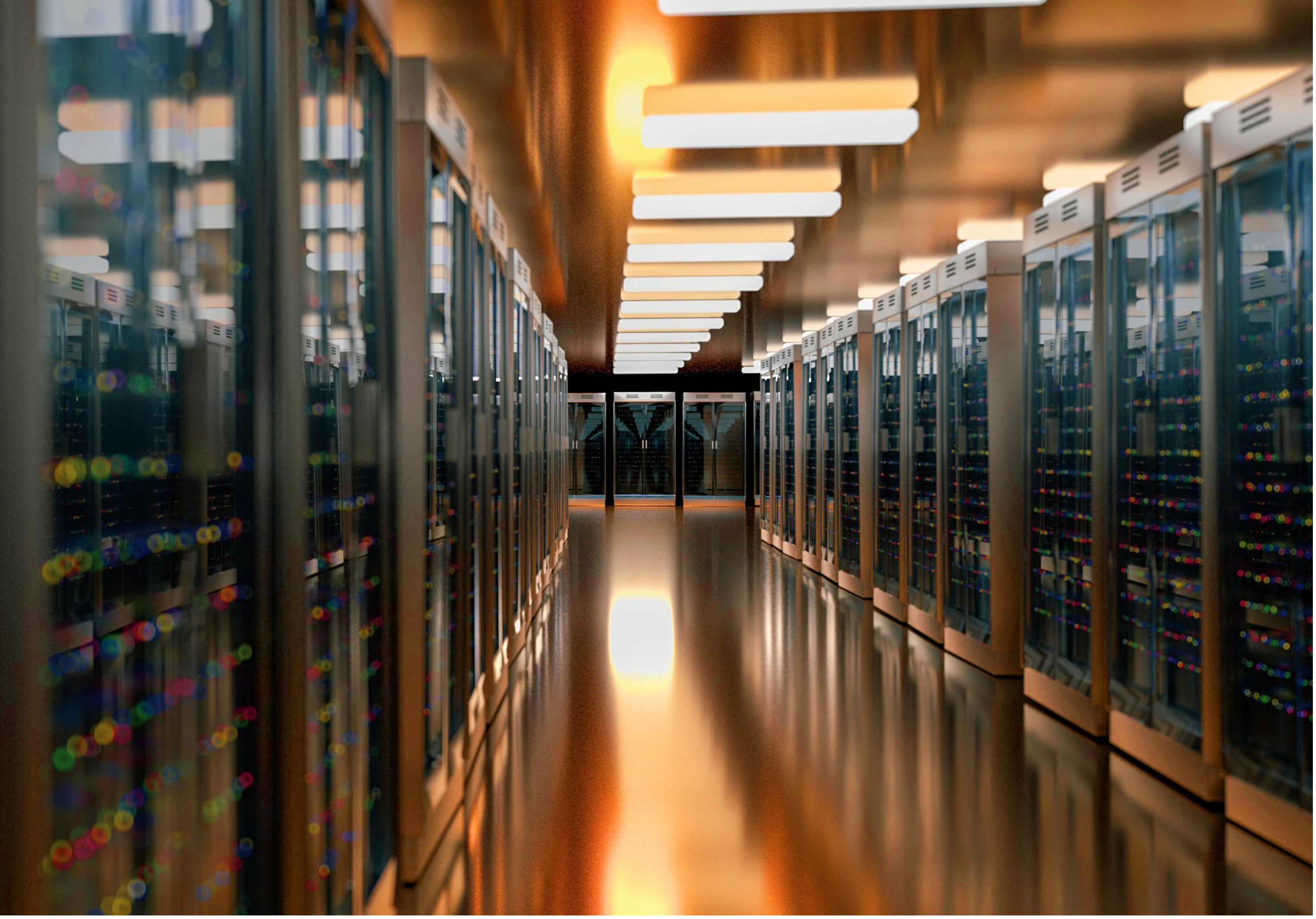

Capital Market Assumptions 2026

Our long-term return expectations for capital markets serve as key inputs into our strategic asset allocation process for multi-asset portfolios and provide context for shorter-term forecasting.

Barbara Reinhard, CFA
Head of Asset Allocation

Elias D. Belessakos, PhD
Senior Quantitative Analyst

Jonathan Kaczka, CFA
Asset Allocation Analyst

Joshua Shapiro, CFA
Asset Allocation Analyst

Ryan Sitarz, CFA, CFP
Portfolio Specialist

Voya Investment Management

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Foreword

Each year, the Voya Multi-Asset Strategies and Solutions team develops capital market forecasts for the coming decade. This process focuses on structural trends that shape returns and risks—essential for setting strategic allocations of major asset classes across multi-asset portfolios.

Drawing on a broad set of macroeconomic and financial data, we analyze how evolving economic drivers—such as labor force growth—could affect potential GDP relative to productivity trends. Historically, immigration-driven labor expansion matched productivity's contribution to U.S. GDP growth. However, recent policy changes are expected to reduce annual immigration from ~2.5 million to ~500,000. **This sharp slowdown in labor force expansion is likely to weigh on potential GDP.**

At the same time, **productivity is gaining traction after years of historically weak growth,** supported by a surge in capital investment and rapid technology adoption. A shrinking labor pool and demographic challenges are spurring companies to spend more on automation, artificial intelligence, and advanced technologies, reinforced by government initiatives.

The result has been a shift in the balance of growth drivers, where productivity gains have sustained America's economic momentum, offsetting slower growth in the labor force. GDP data signal resilient private demand despite fiscal uncertainty. Two Fed rate cuts in 2025 have brought the federal funds target range to its lowest level in three years. Further easing plus the end of quantitative tightening should support liquidity.

Still, inflation is expected to remain above the Fed's 2% target and exhibit greater volatility due to structural factors such as tariffs, deglobalization, supply constraints, and rising state intervention. Disinflationary effects from technology and productivity gains may offset some of these pressures, but these benefits will likely unfold over a longer horizon.

We also examine whether corporate profit margins will revert to historical norms. Our research suggests that investments in AI and automation could continue to reduce marginal costs and enhance productivity, similar to the IT revolution. **These innovations, coupled with premium pricing for advanced products, may allow profit margins to remain elevated or even expand, supporting current valuations.**

In equities, elevated valuations and compressed risk premiums point to **a decade of below-average U.S. equity returns.** Meanwhile, global markets, particularly emerging markets, offer more attractive valuations.

In fixed Income, bond yields have normalized, with the 10-year Treasury expected to hold in the 3.5-4.0% range amid fiscal pressures and sticky inflation. **Starting nominal yields near decade-long highs are providing opportunities.**

These trends point to a market shaped by new growth drivers, shifting valuations, and evolving risks. Disciplined asset allocation and active risk management remain key to uncovering alpha in an an era of lower-beta returns and heightened volatility. We hope this report supports your decision-making process and wish you a successful 2026.

Sincerely,

Barbara Reinhard, CFA
Head of Asset Allocation

Elias D. Belessakos, PhD
Senior Quantitative Analyst

Summary of findings

Our Capital Market Assumptions (CMA) 2026 report details our research on asset class returns, standard deviations and correlations over the 10-year horizon from 2026 through 2035. These estimates represent key inputs into strategic asset allocation decisions for our multi-asset portfolios and provide context for shorter-term macroeconomic and financial forecasting.

Our base-case forecasts are informed by modest potential gross domestic product (GDP) growth, reduced labor supply and elevated inflation. To avoid using a single-point-estimate forecast, we also incorporate an alternative scenario reflecting slightly better macro inputs. Our alternative scenario is based on marginally higher productivity and a lower terminal federal funds rate.

Key takeaways:

- The next decade will likely be characterized by returns near or below historical averages across major asset classes.
- Developed market equities are likely to deliver mid-single-digit returns, with the U.S. in-line with most other comparable markets.
- Emerging market equities should produce relatively strong returns, but with higher expected volatility than developed markets.
- Fixed income return expectations are broadly in line with long-term historical norms, yet meaningfully higher than the past decade's averages due to elevated starting yields.

Exhibit 1: 10-year return forecasts

2026–2035, in USD

	Expected returns (%)		Volatility (%)	Skewness	Kurtosis	Sharpe ratio
	Geometric mean	Arithmetic mean				
Equity index						
S&P 500	4.5	5.7	15.9	-0.51	1.0	0.18
Russell 1000 Growth	3.7	5.3	18.3	-0.44	0.6	0.14
Russell 1000 Value	5.0	6.1	15.3	-0.60	1.5	0.22
MSCI U.S. Minimum Volatility	4.4	5.0	11.7	-0.63	1.1	0.19
Russell 3000	4.5	5.7	16.2	-0.55	1.1	0.18
Russell Midcap	4.3	5.9	18.0	-0.61	1.4	0.17
Russell 2000	3.8	6.2	22.1	-0.53	1.4	0.16
MSCI EAFE	4.0	5.8	18.7	-0.27	0.2	0.16
MSCI World	4.6	5.7	15.7	-0.58	1.0	0.19
MSCI EM	3.6	6.7	25.1	-0.32	0.7	0.16
MSCI ACWI	4.7	5.8	15.7	-0.60	1.1	0.19
Alternative assets index						
Bloomberg Commodity	2.4	3.6	15.4	-0.46	1.7	0.05
FTSE EPRA/NAREIT Developed	3.2	5.3	20.5	-0.47	2.0	0.12
Fixed income index						
Barclays U.S. Aggregate	3.8	3.9	6.9	0.48	4.0	0.18
Barclays U.S. Government Long	3.3	4.1	13.0	0.21	0.5	0.11
Barclays U.S. TIPS	3.6	3.7	5.5	-0.91	4.1	0.17
Barclays U.S. High Yield	5.3	5.8	11.1	-0.42	4.1	0.26
Credit Suisse Leveraged Loan	6.8	6.9	7.2	-1.63	21.7	0.31
Barclays Global Aggregate	2.7	3.0	7.9	0.11	0.6	0.03
Barclays Global Aggregate ex U.S.	1.8	2.3	10.1	0.03	-0.1	-0.04
JPMorgan EMBI+	5.8	6.7	13.9	-1.02	7.3	0.26
U.S. Treasury Bill 3-Month	2.7	2.7	1.0	0.96	1.4	0.00

As of 09/30/25. Source: Voya IM. Forecasts are subject to change.

Ten-year forecast for strategic asset allocations

Our forecasting approach assumes a process by which global economies and financial markets gradually move toward a steady-state equilibrium over 10 years. While real-world conditions won't perfectly align with this endpoint, we find this academic construct helps to anchor our analysis. As always, this approach does not assume any recessions or contractions during the 2026–2035 period.

With this framework in mind, let's delve into our economic views for the U.S. over the next decade.

Though our model currently points to a low-productivity regime, we see potential for meaningful productivity improvements, driven by AI investments.

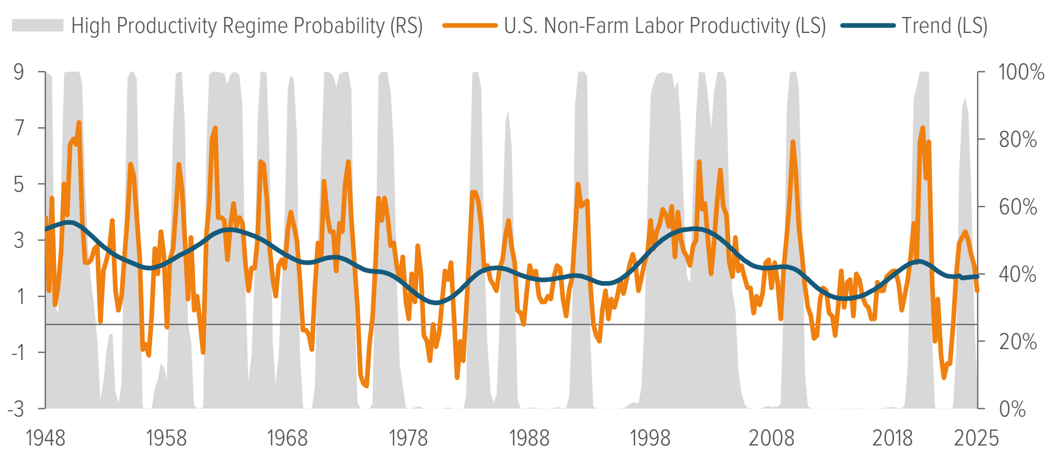
Is U.S. productivity breaking out?

Our answer is an emphatic "yes." While U.S. growth will be constrained by labor force trends, we believe the economy can achieve a somewhat higher and more sustained trajectory than in the previous business cycle. The key will be for the U.S. to break out of the low-productivity regime that has held back the economy.

Productivity growth primarily comes from two sources: capital deepening and total factor productivity (TFP). The TFP is an indirect measure derived from breaking down real GDP growth—it's what's left after accounting for the contributions of capital and labor, often referred to as "Solow's residual." This residual can capture various elements such as technological advancements, improvements in labor effectiveness, the strength of property rights, and the quality of the workforce. It also encompasses cultural attitudes, including risk tolerance and high levels of confidence in the future, which can boost productivity through the TFP channel.

Labor force productivity growth typically alternates between high- and low-productivity regimes over time. To determine the current regime, we analyzed productivity data using a Markov model (Exhibit 2). The latest data show that U.S. productivity has stabilized following negative levels in 2022 but remains modest at 1.3% year over year through the second quarter of 2025. This level is consistent with a low-productivity regime. (Low-productivity regimes, indicated by non-shaded areas, average 1.0%, whereas high-productivity regimes in gray shading average 3.8%.) Using a Hodrick-Prescott filter to break down year-over-year productivity growth into trend and cycle components shows that the current trend of U.S. productivity growth is 1.2%.

Exhibit 2: Productivity growth remains low



As of 09/30/25. Source: Voya IM.

While our productivity model shows that we are currently in a low-productivity regime, it's important to note that these models rely on backward-looking data. Going forward, we see potential for meaningful positive change in productivity driven by artificial intelligence (AI). Investments in AI have the potential to drive productivity into an advanced state by dramatically lowering the marginal costs of production and distribution, similar to the productivity gains seen during the IT revolution in the 1990s.

By automating complex tasks, optimizing workflows and enabling rapid data analysis, AI can streamline operations across industries, allowing teams to accomplish more in less time. Moreover, the enhanced features of AI-powered tools allow workers to perform high-value tasks more efficiently and effectively, supporting both the speed and quality of outputs. As AI technology continues to evolve, it will likely amplify productivity by freeing up resources, enhancing precision, and enabling real-time adjustments in production and distribution processes, ultimately creating a faster and more adaptive economy.

Our forecasting model uses a 60/40 blend of base-case economic assumptions and an alternative scenario reflecting a more favorable backdrop.

Economic projections

As in past years, our CMA 2025 forecast considers both "base" and "alternative" scenarios, leveraging S&P Global's economic modeling capabilities.[1] These two scenarios capture the most important up and downside risks facing the global economy and markets over the forecast horizon. Furthermore, in response to client demand, and following guidance from organizations such as the Task Force on Climate-Related Financial Disclosures (TCFD), we have continued to include climate scenarios into our economic forecasts. (See Appendix, page 12: "Accounting for climate change.")

Our **base case** forecasts 2.0% U.S. GDP growth through 2035, driven by below-trend productivity growth and subdued labor force growth. The **alternative scenario** assumes modest gains in output per hour, largely driven by TFP gains as labor shifts away from brick-and-mortar to more productive firms. It also assumes a higher dividend payout ratio, higher inflation, and that the Fed allows the economy to run hotter than in the base case. Under these assumptions, returns for risk assets are modestly higher in the alternative scenario than in the base case.

Exhibit 3: 10-year economic forecasts variables

	2035 forecast
U.S. GDP growth	**2.2%**
Inflation (CPI-U)	2.5%
CPI ex food and energy	2.5%
Federal funds rate	2.9%
10-year U.S. treasury yield	3.8%
Profit share	9.7%
Savings rate	5.4%

As of 09/30/25. Source: Voya IM, S&P Global. Forecasts are subject to change.

Assigning a 60/40 weighting to the base and alternative scenarios, respectively, we estimate a 10-year U.S. GDP growth trend of 2.1%. The 2035 values from this forecast (Exhibit 3) align with our long-term, steady-state estimates for key U.S. economic variables. From these top-down economic projections, we are able to determine asset class risk and return estimates.

Return estimates

For U.S. equities, we estimate earnings and dividends for the S&P 500 Index based on macroeconomic assumptions in our 60/40 blended scenario. Our earnings growth projections are bound by the neoclassical principle that profits as a share of GDP stabilize at a long-run equilibrium rather than increasing indefinitely. We then employ a dividend discount model to calculate the Index's fair value for each year in our forecast period.

[1] S&P Global is an independent research firm that provides a comprehensive global macroeconomic model, linking 68 individual country models with key global drivers of performance. The model accounts for 95% of global GDP, covering 250–500 time series per country.

For other equity indexes (including global REITs), we use a single-index factor model that derives beta sensitivities for each asset class versus the market portfolio from our forward-looking covariance matrix estimates (Exhibit 4). By definition, beta is the ratio of covariance to variance. (See Appendix, page 8: "Covariance and correlation matrixes.") The return for each equity asset class is determined by adding the risk-free interest rate to a specific risk premium, which is a function of our beta sensitivity estimate and market risk premium forecasts (Exhibit 1, page 3).

For U.S. bonds, we use our blended-scenario interest rate projections to determine expected returns across different durations. These return estimates are calculated by combining the current yield with any capital gains or losses, which depend on duration and the expected change in yields. We use a similar process for non-U.S. bonds, but we add an adjustment for expected currency movements. For credit-related fixed income, our return expectations incorporate yield spreads along with forecasts for default and recovery rates.

Glide path assumptions for target date strategies

Long-run equilibrium return assumptions inform how we determine an optimal asset mix over time for our target date products.

Whereas our strategic asset allocations are guided by 10-year forecasts, our target-date glide path assumptions rely on long-run equilibrium return assumptions spanning much longer periods, typically 40 years. In this extended timeframe, we think of the economy as existing continuously in a steady state—unlike the 10-year forecast, where it is *transitioning* toward this state.

We define a "steady-state" economy as:

- GDP growth is at its trend rate.
- Inflation is at target.
- Unemployment is at a level where inflation does not accelerate.
- The real interest rate equals the "natural" rate of interest—neither contractionary nor inflation inducing.
- All capital and goods markets are in equilibrium.

These forecasts use a building block methodology. Starting with our expectations for real short-term yield and inflation, we generate a risk-free rate forecast and, from that, derive all equity and fixed income assets by adding the relevant risk premium. For U.S. equities, the risk premium is derived from the Gordon growth model, representing the sum of the dividend yield and the nominal earnings growth rate in excess of the risk-free rate. Forecasts for non-U.S. equities add an international equity risk premium. Government bond forecasts are the sum of the risk-free rate and an appropriate term premium, while corporate bond forecasts add a credit risk premium.

In theory, all risk premiums tend to revert to a long-run equilibrium, as the economy is in a steady state. This mean reversion occurs because investment opportunities fluctuate over time. Given that the pace of new information varies, return volatility and covariance also fluctuate in the short term. Our econometric work, along with that of academic researchers, confirms the stationarity of various risk premiums. This evidence supports our assumption that average risk premiums, term premiums and credit spreads remain constant in the long-run equilibrium (Exhibit 5).

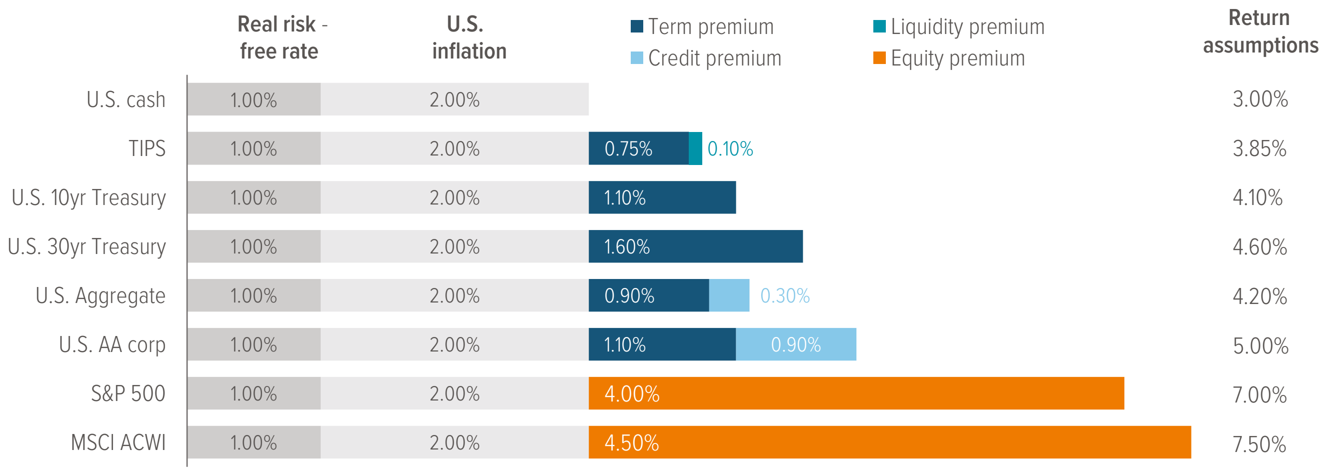
Exhibit 4: 10-year forecasted correlations matrix

2026–2035

	S&P 500	Russell 1000 Growth	Russell 1000 Value	MSCI U.S. Minimum Volatility	Russell 3000	Russell Midcap	Russell 2000	MSCI EAFE	MSCI World	MSCI EM	MSCI ACWI	Bloomberg Commodity	FTSE EPRA/NAREIT Developed	Barclays U.S. Aggregate	Barclays U.S. Government Long	Barclays U.S. TIPS	Barclays U.S. High Yield	Credit Suisse Leveraged Loan	Barclays Global Aggregate	Barclays Global Aggregate ex U.S.	JPMorgan EMBI+	U.S. Treasury Bill 3-Month
S&P 500	1.00	0.96	0.94	0.89	1.00	0.95	0.84	0.70	0.96	0.53	0.95	0.29	0.66	0.24	0.10	0.25	0.59	0.35	0.26	0.23	0.45	0.06
Russell 1000 Growth	0.96	1.00	0.82	0.82	0.96	0.91	0.82	0.65	0.92	0.52	0.92	0.26	0.60	0.23	0.11	0.25	0.56	0.32	0.24	0.21	0.43	0.05
Russell 1000 Value	0.94	0.82	1.00	0.89	0.95	0.92	0.81	0.68	0.92	0.51	0.91	0.32	0.69	0.24	0.08	0.25	0.58	0.37	0.26	0.23	0.45	0.07
MSCI U.S. Minimum Volatility	0.89	0.82	0.89	1.00	0.89	0.85	0.73	0.65	0.87	0.47	0.86	0.26	0.69	0.33	0.22	0.30	0.55	0.35	0.34	0.29	0.49	0.09
Russell 3000	1.00	0.96	0.95	0.89	1.00	0.96	0.88	0.70	0.97	0.54	0.96	0.31	0.67	0.24	0.10	0.26	0.60	0.36	0.26	0.23	0.46	0.06
Russell Midcap	0.95	0.91	0.92	0.85	0.96	1.00	0.93	0.69	0.93	0.55	0.93	0.35	0.69	0.23	0.08	0.26	0.62	0.40	0.26	0.23	0.47	0.04
Russell 2000	0.84	0.82	0.81	0.73	0.88	0.93	1.00	0.63	0.84	0.52	0.84	0.32	0.64	0.17	0.02	0.20	0.60	0.37	0.20	0.18	0.41	0.02
MSCI EAFE	0.70	0.65	0.68	0.65	0.70	0.69	0.63	1.00	0.86	0.57	0.85	0.35	0.72	0.22	0.07	0.23	0.52	0.32	0.45	0.49	0.41	0.06
MSCI World	0.96	0.92	0.92	0.87	0.97	0.93	0.84	0.86	1.00	0.59	0.99	0.34	0.74	0.25	0.10	0.27	0.61	0.37	0.35	0.34	0.47	0.07
MSCI EM	0.53	0.52	0.51	0.47	0.54	0.55	0.52	0.57	0.59	1.00	0.69	0.35	0.58	0.07	-0.05	0.17	0.48	0.31	0.18	0.21	0.58	0.06
MSCI ACWI	0.95	0.92	0.91	0.86	0.96	0.93	0.84	0.85	0.99	0.69	1.00	0.36	0.75	0.24	0.08	0.27	0.63	0.38	0.33	0.33	0.52	0.07
Bloomberg Commodity	0.29	0.26	0.32	0.26	0.31	0.35	0.32	0.35	0.34	0.35	0.36	1.00	0.28	-0.02	-0.13	0.21	0.27	0.29	0.16	0.22	0.20	0.01
FTSE EPRA/ NAREIT Developed	0.66	0.60	0.69	0.69	0.67	0.69	0.64	0.72	0.74	0.58	0.75	0.28	1.00	0.29	0.17	0.30	0.56	0.37	0.40	0.39	0.52	0.04
Barclays U.S. Aggregate	0.24	0.23	0.24	0.33	0.24	0.23	0.17	0.22	0.25	0.07	0.24	-0.02	0.29	1.00	0.89	0.59	0.23	0.03	0.79	0.57	0.41	0.16
Barclays U.S. Government Long	0.10	0.11	0.08	0.22	0.10	0.08	0.02	0.07	0.10	-0.05	0.08	-0.13	0.17	0.89	1.00	0.56	0.09	-0.15	0.68	0.48	0.30	0.07
Barclays U.S. TIPS	0.25	0.25	0.25	0.30	0.26	0.26	0.20	0.23	0.27	0.17	0.27	0.21	0.30	0.59	0.56	1.00	0.31	0.20	0.58	0.49	0.35	-0.03
Barclays U.S. High Yield	0.59	0.56	0.58	0.55	0.60	0.62	0.60	0.52	0.61	0.48	0.63	0.27	0.56	0.23	0.09	0.31	1.00	0.57	0.23	0.20	0.44	0.05
Credit Suisse Leveraged Loan	0.35	0.32	0.37	0.35	0.36	0.40	0.37	0.32	0.37	0.31	0.38	0.29	0.37	0.03	-0.15	0.20	0.57	1.00	0.05	0.05	0.22	0.05
Barclays Global Aggregate	0.26	0.24	0.26	0.34	0.26	0.26	0.20	0.45	0.35	0.18	0.33	0.16	0.40	0.79	0.68	0.58	0.23	0.05	1.00	0.96	0.38	0.12
Barclays Global Aggregate ex U.S.	0.23	0.21	0.23	0.29	0.23	0.23	0.18	0.49	0.34	0.21	0.33	0.22	0.39	0.57	0.48	0.49	0.20	0.05	0.96	1.00	0.31	0.08
JPMorgan EMBI+	0.45	0.43	0.45	0.49	0.46	0.47	0.41	0.41	0.47	0.58	0.52	0.20	0.52	0.41	0.30	0.35	0.44	0.22	0.38	0.31	1.00	0.09
U.S. Treasury Bill 3-Month	0.06	0.05	0.07	0.09	0.06	0.04	0.02	0.06	0.07	0.06	0.07	0.01	0.04	0.16	0.07	-0.03	0.05	0.05	0.12	0.08	0.09	1.00

As of 09/30/25. Source: Voya IM. Projections are subject to change.

Exhibit 5: Long-run equilibrium return assumptions



As of 09/30/25. Source: Voya IM. Assumptions are subject to change.

Appendix: Notes on methodologies

Covariance and correlation matrixes

Matrixes of estimated asset class covariance and correlation are the foundation of our asset class standard deviation forecasts. This differs from return forecasting, as correlations tend to wander over time. Using a historical average or an exponentially weighted methodology—which emphasizes recent observations within a long-term history—could result in risk forecasts that reflect the past but bear little resemblance to the future.

Therefore, our asset class risk forecasts are represented in the return covariance matrix—a crucial component of our capital market assumptions process.

Consider the example of stocks and bonds. Over the past 20 years, the correlation between the S&P 500 Index and Bloomberg U.S. Aggregate Bond Index was -0.02. But what does that tell you about the relationship between these two asset classes during unusual or extreme market conditions? During normal periods within that 20-year span, the correlation was -0.10, but it shifted to +0.07 during unusual periods (Exhibit 6).

Accounting for these unusual correlation patterns helps us more accurately assess the durability of diversification among asset classes. We capture these atypical periods in our standard deviation and correlation forecasts using an academic framework known as “turbulence.”

Measuring financial turbulence

The turbulence framework we use to estimate return correlations and standard deviations traces back to the pioneering work of statistician Prasanta Chandra Mahalanobis in the early 20th century. Mahalanobis developed a formula to analyze human skull similarities among Indian castes and tribes, which evolved into the “Mahalanobis distance”—a groundbreaking measure that accounted for both standard deviations and correlations among datasets.[2]

More than 70 years later, Mark Kritzman and Yuanzhen Li adapted this concept to introduce “financial turbulence.”[3] They defined this as a state in which asset prices, given their historical return patterns, exhibit unusual behavior such as extreme price movements. Financial turbulence often coincides with heightened risk aversion, illiquidity and price declines for risky assets. We have used this turbulence framework—focusing on the unusualness of returns and their correlations—to forecast risk measures in our capital market assumptions.

Turbulence can be computed for any set of asset classes. Revisiting our example of U.S. stocks and bonds, the returns of the S&P 500 Index and the Bloomberg U.S. Aggregate Bond Index can be visualized as an elliptical equation (Exhibit 6). The ellipse’s center represents the average joint returns of the two assets classes, while its boundary is a level of tolerance that distinguishes normal from turbulent observations. This threshold is an ellipse rather than a circle because it accounts for the covariance of the asset classes.

[2] Mahalanobis, P., “On the Generalized Distance in Statistics,” *Proceedings of the National Institute of Sciences of India* vol. 2 no. 1 (1936): 49–55.
[3] Kritzman, M. and Y. Li, “Skulls, Financial Turbulence, and Risk Management,” *Financial Analysts Journal* vol. 66 no. 5 (2010): 30–41.

Financial turbulence analysis helps us better assess the durability of asset class diversification by capturing unusual correlation patterns.

The idea captured by this measure is that periods are considered turbulent not just when returns are unusually high or low, but also when they move contrary to expected patterns based on the average correlation.

Turbulence and portfolio construction

The boundary between normal and turbulent periods, as depicted in Exhibit 6, isn't fixed—it evolves over time. Our process identifies turbulent market regimes by estimating a covariance matrix specifically for periods of market stress, using a Markov model. This model classifies regimes rather than relying on arbitrary thresholds, which could miss the sustained nature of volatility shifts (Exhibit 7).

To pinpoint turbulent market regimes, we make use of the concept of multivariate outliers within a return distribution. This involves examining how an asset class's return deviates from the average, along with its volatility and correlation with other asset classes. We then estimate separate covariance matrixes for normal and turbulent market periods. These matrixes are combined using weights to express views about the likelihood of each normal or turbulent regime and differing risk attitudes.

Our strategic asset allocation portfolios use a 60% normal and 40% turbulent weighting. While turbulent regimes occur only 30% of the time, we overweight them to 40% to address structural issues such as globalization, demographics and global central bank interventions, which are prevalent today. This overweighting also increases assumed risks, resulting in a more conservative matrix that prioritizes diversification during volatile periods.

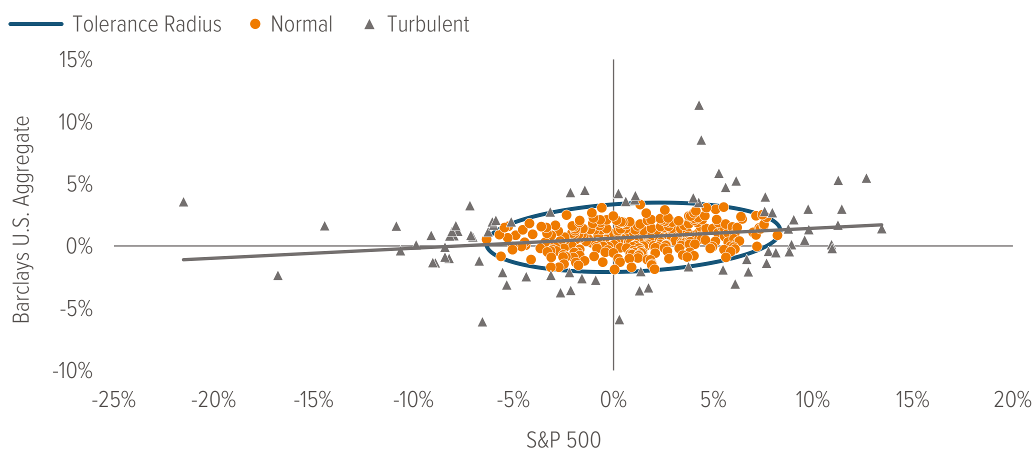
From this blended covariance matrix, we extract the implied correlation matrix and standard deviations for each asset class. In our view, this process helps create a strategic asset allocation portfolio that can account for the empirical evidence of shifting correlations over time.

Time dependency of asset returns and its effect on risk estimates

Recent research indicates that expected asset returns fluctuate in relatively predictable ways, with changes often persisting over extended periods. Consequently, changes among investment opportunities—encompassing all possible combinations of risk and return—are also persistent. Below are the economic reasons behind this return predictability, its implications for strategic asset allocation, and the adjustments we have made to account for it in our estimation process.

Exhibit 6: It is critical to account for non-normal observations by considering correlations

Normal and turbulent periods of stock and bond correlations, 20 years ended 09/30/25



As of 09/30/25. Source: Voya IM.

The relationship between valuation components and predictable economic variables generally leads to predictable expected returns.

We attribute the predictability of financial asset returns primarily to the business cycle, which itself is persistent, making real economic growth somewhat predictable. This persistence is due to the shared qualities of its components: consumption, investment and government expenditures.

Consumers don't respond well to abrupt changes in their lifestyles and therefore tend to smooth their consumption, using borrowing or savings to maintain spending when facing a temporary income shock. (Robert Hall formalized this idea by showing that consumers will optimally choose to keep a stable path of consumption equal to a fraction of their present discounted value of human and financial wealth.[4]) Investment, the second component of GDP, is sticky, as corporate investments in projects are usually long term in nature. Government expenditures also have a low level of variability.

Over a medium-term horizon, negative serial correlation sets in, as the growth phase of the cycle is followed by a contraction, which subsequently is followed by renewed growth.[5]

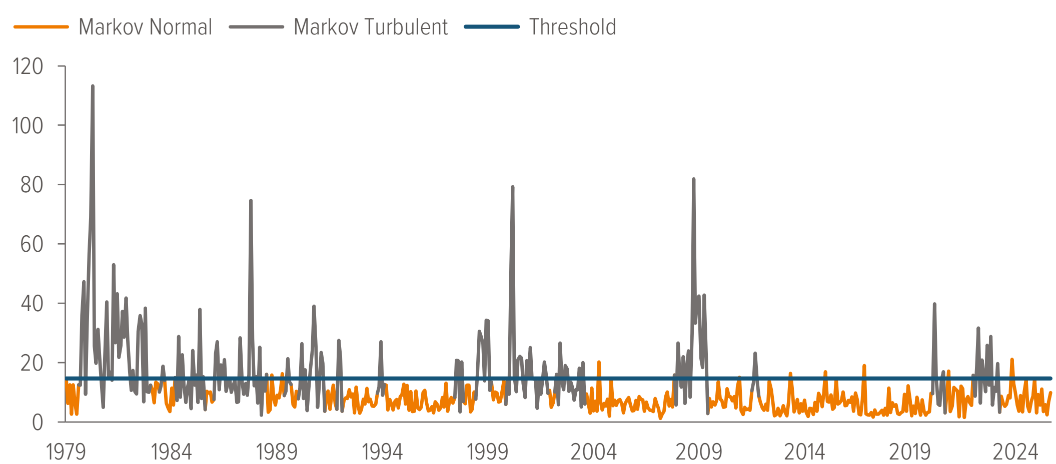
To understand how the predictability of economic variables leads to predictable asset returns, consider stocks. Equity values are determined as the discounted present value of future cash flows, dependent on four factors:

1. **Expected cash flows:** tend to move with the business cycle
2. **Expected market risk premium:** peaks at business cycle troughs (when consumers are trying to smooth consumption and are less willing to take risks with their income) and troughs at business cycle peaks (when people are more willing to take risks)
3. **Expected market risk exposure ("beta"):** changes over time and is a function of a company's capital structure (risk increases with leverage, which is related to the business cycle)
4. **Term structure of interest rates:** determines the risk-free rate, reflecting expectations for real interest rates, real economic activity and inflation (all connected to the business cycle)

These links to the business cycle mean that returns for equities—and for financial assets in general—are predictable, to an extent. Risk premiums of many assets tend to be high when macroeconomic conditions are challenging and low when conditions are good.

Exhibit 7: Both means and variances matter when determining if observations are turbulent

Turbulence across asset classes



As of 09/30/25. Source: Voya IM.

[4] Hall, R., "Stochastic Implications of the Life-Cycle-Permanent Income Hypothesis: Theory and Evidence," *Journal of Political Economy* vol. 86 (1978): 971–988.

[5] Poterba, J. and Summers, L., "Mean Reversion in Stock Prices: Evidence and Implications," *Journal of Financial Economics* vol. 22 (1988): 27–60.

Correcting for autocorrelation helps avoid bias toward less-volatile asset classes.

Autocorrelation biases portfolios toward low-volatility asset classes

The predictability of returns manifests itself in statistics through autocorrelation. In time series of returns, autocorrelation describes the degree to which values at a point in time are anchored by previous values. A positive autocorrelation indicates that high returns tend to be followed by high returns (market momentum), whereas a low autocorrelation means that high returns tend to be followed by low returns (mean reversion).

Traditional mean-variance analysis assumes that returns are not time dependent and prices follow a random walk, meaning that expected returns are constant (zero autocorrelation) while realized short-term returns are unpredictable. This implies that volatilities and cross-correlations among assets do not change with the investment horizon. Therefore, annualized volatility calculated from monthly data (scaled by the square root of 12) should be equal to the volatility from quarterly data (scaled by the square root of 4).

The presence of autocorrelation invalidates this scaling rule, because the sample standard deviation estimator is biased. Positive autocorrelation causes an underestimation of true volatility, and it also biases the cross-correlation matrix. As a result, the risk/return tradeoff can vary significantly between long and short investment horizons.

In a multi-asset portfolio where different asset classes have varying degrees of autocorrelation, not correcting for the bias in volatilities and correlations results in suboptimal mean-variance portfolios. Asset classes with low volatilities, such as hedge funds, emerging market equities and non-public-market assets (e.g., private equity and private real estate) may receive excessive allocations.

Adjusting for autocorrelation bias

One way to correct the autocorrelation effect is a direct approach that involves adjusting the sample of estimators of volatility, correlation and all higher moments. This approach becomes quite complex beyond the first two moments. We prefer an indirect method: cleaning the data of autocorrelation, which allows for the use of standard estimators to calculate the moments of the distribution.

The first step is to estimate and test the statistical significance of autocorrelation in our data series. Using monthly returns from 1979 to 2014, we estimated first-order autocorrelation as the regression slope of a first-order autoregressive process. We then tested its significance using the Ljung-Box Q statistic, which follows a chi-square distribution with k degrees of freedom ($k = 1$ for first-order serial correlation).[6] About 80% of our return series showed positive and statistically significant first-order serial correlation at the 10% significance level.[7]

Khandani and Lo show empirically that positive return autocorrelation indicates illiquidity across a broad set of financial assets, including small cap stocks, corporate bonds, mortgage-backed securities and emerging market investments.[8] In a frictionless market, predictability in returns can be quickly exploited and eliminated. Autocorrelation is the sole illiquidity measure that applies to both public and private securities and requires only return data to calculate.

[6] Ljung, G.M. and Box, G.E.P., “On a Measure of Lack of Fit in Time Series Models,” *Biometrika* vol. 65, (1978): 297–303.

[7] The p-value is the probability of rejecting the null hypothesis of no serial correlation when it is true (i.e., concluding that there is serial correlation in the data when in fact serial correlation does not exist). We set critical values at 10% and thus reject the null hypothesis of no serial correlation for p-values <10%.

[8] Khandani, A.E. and Lo, A., “Illiquidity Premia in Asset Returns: An Empirical Analysis of Hedge Funds, Mutual Funds, and US Equity Portfolios,” *Quarterly Journal of Finance* vol. 1 (2011): 205–264.

Physical climate risks include direct economic impacts from climate events such as wildfires, extreme weather and flooding.

Energy transition risks reflect the economic ripple effects of policy actions taken to reduce carbon emissions.

Both risk factors are important to consider when making long-term forecasts.

Since the vast majority of the return series we estimate exhibit autocorrelation, we apply the Geltner unsmoothing process to all of them, correcting for first-order serial correlation. We do this by subtracting the product of the autocorrelation coefficient (ρ) and the previous period's return from the current period's return, and then dividing by 1-ρ. This transformation has no impact on the arithmetic return, but it does affect the geometric mean due to its sensitivity to volatility. Therefore, this correction is important for long-horizon asset allocation portfolios.

Accounting for climate change

According to the International Monetary Fund and other respected institutions, the ecological impact of climate change poses significant economic risks.[9] Even though business cycles and event stresses will continue to dominate global economic outcomes, climate change is a material issue that could become increasingly important. Therefore, both physical and transition risks associated with climate change should be considered when making forecasts. Physical risks are often best incorporated at the security level, although they are more easily connected to certain countries and asset classes, such as real estate.

There are three key channels through which climate change could theoretically influence capital market assumptions:

- **Macro:** Climate-related factors influence consumer behavior, investment needs, financing, supply chains, cross-border trade and stranded assets. These are primarily related to transition risk, driven by government policies and market forces. These impacts directly affect GDP growth and inflation, with the magnitude partly determined by advances in productivity-enhancing technologies.
- **Fundamentals:** Top-line output establishes the base for corporate earnings, with profit margins being the other key factor. While the transition will affect industries differently, the overall effects are hard to predict. Thus, we maintain our approach of assuming profit margins mean-revert to equilibrium.
- **Repricing:** Changes in valuation are the most difficult to gauge, as the factors that determine valuations at a given moment and over time are highly uncertain—especially for broad asset classes such as U.S. large cap equities, which is the level at which we forecast our CMA. While certain sectors may deserve higher valuations than others and capital may shift towards more "sustainable" investments, predicting relative pricing changes based on inherent "greenness" is challenging, particularly across countries. Instead of comparing asset class carbon footprints by sector, sustainability should be assessed at the industry level or below. Therefore, premiums and discounts for factors such as climate change should be applied to individual companies within their respective groups. As a result, our efforts focus primarily on macro and some fundamental inputs.

[9] International Monetary Fund, www.imf.org/en/Topics/climate-change/climate-and-the-economy#publications, accessed 10/31/22.

To assess the effects of changes in climate-related macro and fundamental inputs, we collaborated with S&P Global to develop likely climate scenarios and expected economic outcomes. While numerous climate scenarios are possible and investors should stress-test portfolios against various possibilities, only one will actually happen. Therefore, we focused on the most probable scenario (named "Base Case" in Exhibit 8) and integrated those assumptions into our global economic model, which we leverage to produce our CMAs.

The climate scenarios (Exhibit 8) are updated annually and developed within the context of achieving net-zero carbon emissions by 2050. As this is a longer horizon than our 10-year CMA, they must be rescaled. However, they help us capture important developments along different temperature pathways.

No major country is on track to meet net-zero emissions targets by 2050, reflecting persistent challenges such as fragmented climate commitments, technological limitations, and heightened geopolitical tensions.

The latest scenario analysis indicates that by 2100, the average global temperature is on pace to rise by 2.4°C above preindustrial levels—slightly lower than last year's estimate but still well above the Paris Agreement's goal of less than 2° (Exhibit 9). In this Base Case scenario,

Exhibit 8: Climate scenarios

	Net-Zero 2050	Renaissance (optimistic)	Base Case (central)	Adaptation (growth-focused)	Fracture (pessimistic)
Implied temperature rise[a]	+1.5°C	~1.8°C	~2.4°C	>2.5°C	>3°C
General themes	Rapid, coordinated decarbonization; high global policy ambition; strong technology deployment	Strong governance and technological progress; rapid energy transition; global cooperation	Pragmatic governance; uneven energy transition; multipolar world; gradual decline in GHG emissions	Prioritizes economic growth; slower energy transition; elevated long-term climate risks	Weak governance; fragmented policies; stalled energy transition; high climate impacts
International cooperation	**Very strong:** global alignment on climate goals and standards	**Strong:** renewed multilateralism and collaboration	**Mixed:** cooperation improves over time but national interests dominate in the near term	**Weak:** countries focus on domestic priorities, limited global coordination	**Very weak:** isolationism and mistrust prevail
Economic environment	**Moderate:** costs of rapid transition offset by long-term benefits	**Strong:** economic growth supported by innovation and investment	**Moderate:** growth affected by policy uncertainty and market adaptation	**Strong in near term:** long-term risks from climate impacts	**Weak:** persistent instability and economic fallout
Climate policy	**Very strong:** high carbon prices, binding commitments	**Strong:** ambitious targets, effective incentives	**Moderate:** policy support varies, national interests often outweigh global goals	**Weak:** fragmented policies, limited progress	**Very weak:** climate policy loses momentum, many countries abandon net-zero goals

As of 11/15/25. Source: S&P Global, Voya IM. a) Implied temperature rise is the estimated increase in global average temperatures above pre-industrial levels by 2100. The Paris Agreement targets limiting warming to well below 2°C—ideally 1.5°C.

A fractured geopolitical landscape and national self-interest are preventing the type of global coordination to seriously address climate risks.

However, accelerating investments in renewable energy sources to meet surging electricity demand suggest incremental progress toward decarbonization.

global greenhouse gas emissions peak in 2024 then gradually return to early-2000 levels by 2060. However, progress varies widely by region, with national self-interest and economic priorities often outweighing international cooperation. Carbon pricing and related government policies remain critical to driving emissions cuts. Reaching net-zero would require making emitting greenhouse gases consistently more expensive than low-carbon alternatives—a threshold that current policies and market conditions have yet to achieve.

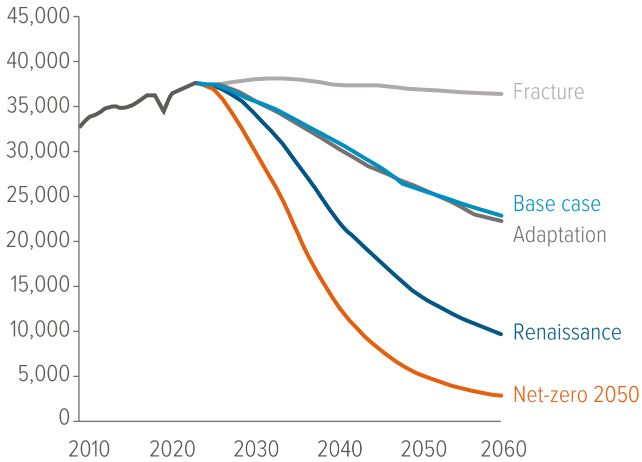
Like climate change itself, the economic impact will be gradual, with a modest difference across most scenarios, making the effect on our capital market assumptions minor. Geopolitical fragmentation and inconsistent climate policies are expected to affect both global growth and the pace of decarbonization. In such scenarios, economic damage is driven more by the underlying crises and policy discord than by direct climate impacts over the 10-year forecast horizon. However, over longer periods, the risk of significant and potentially irreversible physical costs from climate change increases. Compared with inaction, taking steps to address the negative externality of climate change continues to improve outlooks for the economy and most risk assets.

Incorporating climate change views into our forecasts provides a more complete picture of the world, helping us generate better estimates.

Over the past year, we have incorporated several major shifts into all five long-term outlooks based on global political, economic and market events:

- The world continues to experience instability and uncertainty, with a marked increase in geopolitical fragmentation and economic nationalism, especially in the U.S. and Europe. In the resulting shift toward pragmatic governance, countries are prioritizing domestic stability and energy security over ambitious decarbonization goals.
- The energy transition remains uneven. While renewable energy technologies are gaining traction globally, fossil fuels maintain a central role, particularly in developing economies. China's clean energy technology sector continues to expand, driving both domestic and export-led decarbonization.
- The U.S. has rolled back some support for clean energy and imposed tariffs on imports, while Europe has softened its climate policy targets in favor of energy security and competitiveness. China remains a leader in clean energy manufacturing and deployment.
- Developing economies are pursuing "all-of-the-above" energy strategies, balancing immediate economic growth and energy security needs with longer-term clean energy adoption. The cost of renewables continues to fall, enabling faster deployment, but fossil fuel use remains high in many regions.
- Multilateral institutions such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Conference of the Parties (COP) have struggled to maintain relevance, with climate negotiations yielding limited progress.
- Over the next decade, the energy transition is expected to gather pace, with renewables surpassing oil and natural gas as the largest primary energy source by the late 2050s. However, oil, gas, and coal will still account for just over 50% of global primary energy demand in 2060.

Exhibit 9: Global energy-related CO_2 emissions by scenario, 2010-60 ($MMtCO_2e$)



As of 09/30/25. $MMtCO_2e$ = million metric tons of CO_2 equivalent.

Sources: S&P Global Commodity Insights and the IEA for history; S&P Global Commodity Insights for outlooks.

About Voya Multi-Asset Strategies and Solutions

Voya Investment Management's Multi-Asset Strategies and Solutions (MASS) team, led by Chief Investment Officer Barbara Reinhard, manages the firm's suite of multi-asset solutions designed to help investors achieve their long-term objectives. The team consists of 17 investment professionals who have deep expertise in asset allocation, manager research and selection, quantitative analysis and portfolio implementation. Barbara also leads the asset allocation team, which is responsible for constructing strategic asset allocations based on its long-term views. The team also employs a tactical asset allocation approach, driven by market fundamentals, valuation and sentiment, which is designed to capture market anomalies and reduce portfolio risk.

A note about risk

The principal risks are generally those attributable to stock and bond investing. The value of an investment is not guaranteed and will fluctuate. Equity investments are subject to market, issuer and other risks. Market Risk: Securities may decline in value due to factors affecting the securities markets or particular industries. Issuer Risk: The value of a security may decline for reasons specific to the issuer, such as changes in its financial condition. Bonds are also subject to Market and Issuer risk, as well as interest rate, credit, prepayment, extension and other risks. Bonds have fixed principal and return if held to maturity but may fluctuate in the interim. Interest Rate Risk: When interest rates rise, bond prices fall; bonds with longer maturities tend to be more sensitive to changes in interest rates. Foreign securities: Foreign investing poses special risks including currency fluctuation, economic and political risks not found in investments that are solely domestic. These risks are generally intensified in emerging markets. Additional risks include, but are not limited to: Other Investment Companies' Risks, Price Volatility Risks, Inability to Sell Securities Risks, Securities Lending Risks, Investment Model Risks, Liquidity Risk and Market Capitalization Risk.

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