency. Past performance is not indicative of future results









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**DIGITAL ASSETS DIGITAL WALLETS FINAL THOUGHTS** 

#### THIS WEEK'S TOPIC: **NEXT GEN INTERNET ARK** WEDNESDAY, DECEMBER 20TH, 2023

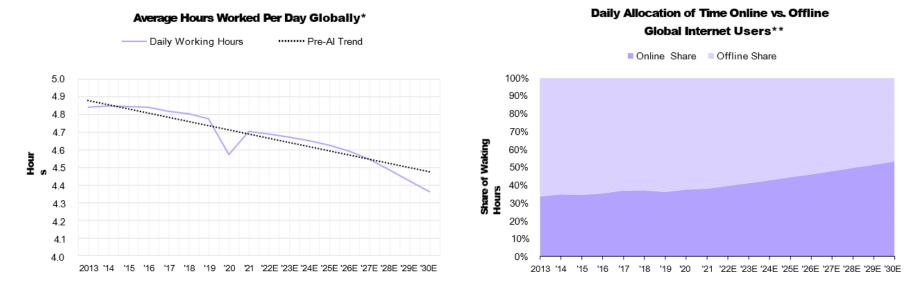
**BMO ETFs** 



#### Artificial Intelligence Should Increase Time Spent On Digital Entertainment

Thanks to the productivity gains associated with generative AI, daily hours worked globally could decline 0.9% on average at an annual rate during the next five years, from 4.7 hours in 2022 to 4.4 hours in 2030, an accelerated decline from the -0.4% prior rate as of 2013.

In our view, consumers will reallocate extra time to online instead of offline activities, increasing the share of total waking hours spent online from 39% in 2022 to 53% in 2030.



\*To calculate global daily working hours, we take the total annual hours of labor per worker as published by the OECD and divide the figure by the total days of the year. \*\*The chart illustrating daily allocation of online vs. offline time captures total daily waking hours, including those allocated to labor or education. Sources: ARK Investment Management LLC, 2023. OECD Data, data as of 12/28/22; Kemp, S. 2022 – 2012. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security. Past performance is not indicative of future results.







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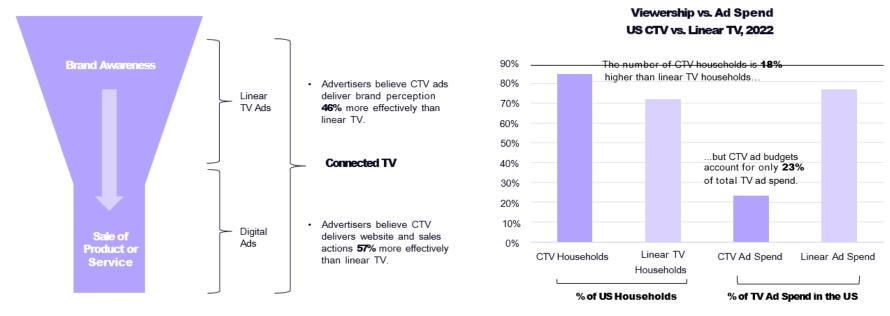
DIGITAL ENTERTAINMENT EVOLVING





#### Advertisers Have Yet To Unlock The Potential Of CTV

CTV provides advertisers with the targeting and attribution measurement once reserved for traditional digital advertisers. Combining the advantages of linear TV and digital advertising, CTV could capture share of both brand and performance ad budgets.\* A meaningful disconnect exists between viewership and advertising budgets in the US. In our view, advertisers will close the gap within the next five years.



\*We view a connected TV household as any household owning at least one large-screen display that can stream over-the-top (OTT) content natively through a built-in operating system (OS), external streaming media devices, video game consoles, etc. We define a linear TV household as any household that views TV via traditional pay TV subscriptions and/or free over-the-air broadcast. A single household may both be a connected TV household and a linear TV household. Sources: ARK Investment Management LLC, 2023. IAB 2022; Insider Intelligence, data as of 01/12/23; Insider Intelligence, data as of 01/12/23; S&P Global Market Intelligence, data as of 01/12/23. To recast are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security. Past performance is not indicative of future results.







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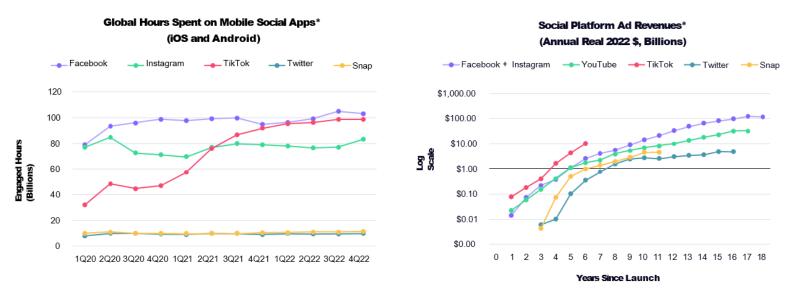
### DIGITAL ENTERTAINMENT EVOLVING





#### Short-Form Video And Recommendation Engines Are Displacing Incumbent Social Media

In 2022, TikTok and Facebook were roughly equal in engagement hours, which could mark the peak in traditional follow-and-feed social media. Despite scaling faster than other social media platforms, TikTok\* accounted for only \$10 billion, or 2% market share, of the estimated \$470 billion spent on search, video, and social ads in 2022. Content-based social media is likely to capture advertising share more in line with its engagement hours.



\*Estimates for TikTok's engagement hours do not include Douyin. Sources: ARK Investment Management LLC, 2023. Unified, data as of 01/02/23; Tsotsis, A 2012; Meta Platforms, Inc., data as of 12/30/22; Aprington, M. 2027; Time of 12/30/22; Millhelm, A 2013; Colao, J. 2012; Chapta of 12/30/22. Foreign of 12/30/22. Foreign of 12/30/22 as of 12/30/22; Aprington, M. 2022; Twitter, Inc., data as of 12/30/22; Aprington, M. 2023; Twitter, Inc., data as of 12/30/22; Aprington, M. 2023; Twitter, Inc., data as of 12/30/22. Foreign of 12/30/22. Foreign of 12/30/22; Aprington, M. 2024; Twitter, Inc., data as of 12/30/22. Foreign of 12/30/22. Foreign of 12/30/22; Aprington, M. 2023; Twitter, Inc., data as of 12/30/22. Foreign of 12/30/22. Foreign of 12/30/22; Aprington, M. 2023; Twitter, Inc., data as of 12/30/22. Foreign of 12/30/22. Foreign of 12/30/22 as of 12/30/22. Foreign of 12/30/22 as of 12/30/22







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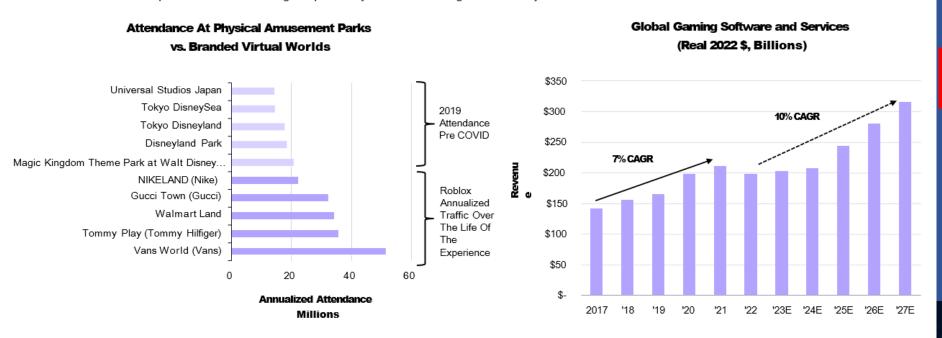
### DIGITAL ENTERTAINMENT EVOLVING





#### Immersive Virtual Experiences Should Galvanize The Next Wave Of Gaming

As the gaming industry transitions to full-service virtual worlds, video games and social media could merge as consumers socialize and entertain in game-supported virtual spaces, at the expense of physical environments. According to ARK's research, the convergence between gaming and social media should boost the growth in gaming revenue from 7% at a compound annual rate during the past five years to 10% during the next five years.



\*Compound Annual Growth Rate (CAGR). Note: We annualize Roblox traffic by taking all-time traffic data as provided by Roblox and take the difference between the date pulled and the experience's launch date. We then calculate the average traffic per day for each experience to ultimately gross up the daily traffic estimate to an annualized figure. Sources: ARK Investment Management LLC, 2023. Altruda, C. 2022; Roblox, data as of 12/30/22; S&P Global Market Intelligence, data as of 01/25/23. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security. Past performance is not indicative of future results.







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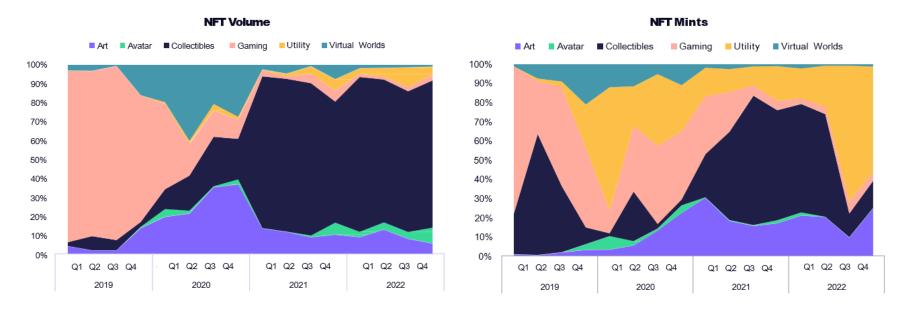
DIGITAL ENTERTAINMENT EVOLVING





#### Trading And Creation Of Digital Assets Diverged During The Bear Market

In 2022, NFT\* trading volume increased 15% year-over-year, dominated by high-profile collectible projects like Bored Ape Yacht Club and Crypto Punks. The share of NFTs minted, however, shifted toward utility-based projects like on-chain domain names and digital memberships. Focused on underlying value instead of speculation, the shift toward utility is a healthy development.



\*Non-fungible token (NFT), a unique, programmable blockchain-based digital object that proves ownership of digital assets. Sources: ARK Investment Management LLC, 2023. Dune Analytics, data as of 01/23/23; CryptoSlam, data as of 01/25/23. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security. Past performance is not indicative of future results.





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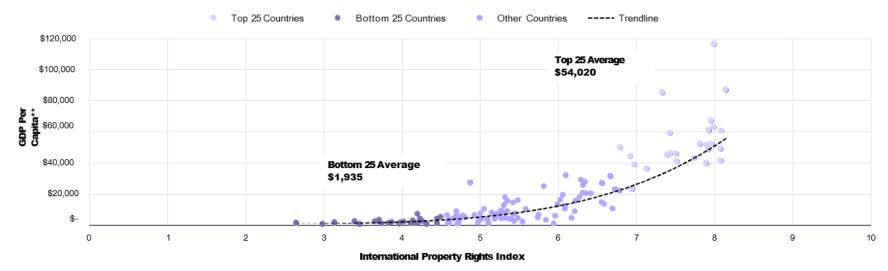




#### Based On The Introduction Of Property Rights, Digital Assets Should Accrue Significant Value

Physical and intellectual property rights correlate positively to GDP\* per capita, a common proxy for quality of life. In our view, thanks to decentralized proof-of-ownership, digital assets are likely to increase online spending per capita. ARK forecasts that global NFT transaction volume will grow more than five-fold from \$22 billion today to \$120 billion by 2027.

#### Property Rights vs. GDP Per Capita (Correlation Across Countries, 2021)



\*Gross domestic product (GDP) is the total monetary or market value of all the finished goods and services produced within a country's borders in a specific time period. \*\*Real 2022 \$. Sources: ARK Investment Management LLC, 2023. Property Rights Alliance, data as of 01/25/23; The World Bank, data as of 12/30/22; CryptoSlam, data as of 01/02/23. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security. Past performance is not indicative of future results.







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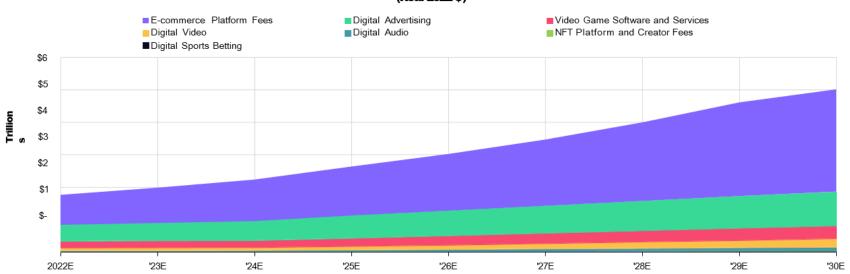




#### Digital Leisure Revenue Could Reach \$5 Trillion Globally In 2030

Based on the shift toward digital leisure and digital property rights, real digital revenue\* should grow 14% at an annual rate during the next eight years, from ~\$2 trillion in 2022 to \$5 trillion in 2030.

#### Gross Leisure Spend Digital vs. Physical (Real 2022 \$)



\*We define digital leisure revenue as the revenue accrued to platforms and creators from digitally-facilitated leisure spending. We sum e-commerce marketplace fees related to leisure-related goods and services, total digital ad expenditures, gross video game software and services revenue, gross streamed audio revenue, gross gaming revenue attributable to online sportsbook operators in Canada and the US, and NFT platform and creator fees. Sources: ARK Investment Management LLC, 2023. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security. Past performance is not indicative of future results.







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#### Digital Wallets Are Scaling Faster Than Accounts At Traditional Financial Institutions

The network effects associated with low customer acquisition costs and a superior user experience are powering digital wallet adoption. After the COVID-induced acceleration and subsequent churn, US digital wallet adoption rebounded in 2022, surpassing previous highs. According to our estimates, US digital wallet users will increase 7% at an annual rate during the next eight years, from ~160 million in 2022 to more than 260 million, while the number of global digital wallet users increases 8% at an annual rate, hitting 5.6 billion, 65% of the global population, by 2030.

#### **US Unique Digital Wallet Users Global Unique Digital Wallet Users** ARK Estimate And Forecast\* **ARK Estimate And Forecast** JP Morgan Deposit Accounts ■ North America (NA) Latin America (LATAM) Unique Digital Wallet Users Asia-Pacific (APAC) ■ Europe, Middle East, and Africa (EMEA) ---- ARK Digital Wallet User Forecast - Base Case 6,000 300 250 5.000 200 4.000 150 Users (Millions) 3,000 50 '20 '22 '23E '24E '25E '26E '27E '28E '29E '30E

\*Due to a regulatory reporting change, JP Morgan publicized the number of deposit accounts of \$100,000 or less until 2010. From 2010 onwards, JP Morgan has since publicized the number of deposit accounts accounts of \$250,000 or less. Data from 1990 to 2009 reflect the number of accounts as of June 30th of each calendar year, while subsequent data reflect the number of accounts as of calendar year end. Sources: ARK Investment Management LLC, 2023. FDIC, data as of 01/17/23; FFIEC, data as of 01/17/23; The World Bank, data as of 01/20/23; Anan, L. et al. 2020; Anan, L. et al. 2020; Forecasts are inherently inhe







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#### Digital Wallets Eliminate Middlemen By Enabling Direct Payments Between Consumers And Merchants

In the traditional payment chain, several intermediaries take tolls on payments\* between consumers and merchants. By enabling in-network transactions, digital wallet providers capture more value per transaction and can share the savings with merchants and consumers.

#### **Traditional Open-Loop Credit And Debit Card Transaction**

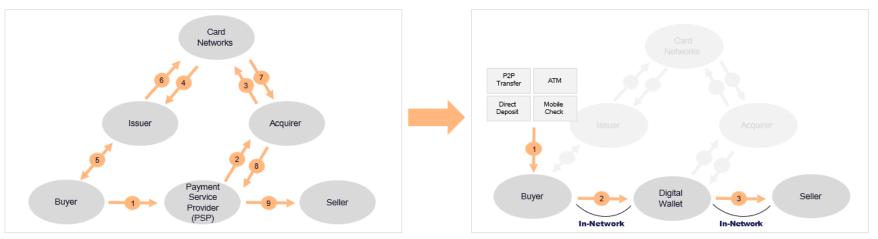
Steps Between Buyer and Seller: 9

Estimated Intermediary Fees: 2.6%

#### **Closed-Loop Balance-Funded Transaction**

Steps Between Buyer and Seller: 3

Estimated Savings: 2.4%



\*Estimated fees and payment processes are rendered for illustrative purposes only and are based on sources specific to payment infrastructure in the United States. To estimate intermediary fees under the current payment value chain in the US, we embed our estimate for interchange, card network, issuer, acquirer, and PSP fees. We assume that a closed-loop transaction can eliminate interchange, card network, issuer, and legacy acquirer fees, but we add back estimated costs associated with topping up digital wallet balances and usage of modern payment facilitators. Sources: ARK Investment Management LLC, 2023. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security. Past performance is not indicative of future results.





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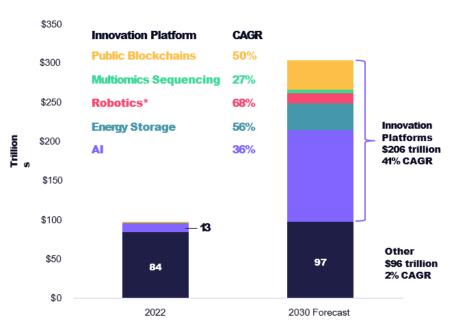






#### Disruptive Innovation Platforms Could Constitute The Majority Of The Global Equity Market Value By 2030

#### **Total Equity Market Value**



- Al, Energy Storage, Robotics, Multiomics Sequencing, and Public Blockchains could scale ~15-fold to ~\$200 trillion in equity value over the course of this business cycle.
- Even if non-innovation exposures to the market continue to accrue value, disruptive innovation is likely to dominate equity market values by 2030.
- Including cryptoassets, disruptive innovation exposures could constitute roughly 68% of risk asset value by 2030.

\*CAGR: Robotics including home robots as opposed to industrial robots. Sources: ARK Investment Management LLC, 2023. Equity market value includes the value of public blockchain protocols. Forecasts are inherently limited and cannot be relied upon. For informational purposes only and should not be considered investment advice or a recommendation to buy, sell, or hold any particular security or cryptocurrency. Past performance is not indicative of future results. In this specific estimation, 2022 and 2030 total equity market values and CAGRs for Public Blockchains are inclusive of three technology platforms: Cryptocurrencies, Smart Contracts, and Digital Wallets.





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