MEGATRENDS 2024

Artificial Intelligence: from imagination to investment

Making the future state tangible for investors today

NEW YORK LIFE INVESTMENTS

Global Market Strategy at New York Life Investments

Our team of market strategists connects macroeconomics to asset allocation. Leveraging proprietary research alongside the breadth and depth of the New York Life Investments platform, we provide actionable insight into market-driving events, structural themes and portfolio construction to empower investment decision-making.

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Special thanks

Exploration of Artificial Intelligence as an investment megatrend has been a collaborative effort. Over many months and dozens of interviews, we've relied on the experience and expertise of everyone from data scientists to business managers to futurists.

Special thanks to our parent company, New York Life, which has made impressive strides in this space. The generous collaboration of the AI Acceleration Office, which includes, among others, NYL's AI & data, technology, legal, risk management, compliance, and NYL Ventures teams, has been transformative for this research and is a testament to the firm's "one team, one purpose" culture.

Gratitude is also due to our partners across the New York Life Investments platform. We humbly thank the New York Life Investments boutiques, including Apogem, Ausbil, Candriam, MacKay Shields, and Tristan Capital Partners. Your skilled research and healthy debate show the true value of the breadth and depth of this platform. We also benefited from collaboration with numerous colleagues including the Multi-Asset Solutions team, Data and Technology Solutions, and Product Management. Our rotating analyst, Sal Cimato, has enriched this project with extensive research.

Introduction

"By 2005, it will become clear that **the internet's impact on the economy** has been no greater than the fax machine's."

Paul Krugman
Nobel Prize-winning economist, 1998

Artificial Intelligence (AI) has been around since the 1950s. Yet it was ChatGPT that brought the stuff of people's imaginations – and decades' worth of books and movies – to life, ushering AI into homes and boardrooms alike. In addition to the equity market boom this created, we've seen a tidal wave of new research into and debate about AI's applications in nearly every industry and region.

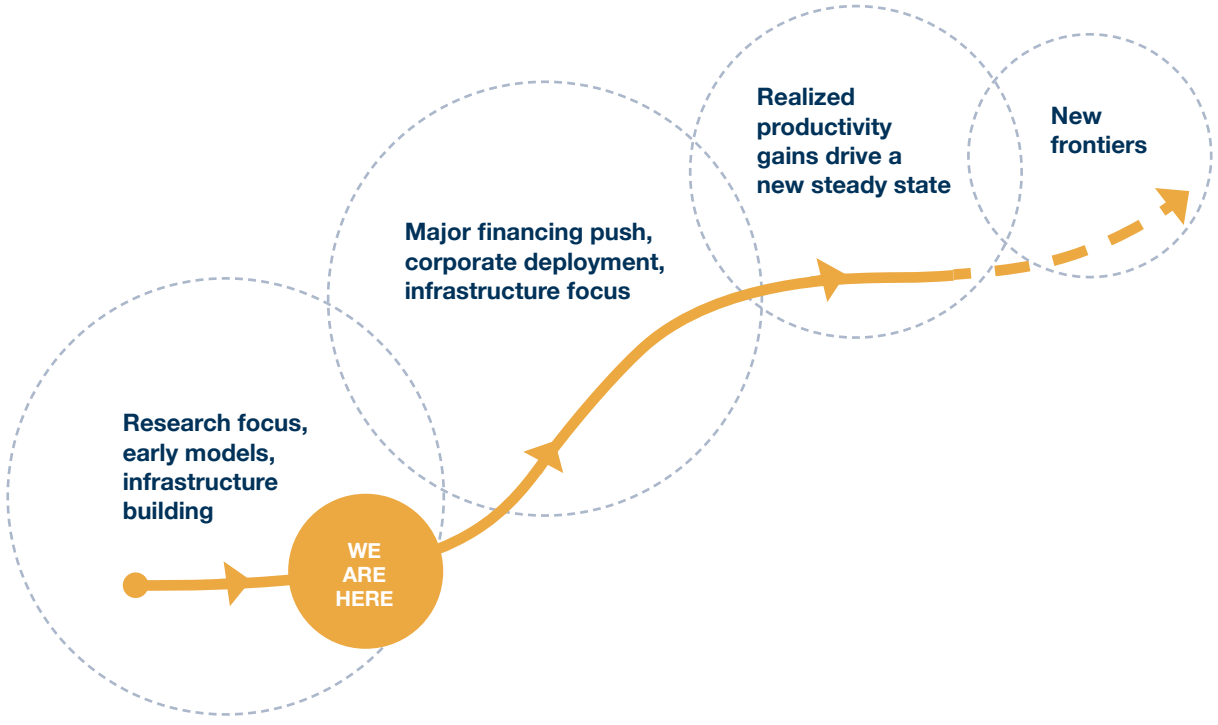
We can easily imagine a future state full of possibility thanks to AI: exponentially faster pharmaceutical discovery, education tailored to each child, and wider access to services, from personal training to personal finance. Of course, these advances are not wholly without cost. For example, AI could be another mechanism reducing human interconnection and entrenching existing areas of privilege and bias. It is also likely to spark labor shifts, some of them painful.

For better and worse, everyone seems to agree on one thing: AI is going to change the world.

Many have done excellent work to anticipate how the future will be changed by AI, but have done so with a common underlying assumption that AI will achieve the scale required to be a driver of transformative change. We agree, which makes the next, most actionable investment question: *what will it take to get there?*

In business and technology, we speak of the S-curve, the concept that people and processes adapt glacially until an inflection point or force for change, after which they change rapidly. Much of the research on AI today has focused on the top of the S-curve: the new steady state for economic growth. But in our view, an AI-driven future state is still abstract. **We find the most compelling and concrete 10-year investment opportunities in AI's rapid run-up to scale.**

The innovation S-curve: stages of AI adoption over time



Sources: New York Life Investments Global Market Strategy, June 2024. For educational and illustrative purposes only.

We believe AI is at this initial inflection point – the infancy of a potentially seismic innovative shift. But its implementation will require a massive reallocation of capital across countries, industries, companies, and even households. We see preliminary progress in capital reallocation and investment taking place in the following underpinning "layers" of AI:

Infrastructure: chips, data centers, power
AI, and generative AI in particular, require substantial infrastructure capacity extending across the data center supply chain. Unlike some other recent innovation waves, we believe AI's daunting physical requirements can and will be achieved, creating a plethora of investment opportunities.

Foundational models: data, model creators, cloud
As AI use-cases broaden and models grow in variety and specialization, a few hyperscaler companies bear the responsibility of building model and data foundations. Over time, monetizing these foundations is likely to foster competition.

Corporate applications: software, services, use case exploration
Four considerations will shape the pace and scope of corporate AI uptake: ethics, regulation, competition, and labor policy.

As a future state emerges with AI at the center of digitization, we also explore AI's potential to drive potential economic growth, inflation, and interest rates. Putting it mildly, we expect investment opportunities to broaden and deepen over the coming decades—good news for those that have hesitated to place all their AI-related "eggs" in the Magnificent 7 basket. Investors have not missed the boat on the promise AI has to offer; in fact, investors have the chance to build the boat.

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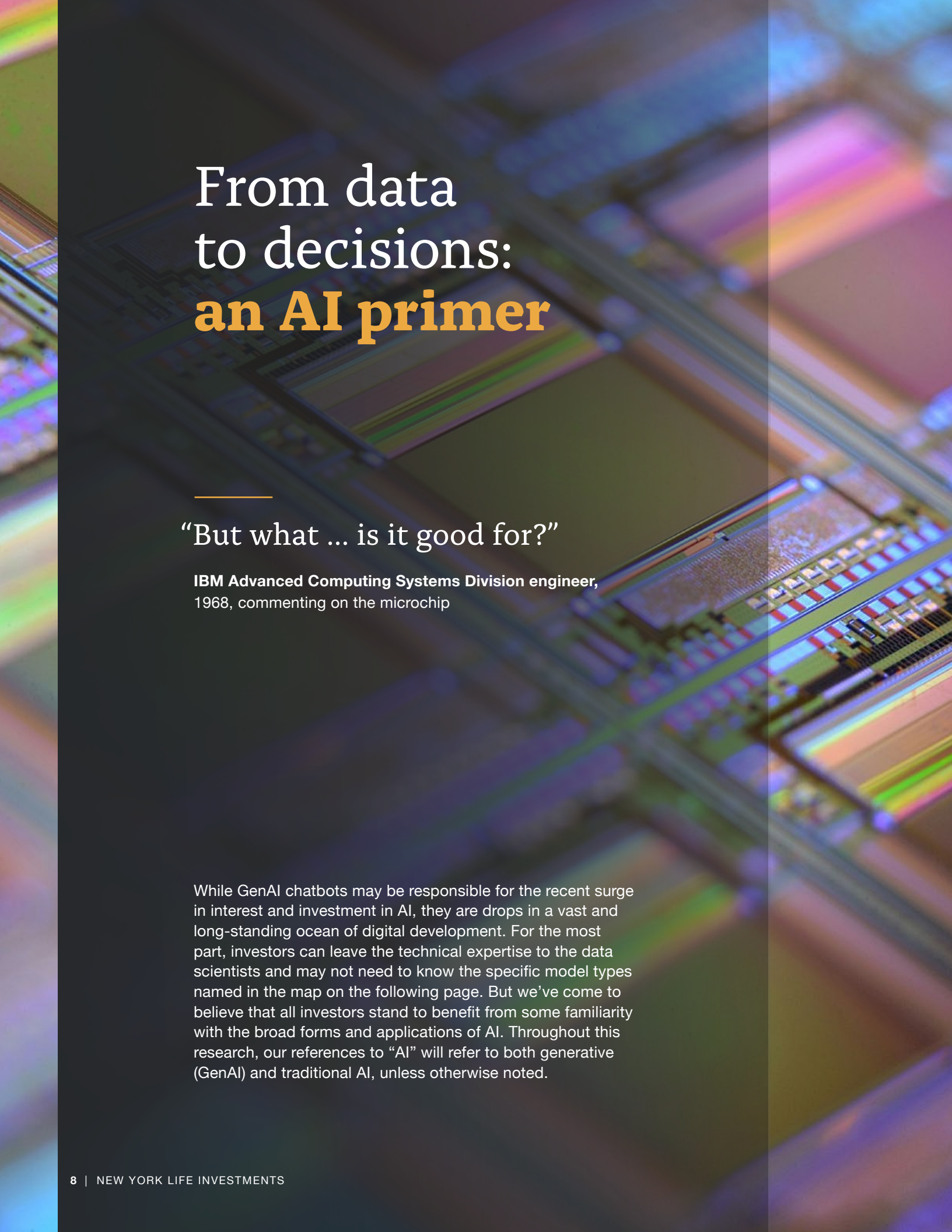


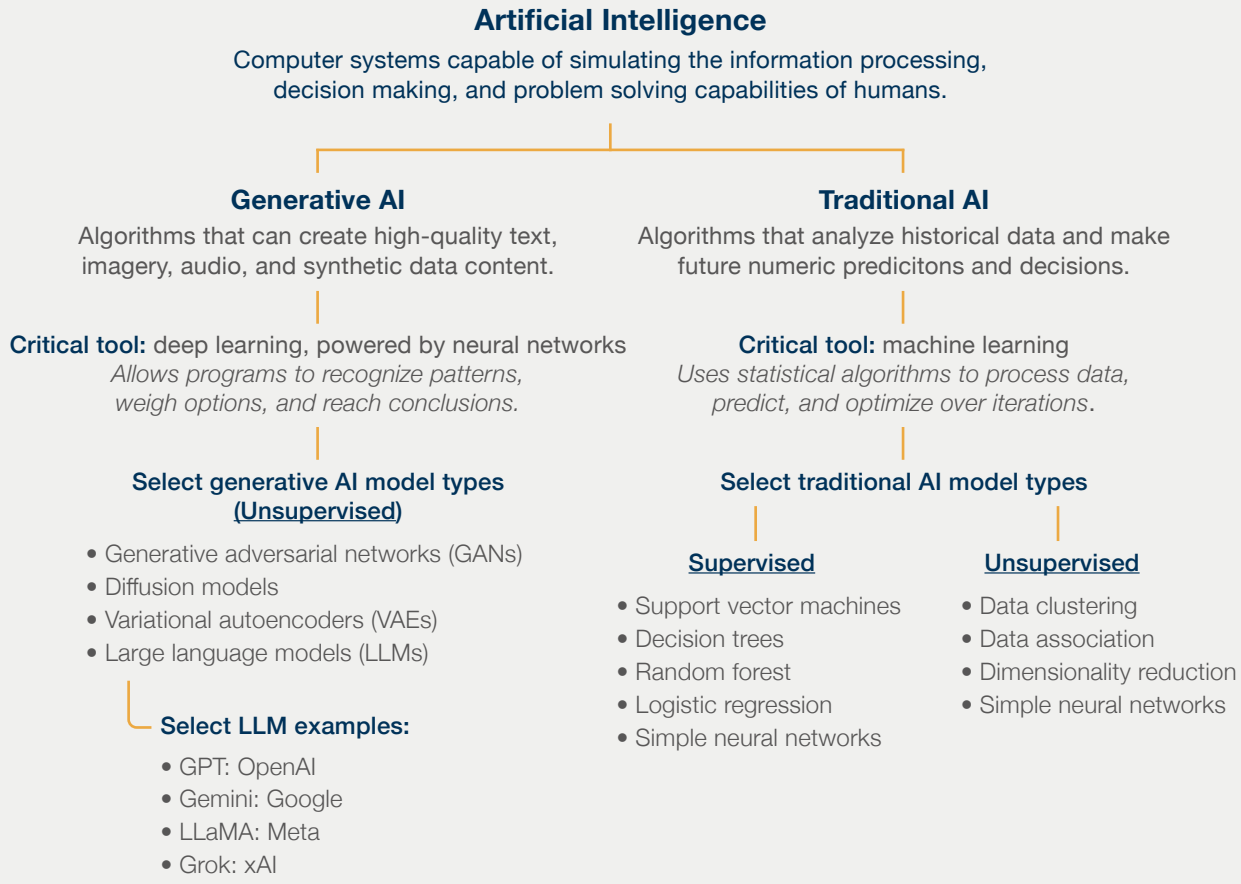
From data to decisions: **an AI primer**

"But what … is it good for?"

IBM Advanced Computing Systems Division engineer,
1968, commenting on the microchip

While GenAI chatbots may be responsible for the recent surge in interest and investment in AI, they are drops in a vast and long-standing ocean of digital development. For the most part, investors can leave the technical expertise to the data scientists and may not need to know the specific model types named in the map on the following page. But we've come to believe that all investors stand to benefit from some familiarity with the broad forms and applications of AI. Throughout this research, our references to "AI" will refer to both generative (GenAI) and traditional AI, unless otherwise noted.

The data scientist's AI roadmap



Sources: New York Life Investments Global Market Strategy, New York Life Investments Multi-Asset Solutions, IBM, June 2024.
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Since artificial intelligence has been used for years, why all the buzz now?

The advent of GenAI marks a revolutionary stride in the field of technology, built upon the rich legacy of traditional AI that spans several decades. Unlike traditional AI systems based on machine learning, which rely on direct instructions and rule-based processes, GenAI algorithms are trained to understand and generate new data, such as text, images, and music that resemble the input they are fed. They rely on tools called neural networks—the history of which helps explain why GenAI has appeared now and with such impact. Neural network-based algorithms had a renaissance in the 1980s, but quickly faced limited computing power and were considered obsolete by the early 2000s. Other machine learning models took off instead.
In recent years, improvements in computer processing have allowed neural networks to add "layers," driving deep learning capacity and enabling the rise of GenAI.

From gigs to grids: **AI's infrastructure challenge**

"What can be more palpably absurd than the prospect held out of locomotives traveling twice as fast as stagecoaches?"

Quarterly Review
1825

The infrastructure layer of AI is comprised of its physical base: semiconductors, data centers, network connectivity, and power capacity required to build, train, and maintain traditional and generative AI models and support their global application.

We believe the infrastructure layer currently provides the broadest near-term opportunity set for investors to participate in the AI theme.

Data centers are the lifeblood of AI, housing the servers that handle the facets of an AI model's computing needs: initial model training, ongoing usage, maintenance, and model updates. These data centers are resource-intensive in every way.

They require:

Ample computing capacity

Chips that are sophisticated enough to handle a given model's computing needs

Low latency, or minimal time for data transfers

Necessitating locations with ideal fiberoptic network connectivity

Electric power, with emergency backups

Data centers' electricity demand comes from a roughly even split between computing and cooling, the latter compensating for the heat generated by the former

All of these factors require significant raw materials and can benefit from improved efficiency as technology evolves. But the largest outstanding infrastructure need associated with AI is power.

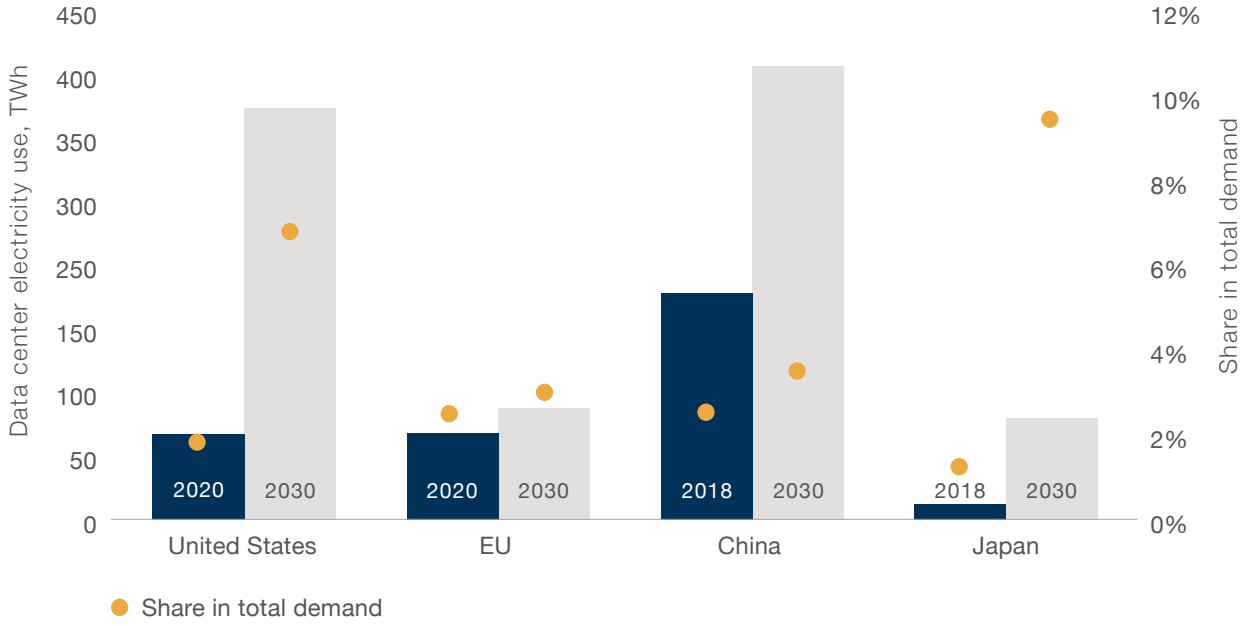
What it takes to power AI

Data centers' astronomical electric power demand is a function of the complexity and usage of AI models. This means that as AI models become more sophisticated and complex, and as their user base grows, the already considerable power needs of the AI space will only grow. In this context, it would be fair to ask whether AI, a true hub of innovation, could innovate its way toward lower energy needs. We do not believe this will happen any time soon. Data centers' heat generation can potentially be harvested in the very near term, offsetting total power needs. But innovations that could lower AI's computing power include more efficient chips and even quantum computing, both likely decades out.

Unless and until a technological advancement changes power use structure, we have to expect that AI's power requirements will grow at an increasing rate. Any investor enthusiastic about AI must therefore consider how big a tug this will be on the global electric grid. The IEA estimates global electricity consumption of data centers could roughly double to 1000TWh by 2026, roughly equal to adding the electricity consumption of Germany in just a few years. Half of this expansion could take place in the U.S. and China alone.[i]

AI is expected to drive astonishing increases in electricity demand from data centers

Data center power use and share in total national electricity demand: historic and forecast



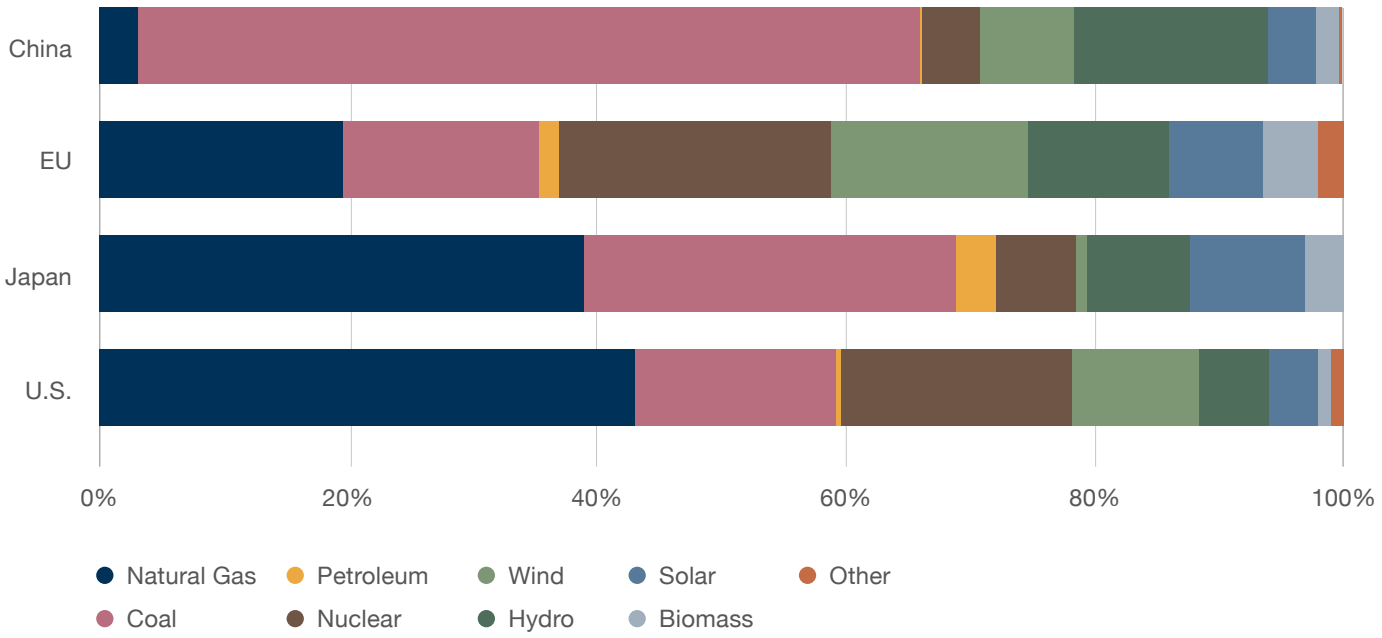
Sources: New York Life Investments Global Market Strategy, International Energy Agency, CBRE Investment Management, European Commission, China's State Council, Japan Science and Technology Agency, S&P Global, U.S. Energy Information Administration, June 2024.
TWh = terawatt hours of electricity.

If AI integration will add the equivalent of a developed country's energy needs to the global grid in just the next few years, countries will need to reach toward every possible electric power source to make it possible. In this sense, AI may encourage greater investment in traditional energy capacity for the countries that have it, and in green and nuclear capacity for countries that are not self-sufficient in fossil fuels. Investments in a diversified electricity mix would not only increase total power capacity to enable AI, but would also serve as a risk mitigant; we've seen how easily natural disasters and trade disruptions can curtail a wide range of power sources.

As AI models become more sophisticated, their power needs will grow.

AI's power needs may demand a diversified energy mix

Electricity generation by power source



Sources: New York Life Investments Global Market Strategy, U.S. Energy Information Administration, Council of the European Union, June 2024. U.S. data as of 2023. EU data as of 2022. Japan and China data as of 2021.

Is AI the next boon for nuclear?

After the nuclear disaster at Fukushima in 2011, Japan took nearly all its nuclear reactors offline, bringing the nuclear share in the country's power generation from around 30% in the 2000s to a trough of 0% in 2014.[ii] But facing instability in power sources and carbon commitments, new policies aim to bring nuclear back up to 20% of Japan's power capacity by 2030. AI-related power needs are part of this goal: during Prime Minister Kishida's trip to the U.S. in April 2024, the White House shared that the U.S. and Japan "…look to expand the use of…clean energy, including from both large nuclear reactors and advanced and small modular reactors (A/SMRs),[iii] as they attempt to meet their own decarbonization goals and drive innovation in power-intensive industries such as Artificial Intelligence, quantum computing, and data centers."[iv] The role of nuclear power in enabling AI capacity is not unique to Japan – Microsoft co-founder Bill Gates has also been a leading investor in small modular nuclear reactors.

The companies providing AI models to the world, along with the companies hoping to utilize them, are well aware of the near-term bottlenecks in data center availability and power capacity. This is in part because they've been here before, building out infrastructure for traditional AI. GenAI is a different story, leading an off-the-charts surge in data center demand: 1.2 million exabytes of data are expected to be created and used in data centers by 2025 (28% growth).[v] Our partners at Ausbil report that even the first-phase buildouts of some data centers for single companies can reach 1GW of power – matching the output of a large nuclear reactor.[vi] Not every region can handle these needs. In the U.S., the majority of this activity has been concentrated in eight data center hubs: Northern Virginia, Portland, Atlanta, Chicago, the Bay Area, Dallas, Phoenix, and Seattle.[vii] The result has been record low vacancy rates and soaring rental prices in listed data centers, a gold rush also harnessed with ample private equity investment.[viii]

In our view, AI is likely to achieve its daunting infrastructure requirements.

China: where AI leadership meets geopolitics

The U.S.-China rivalry has many aspects: economic and trade prowess, tech leadership, and military might. AI can become a key component of all of these strategic priorities, and has itself become a front for bilateral tensions.

As with so many other critical supply chains, the U.S. and China are discovering that true siloing of their AI capabilities, while idealized as a national goal, is simply not possible. Since trade tensions escalated with higher tariffs in 2017, the U.S. has used its global influence to place heavy restrictions on China's access to chips – particularly the advanced processors capable of efficient AI computing – and even the equipment used to manufacture them. But China is not without its own area of leverage over tech and AI capabilities. It controls as much as 75% market share over raw silicon and 90% of rare earth minerals, both of which are irreplaceable in chip production.[ix]

Both countries have sought to invest their way around the vulnerabilities in their access to AI, to the tune of $350 billion in China,[x, xi] and over $283 billion in the U.S.:[xii]

China

Increasing the efficiency of less sophisticated chips

Bolstering domestic suppliers: "Made in China 2025" roadmap aims for 80% localization of Chinese chip inputs by 2030

Sourcing AI talent: a version of the Thousand Talents Plan seeks to recruit foreign PhD-level experts from critical sectors, including semiconductors

U.S.

Diversifying the Taiwan-based manufacturing of advanced processor chips with the build-out of multiple semiconductor plants, or "fabs," in the U.S., including incentive grants to individual semiconductor firms

Entering bilateral trade agreements to secure access to key raw materials for tech

Sources: New York Life Investments Global Market Strategy, Center for Strategic and International Studies, June 2024.
For educational and illustrative purposes only.

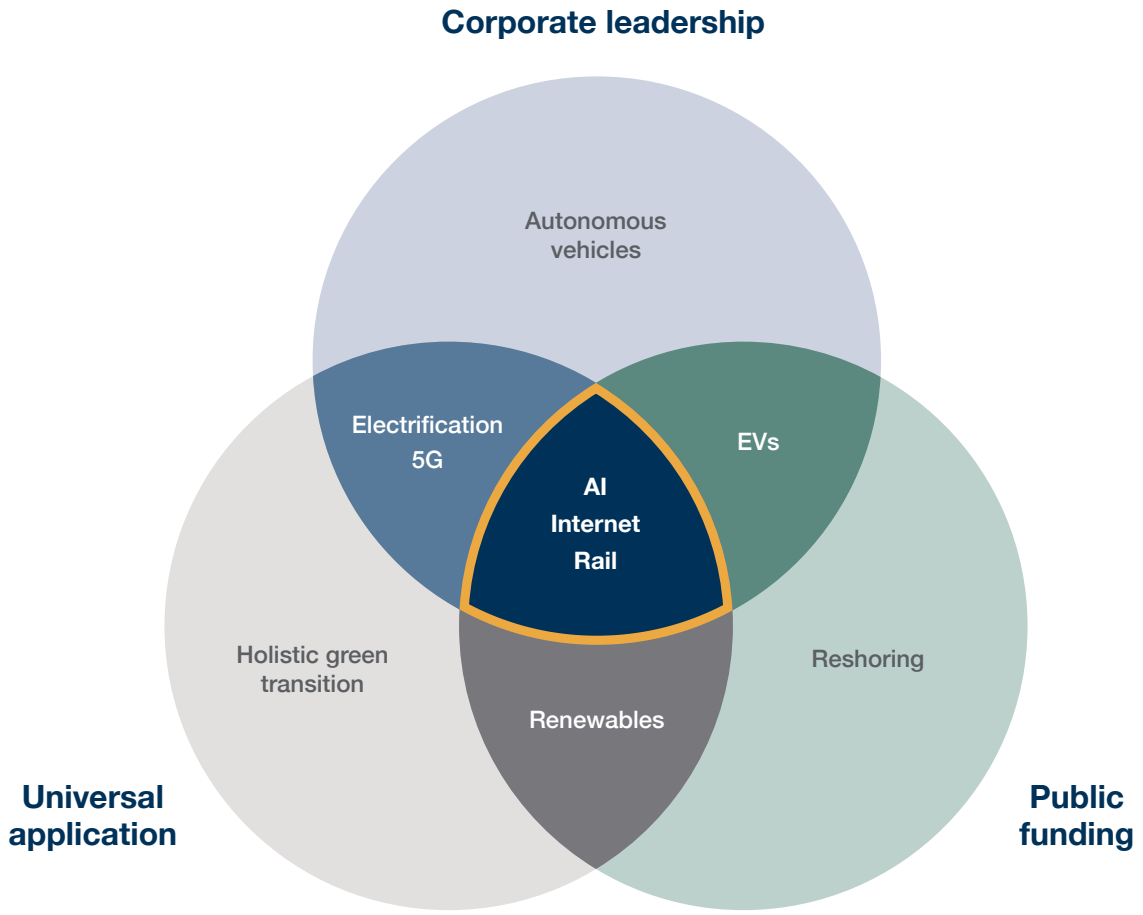
With two global powerhouses in different positions of dominance, these early days of AI development may necessitate greater global cooperation than investors currently appreciate. We expect to see AI-related innovation extend beyond the tech itself and branch into a re-thinking of bilateral cooperation in the coming decade.

What makes or breaks an infrastructure timeline?

Consider the electric vehicle (EV) wave: a case of potentially transformative innovation, so far stymied by its infrastructure requirements. EVs, in many ways a poster child of a green future, require major investment and innovation in batteries and charging infrastructure that have challenged most developed countries. The U.S. and Europe's moderate incentive and subsidy-based policies have proven insufficient in ushering a timely, holistic uptake in EVs. China has become the global leader in EV infrastructure, but only did so by deeming the industry a national champion and funneling hundreds of billions of dollars toward this goal.

We do not believe AI will be a repeat case of the EV predicament. In our view, AI is likely to achieve its daunting infrastructure requirements. When we consider the pace of physical execution on the world's transformative ideas, from the internet to the green transition, we find that AI benefits from several common ingredients to a timely, successful infrastructure buildout: corporate leadership, public funding, and applications reaching a broad audience.

AI, like select waves of innovation before it, meets three tenets enabling a timely infrastructure buildout



Source: New York Life Investments Global Market Strategy, June 2024. For educational and illustrative purposes only.

Corporate leadership

It's no secret that the U.S. has housed the leading providers of GenAI models and foundational capacity. And in the U.S., a willingness of major corporations to bear the brunt of AI infrastructure costs is likely to be one of the keys to its success. The "Magnificent 7" are rapidly deploying tens of billions of dollars on data center capacity – *essentially driving U.S. AI infrastructure policy by sheer force of spending.*

Public funding

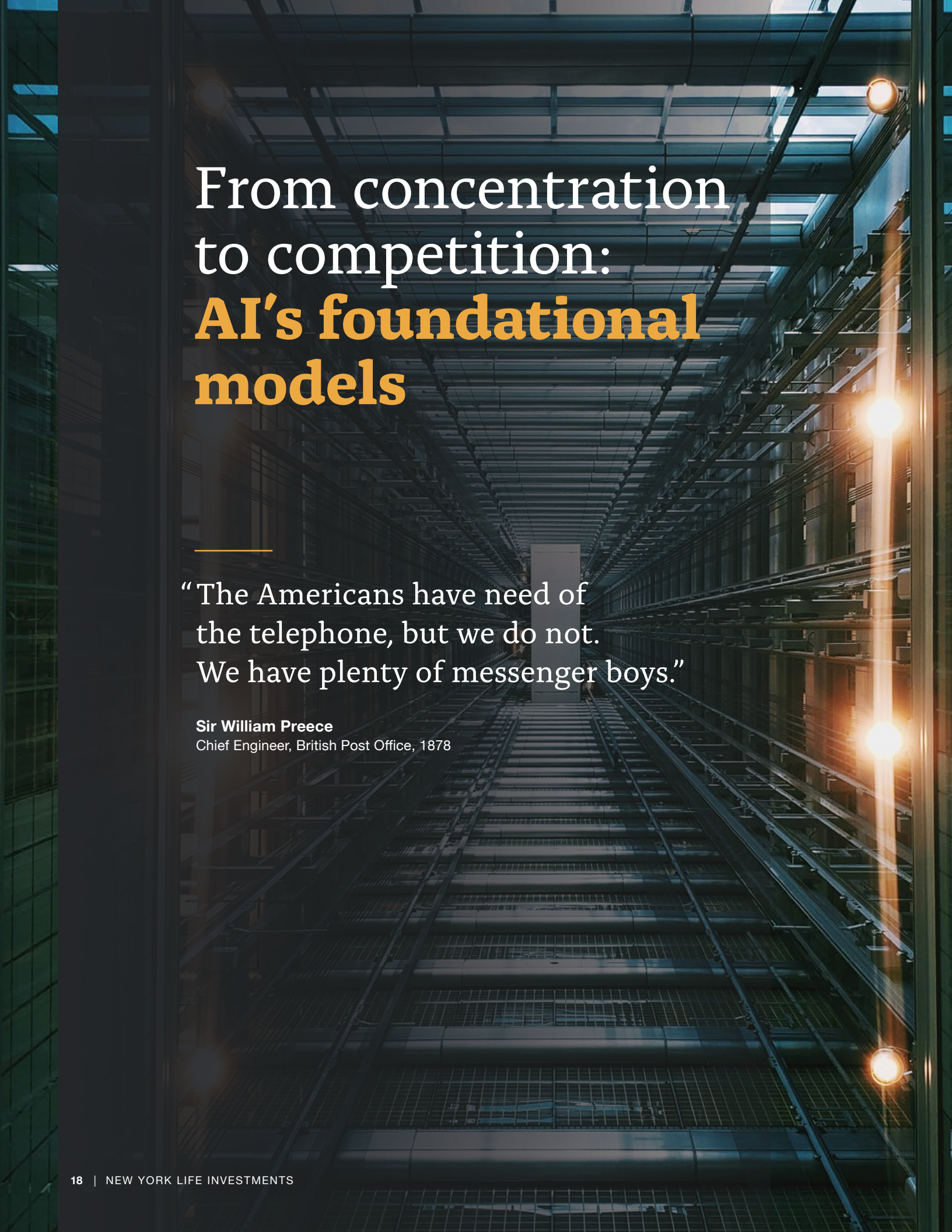
No matter the spending power of large corporations, public funding is a critical component to any rapid infrastructure push.

Public spending, such as the CHIPS Act, has and will play a key role in AI's power and network needs. The AI infrastructure push is likely to foster public-private partnerships, but in response to, rather than leading, corporate spend. We expect to see policy prioritization and government funding play a greater role in setting the pace and scope of AI adoption in Europe, China, and Japan.

Consider the U.S. rail build-out from 1870-1900: private companies executed on the build but were massively subsidized in the form of land grants, which spared rail companies from negotiating rights with individual landowners. Land granted along the railways could also be sold, providing revenue for construction. Thanks to holistic government sponsorship, the 30-year rail infrastructure push contrasts with the much more gradual 100-year electrification process in the U.S., which received government sponsorship only for rural initiatives.

Universal application

Execution on innovation-based infrastructure often depends on perceived "bang for your buck." The critical mass of governments, companies, and households must be able to see the applicability, benefit, or possibilities of an innovation in their daily lives. Case in point: the world's leading generative AI tool, ChatGPT, has 100 million weekly active users. Universality of an innovation is also supported by cheap, easy access. With a small set of mega-cap firms and governments bearing the infrastructure cost, most corporations will see minimal relative cost to use AI. And though AI providers and governments may recoup some of their investments by adding hidden costs for consumers (personal data use and higher taxes, respectively) many people will use it for "free," garnering broad support for the AI buildout.



From concentration to competition: **AI's foundational models**

"The Americans have need of the telephone, but we do not. We have plenty of messenger boys."

Sir William Preece
Chief Engineer, British Post Office, 1878

The foundational model-based layer of AI refers to the models and data structures designed to enable machines to create content that mimics human-like creativity and intelligence. While scale challenges have made the foundational model provider space highly concentrated to date, we believe competition will rise as these providers monetize their AI models, creating opportunities for accompanying service providers.

Most large companies already have traditional AI embedded into their businesses. Machine learning models are ubiquitous, performing tasks like email automation, online product recommendations, and even facial recognition. Large companies often have their own in-house data teams that have built, tested, and deployed their own machine learning models. In this sense, AI has already been an investable theme for decades.

Enter: Generative AI. GenAI poses a unique challenge for corporate application because today and for the foreseeable future, most corporations cannot build foundational GenAI models in-house due to the exorbitant complexities and costs they entail.

Training complexities

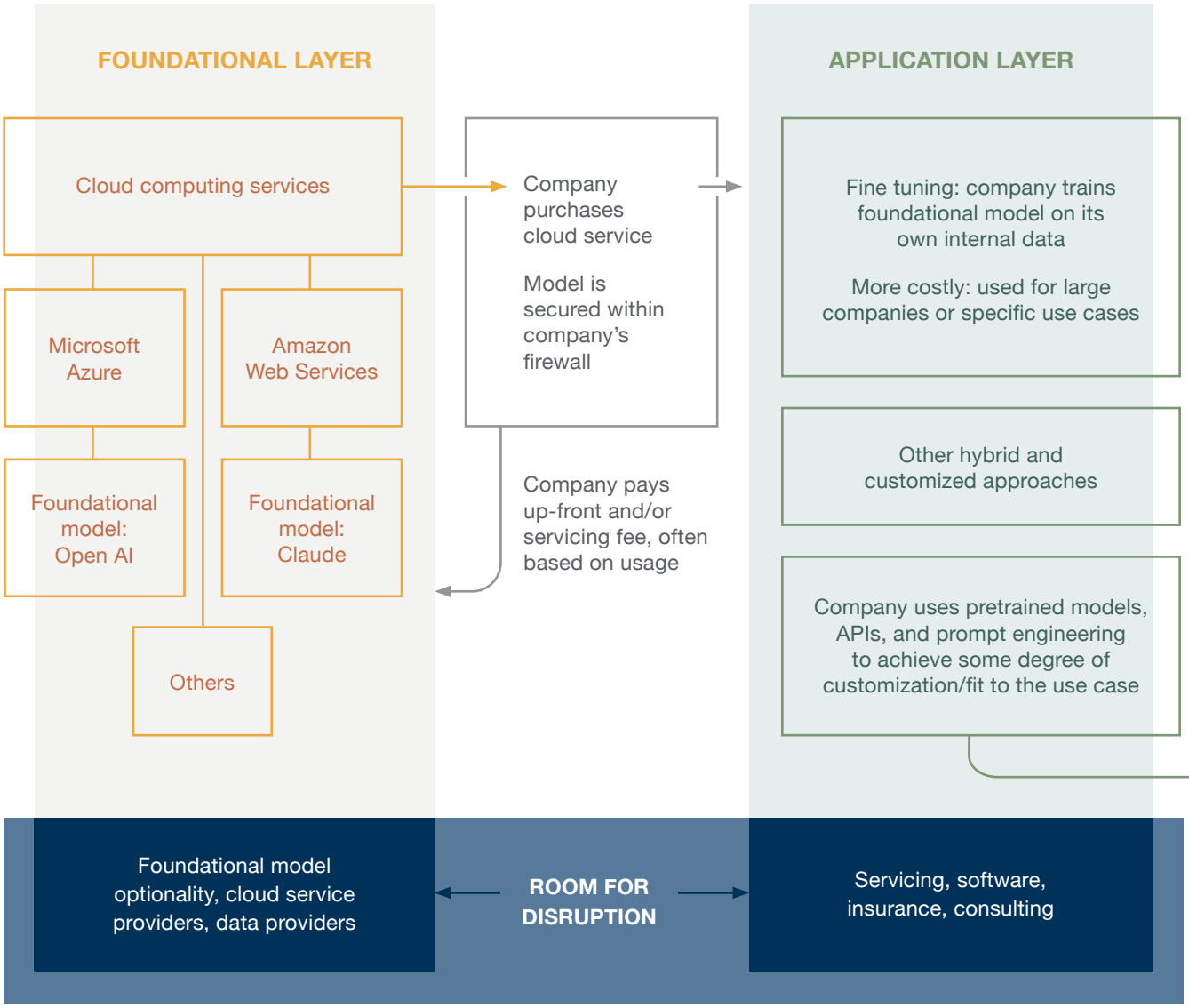
GenAI models are trained using a method by which they're fed vast amounts of data and tasked with making predictions or decisions based on that data. Sourcing high-quality data from public or non-public sources is the first costly challenge. For example, having been sued by The New York Times for the use of its articles without consent, OpenAI has struck licensing deals to train its models on content from The Associated Press, the Financial Times, and other global media outlets; financial terms have not been disclosed but are estimated to be in the tens of millions of dollars. Then the models, which can have billions of internal variables, called parameters – ChatGPT 4 has one trillion parameters – "learn" by adjusting these parameters to minimize the difference between their predictions and actual outcomes. This iterative process is done over many cycles, enhancing the model's accuracy and ability to generalize from the training data to make informed predictions on new, unseen data. This allows GenAI to learn complex patterns and insights without being explicitly programmed for specific tasks, enabling applications ranging from natural language processing (including chatbots) to image and video generation.

Costs

Training GenAI models involves significant computational resources, substantial input costs, a specialized talent pipeline, and time. It would be hard to find a company capable of doing so today with a valuation under $1 billion. Large-scale models require weeks or even months of training on hundreds or thousands of high-end graphics processing units (GPUs) or specialized hardware. The cost of each training day – a function of the computation and cooling-based power needs of the data center – can be substantial, ranging from tens of thousands to millions of dollars, depending on factors like the size of the model, the duration of the training, and the price of cloud computing resources or dedicated hardware. For these reasons, the cost of building and maintaining a GenAI platform is prohibitive for most companies.

We know the costs of developing and training GenAI models are enormous, and only a handful of companies are currently capable of bearing these costs and delivering GenAI models to the world. That said, these high costs have been accompanied by high revenues and rising valuations, and where high profits are expected, competition is sure to follow. Below, we map out ways GenAI models can be monetized by their creators (the foundational model layer) for corporate use (the corporate application layer) and where new entrants might disrupt the market landscape over the coming years.

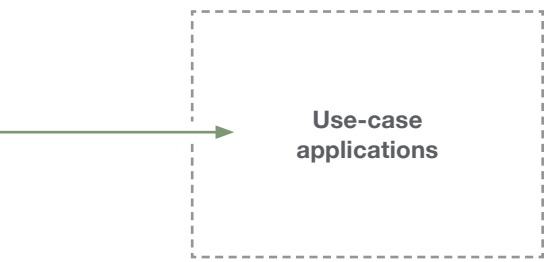
The monetization pipeline from foundational models to corporate applications shows room for competition



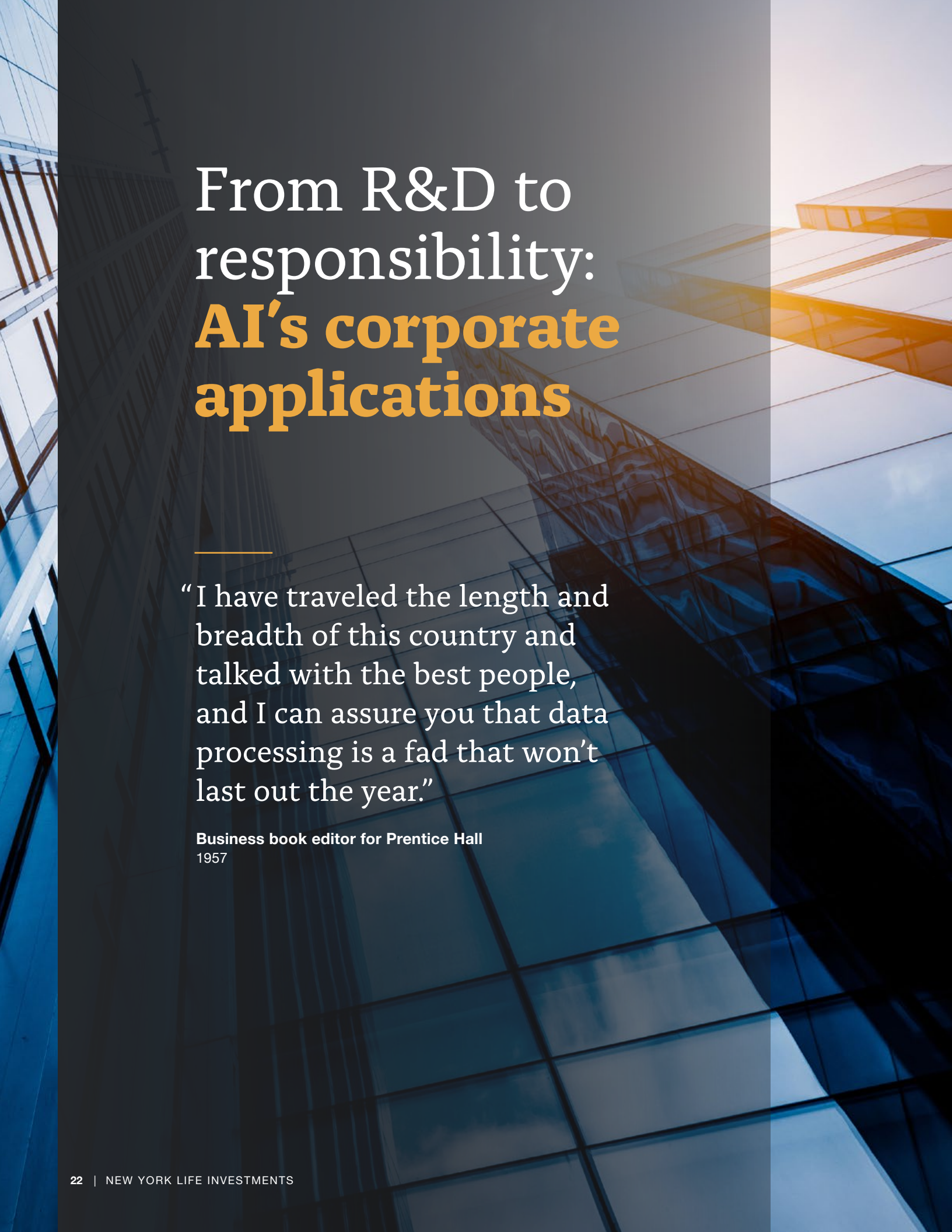
Sources: New York Life Investments Global Market Strategy, New York Life Investments Technology and Data Solutions, June 2024.
API: Application Programming Interface, used to adjust existing models for a given purpose. For educational and illustrative purposes only.

Since the early GenAI models appeared in 2016, their size and complexity have compounded, resulting in higher total training costs. How could new entrants to the foundational model layer move past the sky-high costs to entry in this space? A decline in computation costs could be a launching point for disruption. Due to both hardware and software improvements, AI training costs fell roughly 10x from 2017 to 2020.[xiii] Although we do not expect this pace of improvement to be sustainable, further efficiency gains are likely from here.

Regardless of how computing costs decline, lower barriers to entry in building or distributing new GenAI models would signal greater potential competition in the foundational layer of AI. In turn, a larger number of players in the foundational layer may broaden the ways corporate AI users can purchase and implement GenAI services.



Greater competition among foundational model providers can broaden opportunities for corporate users of GenAI services.



From R&D to responsibility: **AI's corporate applications**

"I have traveled the length and breadth of this country and talked with the best people, and I can assure you that data processing is a fad that won't last out the year."

Business book editor for Prentice Hall
1957

The application layer of AI leverages physical infrastructure and foundational models to perform specific functions for end users. While end users can be government, corporate, or household-based, corporate use-cases are likely to provide investors the best visibility into how AI will scale in the medium term.

In our view, predicting the winners and losers of corporate AI application is guesswork, but four considerations have emerged shaping how quickly, and to what extent, companies use AI to power their business models.

Companies of all kinds are rushing to add GenAI capabilities. Per *The Wall Street Journal*, 72% of 400 U.S. CEOs surveyed in 2023 said generative AI is a top investment priority.[xiv] Buzzwords like productivity, efficiency, and cost savings abound, and might also be the eventual result of AI application. But getting there is far easier said than done. As companies reallocate capital toward exploring AI use cases, four considerations have emerged that, in our view, are likely to be the primary determinants of the pace, extent, and areas of corporate AI adoption: responsible AI, regulation, competition, and labor policy.

Determinants of corporate AI adoption

Responsible AI

Ethical use of AI, including management of model-based issues such as bias and data sourcing, will be critical for the sustainability of AI in business models.

Regulation

The trade-off between regulatory uncertainty and cost may create challenges for cross-border AI deployment, but may spark government cooperation.

Competition

Competition among service providers should lower costs to corporate AI users. Nearly every industry is likely to see some degree of an "AI arms race."

Labor policy

Despite its ability to displace a wide number of job functions, we believe AI will have a net effect of upskilling the global labor force.

Source: New York Life Investments Global Market Strategy, June 2024. For educational and illustrative purposes only.

Responsible AI

The responsible use of AI is an emerging ethical frontier, one that is likely to influence almost all facets of how companies explore and execute on AI integration. Generally, ethics fill the gaps in and extend beyond legal parameters for behavior: just because an activity is permitted doesn't mean it is the right thing to do for a company or its customers. When it comes to this early stage of AI development, the lack of a clear regulatory backdrop suggests that the companies willing to form a strong ethical framework could see a high return on that investment, as well as lower reputational risk.

Though the potential ethical considerations around AI are unlimited, we've found three areas of ongoing legal action in the U.S. that we believe highlight the importance of – and opportunity to craft – the responsible creation, use, and application of AI models.

	AI model creation	AI model use	AI model application
Seminal question	**Can we rely on the data that trains AI models?**	**Who owns the outputs of GenAI models?**	**When there are ethical violations in the use of AI, who is accountable?**
Landmark legal cases	Authors Guild v OpenAI and Microsoft[xv] The New York Times v OpenAI and Microsoft[xvi]	Thaler v Perlmutter[xvii] (Director of the U.S. Copyright Office)	The U.S. Equal Employment Opportunity Commission v Workday[xviii] (an employment software company)
Details	The Authors Guild, representing a group of content creators, and The New York Times each sued OpenAI and Microsoft for copyright infringement. They allege OpenAI used their content in training its large language model without their consent and without compensation.	Dr. Thaler, an AI developer, attempted to copyright a work generated by the AI system he created. His copyright registration application was denied.	The EEOC alleges that Workday used AI tools that discriminated against job applicants on the basis of protected classes (age, race, gender).
Status	A variety of U.S. court rulings have favored the AI model providers over the makers of copyrighted works. Content creators' cases have been trimmed or dismissed.	U.S. copyright law requires a human creator. So far, the U.S. Copyright Office has determined that there is no ownership of AI-generated works: those who prompted an AI do not have ownership over its output, nor does the model itself or those who created it.	U.S. courts are still deciding who is responsible for outcomes of a biased model – the model creator, software firms, and/or the end client. Until this liability question is resolved, companies face an uncertain environment when deploying AI in their business models.
Implication	In an AI-driven world where everyone can be a creator but nobody is an owner, existing legal and regulatory parameters do not provide sufficient guidance for the responsible use of AI.		

Sources: New York Life Investments Global Market Strategy, Congressional Research Service, June 2024.

Lacking a robust regulatory backdrop, we believe corporations will need a strong stance on AI-related ethics relating to:

- **AI models themselves**
  How is data sourced? How does the company validate the model's potential bias?
- **Monitoring**
  How does a firm ensure a model's outputs are creating the effects intended?
- **Responsibility**
  When anticipated effects such as layoffs occur, how does the company handle change management? What are its human capital policies? When unintended effects occur, how readily does the company take responsibility?

These questions matter just as much for investors. As more and more companies make AI central to their business models, equity and corporate debt investors can consider how they plan to incorporate a company's responsible AI policies into their analysis.

Regulation

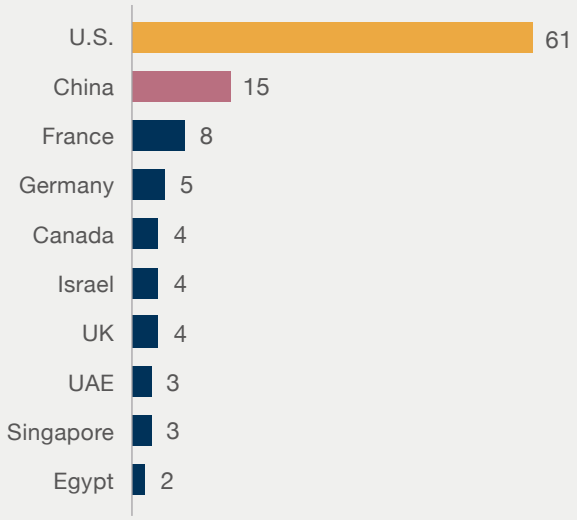
As the world most recently experienced in the cryptocurrency boom, it is exceedingly difficult for legislative and regulatory authorities from any nation to keep pace with innovation. The innovators argue in favor of *self*-regulation, pointing out (often rightly) that the expertise and technical knowledge of their industry often precludes regulators from doing so effectively. However, since AI has the potential to affect the world as broadly and deeply as the internet and has applications ranging from the military to banking, regulation is essential – both within and across borders.

Thus far, the global leader in top-down AI legislation has been Europe. The European Union's AI Act, passed in March 2024, ranks AI functions according to risk levels. AI capabilities classified at the highest level of risk, including the ability to biometrically identify and "social score" individuals or groups, are now banned in the EU. Today, the Act represents global leadership in how government can articulate the role of AI, and complements Europe's established data transfer, privacy, and intellectual property laws. Accordingly, the operating environment for firms deploying or leveraging AI in Europe is relatively well-defined; it may be more costly for companies to source, process, and store data for AI models on the continent, but *these costs are foreseeable*. In contrast, in the U.S. – where the legal infrastructure supporting AI application is far more in flux – firms seeking to deploy AI face a more uncertain operating environment in which regulatory costs are unknown. Will the companies that steam ahead of a legal backdrop benefit from first-mover advantage, or will they be hit with fines and lawsuits that benefit their more patient competitors?

Differences in regulatory costs are likely to influence where and how AI develops globally

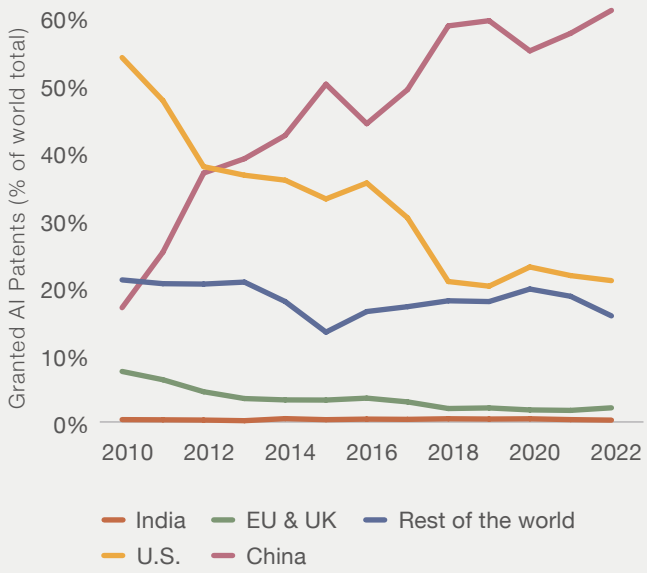
AI model creation has been concentrated in the United States…

Number of machine learning models by geographic area



…but China leads on volume in broader AI innovation

Percent of world total number of granted AI patents



Sources: New York Life Investments Global Market Strategy, 2024 AI Index Report, Epoch, Center for Security and Emerging Technology, June 2024. Data for charts as of 2023.

When it comes to country-level AI deployment, companies are caught in the middle: they're either met with a more robust regulatory backstop and accompanying higher costs, or they face regulatory uncertainty, and the accompanying risk of first-mover folly. These stark differences in operating environments have not hindered the earliest days of GenAI model development, but are likely to drastically affect investment opportunities in the infrastructure and application layers in coming years.

One example: data storage and transfer laws imply that Europe will have country-level AI data center hubs, meaning their infrastructure may be more localized relative to those in the U.S. A second example: global businesses may choose locations for headquarters or strategic expansion based on the AI operating environment. Policymakers will likely see the need for coordination in AI policies with major allies, possibly exacerbating diverging spheres of influence between the U.S. and China.

Competition

We believe competitive dynamics will have a two-pronged effect on corporate AI adoption, serving as an enabler and a driver.

Competition as an AI enabler
Greater competition among AI model and service providers is likely to drive down costs and augment services for corporate users. We expect competition-driven optionality to appear around every facet of the servicing of corporate AI applications, including software, consulting, compliance, monitoring, and risk assessment. Of the many, we offer one example: AI-liability insurance, an extension of existing cloud-liability insurance services.

Competition as an AI driver
To paraphrase Lisa Su, CEO of Advanced Micro Devices: corporate moats do not exist when AI is moving as fast as it is. In other words, if the cost to deploy AI applications is reduced, the "arms race" will only intensify between companies seeking to re-vamp their business models, using AI to drive efficiency and cost savings. Consider the case of Blackberry. The creator of the world's first smartphone, once with a number one market position and a hub of tech talent, fell victim to what was in many ways a piggyback innovation: Apple's touchscreen iPhone. The Blackberry example suggests that given the pace of AI development, even companies that have pioneered areas of AI innovation cannot sit on their laurels. We expect this competition to manifest in higher corporate spending on R&D, greater capital expenditures where physical infrastructure is needed, and fierce rivalry for top talent.

An emerging competitive frontier in AI services: digital risk transfer

As cloud computing services began to emerge in the early 2000s, a need emerged for insurance products to cover the unique risks associated with data storage and processing in the cloud. In most relationships between clould providers and their enterprise clients, the client outsources the service (data migration to the cloud; software as a service) but retains the risk (cyber liability, i.e., data breach). Traditional insurance products did not cover the risks related to cloud infrastructure. The result was the birth of cloud-specific cyber insurance companies and products.

Just like cloud platform providers, GenAI model creators may be limited in what indemnification or liability coverage they can offer to customers regarding the training, use, and security of their platforms. Large enterprise customers may look to mitigate any risks related with leveraging the AI platform with new AI-liability insurance. This represents an investment opportunity in existing cyber insurance providers or new entrants to the cyber insurance space.

Labor policy

The scale and scope of AI's impact on the global labor market will depend on how ethical AI, regulation, and competition shape up – to the benefit of some job functions, and the detriment of others. A company's principles on responsible AI use, for example, may mean that AI-induced layoffs include ample severance pay, extended benefits, and job placement assistance. Regulation may require a huge amount of human oversight over AI-led processes, supporting total employment. Competition, though, may create a "race to the bottom" in labor costs.

There is no doubt that AI will create layoffs: eliminating the need for select job functions, but on a sweeping scale. By one estimate, 80% of the U.S. workforce could have at least 10% of their work tasks affected by GenAI, but 19% of workers could see at least 50% of their tasks disrupted.[xx] Disruption can mean that full-time jobs are lost outright, or workers are pushed to part-time, hourly, or contract status. AI is likely to have many human costs, and job losses are just one of the social sensitivities surrounding its rise.

As economists, we believe the labor opportunities borne from AI integration outweigh the threats to human job functions, with a net effect of global labor upskilling. In past waves of innovation, such as the internet and automation, roles made obsolete by new technology were, on a net basis, more than offset with brand-new job functions that were previously unheard of. Bookkeeping roles, for example, were largely eliminated when Microsoft Excel was born, but it fostered the rise of more complex accounting and financial analyst roles. We are confident these transformations will take place in the AI innovation wave – and in addition to the creation of new jobs we can't yet imagine, we see ample room for a positive AI-driven shakeup within existing labor markets.

Within job functions, AI-enabled upskilling can have a democratizing effect on high-skilled jobs.

In areas such as software development, data analysis, technical support, and graphic design, AI tools can enable workers to produce sophisticated outputs with a less intensive training or educational background. For those with existing expertise, AI can save professionals time and effort, allowing them to achieve greater quantity or quality of work. For project-based or "gig" workers, this means more work completed and more income per hour. In the context of a corporate organization, AI-enabled upskilling can enable greater productivity from junior-level workers and encourage more informed decision making across levels of an organization.

AI may also enable workers to graduate from job execution to monitoring.

This angle of upskilling that can soften the net effect of AI-driven layoffs. After discussions with a wide variety of professionals, it's become clear that as most companies implement new AI functions, cost savings from layoffs will be offset by increased spend on jobs in oversight, regulatory compliance, and internal controls to ensure the AI is executing on job functions as intended. Risk professionals and data scientists alike point to a need for a "human in the loop" for the foreseeable future, in which a human, or team of humans, remains part of any AI deployments to ensure quality and compliance.

Upskilling potential as result of AI adoption

A new boost for unions?

Only 10% of U.S. workers are in a union today,[xxi] but the IMF estimates that 30% of jobs in advanced economies could see negative disruption from AI.[xxii] Just as the buildout of railroad infrastructure coincided with the rise of labor unions in America, we see meaningful potential for AI to prompt a rebirth of union power globally. We've already seen effective union pushback to threats AI poses for the creative industry: the Writers Guild of America (WGA) and Screen Actors Guild (SAG-AFTRA)'s nearly months-long strike against the Alliance of Motion Picture and Television Producers resulted in an agreement that producers must obtain consent to use actors' likenesses in works created by AI. At an even greater scale, Microsoft is working with the largest U.S. union group, the AFL-CIO, to educate its members on AI trends and shape new workforce policies as the job market shifts with AI adoption.[xxiii]

From adaptation to allocation: **AI's investment opportunity set**

"Stocks have reached what looks like a permanently high plateau."

Irving Fisher
Professor of Economics, Yale University, 1929

Key long-term macro drivers

Across the infrastructure, foundational, and application layers, we've focused on how AI investment can drive sweeping change from the company-based, or bottom-up, perspective. For long-term investors, the ability of AI to also shape big-picture macroeconomic factors represents a critically important investment theme. Focusing on the drivers of long-term macro change – rather than guesswork about the end result – can best help asset allocators choose winning approaches for the coming decades.

We expect AI adoption to have a sequential impact on the global economy: first, an inflationary upward glidepath for growth, then a resetting of inflation and interest rates as economies absorb the positive productivity shock.

1 Near term

Starting with the near-term inflationary impulse: today and into the medium term, we see a highly capital-intensive phase of AI development. This includes the hefty startup investment we've enumerated, such as chip manufacturing and data center infrastructure. These costs will be financed across public and private investment and could easily amount to many trillions. Sam Altman, the founder of OpenAI, has estimated that $7 trillion would be needed for his firm to build a vertical chips-to-data center pipeline. Beyond physical investment, companies will be spending on AI use-case exploration (with some necessary added costs of trial and error), AI-related R&D (depending on the industry), and grappling with labor force adjustments, including up- and re-skilling employees. These costs will likely be passed on to consumers in a gradual inflationary push.

2 Medium term

As AI adoption broadens and deepens in the medium to long term, greater productivity is widely expected to follow, pushing down costs for consumers as certain services become automated. We see AI driving an upskilled labor market on a net basis, rather than creating mass unemployment. Those concerned about this downside scenario, though, can consider the role of policy in buffering these shocks. Should the labor market struggle to absorb the impact of AI, more accommodative fiscal spending and looser monetary policy can support households. As a policy tool, higher corporate taxes could also be leveraged toward higher social spending in the event that corporations leverage AI to the detriment of the labor force.

3 Long term

How interest rates absorb the impact of AI's productivity shock over the long term remains uncertain. It comes down to the simplest economic growth formula: the potential growth rate depends on the amount of capital stock, the amount of labor, and how productive labor is in making use of this capital. AI is often thought of as a 'deflationary' long-term force because of its potential to boost productivity with marginal capital investment: the labor force can do more with less. Though as we noted in the infrastructure section, AI's power and computation needs are a positive function of the complexity and usage of the model: as AI grows, so does its necessary capital base. As long as this is the case, we see AI as a positive shock to productivity and to trend growth, but not to the long-term potential economic growth rate.

AI as a driver of the "future state" of macro: our framework

	Capital-intensive phase: 1-5 years	Shock absorption phase: 5-10+ years
Net effect on global economy	Above-trend economic growth, resulting in upward pressures on inflation and nominal interest rates	Positive shock to productivity, resulting in ambiguous impacts on inflation and therefore real interest rates
Factors biasing nominal rates higher	• Greater government spending • Higher private investment • Corporate investments in R&D and application exploration • Labor upskilling/re-training	• Greater productivity: higher output per unit of invested capital • Corporate profitability, fostering positive investment cycles • Looser monetary/fiscal policy can counter deflationary pressures of higher labor supply
Factors biasing nominal rates lower	• Cheaper services where AI is applied • Tighter monetary/fiscal policy can counter inflationary pressures of higher AI spending	• Cheaper services where AI is applied • Positive labor supply shock: lower wages, lesser job availability, higher unemployment

Sources: New York Life Investments Global Market Strategy, New York Life Investments Multi-Asset Solutions, June 2024.
For educational and illustrative purposes only.

For AI to represent a true structural upward shift in potential economic growth and a structural downward pressure on inflation, it would need to continue advancing *without needing new capital* – something no other type of innovation in history has accomplished. AI is not there yet, but has two possible avenues to do so in the coming 20+ years: chip efficiency and quantum computing.

Chip efficiency

Moore's Law suggests that the computing power of chips doubles every 10 years. When applied to AI computing, this means models can run with less power and cooling needs.

Quantum computing

Better chips can reduce AI's capital intensity, but the more holistic and far-off game changer for AI's potential growth is quantum computing. Quantum could drastically reduce the capital intensity of AI's computing needs, bringing AI closer to driving a structural upward adjustment the potential growth rate.

Focusing on the drivers of long-term macro change can help asset allocators choose winning approaches for the coming decades.

Investment strategies

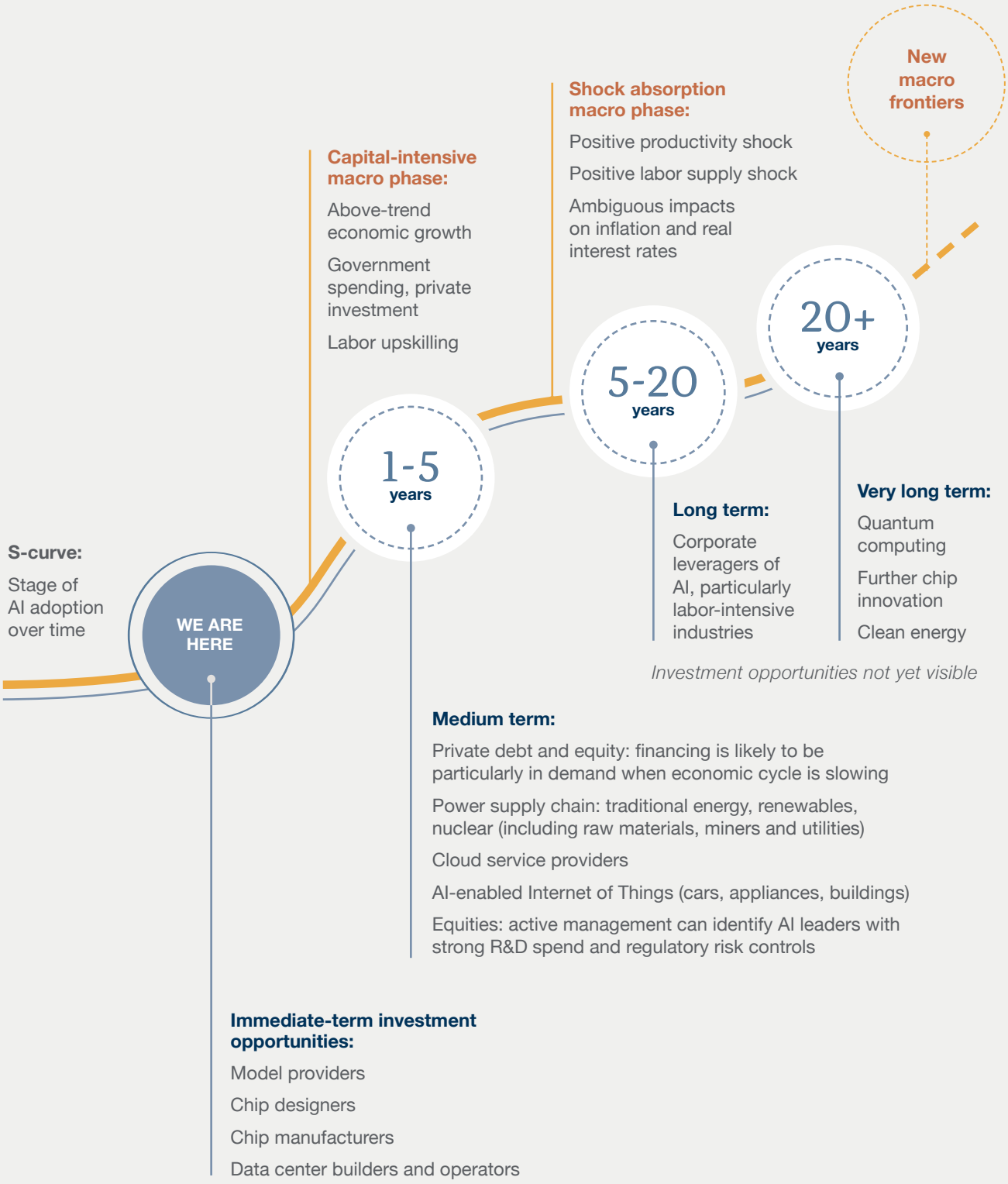
Up to this point, AI investment has been concentrated within the foundational layer, with the major providers of AI models pouring billions into these new capabilities, and investors pouring billions into their publicly listed equities. But as this research has showcased, we believe the AI investment opportunity set is far broader and deeper than this narrow range of companies, and will only expand over time along with competition.

On the precipice of a rapid S-curve ascent, some asset classes have a clear-cut case as AI beneficiaries: energy, materials, tech. Perhaps an even more powerful investment approach is to consider the providers and recipients of AI investment. Over the medium term, we will see multiple economic cycles – and when financing conditions tighten and economic growth slows, we believe private equity and credit vehicles will see outsized demand from this structural investment theme. The pipeline of new companies leveraging AI in their business models will first be seen in venture capital, but should also emerge over the medium term in the form of newly listed public equities. Active management can play a key role in differentiating hype from disciplined AI deployment: emphasis on ongoing R&D and strong corporate governance, namely regulatory risk controls, may merit premium valuations.

A large portion of long-term AI opportunities are not yet visible in the market. Market structure is agile, with the behemoth companies of one era rarely lasting into the next. We envision that many of the great AI business models do not exist yet. These will be revealed over time in companies that leverage AI to transform their value proposition, AI-related services that respond to needs we can't yet foresee, and, of course, next-frontier technologies like quantum computing and cheap, clean energy.

We believe the AI investment opportunity set will broaden and deepen over time along with competition.

How an AI allocation can build over time



Source: New York Life Investments Global Market Strategy, June 2024. For educational and illustrative purposes only.

From hyped to holistic: next steps in AI investing

The potentially ubiquitous reach and transformative capacity of AI makes it a daunting theme for some investors to incorporate into portfolios, and an exciting new era of possibility for others. We're inclined toward the latter, with the understanding that there is almost no existing structure regarding the uptake of AI, and investors will be responsible for imposing their own. Just as governments, companies, and individuals will need to develop their own responsible AI *modus operandi*, investors will need to establish their own frameworks to assess where the disciplined use of AI will make a material difference in their investment theses. Amid all the AI hype, we remind investors that this is indeed a transformative innovation for the global economy, but one that is still in its infancy. Early winners are just that – early – and we look forward to the coming years in which new AI leaders will emerge, productivity gains will be unlocked, and global markets adapt to business models that we haven't yet imagined.

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