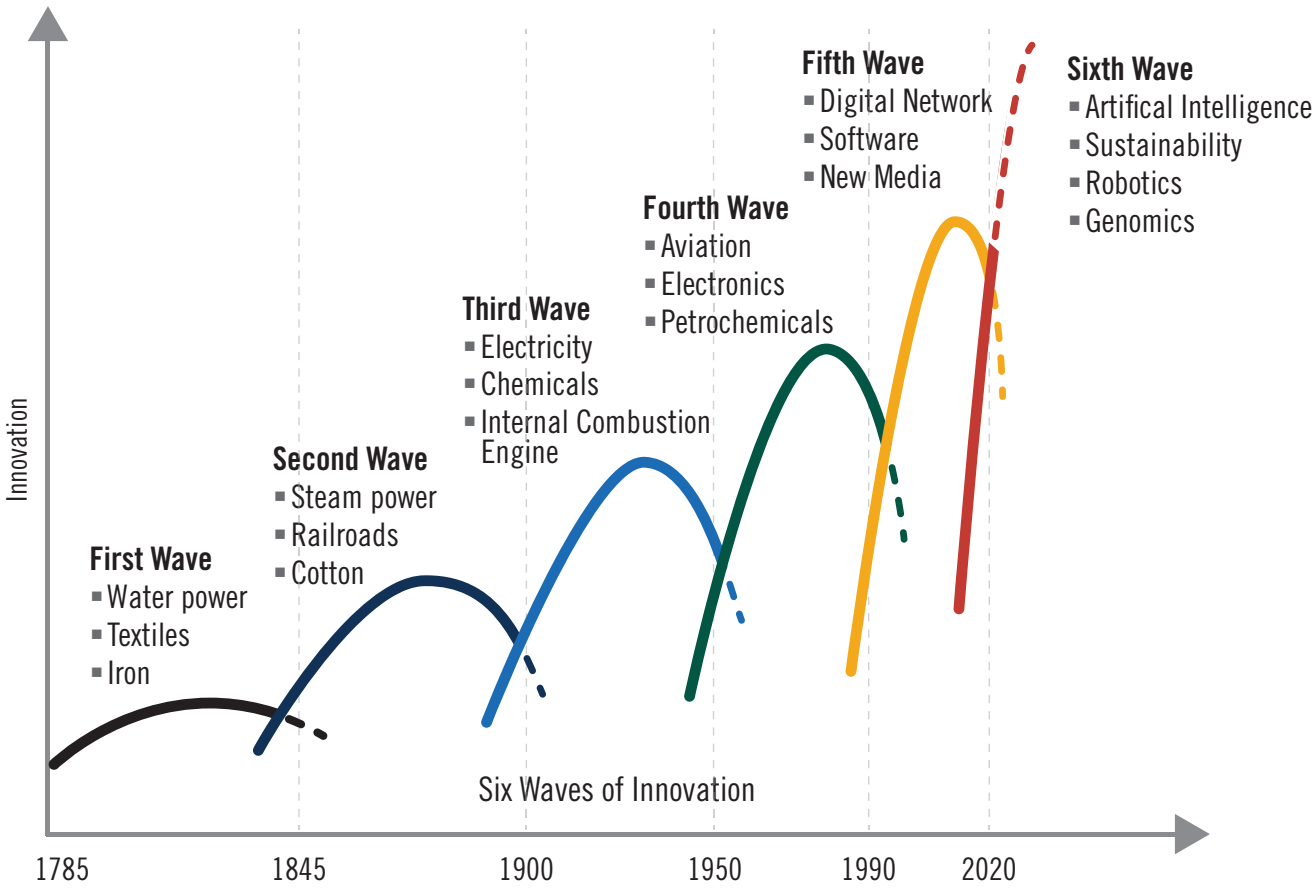
Near the end of the 19th century, major cities around the world endured a seemingly endless struggle against an overwhelming amount of horse manure, known as the great horse manure crisis. During the early phases of the industrial revolution, cities depended on horses as the primary means of transportation for both people and goods. Over 100,000 horses would reside in a major city, amounting to millions of pounds of manure produced daily. Removing the excrement required more horses, introducing additional traffic...and more manure.

As a consequence of rapid urbanization, equine excrement carpeted streets and accumulated into mighty heaps that stretched across entire city blocks. The glut overwhelmed agricultural demand for manure as fertilizer. Second order hazards abounded, including swarms of flies that spread disease, "dust" storms in dry windy conditions, and streams of "mud" during heavy rain. If horses remained the core engine of the economy, it appeared metropolitan areas would forever be rotting from within and growth capped from the staggering level of manure. However, the great horse manure crisis was averted in the very early parts of the 20th century. An innovation wave introduced automobiles and electrified trolleys, which completely displaced horses and their manure emissions.

One of the key characteristics of a capitalist economy is its constant state of evolution: New ideas and products replace the old. Famed economist Joseph Schumpeter observed this phenomenon, coining the term "creative destruction." Historically, the onset of new innovations induced a series of rapid changes for industries and society. Since the start of the industrial revolution, the global economy experienced significant technological progress through five distinct waves of change driven by technological breakthroughs. These are known as Schumpeter's long waves of innovation.

EXHIBIT 1: SCHUMPETER'S WAVES OF TECHNOLOGICAL INNOVATION



Source: Ernst von Weizsacker et al, 2009; Global Trends: Green Technology – Brahmanand Mohanty
https://www.visualcapitalist.com/the-history-of-innovation-cycles/

While two centuries of economic expansion and five innovation waves propelled humans into the modern era, it was not without tradeoffs. Greenhouse gas emissions from the first five innovation waves accumulated to the point of creating a "code red" situation. The advent of internal combustion engines, aviation, and petrochemicals, which originated from the third and fourth innovation waves, contributed heavily to global emissions. On the surface, it might appear the fifth innovation wave offered potential reprieve, since the digital revolution spawned technology companies with less carbon intensity.

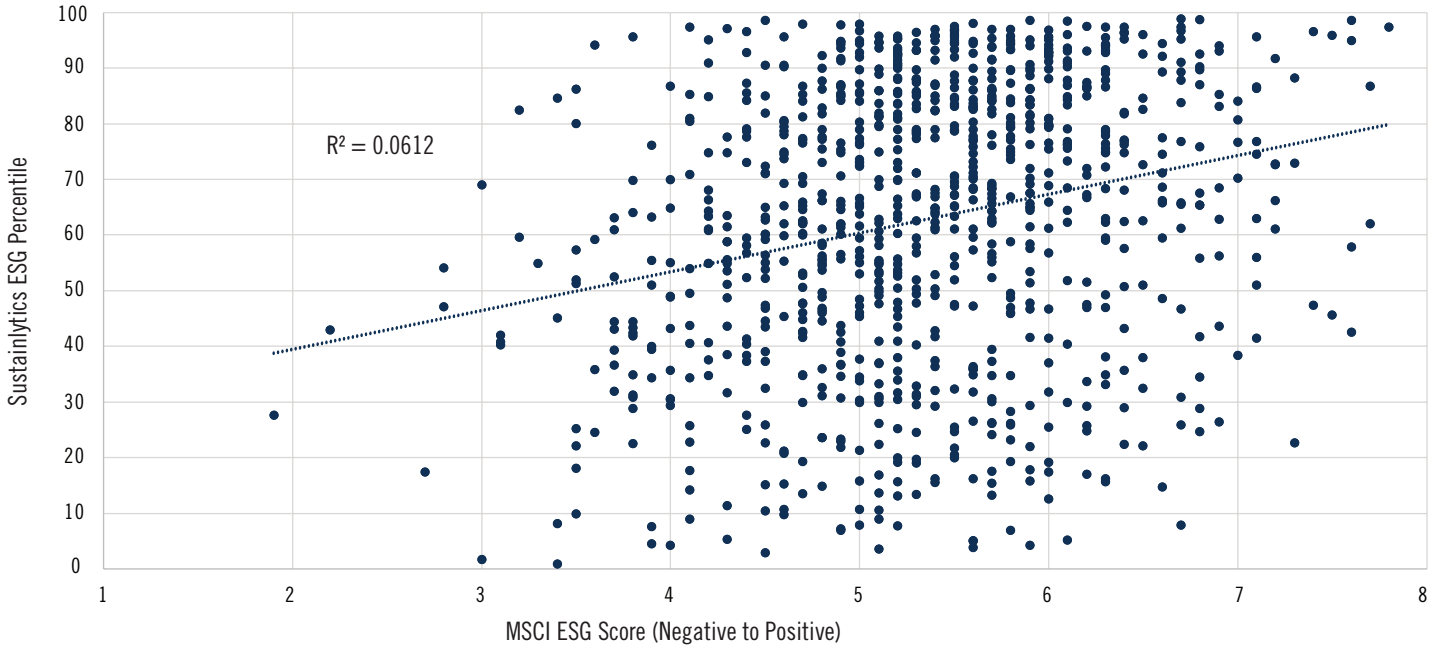
Instead, we argue that the digital economy accelerated globalization, which expanded smokestack industries and created a new middle class in emerging markets. In developed nations, which have a comparable advantage in the technology sector, outsourcing old economy industries became very attractive, freeing up capital and allowing investments to be redirected into the fast-growing digital economy. Further, the internet itself represents the means for coordinating our just-in-time global supply chain, which heavily depends on production capabilities domiciled in developing nations. Today, emerging markets emit two-thirds of annual global emissions—a second order effect of the fifth innovation wave.

With economic growth having direct climate consequences, we believe we have a repeat of the great manure crisis, and the solution to our climate crisis lies with innovation. In our view, the sixth Schumpeterian innovation wave will be the catalyst that corrects the unintended consequences from the previous five waves.

We believe the investment community will play a critical role in capital allocation that will enable this next innovation wave. However, the current state of identifying sustainability leaders is equivalent to equity investing in 1800s, where standard financial statement data was not readily available and modern valuation concepts were virtually nonexistent. We, as an investment community, need to create a unified economic theory that can quantify the sustainability of a company's business model. We do not have the "Gordon Growth Model" for sustainable investing. This has led to inconsistent, opinion-based assessments. Simply put, the investment community needs to evolve to become enablers of the next innovation era.

To illustrate the inconsistency of the investment community's current approach to sustainability investing, we plotted a scatter chart of the Russell 1000® Index's constituents, comparing each company's MSCI and Sustainalytics environmental, social, and governance (ESG) ratings. MSCI and Sustainalytics were selected given their broad coverage. In Exhibit 2, we observe that the two ESG ratings agencies had negligible traces of a linear relationship, with an R^2 near zero. In other words, there is little consensus among top ESG ratings providers.

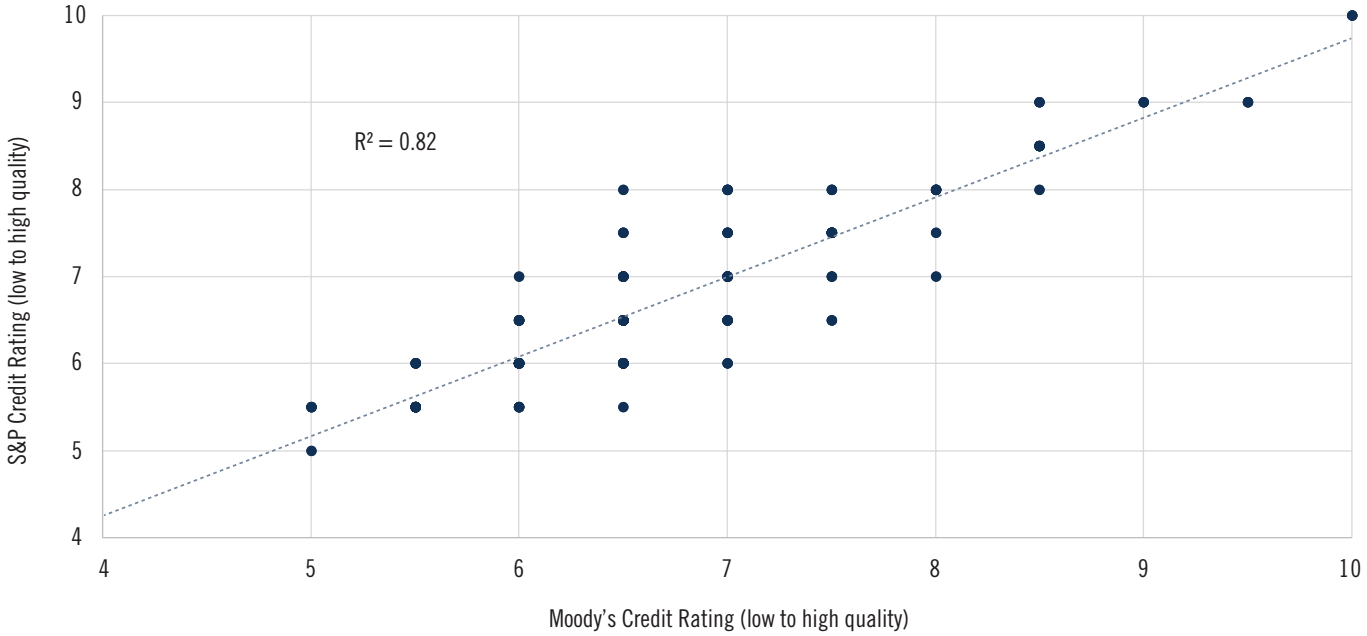
EXHIBIT 2: RUSSELL 1000 INDEX ESG RATINGS: MSCI VS. SUSTAINALYTICS



As of June 2023; Source: FactSet, Bloomberg, Virtus Systematic
Sustainalytics ESG Percentile calculated based on Sustainalytics ESG Risk score ranked against Russell 1000® Index constituents

continued

EXHIBIT 3: RUSSELL 1000 INDEX CREDIT RATINGS: S&P VS. MOODY'S



See appendix for numerical score and equivalent credit rating
As of June 2023; Source: FactSet, Bloomberg, Virtus Systematic

Even when comparing the ESG ratings for same company, there is significant divergence in the assessments that drove the overall score. For example, Sustainalytics issued The AES Corporation, an electric utility, a "high-risk" rating, which ranked among the bottom 10% for the Russell 1000 Index. Specifically, Sustainalytics highlighted material ESG issues that includes corporate governance and carbon emissions from its operations. However, MSCI issued one of the highest ESG rating for The AES Corp. Even when these two agencies evaluate the same issues for the same company, there exists an alarmingly wide discrepancy in their conclusions, signifying the industry's need to undergo maturation and to bring objectivity.

Now, let us compare this with the valuations of a company based on its financial metrics. Indeed, we observe the exact opposite when we repeated the same analysis for fixed income credit ratings. For Exhibit 3, we plotted S&P's and Moody's credit ratings across the constituents of the Russell 1000. Here we have a strong linear relationship between the two agencies' ratings. Moreover, this outcome was a result of a matured credit research framework and the existence of a robust market to signal creditworthiness.

At Virtus Systematic, we apply a multi-pronged approach to synthesize an objective, repeatable approach to the sustainability assessment of a company. First, we compile a host of metrics that provide a clear indication of a company's sustainability profile and quantifies its impact on not only the stakeholders, but also the environment. Second, we introduced an Artificial Intelligence (AI)/Natural Language Processing (NLP) model designed to quantify a company's sustainability efforts in a consistent, objective manner, starting with a data feed from major news outlets across the globe. Lastly, we are embarking on collaboration with a few leading academics to research for a more unifying "Gordon Growth Model" and measure the impact of sustainability on a company's bottom line. We believe this combination of AI and sustainability is naturally Schumpeterian, bridging the environmental issues that came from the fifth wave with a solution from the sixth wave.

Indeed, AI may provide a solution for a disorderly information landscape where material data points are hidden within masses of irrelevant data. A typical U.S. large-cap publicly traded company averages 18,000 news headlines per year and produces thousands of pages of regulatory filings. Objectively evaluating one company using all the sources is difficult already. Repeating this process for all publicly traded companies becomes a monumental undertaking, even with a large team of highly trained professionals.

continued

We believe the solution lies with AI and NLP to gather material information and synthesize a conclusion using this mosaic of data. A properly calibrated and trained AI model represents an important pathway to systematically measure a company's sustainability profile.

Furthermore, we firmly believe there will be a point in the next decade when capital markets will start heavily discounting companies where their cash flows and earnings face sustainability risk. This could come in the form of adverse weather events that disrupt business operations or regulatory changes that increase the cost of doing business for environmental/climate offenders. It was only recently that scientists could decisively conclude that increased extreme weather activity was linked to greenhouse emissions from human activity. Investment professionals unprepared to quantify the amassing sustainability risks can experience detrimental results when a major regime change occurs in markets. Concomitant with the manifestation of sustainability risks, sustainability innovation will continue to push human progress. In both respects, AI and sustainability will be the north star to navigating the environment to come.

APPENDIX 1: S&P AND MOODY'S NUMERICAL SCORE

Moody's	S&P	Numerical Score
Aaa	AAA	10.00
Aa1	AA+	9.50
Aa2	AA	9.00
Aa3	AA-	8.50
A1	A+	8.00
A2	A	7.50
A3	A-	7.00
Baa1	BBB+	6.50
Baa2	BBB	6.00
Baa3	BBB-	5.50
Ba1	BB+	5.00
Ba2	BB	4.50
Ba3	BB-	4.00
B1	B+	3.50
B2	B	3.00
B3	B-	2.50
Caa	CCC	2.00
Ca	CC	1.50
C	C	1.00

Source: Synthesized by Virtus Systematic using S&P and Moody's data.

Kunal Ghosh
Senior Managing Director
Chief Investment Officer

Lu Yu, CFA, CIPM
Managing Director
Senior Portfolio Manager

Jie Wei, CFA
Director
Senior Portfolio Manager

Yang Zhang
Assistant Director
Data Scientist

The Virtus Systematic team specializes in differentiated investment solutions, strategies, and outcomes across asset classes, regions, and securities. The Virtus Systematic team manages U.S. mutual funds for Virtus Investment Advisers, Inc. and other portfolios for Virtus Fund Advisers, LLC.

R^2 is a statistical measure that represents the percentage of a fund or security's movements that can be explained by movements in a benchmark index.

The **Russell 1000® Index** is a market capitalization-weighted index of the 1,000 largest companies in the Russell Universe, which comprises the 3,000 largest U.S. companies. The index is calculated on a total return basis with dividends reinvested. The index is unmanaged, its returns do not reflect any fees, expenses, or sales charges, and is not available for direct investment.

Past performance is no guarantee of future results.

All investments carry a certain degree of risk, including possible loss of principal.