

Look Forward

A World in Disruption

Volume 1 | January 2023



S&P Global

T

he world has reached a unique moment. In my 40-plus years in business, I've never seen a time quite like the one we're living through now.

This is a period marked by uncertainty. Households, the private sector and governments around the globe

face an energy security crisis and climate change, food shortages, high inflation, ongoing supply chain challenges, volatility in financial markets and a host of geopolitical risks.



In this first issue of *Look Forward*, our economists, analysts, researchers and data experts survey the current state of affairs and connect the dots to explain what it all means in an era of instability. The purpose of *Look Forward* is to help decision-makers in asset managers, asset owners, companies, multilateral institutions, nonprofit organizations and governments look beyond the near term and explore the trends that will shape our future.

Readers will benefit from the smart analysis of our cross-divisional Research Council at S&P Global, which produced this journal. The Council has identified six interconnected themes with the greatest potential for large-scale disruption well into the future.

The Council's critical work, as you will read, is focused on energy security, climate and sustainability, technology and digital disruptions, supply chains, capital markets and geopolitical shocks. We have unique datasets and insights in all these areas, and we see the Research Council as a way to make sure that our insights deliver maximum impact to our customers and the markets.

In this age of turbulence and change, the following articles are designed to help navigate the path ahead.

A handwritten signature in black ink that reads "Doug Peterson". The signature is fluid and cursive, with the first name "Doug" and last name "Peterson" clearly distinguishable.

Douglas L. Peterson
President and CEO, S&P Global

A World in Disruption

In the last few years, it has seemed as if the world is spinning ever faster.

A global pandemic. A land war in Eastern Europe and increasing superpower tensions. More frequent and catastrophic weather events. Runaway inflation, stock markets falling and cryptocurrencies collapsing, with global debt reaching record levels. A worldwide energy crisis amid the ongoing energy transition. Soaring commodities prices and jammed supply chains.

The disruptions at play are reshaping the global economy, capital markets and geopolitical order for the long term. Both challenges and opportunities will emerge from this period of profound transformation. That's why we have asked some of our most experienced research leaders to pause, reflect and look forward to 2030 to help you understand the forces that are disrupting the world and creating the future. This journal, the inaugural edition of S&P Global's *Look Forward* series, is the result. Guided by S&P Global's Research Council, these authors have drawn on their deep expertise, insights and data to examine subjects as diverse as physical climate risk, the end of the "cheap-money" era, a nearly \$25 trillion funding gap to meet Paris Agreement decarbonization goals and the emergence of a new style of leadership powered by female CEOs.

This is not a forecasting exercise, but six key themes emerge: The energy transition is gaining speed but is still not proceeding fast enough to meet Paris climate targets. Investments in adaptation need to step up to protect wealth and lives from rising physical risks from climate change. The end of the era of extremely low interest rates will lead to structural changes in the economy. The world has more debt than ever before, and policymakers will need to make trade-offs to limit the risks of a debt crisis. New forms of pragmatic cooperation might emerge, where countries cooperate across spheres of mutual interest while contesting across spheres of national interest. The world is moving from the oil age to an era of batteries and electrification amid the electric vehicle and digital revolutions, leading to a commodity supercycle.

And, centrally, the next eight years will demonstrate once again the truth of the Chinese proverb: "Chaos equals opportunity." A world in disruption is one of not only heightened risk, but also expanding opportunities. The articles in this journal are intended to help you take advantage of those opportunities. We hope you find it valuable and we look forward to hearing your feedback.

With great anticipation,

Alexandra Dimitrijevic

Global Head of Research & Development, S&P Global Ratings
Co-chair, S&P Global Research Council
alexandra.dimitrijevic@spglobal.com

Atul Arya

Chief Energy Strategist,
S&P Global Commodity Insights
Co-chair, S&P Global Research Council
atul.arya@spglobal.com

Key Research Themes



- 1 Sustainability & Climate
- 2 Trade, Resources & Supply Chains
- 3 Geopolitical Shocks
- 4 Future of Capital Markets
- 5 Digital Disruption
- 6 Balancing Energy Security & Energy Transition

Contents



Geopolitical Shocks

A Pragmatic World (Re)order 5

To meet the crosscutting challenges defining the years ahead, a new pragmatism will emerge.



Future of Capital Markets

The End of Lower for Longer: A Post-COVID Silver Lining? 8

Structural changes to the global economy suggest higher prices and rates ahead.



Balancing Energy Security & Energy Transition

Energy Transition: Gaps in the Pathways 12

Despite current economic and geopolitical crises, the energy transition is accelerating — but not fast enough to meet Paris Agreement climate goals.



Trade, Resources & Supply Chains

The World Isn't in a Commodity Supercycle, but It Should Be 17

A brutal series of shocks has left markets ill-prepared for the challenges of the future.



Sustainability & Climate

Women CEOs Model a Diverse Future 21

Women's leadership styles position them well to guide organizations through the profound transformations ahead.



Future of Capital Markets

Global Debt Leverage: Is a Great Reset Coming? 24

Rising rates and slowing economies mean the world's high leverage poses a crisis risk.



Sustainability & Climate

Crunch Time: Can Adaptation Finance Protect Against the Worst Impacts From Physical Climate Risks? 29

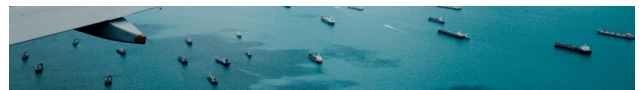
Investments in adaptation must close the gap with mitigation financing to avoid the worst outcomes.



Trade, Resources & Supply Chains

The EV Revolution – Moving From Oil Age to Battery Age? 35

Few stakeholders will be shielded from the transformation of the automotive ecosystem.



Trade, Resources & Supply Chains

Risk Will Define Supply Chains for Years To Come 39

Although the greatest disruption to containerized shipping supply chains since the dawn of the container era has begun to ease, risks remain high.



Digital Disruption

Toward a Tokenized Future 42

Digitization will improve efficiency and open new markets — but the revolution won't happen overnight.

A Pragmatic World (Re)order

To meet the crosscutting challenges defining the years ahead, a new pragmatism will emerge.

Dr. Lindsay Newman

Executive Director, Head of Geopolitical Thought Leadership,
S&P Global Market Intelligence
lindsay.newman@spglobal.com

A world ordered for decades by globalization and geo-economics has of late become a world oriented around geopolitics. Shocks initially thought to be time limited, from the COVID-19 pandemic to the conflict in Ukraine, have proven more lasting and pervasive. Some say we have already landed somewhere new — in a fragmented world where the U.S. has lost its global footing and China is steadily gaining ground.

Entering 2023, we believe that we have not yet reached a new horizon. By 2030, we may have visibility into the international order taking shape. But for the remainder of this decade, we are unlikely to find solid ground in one equilibrium or another — whether unipolar, bipolar, multipolar or a vacuum.

Instead, a set of crosscutting challenges will define the years ahead. These tests are interlinked and borderless: climate change, the energy transition, technological guardrails and cybersecurity, pandemics, and inequities. No country will be able to solve these challenges alone, and no country can solve these challenges for all.

We expect countries to meet these challenges by adopting a new pragmatism: cooperating across spheres of mutual interest (energy transition agendas, pandemic preparedness, humanitarian partnerships) while concurrently contesting across spheres of national interest (economic policy, industrial strategy, critical technologies and resources, supply chain security). Already, we see countries negotiating economic partnerships while one partner maintains trade relations with a third, sanctioned country. We also see a renewed nonaligned movement that is possible and intentional.

For the remainder of this decade, we are unlikely to find solid ground in one equilibrium or another; instead, a set of crosscutting challenges will define the years ahead.

Highlights

The next decade will be a period of disequilibrium.

A set of interlinked challenges will define the years ahead: climate change, making the energy transition, technological guardrails and cybersecurity, pandemics, and inequities.

We expect countries to meet these challenges with a new pragmatism, in which they cooperate across spheres of mutual interest and simultaneously contest across spheres of national interest.

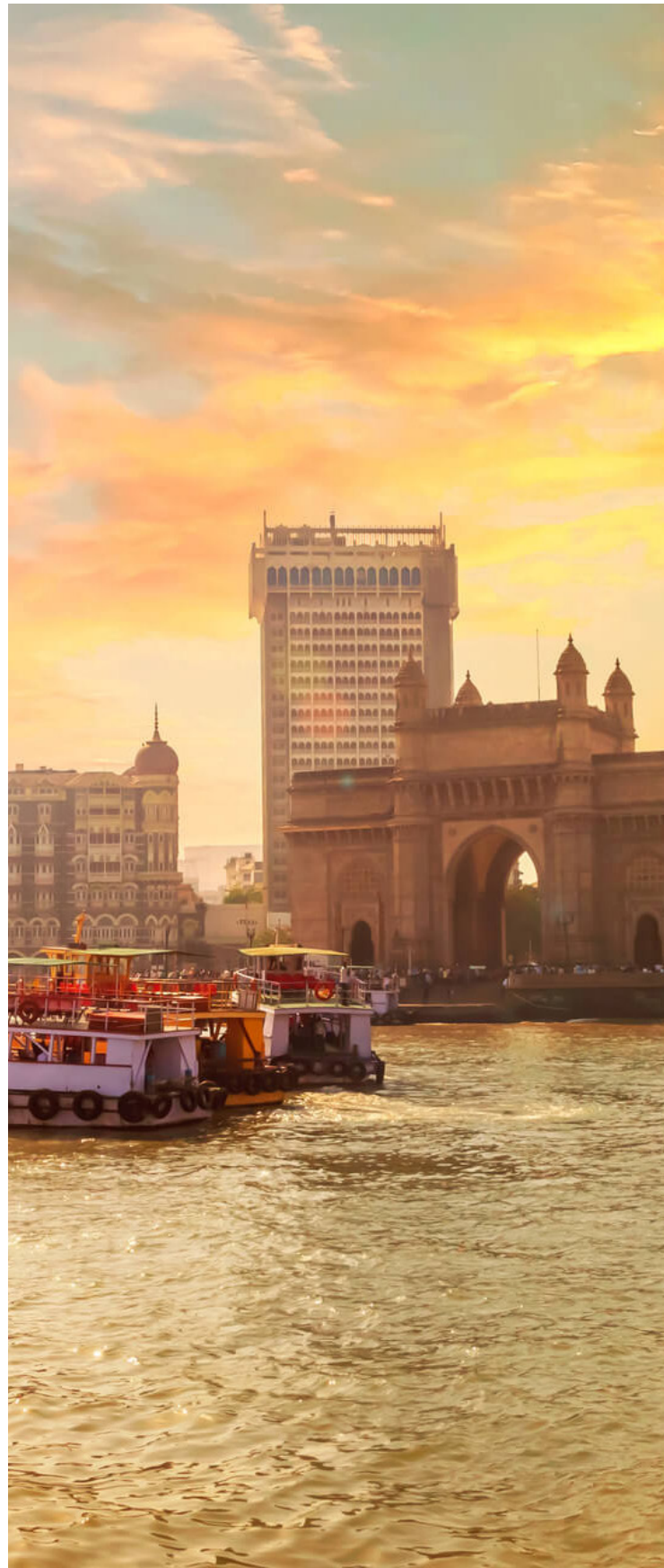
India's Global Role

Perhaps no country reflects that arising pragmatism better than India, which, according to S&P Global Market Intelligence data, is projected to become the third-largest contributor to global real gross domestic product growth over the next decade, behind only China and the U.S.

India sits alongside the U.S., Japan and Australia in the Quadrilateral Security Dialogue (Quad), a partnership committed to advancing “[a free and open Indo-Pacific](#).” Formed after the 2004 Indian Ocean tsunami as a humanitarian and loosely based security partnership, the Quad framework now covers a range of shared challenges, including health security, maritime data-sharing and working groups on climate change, supply chains and advanced technology. India is also a partner in the [Indo-Pacific Economic Framework for Prosperity](#), launched in 2022 by the U.S. and 12 other countries representing 40% of the world's GDP, and dedicated to building a connected, resilient, clean and fair economy.

Yet, even as India partners with the U.S. (and others) on these multidimensional initiatives, it also maintains economic and trade ties elsewhere, including with strategic competitors of the U.S. According to S&P Global's Global Trade Analytics Suite, in late 2022, China remained India's third-largest export market by value, and by far its largest supplier of imported goods. Even more indicative of current geopolitical dynamics is India's positioning during the Russia-Ukraine conflict. According to S&P Global's Commodities at Sea database, as European markets imposed sanctions and sought to disengage from Russian energy resources, India became the second-largest recipient of Russian crude oil in 2022. The previous year, India did not represent a top 10 export market for Russian crude oil. While Indian Prime Minister Narendra Modi cautioned Russian President Vladimir Putin in September 2022 that “today's era is not an era of war,” according to S&P Global's available trade data, that sentiment had only a marginal impact on India's Russian crude imports.

As the demand for oil defined geopolitics in the 20th century, the scramble to secure minerals critical for the energy transition is likely to shape geopolitics in the 21st century.



New Pragmatism at Work

This form of expedient engagement, of collaborating on communal challenges while competing in the national interest, is not only an India story. Turkey, a U.S. ally through NATO, is also a purchaser of the Russian-manufactured S-400 missile system, for which the [U.S. imposed sanctions on the Republic of Turkey's Presidency of Defense Industries](#). South Africa is a member of the [Just Energy Transition Partnership](#) with the EU, U.K. and U.S., which aims to support the country's decarbonization efforts, even as it remained a leading exporter of coal in 2022, including to its BRICS partners India and (less so) China.

As the demand for oil defined geopolitics in the 20th century, the scramble to secure minerals critical for the energy transition is likely to shape geopolitics in the 21st century, leaving countries working side by side to contain a changing climate while leveraging protectionism and localization. The U.S. approach is telling. On the global stage it launched the multilateral [Minerals Security Partnership](#) in 2022 in recognition of the role critical minerals will play in "[our shared future](#)." At home, however, recent administrations have prioritized securing a "Made in America" [supply chain for critical minerals](#), labeling overreliance on "[foreign sources and adversarial nations](#)" for critical minerals as national and economic security threats.

In this landscape, pressure points in one part of the world create ripples globally, with vast commercial impact. This decade has brought trade wars, sanctions expansion, de-dollarization debates, supply chain disruptions, resource protectionism and labor market reshuffling. As the world navigates toward a new equilibrium, it will be pragmatism, if anything, that defines the interregnum. ■

Chart 1 Commercial Impacts of the Geopolitical Landscape



© 2023 S&P Global.



Learn more

[A world rebalancing](#)

[Outlook for India's economic growth and policy platforms](#)

[COP27: Implementation constraints amid the Russia-Ukraine conflict](#)

[Critical minerals: Illuminating the path to an electric future](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

The End of Lower for Longer: A Post-COVID Silver Lining?

Structural changes to the global economy suggest higher prices and rates ahead.

Paul Gruenwald

Global Chief Economist, S&P Global Ratings
paul.gruenwald@spglobal.com

Highlights

“Lower for longer” has resulted in many unwelcome distortions in recent decades, but there are reasons to think it may be coming to an end.

The COVID era highlighted the need for supply chain resilience over efficiency, meaning higher costs for producing, storing and shipping goods, and a faster green transition, meaning higher interest rates as the required investment absorbs savings.

The end of this phenomenon will not be painless, but it should bring benefits.

While the COVID-19 pandemic and climate change represent large shocks to the economic system, there is a silver lining: Each in its own way will contribute to the end of “lower for longer.” This will lead to a more balanced and sustainable macroeconomic environment.

Lower for Longer: The History

The past few decades have been characterized by “lower for longer.” Inflation has generally run below central bank targets, necessitating a policy of ultralow interest rates. When the policy rate reached effective zero, quantitative easing was employed. This involved large central bank purchases of government bonds to further ease financial conditions. The main policy challenges were allowing inflation to rise while cushioning the impact of the global financial crisis and COVID-19 on the financial sector and the economy more generally.

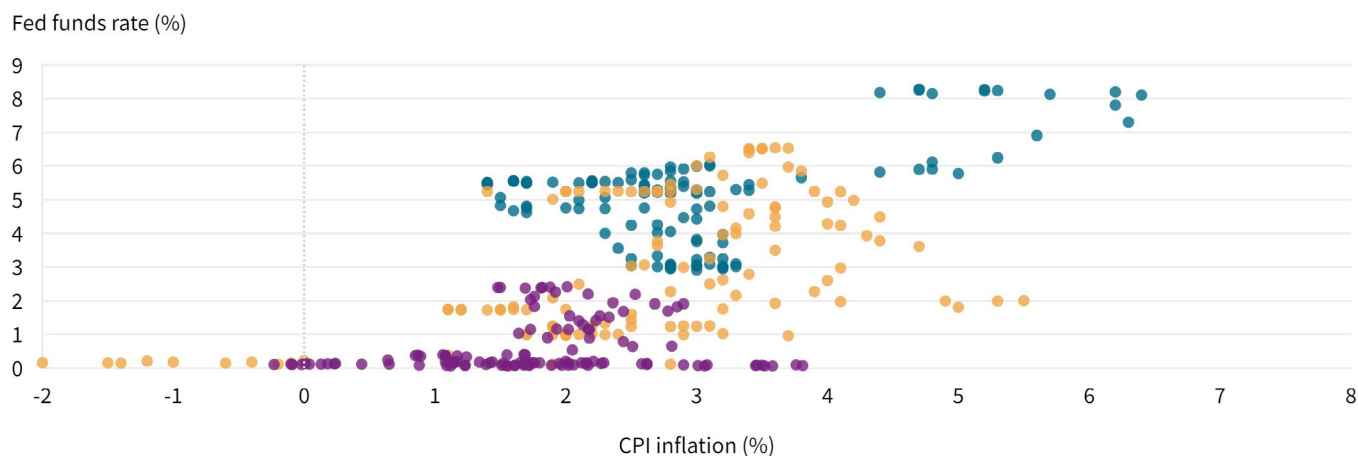
Lower for longer was the result of several structural factors. China’s entrance into the global production and trade system, which amounted to a large, positive supply shock, put persistent downward pressure on prices. Demographic pressures from aging populations, which led to a rise in savings, put downward pressure on interest rates. The ongoing demand for safe assets by central banks and other entities put further downward pressure on rates.

Chart 1 on the next page shows the monthly combinations of policy rates and inflation for the U.S. over three decades. Both inflation and the policy rate have moved steadily lower over that period.



Chart 1
US Inflation and Fed Funds Rates

● 1990s
● 2000s
● 2010s



As of Nov. 18, 2022. CPI = consumer price index. Data source: Federal Reserve Bank of St. Louis (FRED). Source: S&P Global Ratings.
© 2023 S&P Global.

Lower for Longer: The Consequences

Persistent low rates have led to many unwelcome consequences.

- **Low rates distort asset prices.** This is because future revenues are discounted at a lower rate, generating higher present values. This applies to financial assets (such as equities) as well as nonfinancial assets (such as real estate).
- **Low rates restrict room for monetary policy maneuver.** If policy rates are close to (effective) zero, then if activity slows and inflation starts to fall below target, the room to cut rates is limited. So, the necessary stimulus may not be forthcoming. The alternative is quantitative easing, which has its own side effects, such as sucking up valuable collateral (government bonds) from the financial sector.

Low rates distort prices for both financial assets, such as equities, and nonfinancial ones, such as real estate.

- **Low rates keep zombie firms alive.** Abnormally low rates keep so-called zombie firms in existence. These are firms that have difficulty covering their interest costs, let alone generating any profits. They tend to pull down productivity and compete for resources against more productive firms.
- **Low rates encourage the reach for yield and excessive risk-taking.** Fund managers and households that promise or need to generate a minimum return on assets struggle in an abnormally low-rate environment. The response is often to purchase higher yielding but riskier assets.

The world has changed in the COVID-19 era, and lower for longer may be a thing of the past. Here are two reasons why.

Change #1. Resiliency Over Efficiency Means Higher Prices

Supply chains failed the resilience test. The COVID-19 pandemic showed that global supply chains, after having passed the efficiency test for decades, were not able to absorb the wild swings in demand and worker availability that occurred during the pandemic. The results were order backlogs, congested ports and higher prices.

As a result, supply chains are being reconsidered.

They are now likely to include more redundancies, more inventories, and more nearshoring and friendshoring. The last of these reflects geopolitical considerations, which will compound the purely economic changes. Overall, these changes will lead to higher costs.

Change #2. Accelerated Green Transition Means Higher Rates

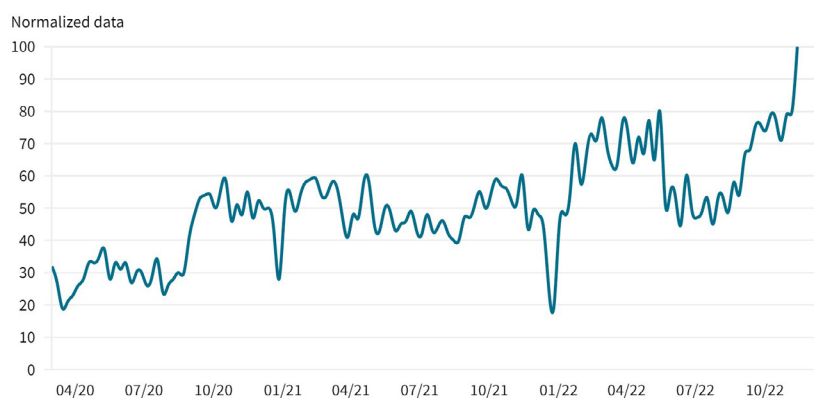
COVID-19 and the war in Ukraine accelerated green transition awareness. An indirect result of the pandemic was increased awareness of climate change — specifically, the need to transition to greener energy sources and sustainability concerns. This shift has taken place across society, involving households, investors, all types of firms, policymakers and activists.

Higher investment means higher interest rates.

A basic tenet of economics is that savings equals investment, with the rate of interest equilibrating the two. Abundant savings push rates lower. That is what has happened in recent decades. Conversely, a rise in investment pushes interest rates higher. Therefore, a sustained rise in green — or any — investment relative to savings will lift rates on a continuing basis.

Chart 2

'Energy Transition': Google Trends Search Data



As of Nov. 18, 2022. Google Search data are normalized and presented on a scale from 0 to 100, where each point on the graph is divided by the highest point, or 100. A line trending downward means a search term's relative popularity is decreasing — not necessarily that the total number of searches for that term is decreasing, but that its popularity compared with other searches is shrinking. Data source: Google Trends search data. Source: S&P Global Ratings.

© 2023 S&P Global.

Benefits of the End of Lower for Longer

The benefits of the end of lower for longer are clear. Rates will rise from zero, lessening the need for investors to reach for yield. Savers will be better rewarded. Asset prices are likely to be valued more moderately as discount factors rise. Higher structural cost pressures will push monetary policy rates higher. And central banks will have the opportunity to unwind their balance sheets and end the associated distortion of asset prices.

Rates will rise from zero, and central banks will have the opportunity to unwind their balance sheets and end the associated distortion of asset prices.

The transition path will not be painless. Weaning the economy off low rates will have a cost. Asset price adjustment will lower wealth and some spending, as we are seeing at present. Borrowing costs will rise, forcing some buyers to delay planned large, credit-driven purchases. Debt service for floating rates debt will increase as well. Zombie firms will face a reckoning. All of these will involve some pain, but this will be more palatable if growth and employment remain strong.

Overall, we think the benefits outweigh the costs, bringing about a more balanced and sustainable macro-credit environment. ■



Learn more

[Take A Hike 2022: Which Sovereigns Are Best And Worst Placed To Handle A Rise In Interest Rates](#)

[How a 300bp Rise In Inflation and Interest Rates Could Hit Borrowers](#)

[Global Debt Leverage: How Heavy Is the World's Debt Burden?](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Energy Transition: Gaps in the Pathways

Despite current economic and geopolitical crises, the energy transition is accelerating — but not fast enough to meet Paris Agreement climate goals.

Ashutosh Singh

Head of Energy Transition, S&P Global Commodity Insights
ashutosh.singh@spglobal.com

Roman Kramarchuk

Head of Future Energy Analytics, S&P Global Commodity Insights
roman.kramarchuk@spglobal.com

Karl Nietvelt

Chief Analytical Officer, Global Infrastructure, S&P Global Ratings
karl.nietvelt@spglobal.com

The energy transition is bumping against energy security requirements in the short term as countries try to navigate numerous immediate crises. While the long-term transition continues to accelerate, this is not sufficient to meet Paris Agreement on climate change goals.

S&P Global Commodity Insights analysis suggests a funding gap of almost \$25 trillion to meet Paris Agreement goals, but funding alone is not the challenge. We identify key gaps in the transition pathways that need attention if we are to meet warming goals.

Hope vs. Reality

To date, governments and the private sector have not lived up to commitments made at the 2015 COP conference held in Paris or to those made since. Action on decarbonization varies across the world based on country- and region-specific interests and is closely linked to perceptions of (and responses to) the energy security debate.

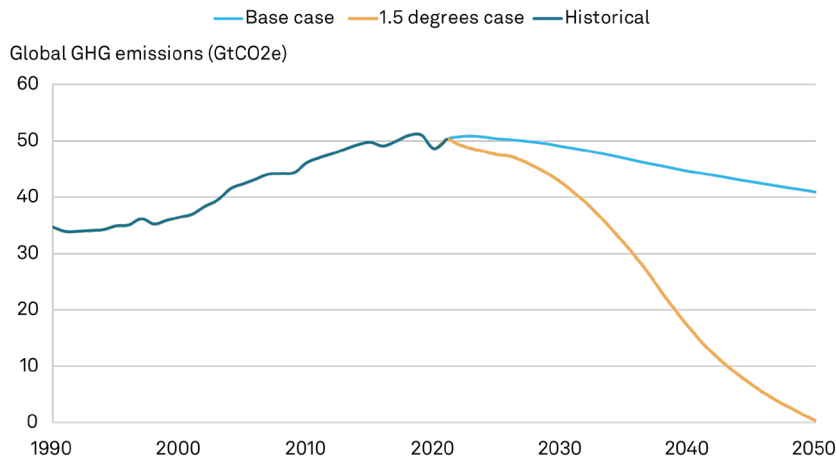
Highlights

Although geopolitical turmoil, macroeconomic headwinds and focus on energy security present bumps in the road to a lower emissions future, the long-term energy transition is accelerating.

There is a wide gap between S&P Global Commodity Insights' base-case forecast and the net-zero by 2050 trajectory required to meet Paris Agreement on climate change goals of < 1.5 degrees C warming. We forecast greenhouse gas emissions will exceed Paris Agreement goals by 8 billion metric tons of CO₂ equivalent by 2030 and 41 GtCO₂e by 2050.

The share of renewables in the energy mix will grow, but it could fall significantly short of the levels needed to meet warming goals. The share of oil and gas is declining, but not fast enough.

The challenge is how to bridge the gap while ensuring a just and smooth transition that maintains the security, reliability and affordability of energy supply for all. The fractured geopolitical environment has created new headwinds.

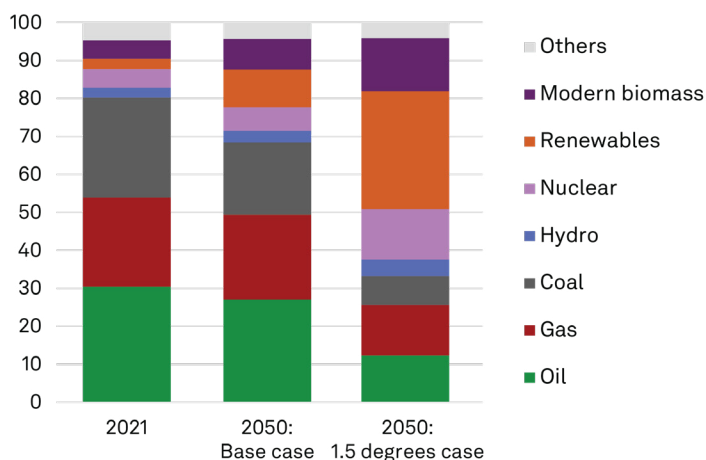
Chart 1**Global GHG Emissions on Track To Miss Paris Agreement Climate Target by 8 GtCO₂e by 2030 and by More Than 40 GtCO₂e by 2050**

Governments and the private sector have not lived up to commitments made at the 2015 COP conference, in Paris, or to those made since.

Although a broad range of fundamental changes across policy, technology and markets have accelerated the energy transition, there remains a wide gap between the reference energy transition path and the net-zero goals of the Paris Agreement.

S&P Global Commodity Insights analysis suggests the world is on track to exceed the greenhouse gas emissions required to meet Paris Agreement climate goals of keeping the temperature rise below 1.5 degrees C by more than 8 billion metric tons of CO₂ equivalent by 2030 and by 41 GtCO₂e by 2050. Since most emissions come from energy usage, it is important to analyze how the share of energy from different fuel sources will change over time.

To meet Paris Agreement climate goals, the global share of energy that comes from renewables needs to increase from 3% currently to 31% by 2050; a tenfold increase. At the same time, fossil fuel (oil, gas and coal) energy usage must decline from 80% currently to 33% by 2050. This outlook assumes significant roles for carbon capture use and storage (CCUS) and direct air capture (DAC). Without these technologies, renewables' share will need to go up by another 10%, and fossil fuels' share will need to fall by the same amount. But our reference case forecast suggests that renewables' growth will fall significantly short of those targets, and fossil fuels will not decline fast enough.

Chart 2**Renewables Share Must Grow More Than Tenfold, Fossil Fuel Share Must Decline by 60% From 2021 Levels To Meet 1.5 Degrees C Goals; Both on Track To Miss by Roughly Half (%)**

Most countries are falling short of their emissions targets to meet even a 2-degree warming goal. S&P Global Commodity Insights' base-case forecast suggests warming levels of around 2.4 degrees by 2050.

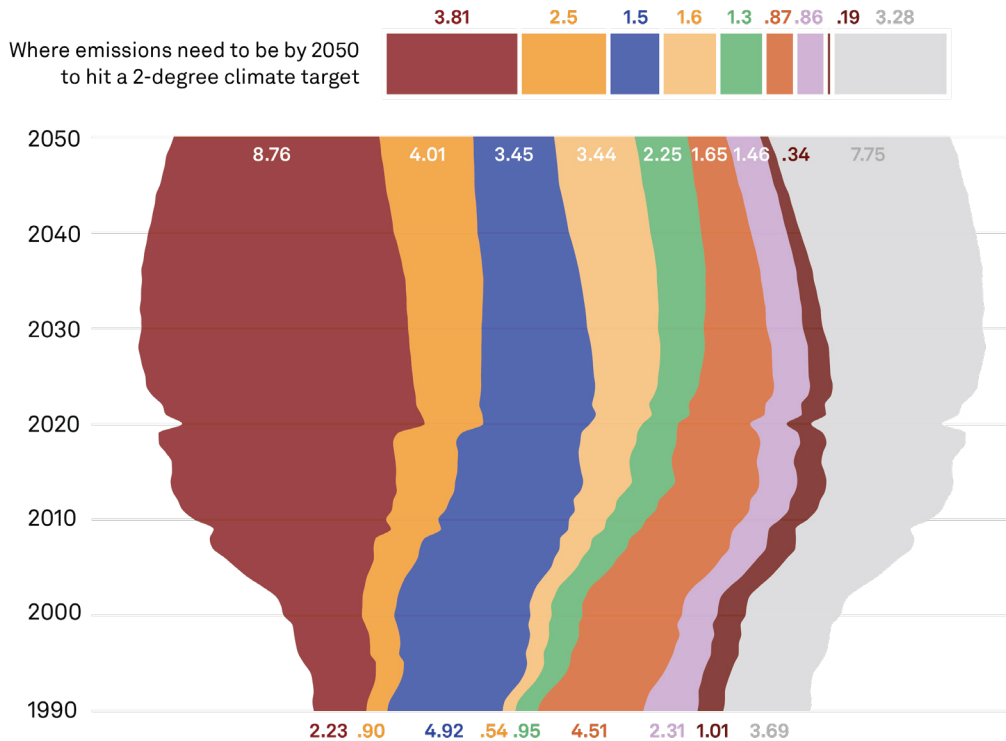
China's greenhouse gas emissions are by far the most above the 2-degree target, followed by the Middle East, the U.S. and India. While U.S. and EU emissions are on a steady decline, they are set to miss the 2-degree emissions target by more than 100% by 2050. China's emissions will not peak until the late 2020s, and those of most other developing nations will not do so until 2050.

The gap between ambition, hope and reality is wide.

Chart 3
Emissions by Region

Millions of mtCO2e

- China
- Middle East and N. Africa
- U.S.
- India
- Latin America and Caribbean
- Europe
- Russia
- Japan
- Other



As of August 2022. Source: S&P Global Commodity Insights Global Integrated Energy Model.
© 2023 S&P Global.



Most countries are falling short of their emissions targets to meet even a 2-degree warming goal.

The Pace of Transition Has Accelerated as a Result of Current Crises

The world faces several major crises, including an energy crisis, a food shortage, a global economic downturn, a divided world and increasingly frequent weather disasters. These crises may be setting us further back.

If we look past the current hurdles, however, the transition to a lower emissions energy future is accelerating — just not fast enough to meet Paris Agreement goals.

The three largest energy consumers and greenhouse gas emitters — China, the U.S. and the EU — have all put significant energy transition policies in place in the past year to accelerate their transition pathways.

- The REPowerEU plan put forward by the EU in response to the ongoing energy and geopolitical crisis caused by the Russia-Ukraine war clearly sets the bloc on an accelerated transition to renewable energy, despite increased use of coal, nuclear and imported liquefied natural gas in the short term.
- The U.S. Inflation Reduction Act, which provides nearly \$370 billion in federal funding and financial incentives to boost clean energy, also provides long-term incentives for CCUS and DAC, which has reinvigorated enthusiasm for these two critical technologies that can help reduce emissions significantly.
- China has used its manufacturing might to establish itself as a global leader in clean energy manufacturing and supply chains. Despite its reliance on coal as well as oil and gas, China sees the energy transition as a strategic advantage. Reducing this reliance on imported oil and gas and transitioning to clean energy will leverage the strengths of the Chinese economy. There is little economic or strategic reason for China to slow its transition policy despite the geopolitical crisis and economic headwinds.

Key Challenges to Closing the Energy Transition Gap to Net-Zero

- **The need for cooperation in an increasingly fractured world.** Russia's invasion of Ukraine has left the world considerably more fractured. In addition, the standoff and tensions between China and the U.S. make global cooperation to reduce emissions challenging. But reducing emissions needs a global solution. Even if emissions in the U.S. and the EU decline to zero, emissions from the rest of the world would still need to fall 65% from current levels by 2050 to reach a global 2-degree target.
- **A transformation of energy systems**, in which equipment and capital last for decades, **that is by nature complex and slow** — as can be seen in the current energy crisis. To have any hope of approaching net-zero targets by 2050, the world needs to:
 - **Meet all incremental energy demand with clean energy sources** on the supply side and **install clean technologies (e.g., electrification) on the demand side.** Even with the strong uptake in renewables and clean energy over the past 20 years, fossil fuels' share today is 80% of total primary energy consumption.
 - **Supplement fossil fuel consumption with widespread use of CCUS and DAC to limit emissions.** Ideally, this will be accompanied by large and efficient global voluntary carbon markets and nature-based carbon offset solutions.
 - Accompany the addition of new energy supplies by efforts to **replace existing energy, industry, transportation and building/housing capital stock with cleaner alternatives — or to find ways to repower/retrofit or fuel switch** these existing assets to low-emitting and zero-carbon alternatives.

- **The need to implement new technologies at scale quickly.** Solar power, wind power and electric vehicles offer some solutions for the energy and transportation sectors. Other technologies such as hydrogen fuels, biofuels at scale, long duration energy storage and heat pumps for buildings are currently more expensive and need to come down in cost. Sectors such as high-temperature industrial heating, long-haul trucking, maritime shipping and aviation are particularly challenging to decarbonize. Technologies around carbon capture and DAC can prove particularly impactful in driving solutions in these areas, but they remain in very early stages of adoption.
- **The large financing gaps.** S&P Global Commodity Insights analysis suggests a \$25 trillion cumulative funding gap between forecast spending and the investment needed to achieve net-zero by 2050. The challenge lies in raising and directing the necessary investment, considering that broad swathes of the population are still relatively energy-poor. Driving these large investments will be more challenging in a world of higher interest rates and inflation.
- **The need for oil and gas companies to be part of the solution.** Strong balance sheets, project management skills and multiyear investment horizons are needed to deploy large-scale energy transition strategies. Major oil and gas companies typically have all of these but are under pressure to balance competing priorities from activists, investors and policymakers. While high commodity prices have significantly boosted cash flows at oil and gas producers, those companies are under pressure from investors to return excess cash instead of investing in fossil fuels (due to fear of stranded assets) or clean energy (due to relatively low returns compared with fossil fuels). Hence, only some global firms have started to allocate capital toward low-carbon technologies, and spending is limited to 20% to 30% of their total annual organic investment.
- **The need for the cost of carbon to be better captured.** To stimulate the competitiveness of low-carbon technologies and attract more investment and financing, the cost of externalities needs to be better anticipated and reflected in product and service prices. Whether this is by way of regulation, taxes or a carbon price may vary across regions.
- **The need to use new and different materials and to establish new supply chains,** many of which will need to scale up to unprecedented levels. The energy transition over time will disrupt current geopolitical energy-related dependencies and create new ones. Geopolitical tensions can heighten the shift in focus away from global efforts and cooperation toward protectionist policies, friendshoring and trading among smaller clubs of nations, and smaller-scale efforts.

Government and industry responses to these key challenges will significantly impact how successful we are at closing the energy transition gap. All credible solutions will require global cooperation with an eye toward security and affordability of energy for all. ■



Learn more

[COP27 Special Report: Advancing Climate Objectives Amidst Conflict](#)

[Inflation Reduction Act: Landmark Legislation Supercharges U.S. Clean Energy Effort](#)

[Atlas of Energy Transition™](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

The World Isn't in a Commodity Supercycle, but It Should Be

A brutal series of shocks has left markets ill-prepared for the challenges of the future.

Dave Ernsberger

Head of Market Reporting & Trading Solutions, S&P Global Commodity Insights
dave.ernsberger@spglobal.com

Simon Redmond

Senior Director, Sector Lead, Corporate Ratings, S&P Global Ratings
simon.redmond@spglobal.com

Highlights

Current commodity market conditions do not meet the requirements of a supercycle.

Commodity market stakeholders are grappling with a series of historic economic shocks that have not yet subsided.

An acceleration of the transition to lower- or zero-carbon energy sources will likely lead to a new commodity supercycle.

Commodity prices were rarely far from the headlines in 2022. With food prices soaring, fuel bills driving global inflation and government intervention in markets from Brussels to Beijing, it is easy to conclude the world is in a commodities supercycle. However, a closer study of commodity markets shows we are not. The noise in pricing signals driven by shock after shock is creating distress in markets, meaning we do not seem likely to enter one soon, either. But the longer shocks go on, the more the fabric of the markets frays. We are not in a supercycle, but maybe we should be.

A multiyear supercycle requires three indicators: Is supply surging? Is demand surging? Are prices surging?

Without passing all three tests simultaneously, commodity markets are not in a supercycle.

A combination of surging demand, high prices and stagnant/falling supply indicates a market in decline. Spikes in coal prices as utilities flee from gas to coal fall into this category.

A sustained surge in supply with no change in (or falling) demand and soaring prices may signal a market beset by inefficiencies: Think of the container market spikes of 2021, driven by supply chain disruptions. It may also indicate reform being driven by policy change, as was the case with the rampant fuel prices in late 2019 as shippers adjusted to stricter environmental standards.

Surging supply and soaring demand paired with no appreciable ramping up in price equal a balanced market environment experiencing benign growth that lifts all boats, the equivalent of Mervyn King's noninflationary continuous expansion (NICE) economic theory. This typified the liquefied natural gas market of 2010 to 2018.

Today's Markets Fail All Three Tests

Looking across commodity markets, prices are generally higher than they were at the start of 2020, and undoubtedly volatile. Generally, though, markets fail each of these three tests. Demand is not surging for commodity markets as a whole; demand growth has been underwhelming for most transport fuels, while sustained increases in demand are likely to be challenged by momentum building in recessionary sentiment. Supply is not surging either: Companies and investors are reluctant to finance supply, seeing market conditions and government policies as too impermanent or timing as too uncertain to warrant the kinds of up-front capital costs involved in new long-term upstream projects or infrastructure. The recent step-up in funding costs erodes the financial incentives for big developments too.

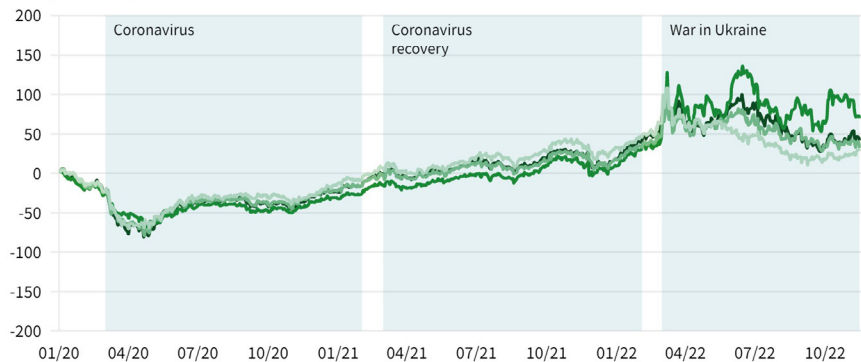
Chart 1 Commodity Markets Are in Distress, Not a Supercycle

Oil

January 2020-November 2022

- Dated Brent crude oil
- European diesel
- Dubai crude oil
- Japan naphtha

Change in value (%)

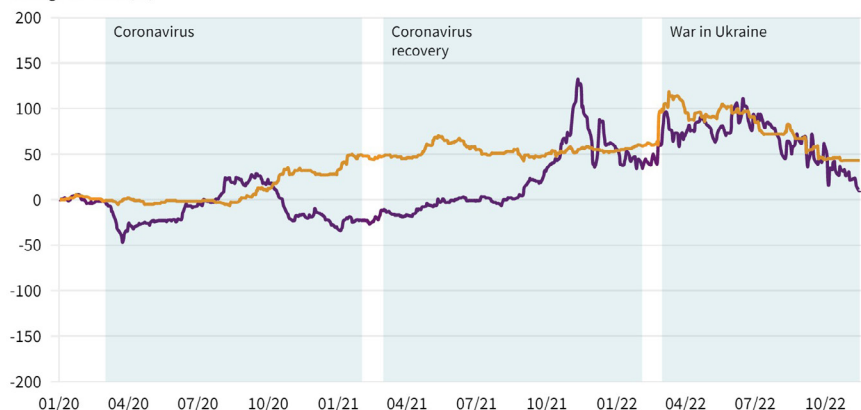


Food and Biofuels

January 2020-November 2022

- Ethanol Rotterdam
- Black Sea corn

Change in value (%)

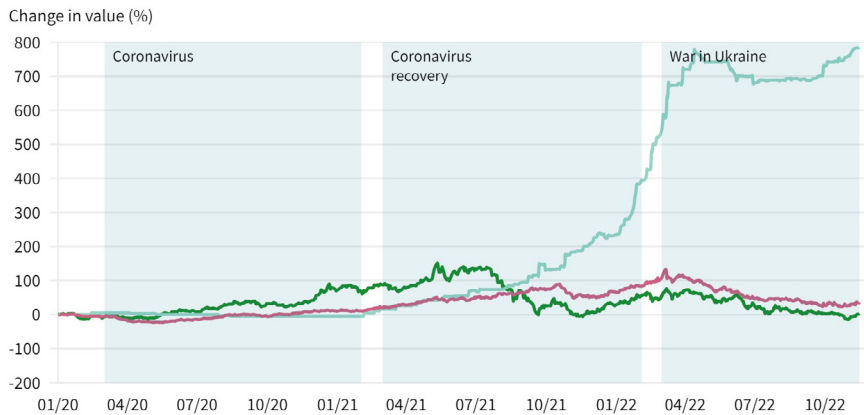


A multiyear supercycle
requires three indicators:
Is supply surging?
Is demand surging?
Are prices surging?

Metals

January 2020–November 2022

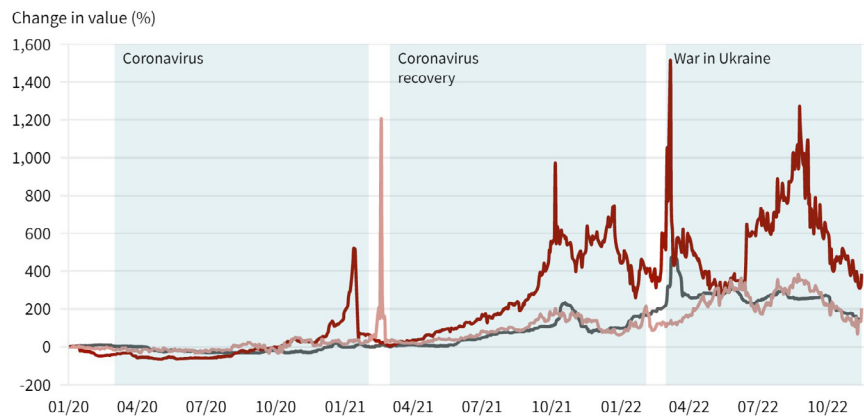
- IODEX iron ore
- Asia lithium carbonate
- US Midwest aluminum



Generating Fuels

January 2020–November 2022

- Australia thermal coal
- JKM LNG
- Henry Hub natural gas



Even price, the subject of so much scrutiny, tends to revert to the mean when distress eases. The triple whammy of COVID-19-related demand destruction, supply chain shocks as the world emerged unevenly from the pandemic, and sanctions on Russia arising from the war in Ukraine have created a nervous, reactionary pricing environment. However, prices should return to 2020 levels at the first sign of demand easing.

Indeed, supply is being curtailed by as much as 2 million barrels per day in the oil markets by cuts from the Organization of the Petroleum Exporting Countries Plus and its allies. Without those cuts, oil prices would arguably be significantly lower — hardly the stuff of a commodity supercycle.



Beyond the noise and volatility of the post-pandemic commodity markets, it is easy to see conditions in which a new supercycle could emerge.

A Supercycle Could Be Around the Corner

Commodity supercycles are surprisingly rare. The last generally accepted supercycle was 2003-2007, as powerful global economic forces were unleashed by China's reforms and accession to the World Trade Organization in 2001.

Looking beyond the noise and volatility of the post-pandemic commodity markets, it is easy to see conditions in which a new supercycle could emerge. The global population is thought to have reached 8 billion people on Nov. 15, 2022 — a striking milestone for commodity market watchers.

Per-capita consumption of commodities remains low in emerging market economies, particularly India, which is only at a relatively early stage of the emergence of a sizable middle class, the way China's economic profile developed at the start of the century.

A more aggressive commitment to the energy transition across G-20 nations could also create the conditions for a sustained surge in demand, supply and prices. Battery metals such as lithium carbonate are showing the sort of sustained price increases that suggest a bigger cycle is on its way, and hydrogen and carbon markets are in the earliest days of showing strong growth in both supply and demand.

Conversely, a return to classic energy supply sources in the medium term could also drive a supercycle as markets scramble to invest in traditional fuel sources.

Today's markets are in the midst of the most brutal and sustained shocks for a generation, and a supercycle may not be far behind. ■



Learn more

[Energy Security Sentinel™](#)

[Commodities 2023: Global PX braces for greater volatility on new supply, demand uncertainties](#)

[Path to net-zero: Miners seek partners to achieve renewables goals](#)

[Global Credit Outlook 2023: No Easy Way Out \(see page 46\)](#)

[Atlas of Energy Transition™](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Women CEOs Model a Diverse Future

Women's leadership styles position them well to guide organizations through the profound transformations ahead.

Daniela Brandazza

Senior Director, S&P Global Ratings
daniela.brandazza@spglobal.com

Dr. Gabriel Morin

Program Director and Associate Professor of Leadership Development,
Master 2 International Human Resources Management,
Paris, Université Paris Panthéon-Assas
gabriel.morin@u-paris2.fr

The gender gap between women and men CEOs worldwide remains extremely wide nearly three years since the pandemic started, even though both are just as effective at delivering financial performance. In some respects, leadership styles adopted by women CEOs during this uncertain time — embracing diversity, empathy and adaptability — position them well to lead organizations and will resonate with diverse publics through the profound transformations ahead.

Our research confirms that women CEOs exhibited a more positive communication style from the peak of the pandemic, in early 2021, to the first quarter of 2022. This is based on sentiment analyses of earnings call transcripts of 6,831 CEOs at companies on the S&P Global Broad Market Index, covering corporations with the largest global market capitalization in 65 countries. We note a shift in the top three most favored styles used by women CEOs to ones categorized as diversity, empathy and adaptability. Ranking fourth was a transformative style addressing the need to respond to long-lasting changes stemming from the pandemic, such as adjustments to consumer behavior and to the workplace. Men CEOs focused more on words related to transaction as well as growth and performance during the period surveyed.

Highlights

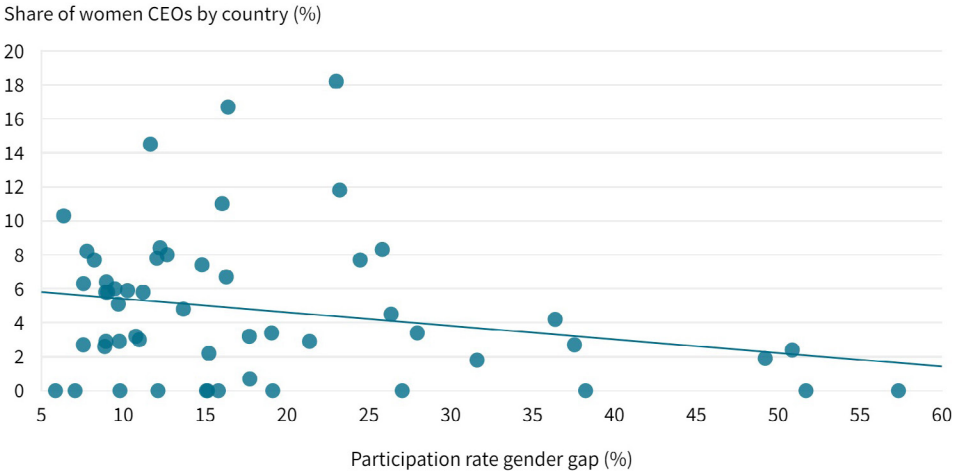
Women are still significantly underrepresented as CEOs globally, with a 5.4% share as of March 31, 2022, among the 8,000 companies on the S&P Global Broad Market Index (BMI), covering corporations with the largest global market capitalization. Women CEO representation is very uneven across industries and geographies. The participation of women on corporate boards is much higher, with an average of 24% across industries.

Women CEOs display more diversity, empathy and adaptability in their leadership styles, consistent with emerging theories around authentic leadership, according to sentiment and natural language processing analysis conducted on earnings call transcripts of leaders at over 5,801 companies in the BMI.

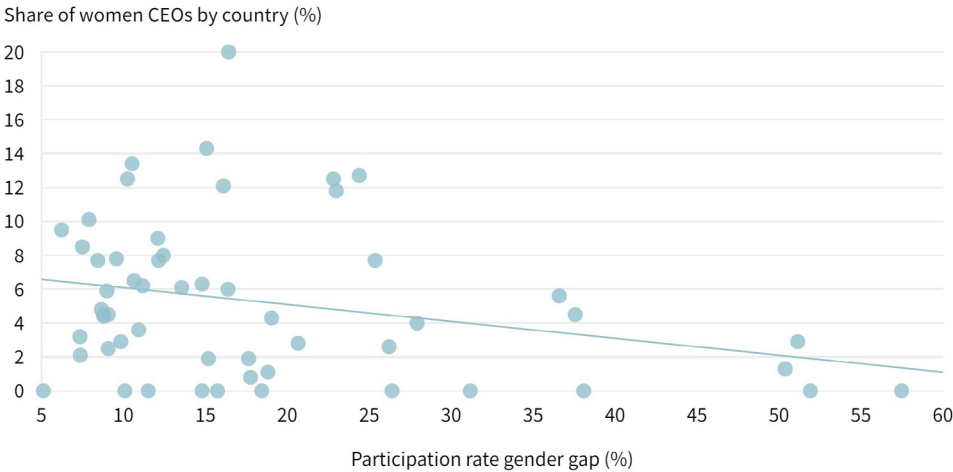
For the past two years, women CEOs have exhibited a more positive communication style and embraced a large range of stakeholders, an approach that could help companies attract diverse talent and prosper.

Chart 1
The Share of Women CEOs Is Higher Where Their Participation Rate Is Also Higher

2021



2022



© 2023 S&P Global.

By 2022, diversity topped empathy and adaptability as the most important trait of women CEOs' leadership style.



Women CEOs remain underrepresented, accounting for only 5.4% of all CEOs at these largest 8,000 companies globally. Even in unprecedented circumstances, women corporate leaders made some inroads over the past year, with the real estate and healthcare sectors leading the way and the energy sector lagging. Our research also shows huge differences among the 65 countries studied, ranging from zero women CEOs in Qatar and Mexico to over 12% in Norway, the Philippines and New Zealand. This remains much lower than the participation of women on corporate boards, which averages 24% across industries.

Women's Leadership Styles Tend To Benefit a Broader Range of Stakeholders

Using advanced techniques in natural language processing, our research aims to shed light on communication styles that women CEOs used during the early and later pandemic periods. Our latest data indicate that the type of positive communication style favored by women CEOs and their focus on diversity seems more aligned with the emerging theory of authentic leadership, which draws from and mirrors the diversity of society. Our 2022 research, which revisits a similar 2021 study, confirms, with one more year of data, that the communication characteristics of women CEOs point to a different leadership style than that practiced by their male counterparts.

The leadership women CEOs exemplify in this report falls into the category of authentic leadership, according to our review of the literature. It is a more inclusive style that promotes team diversity. That said, some of these characteristics can enhance the typical ways men lead by making their approach more comprehensive and sustainable. Women's leadership style tends to benefit a broader range of stakeholders within and outside companies — customers, suppliers and community.

The future of leadership lies in embracing better leadership theories, and authentic leadership is among the emerging leadership theories that form this new paradigm. This research aims to contribute to a better understanding of women leaders as role models in businesses around the world. It also intends to shed light on emerging leadership styles during this time of economic uncertainty and workplace transformation. We believe these data and insights can contribute to an open and honest conversation about leadership styles that has the potential to create a more equitable, productive and sustainable future. ■



Learn more

[Women CEOs: Leadership for a Diverse Future](#)

[Leadership in Turbulent Times: Women CEOs During COVID-19](#)

[Something's Gotta Give](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Global Debt Leverage: Is a Great Reset Coming?

Rising rates and slowing economies mean the world's high leverage poses a crisis risk.

Terry Chan, CFA

Managing Director and Senior Research Fellow,
Credit Research & Insights, S&P Global Ratings
terry.chan@spglobal.com

Alexandra Dimitrijevic

Global Head of Research & Development,
S&P Global Ratings
alexandra.dimitrijevic@spglobal.com

The world's leverage is at a higher level than pre-global financial crisis (GFC) peaks. Yet demand for debt — to help consumers with inflation, mitigate climate change and rebuild infrastructure, for example — will continue. Rising interest rates and slowing economies are making the debt burden heavier. To mitigate the risk of a financial crisis, trade-offs between spending and saving may be needed.

More Debt Than Ever Before

Three hundred trillion dollars. That is the record debt which global governments, households, financial corporates and nonfinancial corporates owed in June 2022, as estimated by the Institute of International Finance. The \$300 trillion is equivalent to 349% of global gross domestic product, 26% higher than the pre-GFC figure of 278% (June 2007, see chart 1). The \$300 trillion works out to **\$37,500 of debt for every person in the world**, compared to a GDP per capita of just \$12,000.

Highlights

Record leverage. Global debt has hit a record \$300 trillion, or 349% leverage on gross domestic product. This translates to \$37,500 of average debt for each person in the world versus GDP per capita of just \$12,000. Government debt-to-GDP leverage grew aggressively, by 76%, to a total of 102%, from 2007 to 2022.

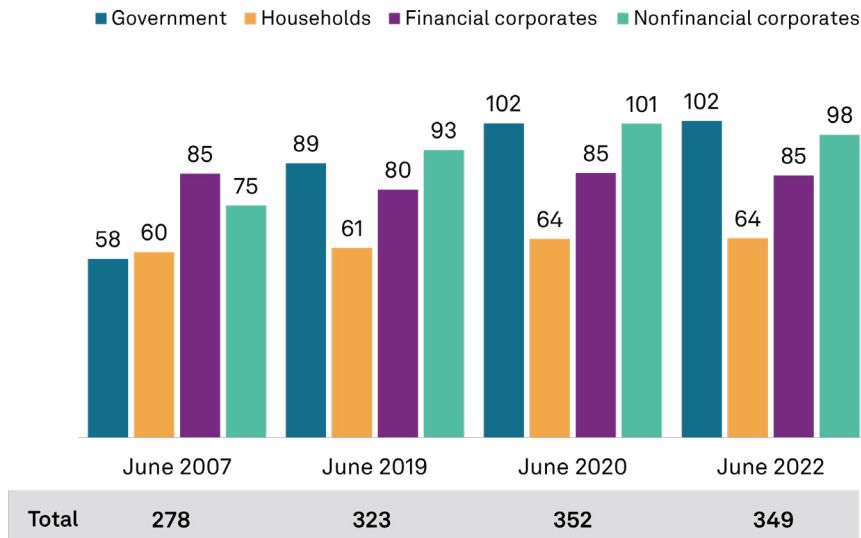
Higher interest rates. Debt servicing has become more difficult. Fed funds and European Central Bank rates were up an average of 3 percentage points in 2022. Assuming 35% of debt is floating rate, this means \$3 trillion more in interest expenses, or \$380 per capita.

Great Reset. There is no easy way to keep global leverage down. Trade-offs include more cautious lending, reduced overspending, restructuring low-performing enterprises and writing down less-productive debt. This will require a "Great Reset" of policymaker mindset and community acceptance.

Global governments, households, financial corporates and nonfinancial corporates owe a record \$300 trillion as of June 2022.

Chart 1
Global Leverage Still Much Higher Than Pre-GFC Despite Post-COVID Easing

Debt-to-GDP (%)



As of Nov. 29, 2022. Data source: Institute of International Finance. Source: S&P Global Ratings.
© 2023 S&P Global.

Productivity from debt has declined. We see this from the upward trend of global debt-to-GDP ratios since the GFC. The economic value-add from every additional dollar of debt has decreased.

Leverage of the government sector has grown aggressively. The sector's debt-to-GDP ratio rose 76%, to a total of 102%, from 2007 to 2022. Mature market governments tend to be more leveraged (see table 1 on next page).

Nonfinancial corporates' ratio is up 31%, to 98%. Corporates in some European, Japanese and emerging markets operate at higher leverage levels. China is of particular concern, as its debt makes up a third of global corporate debt. In a sample of more than 6,000 Chinese corporations, the average debt (net of cash) to earnings ratio was 6.0x in 2021, twice the global level. Meanwhile, the percentage of "B-" ratings and below of U.S. speculative-grade issuers doubled, to 36%, in September 2022 compared with September 2007.

Household and financial sectors were more conservative. Household leverage grew just 7%, to 64%. The financial sector was flat, at 85%.



Table 1
Relative Leverage Risk of Major Economies and Broad Sectors

	2022 GDP (US\$B)	Households	Nonfinancial corporates	Governments	Total nonfinancials	Financial sector	Total nonfinancials plus financial sector
Mature markets							
Australia	1.6	◆ 117	▲ 62	▲ 54	▲ 234	● 44	▲ 277
Canada	2.1	◆ 106	◆ 116	▲ 98	◆ 320	● 154	◆ 474
France	2.7	▲ 66	◆ 166	◆ 123	◆ 354	● 94	◆ 448
Germany	3.9	▲ 55	▲ 72	▲ 70	▲ 198	● 61	▲ 259
Italy	1.9	● 42	▲ 69	◆ 154	▲ 266	● 48	▲ 314
Japan	4.2	▲ 64	◆ 117	◆ 251	◆ 433	▲ 217	◆ 649
Spain	1.3	▲ 57	▲ 100	◆ 123	▲ 279	● 41	▲ 321
U.K.	3.0	▲ 83	▲ 66	◆ 110	▲ 260	● 173	◆ 433
U.S.	24.2	▲ 78	▲ 81	◆ 122	▲ 281	● 78	▲ 359
Euro area	13.1	▲ 59	◆ 110	◆ 107	▲ 275	● 113	▲ 389
Total mature markets	50.8	▲ 75	▲ 96	◆ 124	▲ 295	● 112	◆ 407
Emerging markets							
Brazil	1.8	● 32	▲ 53	▲ 89	▲ 174	● 40	▲ 214
China	17.5	▲ 63	◆ 157	▲ 76	▲ 297	● 50	▲ 347
India	3.1	● 39	▲ 51	▲ 83	▲ 173	● 3	▲ 176
Indonesia	1.2	● 16	● 25	● 38	● 79	● 7	● 87
Korea	1.6	◆ 102	◆ 118	▲ 48	▲ 268	● 89	▲ 357
Mexico	1.5	● 16	● 24	● 39	● 78	● 13	● 91
Russian Federation	2.8	● 20	▲ 75	● 17	● 113	● 6	● 119
Total emerging markets	38.6	▲ 47	◆ 102	▲ 66	▲ 214	● 38	▲ 252
Global	89.4	▲ 64	▲ 98	◆ 102	▲ 264	● 85	▲ 349

As of Nov. 29, 2022. Red diamond ◆ denotes the highest risk sextile; yellow triangle ▲, the third to sixth sextiles; and green circle ●, the fifth to sixth sextiles. Sextile thresholds of households, nonfinancial corporates, governments and financial sector are set at one-third that of total nonfinancials. Other mature and emerging market economies besides those listed in the table are included in totals.

Data source: Institute of International Finance.

Source: S&P Global Ratings.

© 2023 S&P Global.

Why Is This a Risk?

Higher returns required. Central banks are raising policy rates, and investors are demanding higher yields, in response to inflation. We see 2022 as the inflexion point of the monetary environment moving away from low interest rates and easy money. Higher yields imply a repricing of assets, while tighter money could translate to lessened market liquidity.

Three trillion more dollars. Higher interest expenses are already straining less-creditworthy governments and corporates, and lower-income households. The fed funds rate went up about 4 percentage points in 2022, and the European Central Bank rate went up 2 (see chart 2 on the next page). Applying the average of the two rates (3 pps) on the floating-rate portion of debt (we assume 35% of debt is floating and 65% is fixed) implies an additional annual interest expense of \$3 trillion (see chart 3 on the next page). This is equivalent to \$380, or 3% of GDP, per capita, on average debt of \$37,500. As fixed-rate debt is increasingly refinanced, this amount will rise over time to \$8.6 trillion, or \$1,080 per capita.

Chart 2

Fed Funds Up Almost 4 Percentage Points, ECB Up 2

Policy interest rate increase in 2022 (%)



Fed funds rate

ECB fixed-rate tenders
(fixed rate)

As of Nov. 29, 2022. Data sources: Federal Reserve Bank of St. Louis (FRED); European Central Bank. Source: S&P Global Ratings.
© 2023 S&P Global.

Chart 3

Extra \$3 Trillion in Interest, Up to \$8.6 Trillion Over Time

Additional interest expense (US\$ trillion)



Floating debt rate

After all fixed rate
is refinanced

As of Nov. 29, 2022. Source: S&P Global Ratings.
© 2023 S&P Global.

Repricing and project thresholds. Rising interest rates influence asset pricing and project viability. The price of an asset is, in theory, its discounted cash flow. Unsurprisingly, the stock market corrected in 2022. The S&P 500 index price-to-earnings ratio (PE) was 29x at the end of November 2022, implying a 3.5% discount rate (inverse of PE). This rate is about the U.S. “BB” corporate bond average yield in 2021. The PE is now 19x, implying a 5.2% rate — slightly below the “BB” yield for 2022. Previously, borrowers were able to take on low-return projects because of low interest rates. Such projects now require higher return thresholds, making them less viable. This development will add to financial pressures on borrowers and dampen future business activity volumes.

No Easy Way Out

Three scenarios. We examine three possible scenarios to year 2030 of the global debt leverage trend — base case, pessimistic and optimistic.

- **Base case.** Our base-case scenario assumes global total debt leverage over the next eight years, by 2030-end, will grow by 5%, which is about the same rate as that for the eight-year period before COVID-19 hit in 2020. We see the leverage rising slightly faster

for mature markets than for emerging markets, as we expect more GDP growth upside for the latter markets. Altogether, the projected global debt-to-GDP ratio could reach 366% in 2030 (see chart 4) versus June 2022’s 349%. For rated sovereigns, our base case sees the total gross debt-to-GDP ratio of mature market sovereigns rising marginally to 107% by 2025 from 106% in 2022. For emerging markets, the projected ratio remains roughly flat at 65%. (We use the Institute of International Finance’s definitions of mature and emerging markets.)

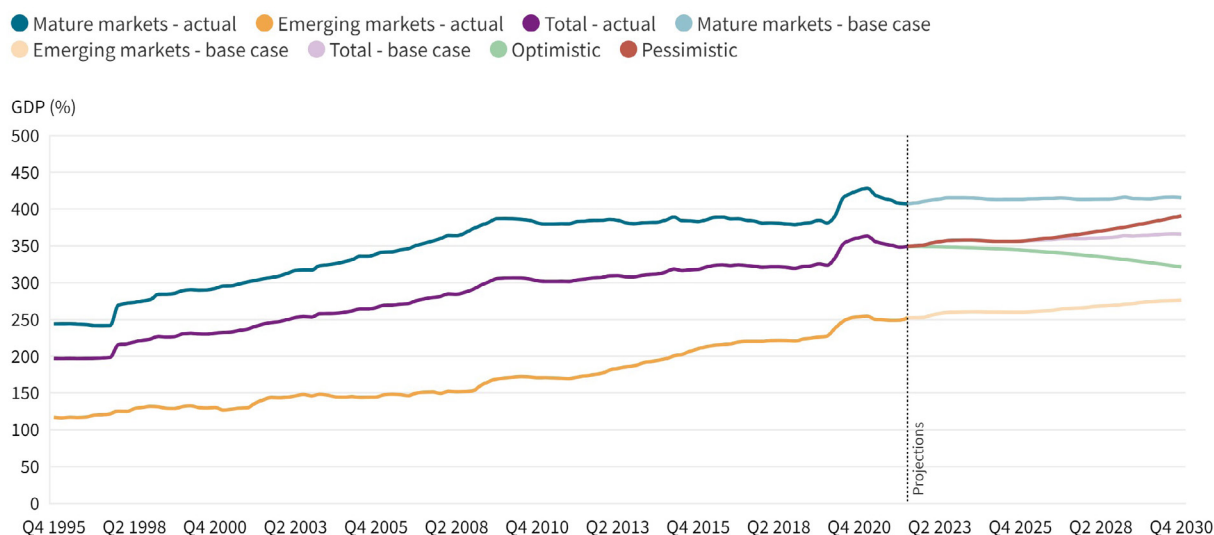
- **Pessimistic.** If global borrowers freely take on more less-productive debt, for example, because governments give in to populist demands or lenders are overly desperate to book assets, the projected debt-to-GDP ratio could hit a much more worrying 391% by 2030, up 12% from June 2022’s 349%.
- **Optimistic.** What if governments and regulators collectively decide to manage their economy’s leverage down, with a goal to return to pre-COVID-19 levels by 2030? In this optimistic scenario, the debt-to-GDP ratio would decline by 8% to 321% by 2030-end. The ratio in the first quarter of 2019 was 321%. This does not imply that no new debt is formed, but rather that productive new debt replaces unproductive old debt.

The projected global debt-to-GDP ratio could reach 366% in 2030, above the 349% reached in June 2022.

Chart 4

It Will Take a Lot of Discipline and Coordination To Reduce Global Leverage by 2030

Global total government, household and nonfinancial corporate debt as a percentage of gross domestic product (%)



As of Nov. 29, 2022. Data source: Institute of International Finance. Projections: S&P Global Ratings.
© 2023 S&P Global.

Is This Optimistic Scenario Possible?

- Governments had to spend money during the 2020 COVID-19 crisis to support their economies. As economic activity recovers, less debt needs to be issued, which should improve leverage.
- Low interest rates and easy access to credit allowed some corporates to overborrow. Lenders should logically be cutting back on such risky borrowers.
- An alternate source of funding for business is, of course, equity. The low interest rate environment had encouraged many companies to lever up rather than raise equity. Some even elected for share buybacks (effectively gearing up) during the stock market bull run. The current higher cost of funds environment could trigger a debt-equity rebalance.

Not all debt is bad. There are good reasons to take on additional debt. Emerging markets are still climbing the economic development ladder. Many governments may help more vulnerable peoples and businesses to cope with surging food and energy prices. Governments, corporates and households will have to pay for more frequent extreme weather events and climate change mitigation. Countries will need to develop new infrastructure to adapt to a low-carbon and digital economy.

Leverage can't grow forever. As Carl Jung said: "No tree, it is said, can grow to heaven unless its roots reach down to hell." Avoiding the hell of a debt crisis may require ensuring only productive new debt is deployed, writing down unproductive debt, curbing overconsumption and restructuring loss-making enterprises. These actions may not be popular. A "Great Reset" of community acceptance of more judicious spending and policymaker caution about debt may be needed. There is no easy way out. ■



Learn more

[Resurfacing Credit Headwinds](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Crunch Time: Can Adaptation Finance Protect Against the Worst Impacts From Physical Climate Risks?

Investments in adaptation must close the gap with mitigation financing to avoid the worst outcomes.

Dr. Paul Munday

Global Climate Adaptation
and Resilience Specialist,
S&P Global Ratings
paul.munday@spglobal.com

Steven Bullock

Managing Director and
Global Head of ESG Innovation
and Solutions,
S&P Global Sustainable1
steven.bullock@spglobal.com

James McMahon

CEO, The Climate Service,
an S&P Global company
james.mcmahon@spglobal.com

Highlights

Adaptation to climate change will become as important as climate mitigation in terms of protecting wealth and lives over the next few decades. Accelerated investments in adaptation finance will be needed to avoid the most severe impacts, and there are signs those investments may be at a turning point.

The physical impacts from climate change are increasing, and the window of opportunity for building resilience and adapting at lower costs is closing rapidly.

Agreements reached at COP27, including the go-ahead for a “loss and damage” fund for developing countries and the Sharm el-Sheikh Adaptation Agenda, which describes 30 actions needed by 2030, will build on other initiatives and serve as catalysts through which investments in adaptation and resilience projects can gain significant traction.

The pace of change over the coming years will likely accelerate, driven by the realization and inevitability of climate impacts as well as the market-based incentives starting to emerge.

Countries, companies and communities are going to have to face the impacts of acute physical risks related to climate change as global emissions and temperatures rise. Still, these effects will not be evenly distributed. Lower- and lower-middle-income countries are more at risk than wealthier peers, even though they have contributed less to climate change and are less ready to cope. Lagging investment in the technologies and interventions needed for adaptation is also widening the gap. With this in mind, adaptation will become as important as climate transition financing in terms of protecting wealth and lives over the next few decades. Accelerated investments in adaptation finance will be needed to avoid the most severe impacts, and there are signs the quality and amount of funding being deployed, including from the private sector, is nearing a turning point.

Physical effects from climate change are occurring, and the impact is rising. In 2022, the U.S. saw at least 15 disasters resulting in \$1 billion or more in damage, extending a growing trend since the 1980s, according to the National Oceanic and Atmospheric Administration. S&P Global Ratings recently estimated that home and office insurance claims in the U.S. rose 5.7% year over year to \$148 billion (as measured in direct premiums written) in 2021. Global average annual insured losses attributed to natural catastrophes (affecting all property-related lines) increased to approximately \$96 billion in 2017-2021 from \$21 billion in the prior five years, according to Munich Re. Rising losses are likely driven by increases in the severity and frequency of extreme weather events as well as a greater number of assets located in vulnerable areas. S&P Global research and other climate studies, including the Intergovernmental Panel on Climate Change's latest assessment report (AR6), point to worsening economic losses even under low-emission scenarios in the absence of a significant uptick in adaptation investments.

Many Countries Will Be Affected and Are Not Ready To Cope

About 4% of global gross domestic product could be lost annually by 2050, according to S&P Global Ratings research, surpassing the 3.3% contraction caused by COVID-19 in 2020. The S&P estimate was based on an assessment of 135 countries' vulnerability to and readiness for climate change over the next 30 years. It used a scenario (RCP4.5) that assumes countries deliver on current emissions reductions commitments as per their nationally determined contributions (see chart 1).

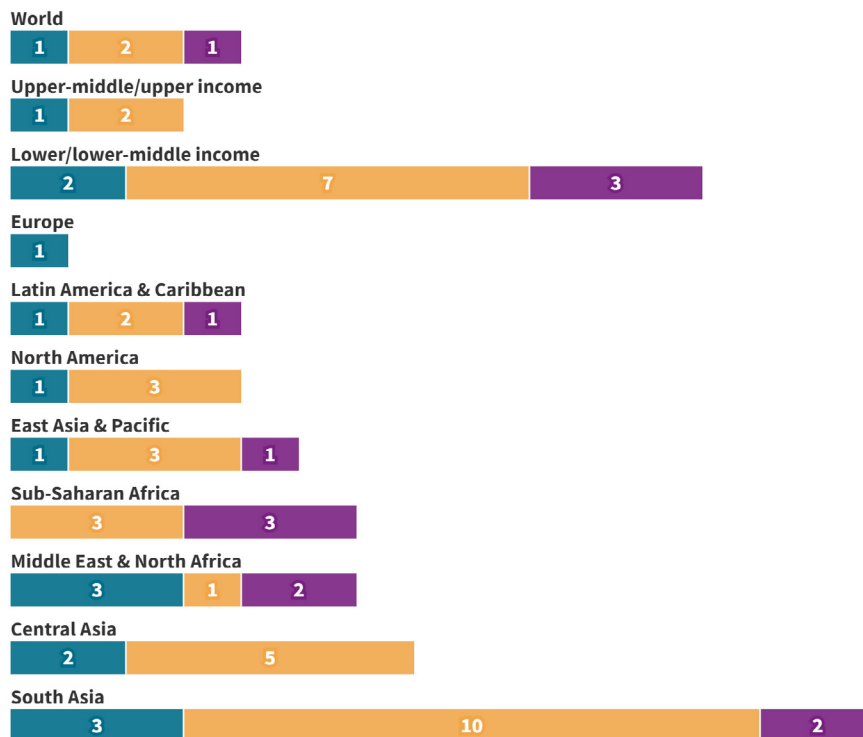
Physical climate risks could expose 4% of countries' GDP to losses each year by 2050 based on current commitments.

Chart 1

Physical Climate Risks Are Not the Same for All Regions – South Asia Is Over 10 Times More Exposed Than Europe

2050 combined gross domestic product at risk under RCP4.5, Physical Risk Contribution (%)

- GDP at risk due to water stress ● GDP at risk due to physical events ● GDP at risk due to heat waves



As of Mar. 14, 2022. RCP = Representative Concentration Pathway. Note: Countries' income and regional classification are based on World Bank. Source: S&P Global Ratings.
© 2023 Standard & Poor's Financial Services LLC.

The adaptation challenges facing individual countries — and, by association, companies — differ because of the varying frequency and severity of climate hazards, such as storms and wildfires. The vulnerability of assets also differs by location and asset type. Still, adaptation measures can help companies and countries withstand climate risks. Japan, for instance, has avoided large wealth damage even in the face of high climate risks, including typhoons. Lower- and lower-middle-income countries have less ability to cope with and adjust to damaging events, leading to higher and more persistent economic losses. This highlights the importance of international cooperation to support equitable distribution of adaptation investments, particularly given that those most at risk have contributed comparatively little to climate change. A compounding problem is that the finance available to support countries' adaptation to physical climate risks is severely lagging what is needed. Furthermore, even ambitious investments in adaptation will not fully avoid climate-related impacts.

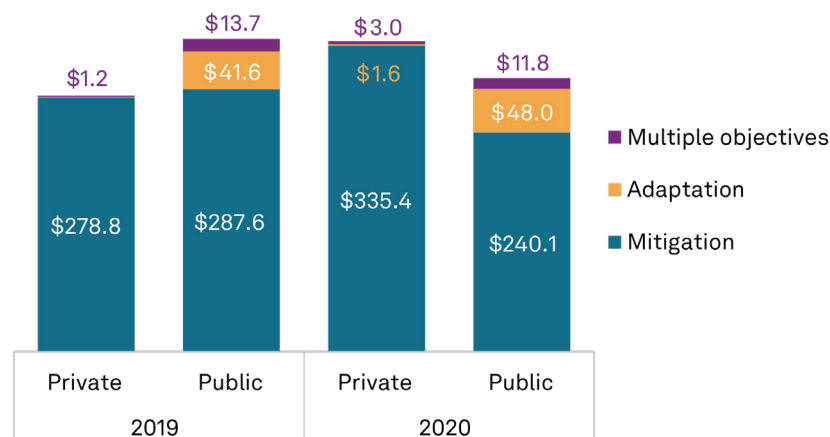
The Adaptation Finance Gap Continues To Widen and Shows Little Sign of Stopping

Annual adaptation costs for developing countries, accounting for inflation, will be in the range of \$160 billion to \$340 billion by 2030, and between \$315 billion and \$565 billion by 2050, according to the [United Nations' Environment Programme \(UNEP\) Adaptation Gap Report 2022](#). In contrast, only about \$83 billion of climate finance, covering both adaptation and mitigation, was mobilized in 2020, missing the \$100 billion-per-year pledge made by developed countries to developing countries under

the Paris Agreement on climate change. The picture is similar when looking at global climate finance flows, where mitigation finance dominates, as reported by the Climate Policy Initiative (see chart 2).

Chart 2
Less Than 8% of Global Climate Finance Goes to Adaptation

(US\$B)



As of Feb. 16, 2022. Data source: Climate Policy Initiative (2022). Source: S&P Global Ratings. © 2023 S&P Global.

Instruments such as green bonds could partly refocus financial flows toward climate-positive outcomes helped by initiatives such as recent guidance from the Global Center on Adaptation. However, while green bond issuance has increased fourfold since 2018 — surpassing the \$3 trillion total issuance mark earlier this year — most green use of proceeds and sustainability-linked bonds are focused on mitigation, with adaptation and resilience accounting for only 4% of green bond spend last year (see chart 3 on the next page).

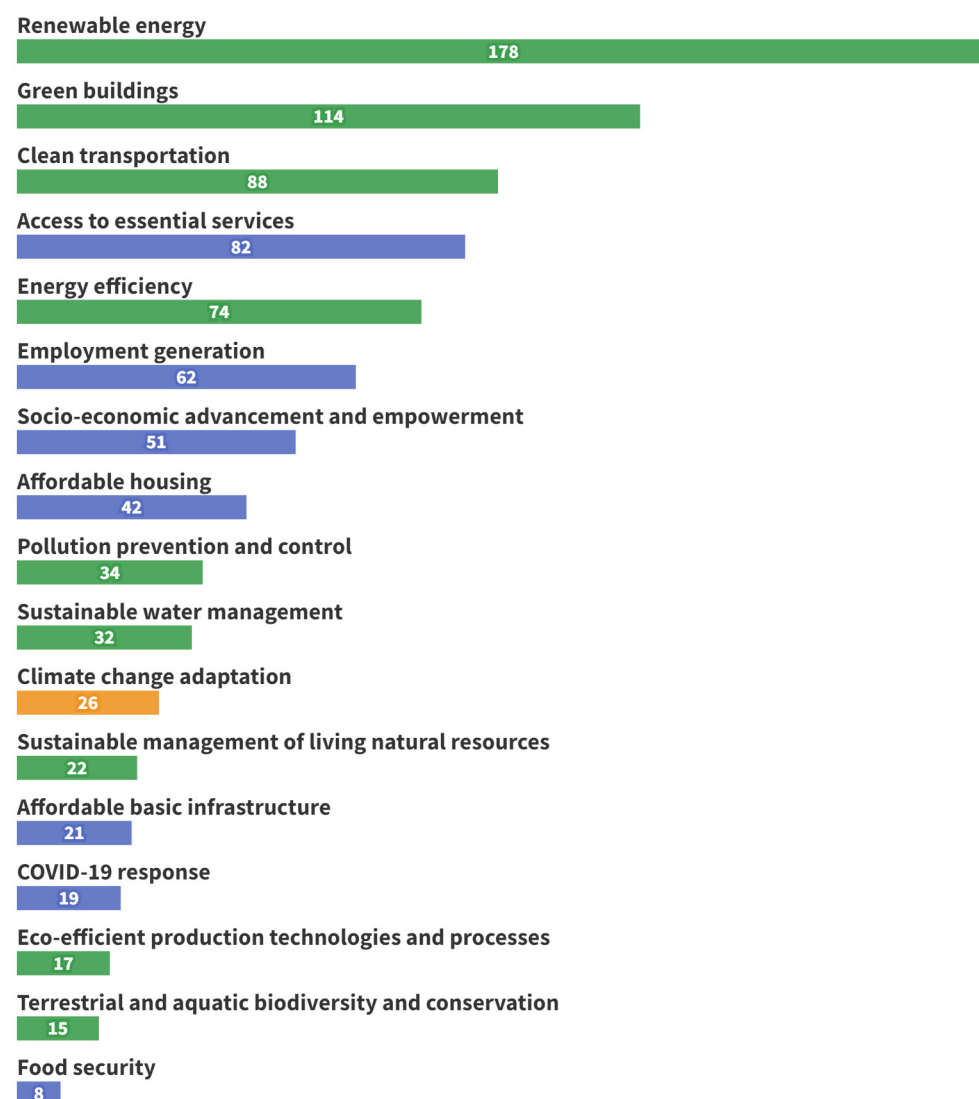
Current adaptation needs are between five and 10 times higher than international adaptation finance flows.

UNEP Adaptation Gap Report 2022

Chart 3

Green Finance Is Dominated by Mitigation, With Adaptation Accounting for Only 4% of Green Bond Spend in 2021 (US\$B)

● Mitigation ● Adaptation ● Social



As of Feb. 16, 2022. Sources: Environmental Finance Bond Database; S&P Global Ratings.
© 2023 Standard & Poor's Financial Services LLC.

The challenges associated with scaling adaptation and resilience finance to the levels required are clear.

- Adaptation tends to be less attractive than mitigation because results and returns are harder to predict and measure. For example, data that describe differences in revenues between resilient and nonresilient assets are not readily available. In addition, some adaptation and resilience investments — such as public infrastructure with a multidecade operational lifetime — may not generate a return for investors.
- There is uncertainty about impacts and necessary responses. Translating the outputs of climate models into specific predictions is not straightforward, even with advances in climate analytics that have improved transparency regarding particular exposures and financial losses.



- Data and standardization, including around investments that should be considered “resilient,” are lacking.
- Building resilience to physical climate risks means addressing a full system, not just an individual company’s assets. This wider approach can be challenging, as it is difficult to secure critical coordination between various stakeholders. The benefits of these adaptation projects also manifest over time, making governments and policymakers less likely to get credit for adaptation efforts, and therefore less likely to pursue them.
- A lack (or perceived lack) of projects appears to be constraining investment. Creating investor awareness of the pipeline of deals in adaptation and resilience is a challenge. Size is also important: Smaller adaptation projects can find it difficult to get on the radar of institutional investors.

New Financial Instruments and Recent Commitments Suggest Improvement

Despite these challenges, there appears to be growing interest from market participants in financing adaptation and resilience projects. Financial instruments such as privately issued climate resilience bonds, debt-for-climate swaps, public-private partnerships and infrastructure investment trusts are likely to go some way toward plugging the growing adaptation gap. Large institutional investors including JPMorgan Chase, Nuveen and Wellington already have

Over 90% of the world’s largest companies have at least one asset highly exposed to a climate hazard by the 2050s.

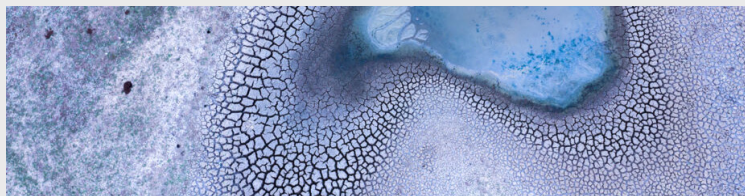
dedicated adaptation investments in their climate or impact funds (which exceed \$1 billion). In 2022, The Lightsmith Group closed a \$186 million private equity fund dedicated solely to adaptation, as reported by Global Adaptation and Resilience Investment (GARI).

At the 2022 COP27 conference in Sharm el-Sheikh, Egypt, there were also calls for more investments in adaptation and resilience, at a time when the window of opportunity to stop the worst impacts of climate change is rapidly closing. We believe that agreements reached at COP27 — including the Sharm el-Sheikh Adaptation Agenda, which describes 30 adaptation actions needed by 2030 — and ongoing initiatives like the Global Goal on Adaptation (established under the Paris Agreement) and Race to Resilience (agreed at COP26) will serve as catalysts through which investments in adaptation and resilience projects can gain traction through 2030. This trend will accelerate amid a growing focus on companies and governments that do not take sufficient action to adapt and build resilience to the physical impacts of climate change. Analysis by S&P Global Sustainable¹ shows that 92% of the world’s largest companies have at least one asset highly exposed to a climate hazard by the 2050s.

In tandem, growing familiarity with, and availability of, climate risk data, improvements in understanding the uncertainties associated with such datasets, efforts to standardize terminologies and the use of specialist labels in the market may partially help to turn the tide against the impacts of the most severe warming scenarios.

The Pace of Change Will Be Driven by Rising Losses

The physical impacts of climate change will increase over the coming decades — even if the world makes significant progress in cutting global greenhouse gas emissions — due to the lag in the climate system between emissions reductions and global temperature change. The opportunity to build resilience and adapt to the worst impacts of climate change is also fading as emissions increase each year. Companies and countries are waking up to a future of more frequent and extreme physical climate risks and growing commitments (and costs) associated with mitigating emissions. We believe that this dawning reality will render adaptation finance as important as transition finance in protecting wealth and saving human lives in the coming decades. The pace of change over the years ahead will likely be driven by the realization and inevitability of what is happening as well as market-based incentives that are already emerging. ■



Learn more

[Storm Clouds Or Clear Skies Ahead: How Rising Insurance Premiums From Environmental Physical Risks Could Affect U.S. RMBS And CMBS](#)

[Weather Warning: Assessing Countries' Vulnerability To Economic Losses From Physical Climate Risks](#)

[Global Reinsurers Grapples With Climate Change Risks](#)

[Keeping The Lights On: U.S. Utilities' Exposure To Physical Climate Risks](#)

[Model Behavior: How Enhanced Climate Risk Analytics Can Better Serve Financial Market Participants](#)

[Damage Limitation: Using Enhanced Physical Climate Risk Analytics In The U.S. CMBS Sector](#)

[Scenario Analysis Shines A Light On Climate Exposure: Focus On Major Airports](#)

[Better Data Can Highlight Climate Exposure: Focus On U.S. Public Finance](#)

[Sink Or Swim: The Importance Of Adaptation Projects Rises With Climate Risks](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

The EV Revolution – Moving From Oil Age to Battery Age?

Few stakeholders will be shielded from the transformation of the automotive ecosystem.

Tom De Vleesschauwer

Senior Director, S&P Global Mobility
tom.devleesschauwer@spglobal.com

Tim Armstrong

SVP and Partner, Planning Solutions, Automotive Insights, S&P Global Mobility
tim.armstrong@spglobal.com

The strong rise in electric vehicle sales has led consumers and media to take notice of what can be termed the EV revolution. In the third quarter of 2022, EVs accounted for about 1 in 4 new vehicles sold in China and Germany. In the U.S., where EV adoption has lagged, several policies have been enacted that should kick EV sales into a higher gear.

Between 2015 and 2030, S&P Global projects the number of EVs sold globally will rise from fewer than 1 million to 52 million, while the sale of all other vehicles will fall from 88 million to 45 million, driven by increasingly stringent government regulations. In other words, batteries will be firmly at the heart of our automotive future.

Highlights

By 2030, there will be more electric vehicles sold globally than other types of vehicles, putting batteries firmly at the heart of our automotive future.

Both winners and losers of the transition from internal combustion engine vehicles to EVs are likely to surface within the automotive and energy industries as well as among governments and workforces.

The nascent EV revolution could have unintended consequences, including the potential for automotive sector redundancies, shortages of battery raw materials and challenges to mitigating declines in government liquid fuel tax revenue.

The EV revolution can only successfully unfold in an environmentally and socially sustainable way through greater levels of cooperation and transparency across the automotive and energy value chains.

The EV battery will be the defining technological and supply chain battleground for the automotive industry in the coming decades.

With a market outlook like this, policymakers could be forgiven for believing they can reduce their support for EVs, as the revolution is truly underway. Indeed, during this period of heightened economic and geopolitical challenges, a cutback in government financial support to develop the EV ecosystem is a possibility. Less government support, at a time when automakers have increasingly gone all in on EV investments, could lead to suboptimal outcomes in terms of EV adoption and

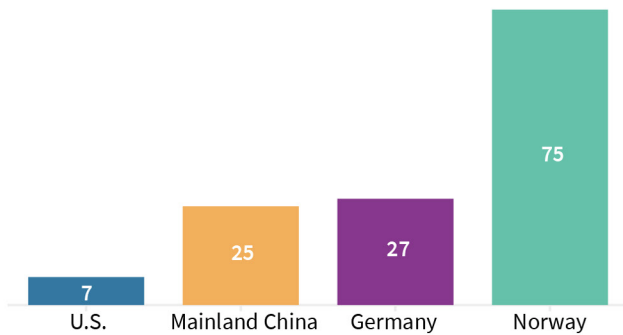
the health of the automotive sector. In any case, both winners and losers from the EV revolution are likely to surface within the automotive and energy industries as well as among governments and workforces. Few, if any, stakeholders will be shielded from changes to operating models — or, indeed, changes to society — in this transformation of the automotive ecosystem (see chart 1 on the next page).



Chart 1 An 'EV Revolution' Is Unfolding

Electric vehicles have entered the new sales mainstream in some key markets — i.e., they are no longer a niche product

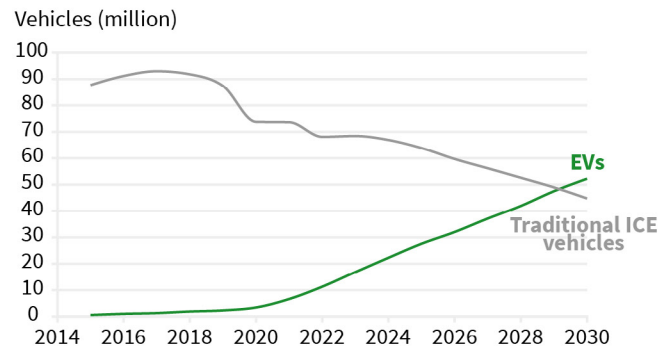
EV Shares of LV Sales
Q3 2022, share (%)



As of Q3 2022. LV = light vehicle. Note: Electric vehicles here include battery EVs and plug-in hybrid EVs. Sales are as measured by registrations. Data for the U.S. are for July and August 2022 only. Source: S&P Global Mobility.

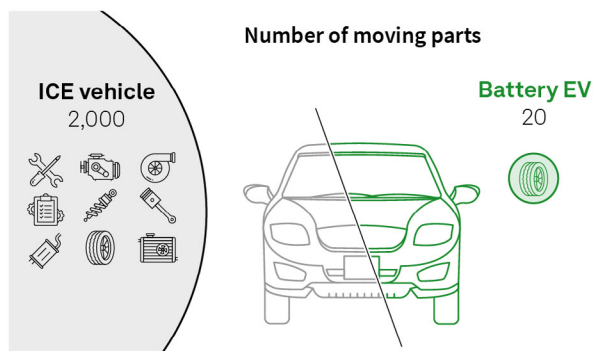
Prospects for EVs are bright: Before the end of this decade, global sales of EVs could overtake sales of traditional internal combustion engine vehicles

Annual Global Sales of EVs and Traditional ICE Vehicles in the S&P Global Mobility 'Green Rules' Scenario



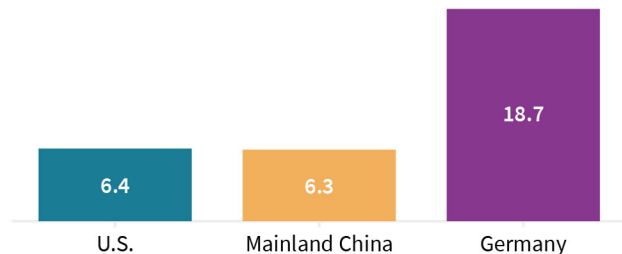
As of August 2022. ICE = internal combustion engine. Data are from S&P Global Mobility and Energy Future service's alternative scenario, Green Rules. Note: Electric vehicles include battery EVs, plug-in hybrid EVs and fuel cell EVs. Data are for light vehicles. Source: S&P Global Mobility.

Battery EVs are less complex to build than ICE vehicles ...



... Yet a reduction in manufacturing complexity could have the **unintended consequence** of bringing about job losses in a key economic sector

Automotive Sector Share of Total Manufacturing Value-Added
Share (%)



As of November 2022. Note: Data are in nominal terms, U.S. dollars, and for 2021. Source: S&P Global Market Intelligence.

A shortfall in the supply of key battery raw materials is a risk that, if realized, could slow the EV revolution

Indicative Risk of Supply Shortfalls for Key Battery Raw Materials to 2030



Data as of December 2022. Note: Risk is expressed as a number between 1 and 5, with 1 being the lowest risk and 5 being the highest risk. Source: S&P Global Commodity Insights.

The effects of the EV revolution will reverberate through a range of stakeholders — far beyond its surface impacts

Jobs at Risk

A large sector of the global economy for more than a century, the automotive industry is one of the pillars of social stability. Now, the sector is facing the most fundamental change to how it operates in its history. The transition away from the stalwart internal combustion engine (ICE) power train — which typically features, on average, about 2,000 moving parts, compared with about 20 moving parts for an EV power train — highlights the scale of the upstream transformation that will reverberate down the supply chain. This could result in widespread redundancies and weaken societal consensus around governments seeking to phase out the ICE. Meanwhile, stakeholders pushing for an accelerated EV shift could be underestimating the challenge of building what will need to be a massive, secure and sustainable battery supply chain.

The Race for Battery Dominance

New opportunities in the next automotive century will present themselves to automakers able to sustainably access and secure the required volumes of battery raw materials. Yet the scale of the challenge is enormous. S&P Global projects that lithium-ion battery demand from the automotive sector will rise more than 500% from 2022 to 2030. Sizable new investments will be necessary to ensure key minerals are available in sufficient quantities to meet this demand. A shortage of battery raw materials later this decade — a distinct risk — could slow the unfolding EV revolution, though demand-side measures hold the potential to mitigate the extent of any supply deficits.

Which countries and companies are best placed to benefit from an increased dependency on a handful of critical elements is unclear. What is clear is the EV battery will be the defining technological and supply chain battleground for the automotive industry in the coming decades, and access to its constituent raw materials will be critical.

Government Budget Strains

It is becoming apparent that a rapid transition to EVs will cause significant budget upheaval for governments as liquid fuel taxation revenues fall. Norway is at the vanguard of this trend: The country remains on track

to reach a 100% EV share of new vehicle sales by 2025, but this progress will come at a price, in the form of lost fuel and vehicle tax revenue. The need to find alternative sources to replace this lost revenue will become an increasingly urgent issue for more and more governments.

Golden Opportunity

Newfound global imperatives such as net-zero, environmental, social and governance criteria, and national zero-emission vehicle mandates are converging to provide strong tailwinds for EVs. The nascent EV revolution can successfully unfold only through greater levels of cooperation and transparency across the automotive and energy value chains. This transition presents stakeholders with an opportunity for reinvention.

The change will be truly challenging. On the automotive side, not all incumbent automakers will make it through the ICE-to-EV transition. On the energy side, declining gasoline demand will put pressure on oil companies, and countries with oil-reliant economies, to find alternative sources of revenue. In any event, the effects of the EV revolution will reverberate throughout the wider stakeholder field far beyond its initial impact. While the pitfalls could delay or derail this revolution, the rewards could be significant for the climate and the economy. ■



Learn more

[Countdown to 2023: China and Norway Lead the World. But in Different Ways.](#)

[A reckoning for EV battery raw materials](#)

[Rising input costs squeezing out entry BEVs](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Risk Will Define Supply Chains for Years To Come

Although the greatest disruption to containerized shipping supply chains since the dawn of the container era has begun to ease, risks remain high.

Peter Tirschwell

Vice President, Maritime, Trade & Supply Chain, Chairman of TPM,
S&P Global Market Intelligence
peter.tirschwell@spglobal.com

Highlights

Supply chain disruptions are easing, but the perception of risk remains.

Performance at North American container ports fell by almost 50% from Q2 2020 to Q3 2022.

Geopolitical risk must be factored in following Russia's invasion of Ukraine and rising tensions over Taiwan.

Great risk and unpredictability will drive decisions on inventory and manufacturing.

As 2022 drew to a close, there were multiple indications that the greatest disruption to containerized shipping supply chains since the dawn of the container era in 1957 was easing. But while clusters of container ships anchored outside ports dwindled or disappeared and freight rates fell precipitously from record heights, a profound change was taking place, even as the COVID-19 threat receded: Supply chain risk, low before the pandemic, emerged highly elevated and likely to remain that way for several years to come.

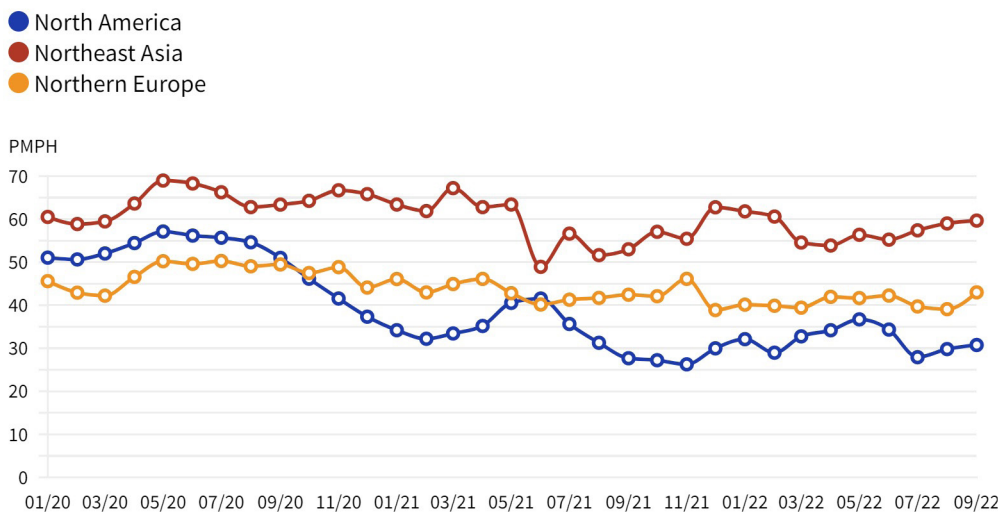
The implications are significant. Elevated supply chain risk for corporations managing long-haul, transcontinental supply chains means a greater risk of delay and less predictability in end-to-end ocean transport transit times. That, in turn, will result in longer product development and manufacturing lead times, higher inventory levels and greater use of airfreight, which can be up to 70 times the cost of ocean freight on a per-unit basis. The need to design products and plan their rollout further in advance makes it more difficult to accurately predict demand and customer preference.

Fundamental Change Since Pre-COVID-19

The decade prior to the pandemic saw a series of disconnected but, compared with COVID-19, relatively minor shocks to the containerized supply chain. After a disruptive six-month stretch of longshore labor unrest affecting U.S. West Coast ports in late 2014 and early 2015, normal flows resumed. They normalized again after the 2016 bankruptcy of Korea-based Hanjin Shipping, which idled 96 ships and \$14 billion of goods worldwide. They did so yet again following a surge of goods in late 2018 as U.S. retailers rushed to get Chinese-made products into the country ahead of the 25% duties threatened by the Trump administration, set to take effect Jan. 1, 2019. While those shocks created short-term delays, supply chains in the aggregate were largely unaffected.

Chart 1
Port Moves Per Hour by Region

January 2020–September 2022



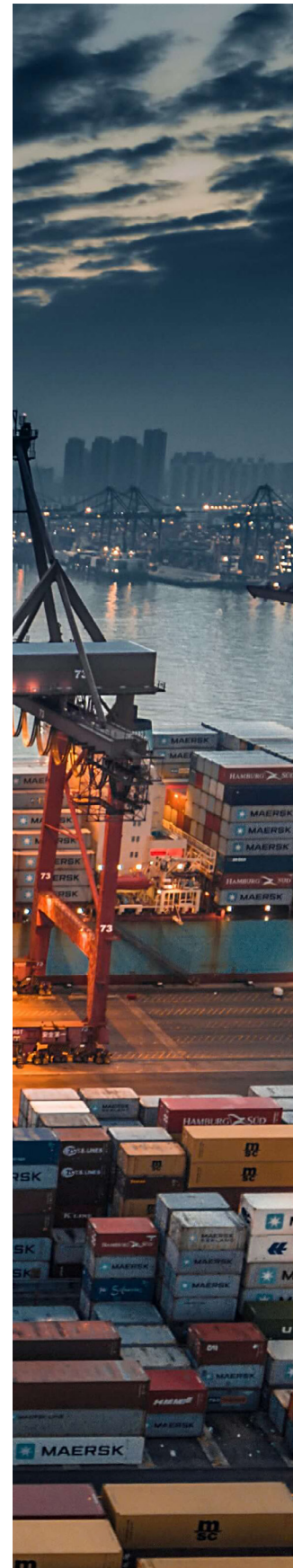
As of Nov. 15, 2022. PMPH = port moves per hour, container moves divided by hours in port. It is the average quantity of containers moved per hour a vessel needs to spend in port, including vessel waiting time plus cargo unloading time. Source: S&P Global Market Intelligence Port Performance Program.
© 2023 S&P Global.

Performance at North American container ports fell by almost 50% from Q2 2020 to Q3 2022.

Disruption Went From Periodic to Constant

COVID-19 marked a radical change to that dynamic. Disruption, instead of being periodic, became constant. With each new shock to the containerized system — record volumes, historic port backups, successive China lockdowns, Suez Canal blockage, inland North American rail service suspension — the disruption was compounded.

Productivity at North American container ports was a case in point. According to S&P Global Market Intelligence, performance at North American container ports fell by close to 50% in the two-year period from Q2 2020 to Q3 2022 (see chart 1). In early 2020, ports were moving an average of 56 containers for every hour a ship needed to spend in port. Now they move an average of fewer than 30 per hour, despite recent improvements as volumes have declined.



It is the unfamiliar aftermath of that experience that corporate leaders and logistics teams will be grappling with in 2023 and for years beyond. Although port and end-to-end transport delays are easing, trust in the supply chain has been damaged. Given that there are multiple new risk factors on the horizon, it is hard to envision trust in the system being restored to pre-COVID-19 levels any time soon. That reality will lead to difficult decisions for corporate leaders, who will be forced to maintain higher just-in-case inventory levels and to plan longer product lead times, increasing risk by elongating the time between product design, inventory planning and when those goods become purchases. On the other hand, new technologies such as 5G, edge computing, artificial intelligence, blockchain and machine learning will improve decision-making and the predictability of supply chains in the future.

It is hard to envision trust in the system being restored to pre-COVID-19 levels any time soon.

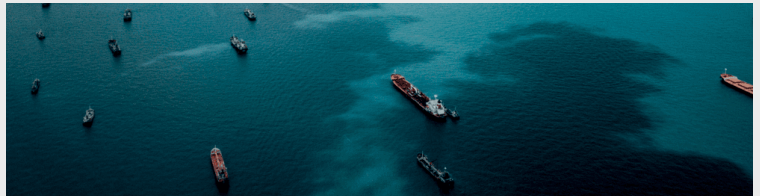
Supply Chains Face Multiple Types of Risk

This elevated supply chain risk is coming from multiple directions. China's path forward on its COVID policy is not yet clear, which will continue to pose the risk of future lockdowns and manufacturing disruptions. Geopolitical risk, rarely part of the supply chain calculus, must be factored in following Russia's invasion of Ukraine and rising tensions over Taiwan; 40% of total U.S. containerized imports originate in mainland China, according to S&P Global Market Intelligence, and diversification of sourcing including "friendshoring" will accelerate through 2030, which is a risk factor in itself. Climate change is increasing the frequency of severe weather events that disrupt cargo movements.

Such transport and logistics risks will continue to rise. In the U.S., virtually no new port capacity is being created, despite expectations for continued containerized trade growth. A marine terminal that opened at Charleston, S.C., in 2021 was the first new facility in the U.S. in over a decade. Longshore labor opposition to cargo-handling

automation means ports have limited ability to improve productivity. Attempts to encourage round-the-clock operations at ports to expand de facto capacity have met with minimal success. Efforts to share data to improve overall cargo movement are in the early stages. The result is that any unanticipated cargo surges, which have always occurred periodically, will almost automatically hit a wall of capacity and lead to delays.

The conclusion is clear: Although supply chain risk was considered minimal or immaterial pre-COVID-19, going forward it will define how supply chains are organized and executed. Technology will play a greater role as companies seek to minimize the impact of a painful and costly transition. ■



Learn more

[The Container Port Performance Index 2021](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Toward a Tokenized Future

Digitization will improve efficiency and open new markets — but the revolution won't happen overnight.

Alexandre Birry

Chief Analytical Officer, Financial Institutions, S&P Global Ratings
alexandre.birry@spglobal.com

Chuck Mounts

Chief DeFi Officer, S&P Global Ratings
charles.mounts@spglobal.com

Tokenization — the conversion of assets and rights into a digital token on a blockchain — will likely upend by 2030 the transaction methods of many well-established asset classes, tangible or intangible. It will also enhance the accessibility of established asset classes, and allow the creation of new ones, for a broader range of investors in underserved frontier markets. It will spur growth in some corners and displace existing intermediaries in others. The investments in technology and skills as well as the changes in law and regulations that these shifts will require represent necessary hurdles in the transition. And while automation will eliminate certain intermediaries, new types of service providers should emerge to help manage the evolution in attendant risks.

The Main Attraction of Tokenization

Tokenization is the process of issuing a digital token that represents a tradable asset. The digital token can then be owned, used and transferred through a blockchain, reducing the need for third-party intermediaries. Higher profile tokens are often “native” ones, such as bitcoin and ether. But increasingly, tokenization is reaching a broad range of “real-world assets,” generally at very early stages of pilot schemes. In principle, anything featuring property rights and economic value can be tokenized. That includes tangible assets, such as property or physical works of art; intangible assets, such as intellectual property, digital art or wireless internet access; private equity (e.g., fund shares) or alternative investments (e.g., carbon credits); and debt and equity, whether listed or private (see chart 1 on the next page).

Highlights

The creation of a digital representation of a broadening array of rights and assets will enable a new scale of market efficiencies and democratize access to previously unavailable investment asset classes.

The crypto downturn and failure of FTX may impact general perceptions and policy formation, but they should not undermine the longer-term potential of tokenization; cryptocurrencies are a minor, though much-publicized, part of the potential tokenized universe.

The pace of transformation will be affected by the need for material investments and an evolution in laws and regulations.

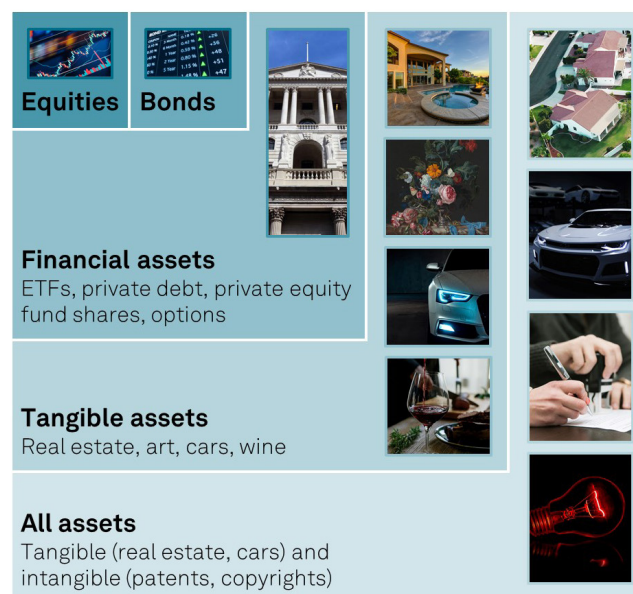
The business models of numerous intermediaries will evolve or even disappear, but new types of service providers will emerge.

In principle, anything featuring property rights and economic value can be tokenized.

The key expected benefits include the following.

- **Accessibility/liquidity.** Tokenization allows fractionalization, whereby investors can purchase tokens that represent very small shares of the underlying assets. This could democratize direct investment in more costly assets, such as commercial real estate. It could also boost access to underserved segments, for instance, in emerging markets, thereby supporting economic growth. This increased liquidity, especially if well-established standards emerge, has been compared to the benefits securitization brought as it gained scale.
- **Efficiency.** Technology and smart contracts can allow faster and lower-cost asset transfers by automating certain parts of the process — in particular, post-trade steps such as clearing and settlement — thereby reducing the need for intermediaries. Large trading pools such as the \$200 trillion global fixed-income and equity markets¹ are prime candidates.
- **Transparency.** The immutable nature of the underlying technology prevents tampering. It allows potential new acquirers to know who they are dealing with, what rights and obligations are attached to the token, and who the previous owners are. Such traceability is very attractive, for example, for supply chain management.
- **Privacy.** Personal data is fully owned and controlled via decentralized identity by each individual or entity. They may provide only the information needed to be verified, with use cases, for instance, in the healthcare or insurance sectors.

Chart 1
Tokenization Will Affect a Broad Range of Assets



© 2023 S&P Global.

Why It Won't Be an Overnight Revolution

Cryptocurrencies are a fraction of the potential tokenized ecosystem. The crypto winter and default of several protocols and players do not impact the prospects of tokenization by 2030, but they have affected perceptions and short-term activity levels. The total value locked in protocols averaged about \$50 billion in the second half of 2022, a fraction of its 2021 peak.

Stakeholders are using this period to advance policies and technology. Absent more progress, both elements will represent long-term bottlenecks. Fundamental questions include whether an asset can be foreclosed on if owned through a token. Progress among jurisdictions varies. Regulators will focus on maintaining financial stability, protecting consumers and ensuring responsible market conduct in the face of new products, processes and players. For example, the fractional ownership of assets previously reserved for institutional investors could expose retail investors to new risks. Fractionalization may therefore not be the impending revolution sometimes portrayed.

¹ Sources: Total debt securities at March-end 2022, BIS; total equity market – market capitalization as of October 2022, World Federation of Exchanges.

The fractional ownership of assets previously reserved for institutional investors could expose retail investors to new risks.

New technology will also advance, requiring large capex investments. Otherwise, capacity will constrain prospects for high-volume applications. In parallel, a tokenized central bank currency or stablecoin will be needed for payments. The lack of interoperability may also limit the fungibility of liquidity across blockchains, introduce an additional element of vulnerability and increase the risk of fragmentation in liquidity.

Likely Impacts

Some intermediaries will disappear, some will evolve and new ones will materialize. For tokenized bonds and equities, the need for a central counterparty to engage in clearing, settlement and custodian activities may disappear or be reduced. An agent will still be needed to provide a regulatorily approved platform, and know-your-customer and anti-money laundering obligations will remain. In addition, increased transparency in the price discovery mechanism may come at the expense of greater volatility in times of stress absent the current market makers.

Agents will impose themselves by 2030 to address the novel risks in the connection between off- and on-chain worlds. The role of reputable custodians guaranteeing the permanence of the link between tokens and the real assets they represent will be paramount. Also, as in the “real world,” governance is key to ensure stability, and evolutions such as fractionalized ownership will pose challenges. New investment opportunities and technologies will also require new advisory services, particularly around risks.

A tokenized future does not mean the emergence of a separate, virtual and totally decentralized ecosystem. For tokenization and its attendant benefits to scale up while containing risks, compromises and hybrid solutions are necessary. Intermediaries will still exist, even if they take new forms, and stakeholders must remain mindful of the emergence of new forms of concentration in some of these agents. ■



Learn more

[Regulating Crypto: The Bid To Frame, Tame Or Game The Ecosystem](#)

[Exploring Crypto and DeFi Risks in Credit Ratings](#)

[Stablecoins: Common Promises, Diverging Outcomes](#)

This article was authored by a cross-section of representatives from S&P Global and in certain circumstances external guest authors. The views expressed are those of the authors and do not necessarily reflect the views or positions of any entities they represent and are not necessarily reflected in the products and services those entities offer. This research is a publication of S&P Global and does not comment on current or future credit ratings or credit rating methodologies.

Contributors

Sponsor, S&P Global Research Council



Martina Cheung

President,
S&P Global Ratings

Co-chair, S&P Global Research Council



Atul Arya

Chief Energy Strategist,
S&P Global Commodity Insights

Co-chair, S&P Global Research Council



Alexandra Dimitrijevic

Global Head of Research & Development,
S&P Global Ratings



Marion Amiot

Head of Climate Economics,
S&P Global Ratings



Alexandre Birry

Chief Analytical Officer,
Financial Institutions,
S&P Global Ratings



Steven Bullock

Managing Director and Global Head
of ESG Innovation and Solutions,
S&P Global Sustainable1



Terry Chan, CFA

Managing Director and Senior Research
Fellow, Credit Research & Insights,
S&P Global Ratings



Tom De Vleeschauwer

Senior Director,
S&P Global Mobility



Dave Ernsberger

Head of Market Reporting & Trading Solutions,
S&P Global Commodity Insights



Lindsey Hall

Head of ESG Thought Leadership,
S&P Global Sustainable1



Tim Armstrong

SVP and Partner, Planning Solutions,
Automotive Insights,
S&P Global Mobility



Daniela Brandazza

Senior Director,
S&P Global Ratings



Rose Marie Burke

Senior Writer,
S&P Global Ratings



Clayton Davis

Senior Data Scientist, Analytical Innovation,
S&P Global Ratings



Gaurang Dholakia

Manager, Central Data,
S&P Global Market Intelligence



Paul Gruenwald

Global Chief Economist,
S&P Global Ratings



Charles Jansen

Senior Director, DeFi,
S&P Global Ratings

**Roman Kramarchuk**

Head of Future Energy Analytics,
S&P Global Commodity Insights

**Gregg Lemos-Stein**

Chief Analytical Officer,
Corporate Ratings,
S&P Global Ratings

**James McMahon**

CEO, The Climate Service,
an S&P Global company

**Turloch Mooney**

Head of Port Performance,
Maritime, Trade and Supply Chain,
S&P Global Market Intelligence

**Chuck Mounts**

Chief DeFi Officer,
S&P Global Ratings

**Dr. Lindsay Newman**

Executive Director,
Head of Geopolitical Thought Leadership,
S&P Global Market Intelligence

**Simon Redmond**

Senior Director, Sector Lead,
Corporate Ratings,
S&P Global Ratings

**Roberto Sifon-Arevalo**

Chief Analytical Officer,
Sovereign and IPF Ratings,
S&P Global Ratings

**Peter Tirschwell**

Vice President,
Maritime, Trade & Supply Chain,
Chairman of TPM,
S&P Global Market Intelligence

**Ruth Yang**

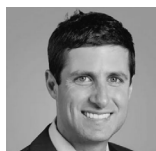
Global Head of Thought Leadership,
S&P Global Ratings

**Shankar Krishnamurthy**

Head of Essential Tech Center of
Excellence & Innovation
S&P Global

**Lai Ly**

Global Head of ESG Research,
S&P Global Ratings

**Jeff Meyer**

Research & Analysis Director,
S&P Global Commodity Insights

**Dr. Gabriel Morin**

Program Director and Associate Professor of
Leadership Development, Master 2 International
Human Resources Management, Paris, Université
Paris Panthéon-Assas

**Dr. Paul Munday**

Global Climate Adaptation and
Resilience Specialist,
S&P Global Ratings

**Karl Nietvelt**

Chief Analytical Officer, Global Infrastructure,
S&P Global Ratings

**Nicole Serino**

Associate Director,
Credit Markets and Insight,
S&P Global Ratings

**Ashutosh Singh**

Head of Energy Transition,
S&P Global Commodity Insights

**Rick Vidal**

Director of Energy,
S&P Global Commodity Insights

Lead Editor, Writer

Richard Martin, Editorial Lead

Project Manager

Alexandra Krief, Director, Business Manager

Production Manager

Brianne Paschen, Visual Design Manager

Copy Editors

Will Lockwood, Senior Manager

Ellen White, Copy Editor

Head of Editorial, Design & Publishing Team

Ken Fredman

Content Strategy

Nathan Hunt, Head of Content and Digital Marketing

Kyle May, Enterprise Content Marketing Lead

Communications

Christopher Krantz, Senior Director of Reputation
and Corporate Communications

Website Development

Kurt Burger, Marketing Specialist

Social Outreach

Camille McManus, Marketing Specialist

Designers

Carla Donaghey, Data Visualization Specialist

Augusto Justiniano, Senior Desktop Publisher

Chrisallen Villanueva, Data Visualization Specialist

For media inquiries, please contact Christopher Krantz
christopher.krantz@spglobal.com.





Copyright © 2023 S&P Global Inc. All rights reserved.

These materials, including any software, data, processing technology, index data, ratings, credit-related analysis, research, model, software or other application or output described herein, or any part thereof (collectively the “Property”) constitute the proprietary and confidential information of S&P Global Inc its affiliates (each and together “S&P Global”) and/or its third party provider licensors. S&P Global on behalf of itself and its third-party licensors reserves all rights in and to the Property. These materials have been prepared solely for information purposes based upon information generally available to the public and from sources believed to be reliable.

Any copying, reproduction, reverse-engineering, modification, distribution, transmission or disclosure of the Property, in any form or by any means, is strictly prohibited without the prior written consent of S&P Global. The Property shall not be used for any unauthorized or unlawful purposes. S&P Global’s opinions, statements, estimates, projections, quotes and credit-related and other analyses are statements of opinion as of the date they are expressed and not statements of fact or recommendations to purchase, hold, or sell any securities or to make any investment decisions, and do not address the suitability of any security, and there is no obligation on S&P Global to update the foregoing or any other element of the Property. S&P Global may provide index data. Direct investment in an index is not possible. Exposure to an asset class represented by an index is available through investable instruments based on that index. The Property and its composition and content are subject to change without notice.

THE PROPERTY IS PROVIDED ON AN “AS IS” BASIS. NEITHER S&P GLOBAL NOR ANY THIRD PARTY PROVIDERS (TOGETHER, “S&P GLOBAL PARTIES”) MAKE ANY WARRANTY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, FREEDOM FROM BUGS, SOFTWARE ERRORS OR DEFECTS, THAT THE PROPERTY’S FUNCTIONING WILL BE UNINTERRUPTED OR THAT THE PROPERTY WILL OPERATE IN ANY SOFTWARE OR HARDWARE CONFIGURATION, NOR ANY WARRANTIES, EXPRESS OR IMPLIED, AS TO ITS ACCURACY, AVAILABILITY, COMPLETENESS OR TIMELINESS, OR TO THE RESULTS TO BE OBTAINED FROM THE USE OF THE PROPERTY. S&P GLOBAL PARTIES SHALL NOT IN ANY WAY BE LIABLE TO ANY RECIPIENT FOR ANY INACCURACIES, ERRORS OR OMISSIONS REGARDLESS OF THE CAUSE. Without limiting the foregoing, S&P Global Parties shall have no liability whatsoever to any recipient, whether in contract, in tort (including negligence), under warranty, under statute or otherwise, in respect of any loss or damage suffered by any recipient as a result of or in connection with the Property, or any course of action determined, by it or any third party, whether or not based on or relating to the Property. In no event shall S&P Global be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees or losses (including without limitation lost income or lost profits and opportunity costs or losses caused by negligence) in connection with any use of the Property even if advised of the possibility of such damages. The Property should not be relied on and is not a substitute for the skill, judgment and experience of the user, its management, employees, advisors and/or clients when making investment and other business decisions.

The S&P Global logo is a registered trademark of S&P Global, and the trademarks of S&P Global used within this document or materials are protected by international laws. Any other names may be trademarks of their respective owners.

The inclusion of a link to an external website by S&P Global should not be understood to be an endorsement of that website or the website’s owners (or their products/services). S&P Global is not responsible for either the content or output of external websites. S&P Global keeps certain activities of its divisions separate from each other in order to preserve the independence and objectivity of their respective activities. As a result, certain divisions of S&P Global may have information that is not available to other S&P Global divisions. S&P Global has established policies and procedures to maintain the confidentiality of certain nonpublic information received in connection with each analytical process. S&P Global may receive compensation for its ratings and certain analyses, normally from issuers or underwriters of securities or from obligors. S&P Global reserves the right to disseminate its opinions and analyses. S&P Global Ratings’ public ratings and analyses are made available on its sites, www.spglobal.com/ratings (free of charge) and www.capitaliq.com (subscription), and may be distributed through other means, including via S&P Global publications and third party redistributors.