
How to make climate-aware adjustments to Capital Market Assumptions

Contents

1

Introduction

- Net-zero by 2050 and 1.5 degrees Celsius
- Our building block approach to Capital Market Assumptions (CMAs)
- How we make climate-related adjustments to a CMA
- Climate-related macro adjustments to a CMA (NGFS)
- Capturing the impact of climate change at a security level (Planetrics)

2

Equities

- **Earnings growth**
Physical risks
Transition risks
- **Inflation risk**
- **Valuation change**
- **The final result – equity CMAs**

3

Fixed income

- Adjusting the 10-year yield, roll return and valuation change
- The final result – fixed income CMAs

4

Using climate aware CMAs to support strategic asset allocation

5

Conclusion

Authors



Jacob Borbidge
Senior Portfolio Manager,
Invesco Investment
Solutions



Greg Chen
Senior Analyst, Invesco
Investment Solutions



Christina Wang
Analyst,
Invesco Investment
Solutions



Drew Thornton
Head of Thought
Leadership, Invesco
Investment Solutions

Executive Summary

- In this note we provide an example of climate aware adjustments to the capital market assumptions (CMAs) we use to construct portfolios. CMAs provide us with a better understanding of future returns and risks for different asset classes and are constructed using a building blocks approach. What we do is adapt some of these building blocks to make them climate aware.
- When we adapt these building blocks, we focus on a scenario that may arise if markets begin to price in a net-zero economy by 2050 (climate-aware CMAs) and compare that to our base-case CMAs which do not fully discount hitting net-zero by 2050.

1

Introduction

Long-term investors face a significant challenge with climate change. It is almost certain that climate change will occur, although the outcome is uncertain. There are many different scenarios that may play out both in terms of how climate is impacted by human activity and how aggressively humans attempt to combat climate change. While the path is still uncharted, we are confident that there will be a cost imposed on corporations and economies to prevent or delay climate change which could affect portfolio returns.

Uncertainty creates and opportunity for investors. Asset allocators can choose to capture this risk when valuing asset classes or run the risk of being overexposed to climate change events.

Net-zero by 2050 and 1.5 degrees Celsius

In 2016, 195 countries signed The Paris Agreement with an ambitious goal of halting a global rise in temperature greater than 1.5 degrees Celsius above pre-industrial levels. Many signatory countries plan to do this by targeting net-zero carbon emissions by 2050.

Over such a long time period, around 30 years from now, many different climate scenarios may develop, which we find are not priced in by the market. The two main scenarios that we focus on within Invesco Investment Solutions are (i) certainty that countries achieve net-zero by 2050, or (ii) whether countries follow their current policies which account for a less than 100% probability of reaching the net-zero 2050 goals through various pathways.

Presently, it appears that the market is pricing in the latter scenario which is accounted for in our broad set of CMAs spanning 170+ asset classes. Our approach to modelling the first scenario, net-zero by 2050, is to adjust the capital market assumptions (CMAs) that we use to construct portfolios. Should the probability of reaching net-zero 2050 become closer to certain, the two sets of CMA scenarios will converge.

How we make climate-related adjustments to our CMAs

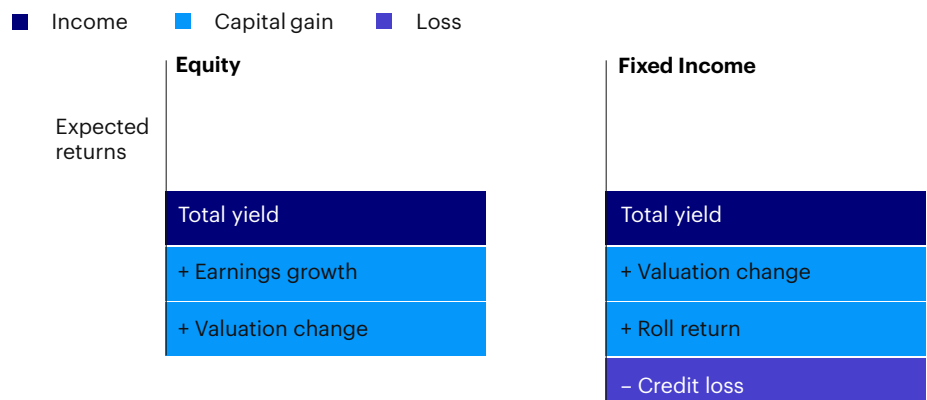
Our goal in developing CMAs is to estimate the expected returns, standard deviations and correlations of asset classes over various time horizons, however we recognize that there may be many possible scenarios for investments in an uncertain future. When a global coordinated effort like the Paris Climate Agreement is proposed for a topic as impactful to assets as climate risk, we developed a scenario containing specific adjustments to our base case CMAs to account for them.

We design our CMAs for the long-term. They target specific investment horizons, namely five and 10 years as these periods represent either one half or a full business cycle for an economy. We then take the five-year and 10-year CMAs and then update them on a quarterly basis to capture material changes to their risk outlook.

The transition to net-zero is around a 30-year time horizon that stretches to 2050, but we have designed our climate aware CMAs to focus on the first part of that transition as that is what investors may experience over the next five to ten years. As we get closer to 2050, the CMAs will take on different stages of the climate risk scenarios which we will highlight in further sections.

The way we construct a CMA at Invesco is through a building block approach, which starts from the bottom-up and deconstructs returns into income, capital gains, and losses. Driving these components are many different factors, which the CMA tries to capture across different asset classes (Figure 1).

Figure 1: A building block approach to estimating returns can be used for various asset classes



Source: Invesco Investment Solutions, as of Dec. 31, 2021. For illustrative purposes only.



Firstly, we can look at the macroeconomic effects climate change will have on an asset class. Secondly, we can look at the effects climate change could have on corporate fundamentals and at a stock level.

The next step is to incorporate climate change adjustments into the CMA, by drilling down into the building blocks that are used to create it. There are two types of adjustments that can be made.

Firstly, we can look at the macroeconomic effects climate change will have on an asset class. Secondly, we can look at the effects climate change could have on corporate fundamentals and at a stock level.

How we make climate-related macro adjustments to the CMA

Our approach is to use studies taken from the “Network for Greening the Financial System” (NGFS). This is a group of 92 central banks and financial supervisors around the world whose aim it is to accelerate and scale up green financing globally.

NGFS develops recommendations for central banks on how they can help fight climate change. We use this analysis to understand how climate change may affect the macroeconomic climate and its impact on different asset classes.

Capturing the impact of climate change at a security level

We can also add adjustments to security-level data, based on the analytics provided by Planetrics. This group is a strategic consultancy and data analytics provider that specializes in climate change. They provide climate change risk assessments and opportunity modelling. We use their climate stress tests to analyze the companies we cover and the effects they have on their fundamentals.

We then make both these climate-related macro adjustments and those made at a security level for the asset class we are looking at: either equities or fixed incomes.

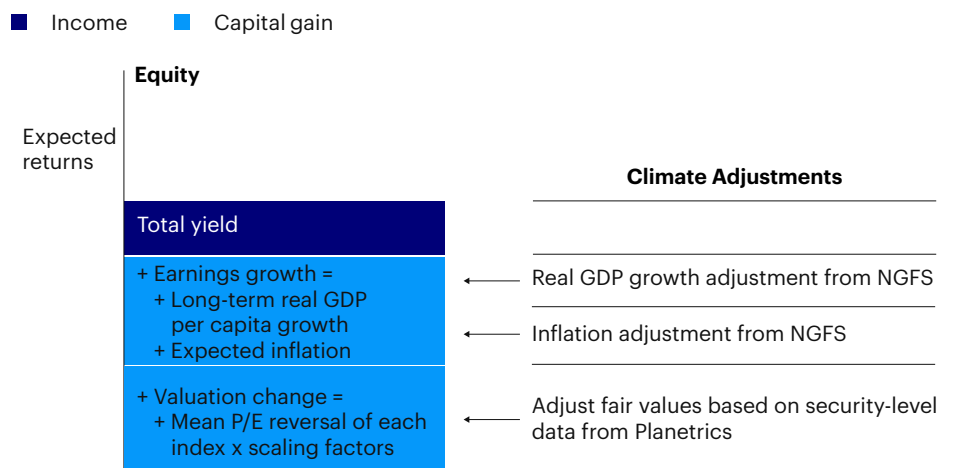
2

Equities

We use three building blocks to develop our equity return expectations. These are yield, earnings growth and valuation change. The climate-related adjustments we make are to the earnings growth and valuation change building blocks (which you can see in Figure 2).

Let’s break these down to explain how we make these adjustments.

Figure 2: Adjustments made to equity returns



Source: Invesco Investment Solutions, as of Dec. 31, 2021. For illustrative purposes only.



The financial consequences of physical risks can be severe, which increases the underwriting risk for insurers and can lower insurance coverage and impair assets.



Transition risks are the costs associated with the policy actions necessary to mitigate the climate impact of businesses, buildings, energy, and transportation, on the environment.

Earnings growth

Over the long run, a company's earnings growth is expected to converge with GDP growth. Any impact on GDP growth caused by climate change will, therefore, impact the earnings growth of the company.

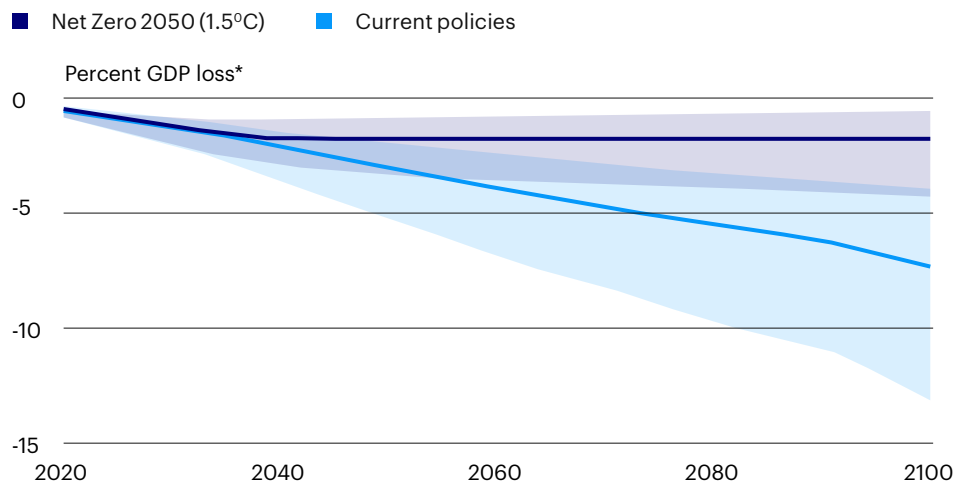
This is why we use NGFS data because it can provide us with long-term projections for real GDP depending on the climate change scenario. The dataset provided by NGFS covers the impact climate change might have on real GDP growth for each country it covers. It breaks down the risk of each scenario by physical and transition risks.

Physical risks

Physical risks are the acute impact felt by climate change, which includes extreme weather events. The financial consequences of such events can be severe, which increases the underwriting risk for insurers and can lower insurance coverage and impair assets. This also increases costs for the essential factors of production such as land, labor and capital, which also slows down economic growth.

The methodology used to calculate the physical risk of climate change is based on research provided by Kalkuhl and Wenz (2020). Here, the average temperature is taken for each country for both scenarios. Figure 3 shows how this methodology captures the physical risk of GDP loss.

Figure 3: Physical risks to GDP loss



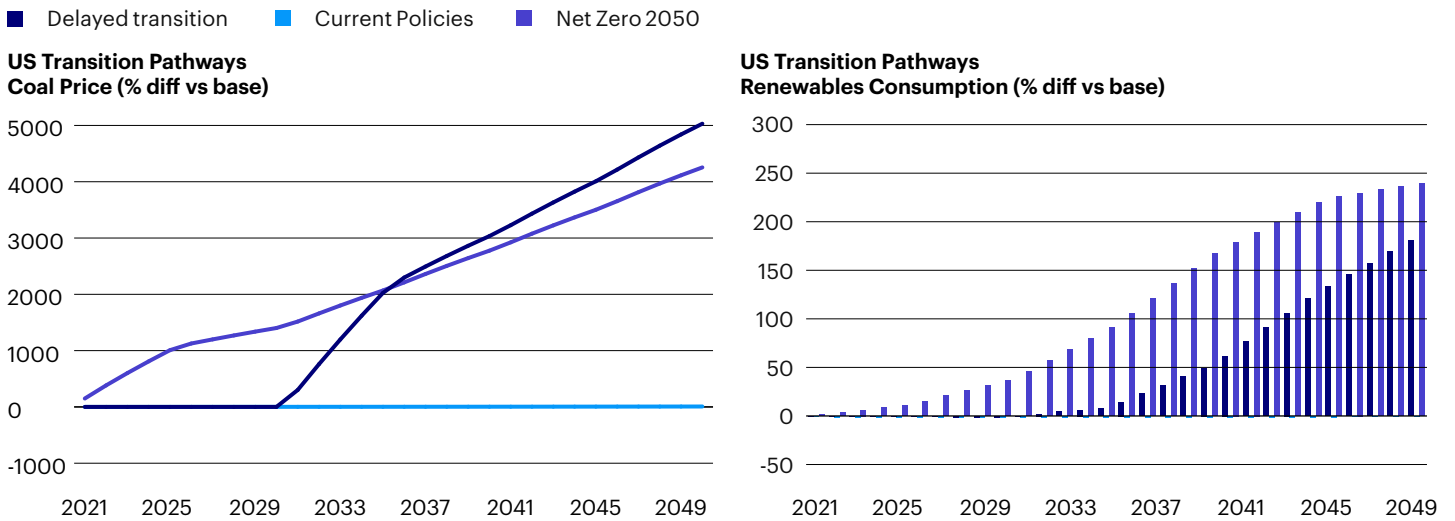
Source: IIASA NGFS Climate Scenarios Database, REMIND model Dec. 31, 2021. *2005 used as the base year.

Transition risks

Apart from physical risks, there are also transition risks that need to be captured when assessing an economy's response to climate change. Transition risks are the costs associated with the policy actions necessary to mitigate the climate impact of businesses, buildings, energy, and transportation, on the environment. The NGFS models transition risks by assuming the cost of emissions are increased, typically through carbon taxes instituted by policymakers. Since alternative carbon-efficient technologies may not be available instantaneously, these additional costs can then go on to affect the broader economy and negatively impact investment and productivity.

NGFS uses integrated assessment models to map different transition pathways which includes capturing changes that may occur in energy markets, the use of land and the carbon reduction policies needed to reach net-zero by 2050. For each scenario, we highlight NGFS's estimated changes in coal prices and the consumption of renewables which feed into the integrated carbon price model.

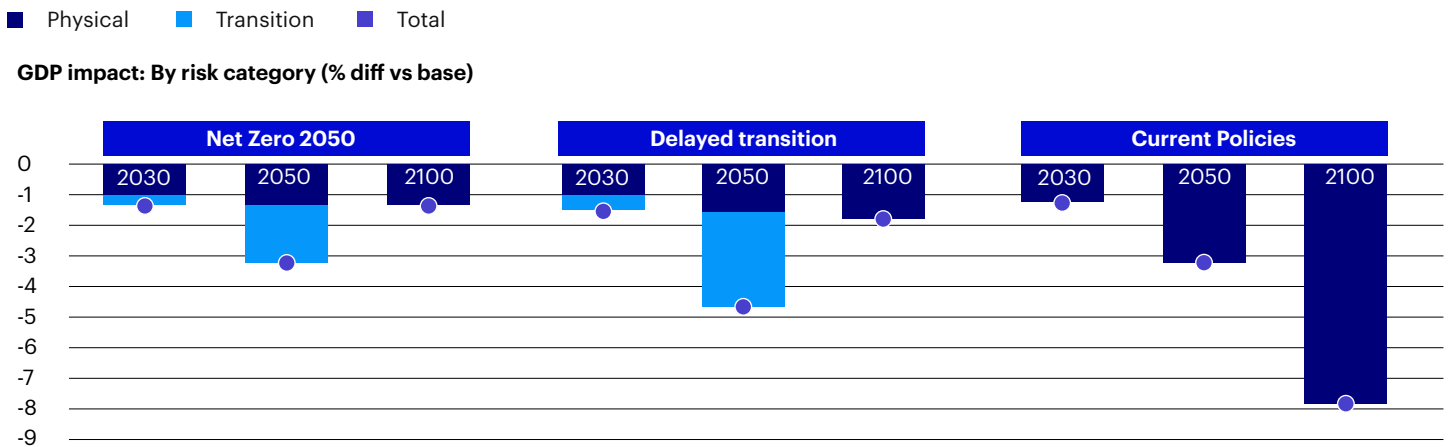
Figure 4: Changes in coal price and renewables consumption by NGFS scenario



Source: IIASA NGFS Climate Scenarios Database, REMIND model Dec. 31, 2021. Carbon prices are weighted global averages. End of century warming outcomes shown.

NGFS also uses a well-developed econometrics model that was created by the National Institute for Economic and Social Research, which is widely used for forecasting and scenario analysis. The National Institute Global Econometrics Model (NiGEM) is able to take the transition inputs from their integrated assessment models to estimate the physical risk of climate change (Figure 5).

Figure 5: GDP impacts relative to prior trend



Source: IIASA NGFS Climate Scenarios Database, NiGEM based on REMIND. IAM data and damage estimates from Kalkuhl & Wenz (2020).

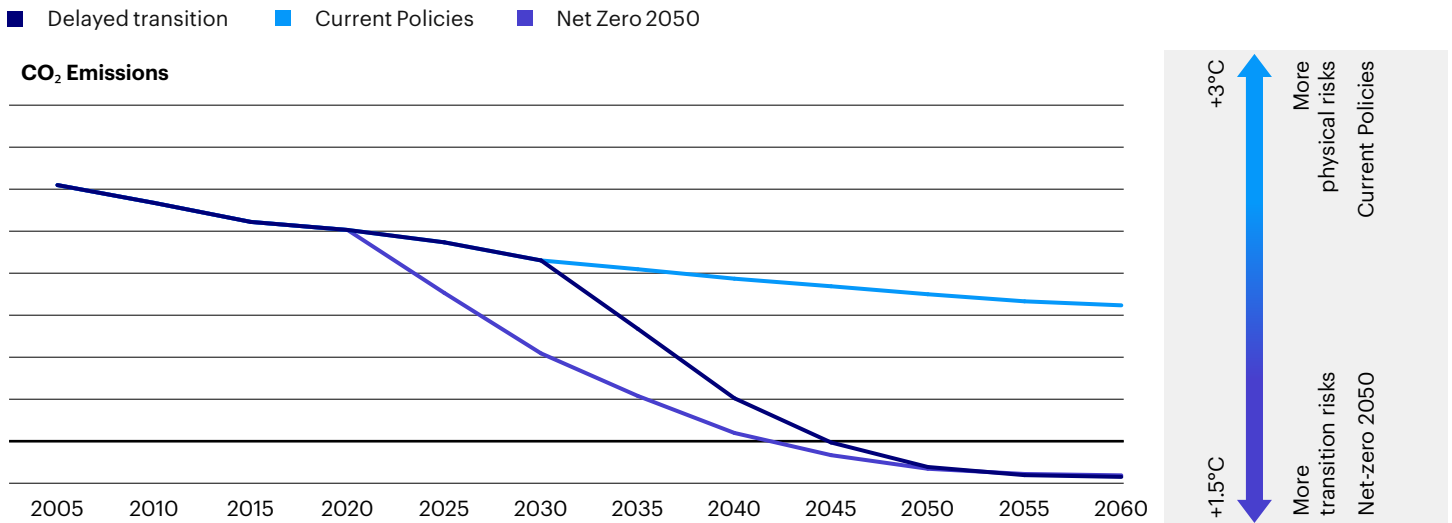
Putting it all together

When you measure both physical and transition risks and apply them to the scenarios you are analyzing, you get a wide range of outcomes.

Depending on the scenario that plays out, the exposure investors have to physical and transition risks will differ. In a run-away global warming situation – 3.0 degrees Celsius above pre-industrial levels – there is a high degree of physical risk. By contrast, in a low-carbon world scenario where climate change is kept under control – 1.5 degree Celsius above pre-industrial levels – investors are more exposed to transition risk. (see Figure 6).

What we are modelling for our climate-aware CMAs is the 1.5 degree scenario.

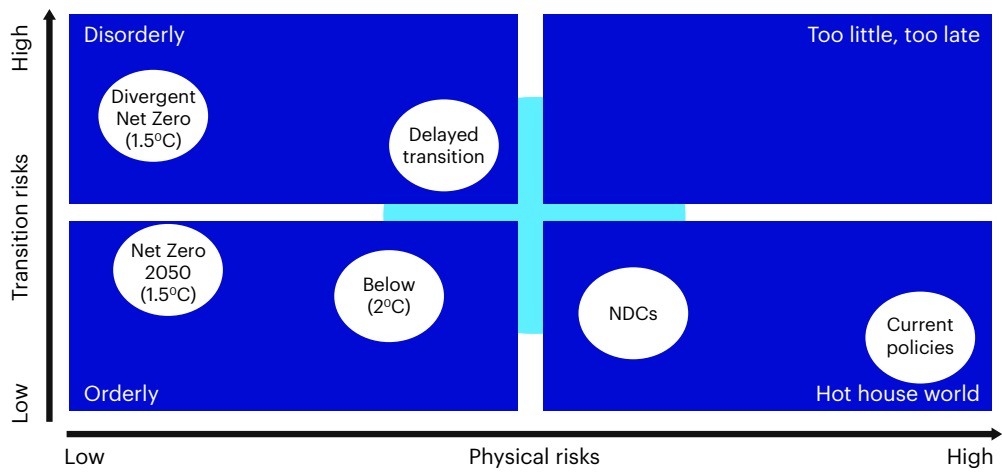
Figure 6: Depending on the scenario investors will be exposed to a high degree of either physical or transition risk



Source: NGFS, Dec. 31, 2021.

This is what forms the framework that NGFS operates under, which you can see below in Figure 7. It shows all the possible outcomes using this framework. For instance, even if we do achieve net-zero by 2050, it may happen in either a disorderly or in an orderly way, which will impact equity returns. There is also a wide range of outcomes that could fall between attaining net-zero by 2050 and sticking to current policies.

Figure 7: NGFS Framework



Source: NGFS, Dec. 31, 2021. Positioning of scenarios is approximate, based on an assessment of physical and transition risks out to 2100.

You can see this more clearly in Figure 8 which shows three different categories of possible outcomes. These describe each bubble in Figure 7 in more detail. Most of these outcomes fall under three categories: orderly, disorderly and a “hothouse world”. The challenge is to map all these different categories, scenarios and outcomes to see how much of an impact they will have on future real GDP growth.

Figure 8: How physical and transition risks affect different scenarios

Colour coding indicates whether the characteristic makes the scenario more or less severe from a macro-financial risk perspective[^]

■ Lower risk ■ Moderate risk ■ Higher risk

Category	Scenario	Physical risk		Transition risk		
		Policy ambition	Policy reaction	Technology change	carbondioxide removal	Regional policy variation*
Orderly	NetZero 2050	1.5°C	Immediate and Smooth	Fast change	Medium use	Medium variation
	Below 2°C	1.7°C	Immediate and Smooth	Moderate change	Medium use	Low variation
Disorderly	Divergent Net Zero	1.5°C	Immediate but divergebt	Fast change	Low use	Medium variation
	Delayed transition	1.8°C	Delayed	Slow/Fast change	Low use	High variation
Hot House World	Nationally Determined Contributions (NDCs)	~2.5°C	NDCs	Slow change	Low use	Low variation
	Current polociies	3°C+	None - current polociies	Slow change	Low use	Low variation

Source: NGFS, Dec. 31, 2021.

+ Risks will be higher in the countries and regions that have stronger policy. For example in Net Zero 2050 the EU, USA and Japan reach net zero GHGs by 2050, but globally only net zero CO2 is reached by this point.

[^] This assessment is based on expert judgment based on how changing this assumption affects key drivers of physical and transition risk. For example, higher temperatures are correlated with higher impacts on physical assets and the economy. On the transition side economic and financial impacts increase with: a) strong, sudden and/or divergent policy, b) fast technological change even if carbon price changes are modest, c) limited availability of carbon dioxide removal meaning the transition must be more abrupt in other parts of the economy, d) stronger policy in those particular countries and/or region

In Figure 9 you can see how all of these risks and outcomes come together on a regional basis. From here, as an investor you can now adjust real earnings growth to be climate aware.

How you make these adjustments are very simple. For instance, if real earnings growth in the US was 2.69%, you would add the combined estimates of physical and transition risks totaling -0.06% to arrive at a climate aware US real earnings growth rate of 2.63%:

Climate Aware US Real Earnings Growth = 2.69% - 0.06% = 2.63%

Figure 9: Breaking down the effects of transition and physical risks on GDP growth

Region	Avg Annualized % vs Base (2022-2031)		
	Total	Transition	Physical
United States	-0.06%	-0.01%	-0.05%
United Kingdom	0.09%	0.12%	-0.03%
Europe	0.15%	0.18%	-0.03%
Japan	0.12%	0.18%	-0.05%
Australia	0.17%	0.21%	-0.04%
Canada	0.16%	0.21%	-0.04%
China	-0.06%	0.01%	-0.07%
World	-0.03%	0.04%	-0.07%

Source: Invesco Investment Solutions, Dec. 31, 2021.

Inflation risk

NGFS also provides time series data on the effects of climate change on inflation for individual countries. Just like the methodology used for real GDP, adjustments are made based upon both current policy and net-zero 2050 scenarios.

The type of expected inflation driven by climate change is derived from forecasts on energy prices and demand. The model maps the impact of inflation and energy costs, which it breaks down by energy type. This includes the consumption of coal, oil, gas and renewable energy. Once calculated, these figures are used to adjust each annual expected inflation rate for the next 10 years (see Figure 10) and the final average is the climate CMA's inflation adjustment.

Figure 10: NGFS annual inflation rate (% difference vs. base forecast)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	10Y Average
US 2022 Inflation Adjustment	0.00	0.00	2.26	2.32	1.94	1.45	1.15	0.89	0.66	0.64	1.13

Source: Invesco Investment Solutions, Dec. 31, 2021. IIASA NGFS Climate Scenarios Database, NiGEM based on REMIND. IAM data and damage estimates from Kalkuhl & Wenz (2020).

Valuation change

The second building block of our CMA that we make climate aware adjustments to is valuation change. The goal here is to adjust the fair values that we have derived for the stocks we cover. These adjustments are based on the analytics provided by Planetrics, which is part of McKinsey Sustainability.

Planetrics has developed proprietary models that estimate the impact of climate risk on individual asset values, which we use for our net-zero 2050 scenario.

The first step is to calculate the impact climate risk will have on earnings up until 2050. Here they account for the demand destruction, carbon costs, abatement and competition caused by a transition towards this net-zero 2050 scenario.

Planetrics then constructs a discount cash flow model based on these projected and adjusted earnings, using the security specific discount rates that they have derived through their financial statement analysis. What is left is a new fair value for a stock, whose valuation is now climate aware.

The US sectors most impacted negatively through this analysis include energy and materials (Figure 11), however these represent fairly small overall portions of the US market (Figure 12). Some sectors are affected positively or minimally, like consumer cyclicals and technology for example, as they have less energy-reliant businesses. This matches the thesis that there will be a cost of carbon in the future, where cleaner companies will have a clear advantage over more carbon intensive firms.

Figure 11: US sector impact

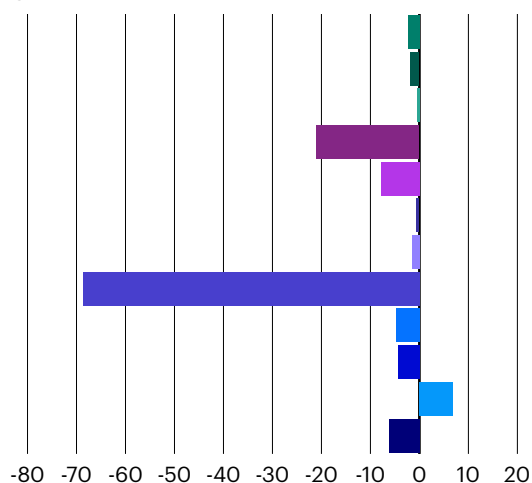
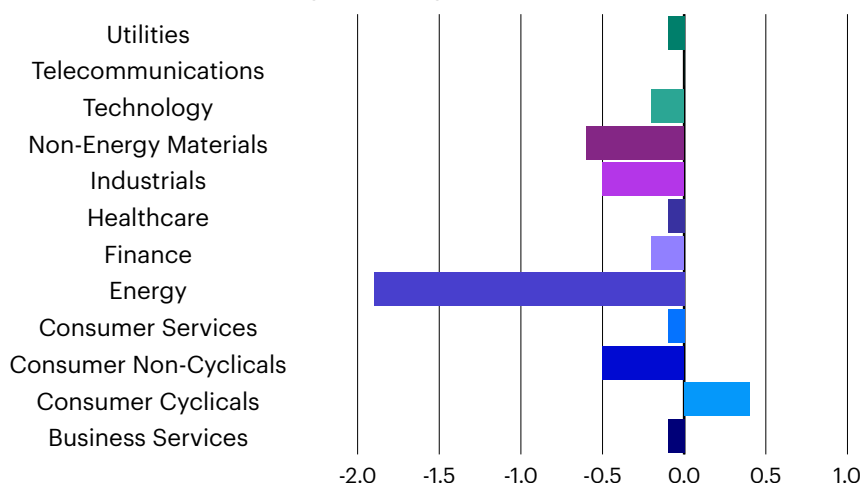


Figure 12: Weighted US sector impact



Source: Invesco Investment Solutions, Dec. 31, 2021. US valuation modeling sourced from Planetrics using S&P 500 sectors.

The next step is to aggregate these sector-level adjustments from valuation changes to a regional or index level by re-weighting the US adjustments to the sector weights of a given universe. You can see examples of this in Figure 13.

Figure 13: Valuation change after fair value adjustments for climate

Asset	Fair Value Adj (2022 Q1 model)	% of coverage	Base CMA	Climate Aware	Delta
US Large Cap	-4.05%	100	-1.36%	-1.88%	-0.52%
US SMid	-5.33%	92	-0.41%	-1.06%	-0.66%
UK	0.31%	100	-0.98%	-0.96%	0.03%
Eurozone	-4.10%	95.7	-1.03%	-1.46%	-0.43%
Japan	-8.29%	100	-1.05%	-2.00%	-0.95%
Pacific Ex JP	-6.41%	98.4	-0.88%	-1.64%	-0.76%
Australia	-8.42%	95.5	-0.38%	-1.25%	-0.87%
Canada	-15.04%	96.2	-0.77%	-2.80%	-2.03%
MSCI EAFE	-4.60%	97.9	-1.01%	-1.53%	-0.52%
China CSI 300	-3.13%	99.7	-0.13%	-0.36%	-0.23%
Emerging Market	-10.15%	98.2	0.02%	-0.32%	-0.34%
MSCI World Ex US	-5.94%	98	-0.98%	-1.66%	-0.68%
World Equity	-4.81%	98.4	-1.10%	-1.65%	-0.54%

Source: Invesco Investment Solutions, Dec. 31, 2021. Proxies listed in appendix. Forecasts are not reliable indicators of future performance.

The final result for equity CMAs

The end result when making these climate aware adjustments to the equity CMAs can be seen in Figure 14. This table captures the adjustments made to real earnings growth, expected inflation and valuation change.

The most significant building block to change is inflation, which is expected to affect the expected equity return on individual stocks by about 1%-2%. This make sense because climate change is expected to have an inflationary effect through the cost of carbon.

Companies are expected to pass off some of this inflation onto the end consumer or customer. However, rising inflation from the cost of carbon is still likely to impact revenues negatively. The frequency of inflation driven supply shocks is also expected to increase in the future with climate change. Both these factors will negatively impact future corporate revenues.

Another interesting observation when you look at this table is that emerging markets like China could be beneficiaries from this transition to a low carbon world. Although China is currently the world's largest polluter, it is also highly committed to reaching net-zero eventually – it has a target of 2060 to reach net-zero, rather than 2050. China has the lowest expected decline in fossil fuel consumption, leading to the highest rate of inflation in the short run.

Another interesting example is Canada. This is an export-focused market that has historically been commodity-driven and carbon-orientated. The country's assets may need to be devalued in valuation change building block to capture this risk. For instance, a large amount of mining and oil stocks are listed in the Canadian TSX, whose future profitability may be negatively impacted by a net-zero 2050 target.

Figure 14: Adjustments Made To Equity Returns

Asset	10Y CMA Return			Yield (No Diff)		Real Earnings Growth			Expected Inflation			Valuation Change			Cur Adj (No Diff)
	Base CMA	Climate Aware	Delta	Dividend Yield	Buyback Yield	Base CMA	Climate Aware	Delta	Base CMA	Climate Aware	Delta	Base CMA	Climate Aware	Delta	Currency Adj
US Large Cap	5.45%	6.03%	0.58%	1.23%	1.09%	2.69%	2.63%	-0.06%	1.75%	2.88%	1.13%	-1.36%	-1.88%	-0.52%	0.00%
US SMid	7.19%	7.64%	0.45%	1.16%	0.80%	3.82%	3.74%	-0.08%	1.75%	2.88%	1.13%	-0.41%	-1.05%	-0.65%	0.00%
UK	7.66%	9.04%	1.39%	3.67%	0.00%	2.45%	2.54%	0.09%	1.93%	3.16%	1.23%	-0.98%	-0.96%	0.03%	0.55%
Eurozone	6.31%	7.07%	0.75%	2.21%	0.00%	2.22%	2.38%	0.15%	1.18%	2.18%	1.00%	-1.03%	-1.45%	-0.42%	1.69%
Japan	4.64%	4.89%	0.24%	2.14%	0.00%	2.29%	2.41%	0.12%	-0.18%	0.85%	1.03%	-1.05%	-1.98%	-0.93%	1.44%
Pacific Ex JP	6.62%	7.24%	0.62%	3.24%	0.00%	2.48%	2.68%	0.19%	1.86%	3.00%	1.14%	-0.88%	-1.62%	-0.75%	-0.13%
Australia	6.57%	6.80%	0.23%	3.01%	0.00%	2.18%	2.35%	0.17%	1.87%	2.77%	0.90%	-0.38%	-1.25%	-0.87%	-0.16%
Canada	5.25%	4.54%	-0.71%	2.36%	0.00%	2.12%	2.29%	0.16%	1.42%	2.52%	1.10%	-0.77%	-2.77%	-2.00%	0.08%
MSCI EAFE	6.17%	6.88%	0.72%	2.53%	0.00%	2.30%	2.44%	0.14%	1.06%	2.12%	1.06%	-1.01%	-1.52%	-0.51%	1.26%
China CSI 300	8.48%	10.16%	1.69%	1.77%	0.00%	5.00%	4.94%	-0.06%	2.97%	4.84%	1.87%	-0.13%	-0.35%	-0.22%	-1.28%
Emerging Market	8.15%	9.23%	1.07%	2.35%	0.00%	3.97%	3.99%	0.02%	2.69%	4.02%	1.33%	0.02%	-0.31%	-0.33%	-0.97%
World Equity	5.92%	6.55%	0.63%	1.71%	0.67%	2.72%	2.73%	0.00%	1.68%	2.81%	1.13%	-1.10%	-1.64%	-0.54%	0.20%
World Ex-US Equity	6.67%	7.38%	0.71%	2.46%	0.00%	2.77%	2.88%	0.11%	1.56%	2.70%	1.14%	-0.69%	-1.26%	-0.57%	0.53%

Source: Invesco Investment Solutions, Dec. 31, 2021. Proxies listed in appendix. Forecasts are not reliable indicators of future performance.

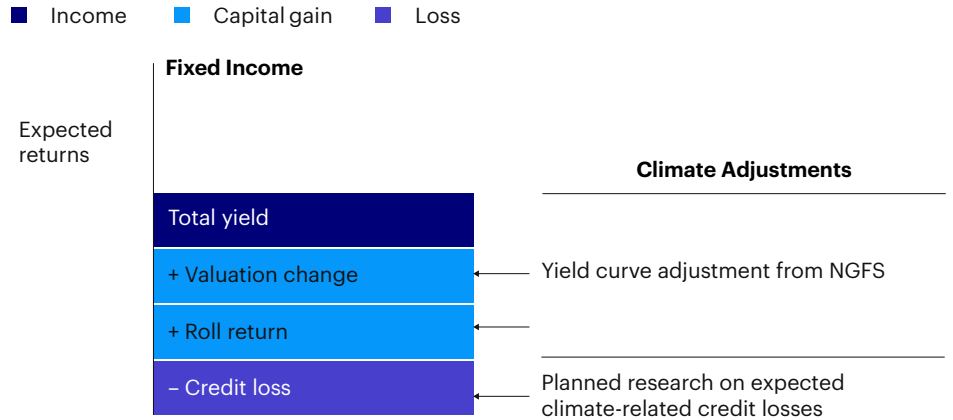
3

Fixed Income

The building blocks for a fixed income CMA are a little different from equities. It includes yield, roll return, valuation change and credit loss. We make climate aware adjustments to the first three: yield, roll return and valuation change (Figure 15).

NGFS provides timeseries data for long-term interest rates and how they are impacted by climate change scenarios. They do this on a country-by-country basis, which is very useful to generating yield curves for markets in various regions. We use their 10-year rate based on their net-zero 2050 scenario to re-estimate the yield, roll yield and valuation change. A future enhancement to our climate-aware building blocks will be to estimate the impact of credit losses which could potentially be large due to stranded assets or physical destruction of property.

Figure 15: Adjustments made to fixed income CMAs



Source: Invesco Investment Solutions, Dec. 31, 2021.

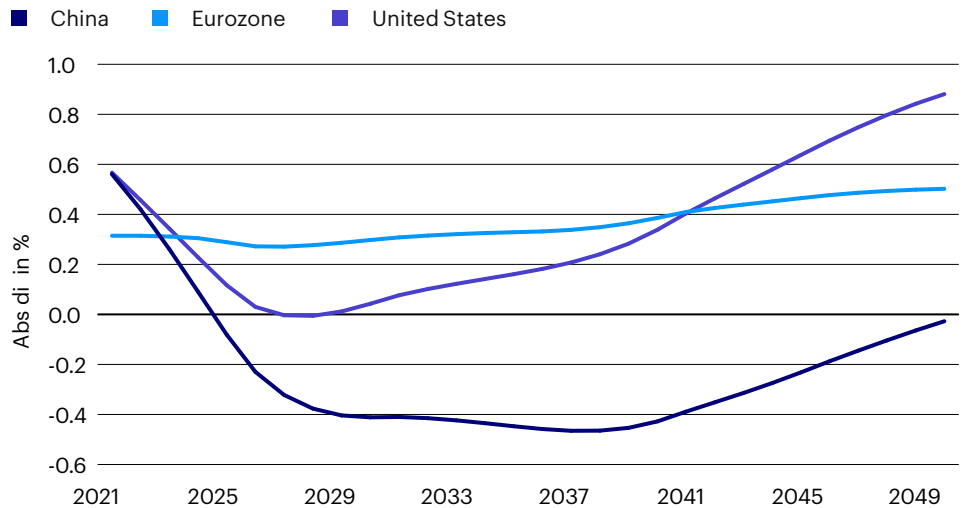
As the world transitions to a low-carbon future in our climate-aware CMA scenario, there may be a cost of carbon, inflationary pressures on the global economy, and potential impacts to fixed income markets.

NGFS provides projected long-term rates for various regions, and in the near term, the difference between their projections and present forward markets is fairly large for markets like China and the US, and slightly less so for the Eurozone. This is probably due to the strong likelihood of large near-term inflationary shocks (see Figure 16) required for the economy to transition that are incorporated into long-term bond yields. This spread then dips, before rising once again in the next five years.



Spreads in interest rates are probably due to the strong likelihood of large near-term inflationary shocks.

Figure 16: Spread in long-term interest rates between base-case and climate-aware CMA

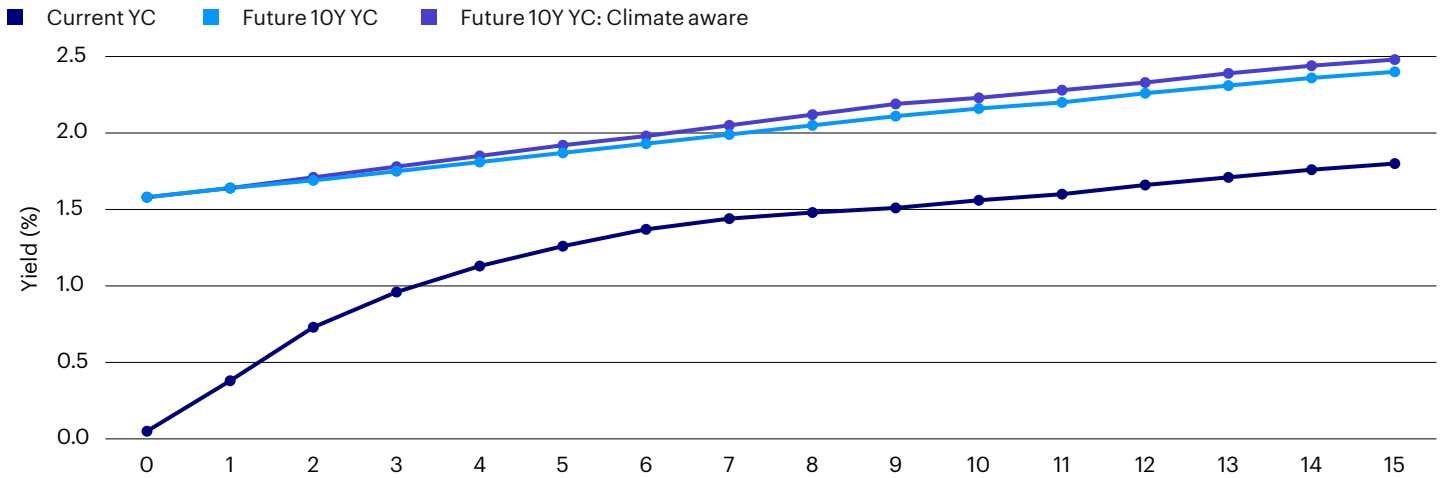


Source: Invesco Investment Solutions, Dec. 31, 2021.

The next step is to take the 10-year interest rate, represented by the 2031 number in Figure 16, and then re-estimate the yield, roll-yield and valuation change building blocks in our climate-aware fixed income CMA.

This is what our climate-aware fixed income CMA captures, which alters the shape and slope of the yield curve. For the US, part of the expected curve is shifted upwards and will likely continue to see upward adjustments (see Figure 16), reducing the valuation building block. China's yield curve however, is shifted downwards, improving valuations.

Figure 17: How the US Yield Curve is transformed by the climate-aware fixed income CMA



Source: Invesco Investment Solutions, Dec. 31, 2021. Forecasts are not reliable indicators of future performance.

Afterwards, we can aggregate these fixed income returns into the asset classes that they represent, as shown in Figure 18.

Figure 18: Climate-aware 10-Year CMAs of various Fixed Income asset classes

	CMA Return			Yield			Roll Return			Valuation Change			Valuation Change Yield Curve			Val Chrg OAS (No Diff)	Credit Loss (No Diff)	Cur Adj (No Diff)
	Base CMA	Climate Aware	Delta	Base CMA	Climate Aware	Delta	Base CMA	Climate Aware	Delta	Base CMA	Climate Aware	Delta	Base CMA	Climate Aware	Delta	Valuation Change OAS	Credit Loss	Currency Adj
China Onshore Credit	2.53	2.48	-0.05	4.16	4.11	-0.05	0.16	0.14	-0.02	-0.27	-0.25	0.02	-0.11	-0.09	0.02	-0.16	-0.24	-1.28
China Onshore Treasury	1.69	1.62	-0.07	2.93	2.77	-0.16	0.30	0.16	-0.14	-0.26	-0.03	0.23	-0.26	-0.03	0.23	0.00	0.00	-1.28
EM Aggregate	3.26	3.27	0.01	4.87	4.90	0.03	0.39	0.42	0.03	-0.81	-0.85	-0.04	-0.40	-0.44	-0.04	-0.41	-1.19	0.00
EM Aggregate Corporate	3.55	3.57	0.02	5.15	5.17	0.02	0.39	0.41	0.02	-0.66	-0.68	-0.02	-0.31	-0.33	-0.02	-0.35	-1.33	0.00
EM Aggregate Sovereign	3.54	3.54	0.00	5.03	5.07	0.04	0.37	0.40	0.03	-0.70	-0.77	-0.07	-0.55	-0.63	-0.07	-0.15	-1.16	0.00
Eurozone Aggregate	1.77	1.78	0.02	0.62	0.75	0.12	0.38	0.48	0.11	-0.70	-0.91	-0.21	-0.42	-0.62	-0.21	-0.28	-0.23	1.69
Eurozone Corporate	2.11	2.17	0.06	1.09	1.17	0.08	0.29	0.36	0.06	-0.59	-0.67	-0.08	-0.27	-0.35	-0.08	-0.32	-0.38	1.69
Eurozone High Yield	4.00	4.05	0.05	4.19	4.24	0.05	0.08	0.11	0.03	-0.70	-0.73	-0.03	-0.19	-0.22	-0.03	-0.51	-1.26	1.69
Eurozone Treasury	2.05	2.05	0.00	0.38	0.52	0.14	0.44	0.56	0.12	-0.46	-0.72	-0.26	-0.46	-0.72	-0.26	0.00	0.00	1.69
UK Aggregate	1.66	1.48	-0.18	1.53	1.64	0.11	0.53	0.53	0.00	-0.84	-1.13	-0.29	-0.54	-0.82	-0.28	-0.30	-0.10	0.55
UK Corp	2.11	2.10	-0.01	2.69	2.79	0.10	0.44	0.53	0.09	-1.11	-1.30	-0.20	-0.43	-0.61	-0.19	-0.68	-0.46	0.55
UK Gilts	1.63	1.44	-0.20	1.17	1.28	0.11	0.50	0.50	0.00	-0.59	-0.89	-0.30	-0.59	-0.89	-0.30	0.00	0.00	0.55
UK High Yield	4.68	4.71	0.03	5.90	5.93	0.03	0.12	0.14	0.02	-0.63	-0.65	-0.02	-0.12	-0.14	-0.02	-0.51	-1.26	0.55
US Aggregate	1.83	1.84	0.01	2.14	2.17	0.03	0.39	0.42	0.03	-0.57	-0.61	-0.04	-0.40	-0.44	-0.04	-0.17	-0.14	0.00
US Bank Loans	4.08	4.08	0.00	5.50	5.50	0.00	0.00	0.00	0.00	-0.48	-0.48	0.00	-0.04	-0.04	0.00	-0.45	-0.93	0.00
US High-Yield Corps	3.09	3.10	0.01	5.70	5.72	0.02	0.35	0.36	0.01	-1.26	-1.28	-0.02	-0.28	-0.29	-0.01	-0.98	-1.70	0.00
US Inv Grd Corps	1.76	1.75	0.00	2.97	3.00	0.04	0.37	0.40	0.03	-1.21	-1.28	-0.08	-0.55	-0.63	-0.07	-0.65	-0.37	0.00
US TIPS	0.70	1.48	0.77	0.96	1.83	0.86	0.60	0.71	0.11	-0.86	-1.06	-0.20	-0.86	-1.06	-0.20	0.00	0.00	0.00
US Treasury	1.50	1.52	0.01	1.51	1.54	0.03	0.39	0.42	0.03	-0.40	-0.44	-0.04	-0.40	-0.44	-0.04	0.00	0.00	0.00

Source: Invesco Investment Solutions, Dec. 31, 2021. Proxies listed in appendix. Forecasts are not reliable indicators of future performance.

4

Using climate-aware CMAs to support strategic asset allocation

The great benefit of using climate adjusted CMAs is that they can be used to construct a climate aware strategic asset allocation model. Climate change and the policies that may be implemented could have a large impact on portfolios. Within Invesco Investment Solutions (IIS), our CMAs are updated quarterly and are a key component in our process for developing multi-asset investment solutions.

Applying these climate-aware CMAs on a balanced portfolio may result in slightly higher equity weights compared to fixed income given the broad nominal increases to the expected inflation component of the earnings building block. Within equities, European and UK markets are likely to be tilted towards at the expense of the US as they have larger positive adjustments coming from earnings and valuations.

5

Next steps For Climate-aware CMAs

This is just the beginning. In the future, we plan on making climate-related adjustments to other asset classes beyond equities and fixed income. For now, our aim in 2022 is to construct green strategic asset allocation models using climate-aware CMAs.

Our present research is focused on making climate-related adjustments to the default probabilities of fixed income assets. Furthermore, we would also like to adjust option adjusted spreads that are used to measure credit risk exposure.

Figure 19: Our future plans for climate research

<ul style="list-style-type: none"> • Applied climate-related adjustments to building blocks of original CMA • Covered most major EQ/FI assets • Constructed green SAA based on climate-aware CMA 	<ul style="list-style-type: none"> • Study climate-related adjustments to default probability and OAS based on Planetrics analytics • Apply climate-related adjustments to liquid alternatives and listed real assets 	<ul style="list-style-type: none"> • Apply climate-related adjustments to private real assets
---	---	--

Source: Invesco Investment Solutions, Dec. 31, 2021.

Should policymakers implement their commitments towards a net-zero 2050 future, our climate-aware CMAs are constructed to capture the impacts in a transparent manner so that investors can account for climate risk in their strategic asset allocations.

Appendix

Asset Class	Index
Asian Dollar HY	BOA ML AC HY
Asian Dollar IG	BOA ML AC IG
Australia Agg	BOA ML Australia Broad Market
Australia Corp	BOA ML Australia Corp
Australia Equity	S&P ASX 200
Australia Tsy	BOA ML Australia Tsy
Canada Agg	FTSE TMX Universe Bond
Canada Corp	BOA ML Canada Corp
Canada Equity	S&P TSX
Canada HY	BOA ML Canada HY
Canada Tsy	BOA ML Canada Gov
Canada Tsy Long	BOA ML Canada Gov (10+ Y)
Canada Tsy Short	BOA ML Canada Gov (1-3 Y)
China Large Cap	CSI 300
China Offshr Credit	BBG Asia ex-JP Credit China IG
China Onshr Tsy	BBG China Tsy TR
China Policy Bk & Tsy	BBG China PB Tsy TR
China RMB Credit	BBG China Corporate
Developed ex-US Equity	MSCI World ex-US
EAFE Equity	MSCI EAFE
EM Agg	BBG EM Agg
EM Agg Corp	BBG EM Corp
EM Agg HY	BBG EM USD Agg HY
EM Agg IG	BBG EM USD Agg IG
EM Agg Sov	BBG EM Sov
EM Equity	MSCI EM
Eurozone Agg	BBG Euro Agg
Eurozone Corp	BBG Euro Agg Credit Corp
Eurozone Equity	MSCI Euro ex-UK
Eurozone HY	ICE BofA Euro HY
Eurozone Tsy	BBG Euro Agg Gov Tsy
Global Agg	BBG Global Agg
Global Agg ex-US	BBG Global Agg ex-US
Global Corp	BBG Global Corp
Global Corp ex-US	BBG Global Corp ex-US

Asset Class	Index
Global Equity	MSCI ACWI
Global ex-US Equity	MSCI ACWI ex-US
Global Gov-Related	BBG Global Agg Gov-Related
Global Gov-Related ex-US	BBG Global Agg ex-USD Gov-Related
Global HY	BBG Global HY
Global HY ex-US	BBG Global HY Corp ex-USD
Global IG	BBG Global Corp IG
Global Infra HY	DJ Brookfield Infra Bond Market Corp Bond HY
Global Infra IG	DJ Brookfield Infra Bond Market Corp Bond IG
Global Sov	BBG Global Sov
Global Tsy	BBG Global Tsy
Global Tsy ex-US	BBG Global Tsy ex-US
India Equity	NIFTY 50
Japan Agg	BBG Global Agg Japanese
Japan Corp	BOA ML Japan Corp
Japan Equity	MSCI JP
Japan Tsy	BOA ML Japan Gov
Pacific ex-JP Equity	MSCI Pacific ex-JP
South Korea Equity	MSCI South Korea
Taiwan Equity	MSCI Taiwan
UK Agg	BBG Sterling Agg
UK Corp	BBG Sterling Agg Non-Gilts Corp
UK Equity	MSCI UK
UK Gilts	BBG Sterling Agg Gilts
UK Gilts Long	BOA ML UK Gilts (15+ Y)
UK Gilts Short	BOA ML UK Gilts (1-5 Y)
UK HY	ICE BofA Sterling HY
UK Large Cap	FTSE 100
UK Mid Cap	FTSE 250
UK Small Cap	FTSE Small Cap UK
US Agg	BBG US Agg
US Agg Credit	BBG US Agg Credit
US Agg Short	BBG US Corp and Gov (1-3 Y)

Appendix

Asset Class	Index
US Broad Market	Russell 3000
US Broadly Synd. Loans	CSFB Leverage Loan
US Gov-Related	BBG US Agg Gov-Related
US HY Corps	BBG US HY
US HY Muni	BBG Muni Bond HY
US IG Corp	BBG US IG
US IG Corp Long	BBG US Long Credit
US IG Corp Short	BBG US Agg Credit (1-3 Y)
US IM Muni	BOA ML US Muni (3-15 Y)
US IM Muni (Taxable)	ICE BOA 5-10 Y US Taxable Muni
US Large Cap	S&P 500
US MBS	BBG US MBS
US Mid Cap	Russell Midcap
US Muni	BOA ML US Muni
US Muni (Taxable)	ICE BOA US Taxable Muni Securities Plus
US Preferred Stocks	BOA ML Fixed Rate Pref Securities
US Small Cap	Russell 2000
US SMid	Russell 2500
US TIPS	BBG US TIPS
US TIPS Short	BBG US TIPS (0-5Y)
US Top 200	Russell Top 200
US Tsy	BBG US Tsy
US Tsy IM	BBG US Tsy IM
US Tsy Long	BBG US Tsy Long
US Tsy Short	BBG US Tsy Short
US Universe	BBG US Universe

Investment risks

The value of investments and any income will fluctuate (this may partly be the result of exchange rate fluctuations) and investors may not get back the full amount invested.

Invesco Investment Solutions develops CMAAs that provide long-term estimates for the behavior of major asset classes globally. The team is dedicated to designing outcome-oriented, multi-asset portfolios that meet the specific goals of investors. The assumptions, which are based on 5- and 10-year investment time horizons, are intended to guide these strategic asset class allocations. For each selected asset class, we develop assumptions for estimated return, estimated standard deviation of return (volatility), and estimated correlation with other asset classes. This information is not intended as a recommendation to invest in a specific asset class or strategy, or as a promise of future performance. Estimated returns are subject to uncertainty and error, and can be conditional on economic scenarios. In the event a particular scenario comes to pass, actual returns could be significantly higher or lower than these estimates.

Important information

By accepting this document, you consent to communicate with us in English, unless you inform us otherwise. This overview contains general information only and does not take into account individual objectives, taxation position or financial needs. Nor does this constitute a recommendation of the suitability of any investment strategy for a particular investor. It is not an offer to buy or sell or a solicitation of an offer to buy or sell any security or instrument or to participate in any trading strategy to any person in any jurisdiction in which such an offer or solicitation is not authorized or to any person to whom it would be unlawful to market such an offer or solicitation. It does not form part of any prospectus. All material presented is compiled from sources believed to be reliable and current, but accuracy cannot be guaranteed. As with all investments, there are associated inherent risks. Please obtain and review all financial material carefully before investing. Asset management services are provided by Invesco in accordance with appropriate local legislation and regulations. The opinions expressed are those of Invesco Investment Solutions team and may differ from the opinions of other Invesco investment professionals. Opinions are based upon current market conditions, and are subject to change without notice. Performance, whether actual, estimated, or backtested, is no guarantee of future results. Diversification and asset allocation do not guarantee a profit or eliminate the risk of loss.

Unless otherwise stated, all information is sourced from Invesco, in USD and as of Dec. 31, 2021.

Further information is available using the contact details shown overleaf.

Important information

This document is intended only for investors in Hong Kong, for Institutional Investors and/or Accredited Investors in Singapore, for certain specific sovereign wealth funds and/or Qualified Domestic Institutional Investors approved by local regulators only in the People's Republic of China, for certain specific Qualified Institutions and/or Sophisticated Investors only in Taiwan, for Qualified Professional Investors in Korea, for certain specific institutional investors in Brunei, for Qualified Institutional Investors and/or certain specific institutional investors in Thailand, for certain specific institutional investors in Malaysia, for certain specific institutional investors in Indonesia and for qualified buyers in Philippines for informational purposes only. This document is not an offering of a financial product and should not be distributed to retail clients who are resident in jurisdiction where its distribution is not authorized or is unlawful. Circulation, disclosure, or dissemination of all or any part of this document to any unauthorized person is prohibited.

This document may contain statements that are not purely historical in nature but are "forward-looking statements," which are based on certain assumptions of future events. Forward-looking statements are based on information available on the date hereof, and Invesco does not assume any duty to update any forward-looking statement. Actual events may differ from those assumed. There can be no assurance that forward-looking statements, including any projected returns, will materialize or that actual market conditions and/or performance results will not be materially different or worse than those presented.

All material presented is compiled from sources believed to be reliable and current, but accuracy cannot be guaranteed. Investment involves risk. Please review all financial material carefully before investing. The opinions expressed are based on current market conditions and are subject to change without notice. These opinions may differ from those of other Invesco investment professionals.

The distribution and offering of this document in certain jurisdictions may be restricted by law. Persons into whose possession this marketing material may come are required to inform themselves about and to comply with any relevant restrictions. This does not constitute an offer or solicitation by anyone in any jurisdiction in which such an offer is not authorized or to any person to whom it is unlawful to make such an offer or solicitation.

This document is issued in the following countries:

- in Hong Kong by Invesco Hong Kong Limited 景順投資管理有限公司, 41/F, Champion Tower, Three Garden Road, Central, Hong Kong. This document has not been reviewed by the Securities and Futures Commission.
- in Singapore by Invesco Asset Management Singapore Ltd, 9 Raffles Place, #18-01 Republic Plaza, Singapore 048619.
- in Taiwan by Invesco Taiwan Limited, 22F, No.1, Songzhi Road, Taipei 11047, Taiwan (0800-045-066). **Invesco Taiwan Limited is operated and managed independently.**