Investing in the Future:
How to Capitalize on Exponential Technologies Ahead of the Curve
The Morningstar® Exponential Technologies Index™ represents companies worldwide that offer exposure to technological transformations across all areas of the economy. Built in collaboration with our equity research team, it’s designed to help investors find opportunities associated with technology themes that we expect to ignite rapid change—within the technology sector and beyond.

**Exponential Technologies Change the World**

Technology has the power to radically change our behaviors and everyday lives. Yet it’s not only how rapidly technologies develop, but how they interact to catalyze growth that magnifies their impact.

The concept of exponential technologies has its roots in Moore’s Law. In April 1965, Gordon Moore published an article¹ in *Electronics* magazine making the bold prediction that the number of components on a single silicon chip would double each year for the following decade (an increase from about 60 to 60,000 components). As the director of research and development at Fairchild Semiconductors, Moore envisioned that this rapid growth would result from improved affordability driven by increases in processing power, lower component costs, and advances with miniaturization. His prediction was later adjusted to reflect a doubling of semiconductor performance every 18 months.² More than 50 years later, Moore’s Law still serves as a benchmark for semiconductor processing power improvement—as well as a metaphor for all types of exponential growth.

Building on Moore’s Law, futurist and computer scientist Ray Kurzweil introduced The Law of Accelerating Returns in his 1999 book, *The Age of Spiritual Machines*. Kurzweil’s law broadens the idea of exponential growth to all forms of technology as a continuation of biological evolution. He teamed up with NASA and Google to found the incubator and think tank Singularity University, which educates people about exponentially growing technologies and how to use them to improve the world.

The work of Kurzweil and his associates at Singularity University to define exponential technologies is what inspired the Morningstar Exponential Technologies Index. Examples of exponential technologies include cars and personal computers, both of which fundamentally changed how we live and created considerable wealth for early investors.

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The technology adoption life cycle\(^3\) models how different groups in the world’s population begin to use new technologies. A technology can’t become exponential unless it builds momentum as it makes the transition from a curiosity used only by the earliest of adopters to a mainstream advance accepted by the majority. When an innovation is disruptive or brings radical change, author Geoffrey Moore calls the leap from the first adopters to the majority beginning to use an innovation “crossing the chasm.”\(^4\) The larger the market is, the greater the potential economic impact — yet the right conditions and infrastructure must exist to accelerate change.

Personal computers began to make their way into millions of businesses, homes, and schools in the early 1980s — fundamentally changing how we work, play, and learn today. IBM was one of the companies responsible for compressing a machine that once cost millions and occupied a quarter-acre-sized room into something that fit on a desktop and cost roughly the same price as a diamond engagement ring in its day. This would not have happened without the development of the microprocessor in the 1970s, which made it possible to reduce both the size and cost of a computer so an ordinary person could own one.

**Why We Built the Morningstar® Exponential Technologies Index**

Investing early in transformational technologies is an opportunity to build substantial wealth. Those who bought shares of IBM in 1924 for $27.50 would have made many multiples on their original investments. But how do you find investments in technologies that will be built to last and not destined for obscurity?

We introduced the Exponential Technologies Index to help investors find high-growth companies across sectors that are in the early stages of developing technologies we believe will transform society. Creating this index allowed us to examine the potential for both the producers and users of technologies, without being constrained by the boundaries of traditional sectors.

**How Morningstar Defines Exponential Technologies**

Morningstar defines exponential technologies as those advances expected to create significantly positive, nonlinear economic benefits for the companies that produce or use them. These are the technologies that integrate seamlessly in our lives and transform how we live and work, which means they typically have a broad impact on society and present a major economic opportunity for investors.

It’s difficult to predict which technologies will change our world and how long their influence will last. We aim to identify companies interconnected with technologies that are poised to “cross the chasm” and grow exponentially because of how quickly and widely they are adopted.

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As depicted in Figure 1, an exponential technology offers significant value relative to normal or linear-growth innovations because of the acceleration and intensity of its growth.

**Curated by Our Global Equity Analyst Team**

After initially attempting to use purely quantitative methods to identify themes and companies to cover in the Morningstar Exponential Technologies Index, we learned this was not an effective approach. Automated screening processes do not work because of how subjective it is to categorize and define emerging technology themes.

Instead, we relied on the research and knowledge of our equity analyst team. Morningstar has one of the largest independent teams of equity analysts in the world, consisting of more than 100 equity analysts with experience across sectors, industries, and regions. Our analysts work on the ground in Chicago, Sydney, Amsterdam, Mumbai, and Shenzhen/Hong Kong to cover more than 1,400 companies.

Morningstar analysts are subject-matter experts on their companies with a profound understanding of each company’s tangible and intangible assets, as well as its capabilities and strategic direction. Our analysts focus on a small number of stocks in one industry, allowing them to maintain a robust understanding of each company’s fundamentals and how its technologies might apply to broader industries.

All of our equity research analysts apply a systematic approach to their qualitative analysis with built-in checks and balances. Our analyst teams engage in intense debates where they are expected to defend their ideas. Every analyst uses the same proprietary model to assess each firm’s financial outlook and competitive position within the context of its sustainable competitive advantage. Our analysts must determine and defend assumptions associated with cash-flow projections, sometimes as far as 20 years into the future.
Morningstar analysts assign a Morningstar® Economic Moat™ Rating to each of the companies they cover. The concept of an economic moat explains how likely a company is to keep competitors at bay for an extended period. After weighing the strength and sustainability of a company’s competitive advantage, the analyst assigns it a moat rating of wide, narrow, or none.

The team that contributes to the Exponential Technologies Index includes all of our equity analysts worldwide. It’s overseen by our Technology Steering Committee of equity research team leaders and our sector directors.

The geographic reach, consistent process, organizational structure, and our ongoing studies of emerging trends position Morningstar’s equity research team to accurately identify exponential technology themes and systematically assess their exposure across the companies we cover worldwide.

**How We Built the Index**

The Morningstar Exponential Technologies Index identifies a global set of publicly traded companies with economic exposure to one or more exponential technology themes — either as a producer or a user. It’s an equal-weighted index representing companies that offer exposures to defined areas of technological transformation across the global economy. We select the constituents for our index from the universe of all the companies around the world that our equity analysts cover.

When constructing our index, we kept these guidelines in mind:

- Not all technology advances are easily investable.
- Not all technology advances at an exponential pace.
- Not all technology advances are created or applied by companies classified in the technology sector.
- Companies sometimes use different language to describe the same technology theme.
- Exponential technology themes evolve over time.

After defining the investment objectives for the index, we built it using this process.

**Step 1: Identify the Exponential Technology Themes**

Our Technology Steering Committee began its search with inspiration from the themes Kurzweil’s Singularity University considers significant. Unlike Kurzweil and his Singularity University, we limit our technology themes to those associated with publicly traded companies. The committee collaborated on a list of themes from their review of our equity research in search of technologies with potential to bring significant economic benefits to companies that produce and use them. To validate the themes, the committee vetted each one through intense peer review and debate.
Through the committee’s work, we identified and defined nine technology themes to launch the index:

**Big data and analytics**
This covers the analysis of data sets that are too large and complex to interpret with standard methods or tools. A few related subthemes include hyperconnectivity, the Internet of Things, machine learning, and artificial intelligence.

**Nanotechnology**
This branch of technology deals with dimensions and tolerances of less than 100 nanometers, especially the manipulation of individual atoms and molecules. We see a range of potential applications spanning medicine, computing, industrial manufacturing, and travel (ground, air, and space).

**Networks and computer systems**
Technology leaps ranging from hyperconnectivity and integrated systems, to service continuity and new software-defined architectures will have a massive impact on the way people think of connecting applications and software with hardware.

**Energy and environmental systems**
This involves the exploration of renewable energy sources—including solar, wind, water, and batteries. As organizations set processes to help reduce environmental impacts and increase operating efficiency, new avenues for technological advancement across sectors will open up.

**Medicine and neuroscience**
This is related to sciences such as neurochemistry and experimental psychology that deal with the structure or function of the nervous system and brain. Key advancements in unlocking the human genome have created an infrastructure of biomarkers, while paradigm shifts in biotechnology that can alter the immune system are radically changing the way we treat diseases.

**Robotics**
This branch of technology deals with the design, construction, operation, and application of robots. Advances in robotics, specifically when combined with other exponential technologies, have seemingly infinite potential applications, spanning technology, industrial, medical, and consumer-facing channels.

**3-D printing**
This process makes a physical object from a three-dimensional digital model, typically by laying down successive thin layers of a material. This emerging trend is ready for mainstream consumption and has ample potential to disrupt several industries, from industrial manufacturing and medicine to consumer products and retail.
Bioinformatics
This is the science of collecting and analyzing complex biological data. The “quantified self” trend of acquiring data to quantify aspects of an individual’s daily life has exponential potential to positively impact both the duration and quality of life.

Financial services innovations
Areas of financial innovation include nontraditional emerging funding sources, platforms, currencies, and stored and transferred value mechanisms. We not only think about exponential opportunities to efficiently expand production, but also the underlying currencies used (including cryptocurrencies), as well as structural shifts in technology and payment delivery methods.

Step 2: Score Possible Companies to Include in the Index
After defining the themes, the Technology Steering Committee trained all of our equity analysts around the world on the rationale for each theme and how to score every company they cover according to the system we created. Designed to generate consistent scores across geographies and sectors, the system is repeatable when analysts re-evaluate themes and rescore companies.

Our equity analysts scored the companies they cover on each of the themes:

0 for little or no exposure
1 for moderate exposure
2 for significant exposure

When scoring companies, our analysts examine third-party research, industry information, and macroeconomic analyses. Taking a valuation-driven approach, they must forecast and substantiate their analysis using our methodologies and models. Our analysts make forward-looking assessments rather than relying on single point-in-time metrics such as percent of current revenues. Typically, they use models to project growth over five, 10, and 20 years.

In order to justify a score of 1 or 2, companies must have a commercialized product or be expected to have a commercialized offering with a high degree of certainty related to that specific theme. It’s possible for a company without a moat to receive a score of 1 or 2; this would be a case when the analyst expects the company’s moat could grow because of its exposure to an exponential technology that may currently be in the research and development stage.

Calibrating the Company Scores
When all of the analysts submitted their scores, the sector director and strategist discussed them with each analyst on the relevant sector team. This helps maintain consistent scores across sectors, while allowing us to validate or correct any outliers.

The Technology Steering Committee then reviewed the scores for each company, checking for thematic, sector, geographic, or individual calibration biases. During this step, the committee members offered feedback to the analysts and directors as part of our normal process to test the rationale behind the results.
Step 3: Name the Leaders for Each Theme

The Technology Steering Committee worked with the sector directors, strategists, and analysts to identify the leaders within each theme. We define leaders as those companies expected to capture disproportionate economic benefits when compared with the companies scored with a 2.

To indicate leaders, we added another level to the scoring system:

- 0 for little or no exposure
- 1 for moderate exposure
- 2 for significant exposure
- 3 for leaders

Each theme may have up to five leaders. After reviewing all the scores, the committee selected the top five firms expected to have the greatest potential to benefit from the exponential technologies covered in each of the themes.

We noted the frequency of 2s and 3s in a particular theme and leveraged our work on competitive advantages as a way to think about which companies would be more likely to have attributes that would allow them to benefit from exposure to one or more of these themes.

Some of the leadership factors we considered included:

► Beneficiaries of the network effect
► Gatekeeper companies (those with extraordinary influence because of how they define processes and/or control resources)
► Cost advantages
► Brands and intangibles

One of the most powerful forces we have observed in technological adoption is the network effect. This occurs when the value of a company’s service increases for both new and existing users as more people use the service—like Facebook or financial exchanges, for example.

Gatekeeper companies can be difficult to identify for disruptive technologies where new industries are still developing and have not yet achieved scale. We define these as companies that currently control a particular exponential technology theme because of their power over an industry or supply chain, creating a situation where other businesses must rely on them. One example is Intel, which is the largest producer of microprocessors in the world and drives the standard for smaller circuit widths within semiconductors. As an ingredient brand, Intel chips appear in products across commercial and residential channels, as well as in private- and public-sector verticals.

In many cases, the variations in scores result from the difference between simply being a user of the technology versus a company that’s leading or defining the path of the technology. Those companies that scored no exposure or received 1s tend to be the commodity players, such as Yahoo in the big data and analytics theme. Google, on the other hand, is a leader within the same theme because its web-crawling algorithm has allowed it to gain a competitive advantage through the network effect.
Step 4: Select the Top 200 Companies For the Index

After identifying the themes and leaders, the Technology Steering Committee collaborated with our indexes team to decide which of the companies we scored would be included in the Exponential Technologies Index. While making their decisions, they weighed input from the analysts and sector directors.

At inception, each of the 200 companies in the index was exposed to an average of 3.75 of the exponential technology themes. Most of the companies on the initial list are expected to benefit from the more mature, widely adopted themes—such as big data and analytics, nanotechnology, and networks and computer systems—primarily as users of those technologies.

Index Maintenance and Reconstitution

Our research teams worldwide are in constant contact with one another to share ideas. This level of communication, in combination with our view across global markets, allows us to identify, vet, and closely monitor broad technology trends and cross-sector themes as they mature and emerge.

On an annual basis, the Technology Steering Committee will review all exponential technology themes and the analysts will rescore every company they cover. After this annual review, we will reconstitute the index.

We use this methodology to adjust each company’s score for:

- **Elimination from the index.** If a company experiences an activity that eliminates its association with other constituents (such as bankruptcy or acquisition by a company that’s not a constituent), we will remove that company’s exposures from the aggregate scores and the total company count will decrease by one.
**Acquisition by another constituent.** If a company is acquired by another constituent, the acquiring company’s scores on each of the themes will be adjusted to reflect the highest score on each theme. For example, if the acquirer had a score of 1 on a theme and the firm acquired scored a 2, the acquirer’s new score would be 2.

Our equity research team will allow us to be nimble about addressing new themes as they arise, as well as any changes in the status of leader companies or new entrants in the theme. We publish these in regular industry reports, known as our *Observer* pieces, where we will capture any emerging themes that we can continue to investigate during our annual reviews.

**What the Exponential Technologies Index Reveals**

The sector exposure for the Exponential Technologies Index varies significantly from the sectors associated with Morningstar’s mutual fund and exchange-traded fund technology category averages. While technology mutual funds and ETFs had 74.1% and 88.8% exposure to the technology sector, respectively, our Exponential Technologies Index had less than 30% exposure to technology-classified firms. During its first year (2015), the largest relative sector overweightings for our Exponential Technologies Index were in technology, health care, and communication services, as Figure 3 shows.

Because technology advances and applications extend broadly throughout our economy, we believe an indexing approach that’s agnostic to traditional company sector classifications is required to achieve more complete and pure exposure to the exponential technology themes where we see accelerating growth.

The Morningstar Exponential Technologies Index is equal-weighted, which gives it a relative overweighting to mid-cap exposure. This prevents the index from being too heavily weighted toward large-cap companies, allowing an equal opportunity for constituent companies of all sizes to influence the portfolio’s overall return. Emerging technologies, by their nature, often come from smaller companies that are able to be more nimble and innovative. At the same time, those companies are sometimes acquired and absorbed by larger companies for their intellectual property.
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Figure 4. Greater Exposure to Mid-Cap Companies

<table>
<thead>
<tr>
<th>Morningstar Global Markets Index</th>
<th>Morningstar Exponential Technologies Index</th>
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</thead>
<tbody>
<tr>
<td>Large-Cap Companies</td>
<td>74.25</td>
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<tr>
<td>Mid-Cap Companies</td>
<td>61.44</td>
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<tr>
<td>Small-Cap Companies</td>
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</table>

Source: Morningstar

The Morningstar Exponential Technologies Index exhibits more global exposure than the typical technology-focused fund, illustrating its ability to pursue opportunities wherever they might manifest. While the typical technology sector fund devotes nearly 90% of assets to the U.S. market, the Morningstar Exponential Technologies Index has nearly 30% of assets outside the U.S. — mostly in European companies, with the remainder in Asian companies.

Figure 5. Global Exposures

<table>
<thead>
<tr>
<th>Morningstar Global Markets Index</th>
<th>Morningstar Exponential Technologies Index</th>
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</thead>
<tbody>
<tr>
<td>Developed Asia Pacific</td>
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<tr>
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<td>Developed Middle East and Africa</td>
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<tr>
<td>Emerging Middle East and Africa</td>
<td>0.97</td>
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Source: Morningstar
At inception in December 2014, the index had 200 constituents. We have removed four of those constituents between inception and June 30, 2015 because of acquisitions.

Most companies in the index have exposure to multiple themes. As of June 30, 2015, each of the constituents was exposed to an average of 3.75 of the nine themes. Companies with moderate exposure tend to be users of the technology. Two firms at the initial construction of the index were exposed to a single theme each: Intuitive Surgical, Inc. in robotics and Covanta Holding Corp. in energy and environmental systems. Our goal was to identify themes that were pervasive enough to exert their influence in multiple ways through companies in different industries. These results prove the influence of the themes.

![Figure 6. Distribution of Leader Companies Across Exponential Technology Themes](image)

**Source:** Morningstar

**Making Exponential Technologies Investable**

Until now, it has been a challenge for investors to identify investable opportunities associated with exponential technologies. We combine our disciplined, fundamentals-based approach to equity research with our indexing expertise to deliver investors consistent exposure to emerging technologies through the Morningstar Exponential Technologies Index.
About Morningstar Indexes

Morningstar combines the science and art of indexing to create a comprehensive offering of global equity, fixed-income, alternative, and multi-asset class indexes. We make these available to meet a range of needs, including benchmarking, performance measurement, asset allocation, product development, and more. Whether beta or strategic beta indexes are required, we deliver flexible solutions built on our ecosystem of high-quality data and proprietary research.

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