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# Climate Change Scenarios – Implications for Strategic Asset Allocation

## Report Highlights



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“Technologies change, competitive structures change, government policies change, and the way in which they operate change. If we are going to have markets that work well tomorrow, we must be continually concerned that they are going to adapt to new problems and new strategies.”

– North (1999:24)

# Climate change is a systemic risk

Climate change was described by Nicholas Stern as “the greatest market failure the world has seen” (Stern Review, 2007). But relatively little research has focused on the investment implications of climate change at the total-portfolio level and how institutional investors might respond. That is the purpose of this project.

Uncertainty is a key stumbling block in climate-change research. Every link in the chain of manmade greenhouse gas emissions, physical changes in the climate system and their socioeconomic impacts is highly uncertain. Therefore, investors cannot simply rely on a best guess as to how the future will unfold when planning their investments. Moreover, because many of these uncertainties emanate from complex systems that are poorly understood and difficult to model, climate change has been called a problem of “deep uncertainty” (Lempert, Groves et al, 2006).

In this context, deep uncertainty implies that probabilities cannot be assigned to future states with high confidence. This calls into question the appropriateness of relying too heavily on quantitative modelling tools, for which investors must specify probability distributions to underpin the parameters of their investment models.

Institutional investors must develop new tools to more effectively model systemic risks such as climate change. These tools require an expansion of the way we think about portfolio risk, looking beyond mere volatility. Describing probable scenarios, identifying the potential sources of risks, and measuring and monitoring them over time are the components of an improved risk management strategy that seeks to protect the long-term assets that institutional investors oversee on behalf of their stakeholders.

It is in this context that the collaborative group came together to look at the implications of climate change for strategic asset allocation (SAA). Box 1 (on page 5) summarises the role of SAA in the institutional investment management process. Led by Mercer, 14 global institutional investors, the IFC and the Carbon Trust all joined forces to examine what climate change might mean for the underlying drivers of the major asset classes and regions around the world. Grantham LSE/Vivid Economics and a research group composed of specialist practitioners and academics were also involved in parts of the process along the way.



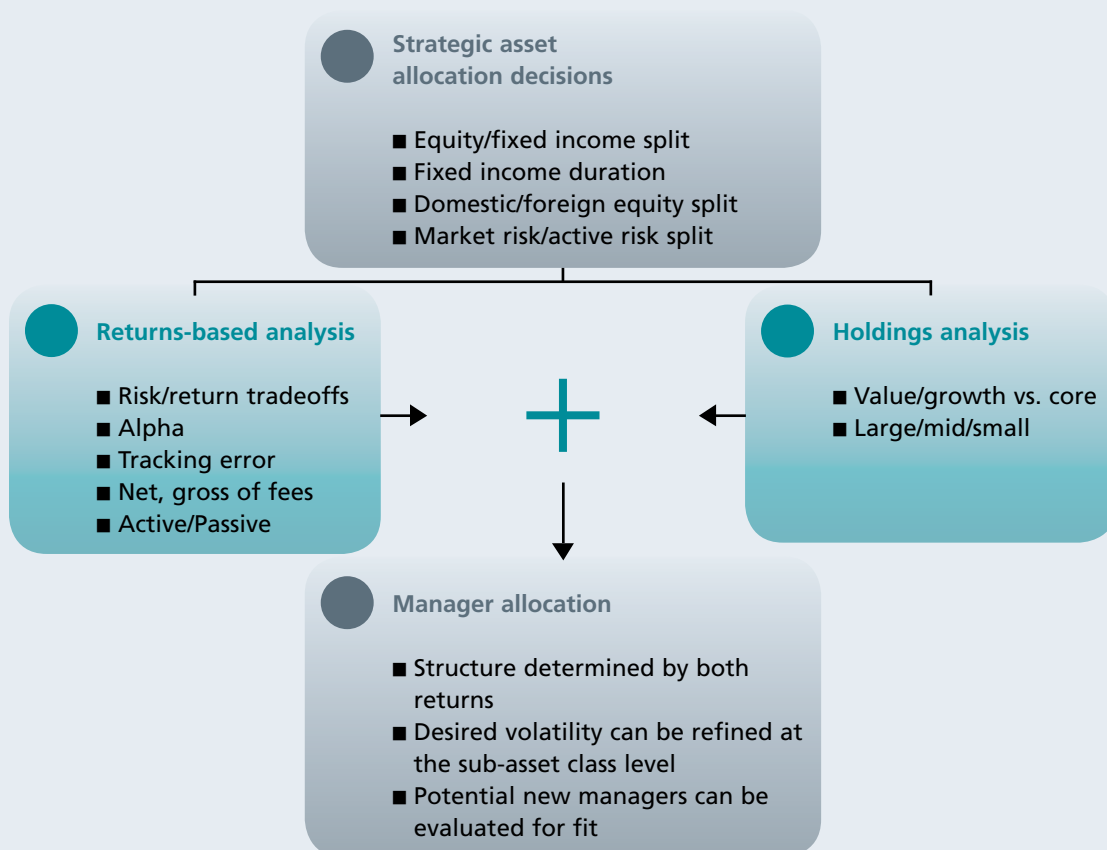
## Highlights Box 1: Systemic risk and the role of strategic asset allocation

SAA can be broadly defined as the use of optimisation tools by asset owners to determine long-term asset allocation benchmarks to achieve their long-term objectives. The objectives vary depending on the type of asset owner and its obligations to beneficiaries or other stakeholders. For example, the objective may be to generate sufficient returns to hedge liabilities, to protect a reserve pool of assets while minimising risk and maximising return, to minimise variations in contributions for sponsors, or to target a certain funding level.

SAA involves making decisions about allocation to high-level asset classes – that is, equity/fixed split, domestic/

international/emerging equity split, duration of fixed income and the split between nominal and inflation-adjusted fixed income, allocation to unlisted assets and sustainability-themed assets. This is distinct from other considerations such as portfolio structuring (including allocation to capital weightings, styles and sectors, and includes active/passive analysis) and manager selection (the evaluation of manager performance in order to select one suitable for a client's requirements).

Below is a visual depiction of the distinction between SAA decisions and other investment decisions.





SAA is a key component of the portfolio management process, with academic research estimating that more than 90% of the variation in portfolio returns over time are attributable to SAA.<sup>1</sup> When considered just in terms of contribution to returns, SAA dominates over market timing and security selection.

This backdrop was relevant for considering the investment implications of climate change, as many investors have, to date, approached climate change primarily from a bottom-up, opportunistic perspective, investing in climate-sensitive securities and assets when opportunities arise. While this is important, it addresses only part of the picture.

Additional consideration should be given to exploring what climate change might mean for the underlying determinants of asset-class risk and return, as well as for overall market risk. Bottom-up analysis may not in itself be sufficient to reveal market shortcomings in the pricing of systemic risks ahead of time, which potentially leaves institutional investors exposed to unexpected adjustment costs from large-scale events, as the global financial crisis has reminded us.

It is therefore prudent for institutional investors to work towards building in, ahead of time (to the extent possible), potentially large-scale systemic risks, such as climate change, into risk management and SAA decision-making processes.<sup>2</sup> This requires the development of a framework to unravel the uncertainties around climate change, combining both top-down and bottom-up tools and processes.



<sup>1</sup> See Brinson et al (1986); Grinblatt and Titman (1989); Brinson et al (1991); Blake et al (1999); and Ibbotson and Kaplan (2000).

<sup>2</sup> See "Beyond the Credit Crisis: The Role of Pension Funds in Moving to a More Sustainable Capital Market" (2009), available at <http://www.mercer.com/referencecontent.htm?idContent=1332305>.



## Traditional asset allocation methodologies do not adequately capture climate change risks

Traditional modelling approaches do not adequately capture the nature of the economic transformation process and the potential source of risks associated with climate change. As such, the tools to integrate climate change into the way we think about SAA risk must be expanded to reflect the following:

- 1. Need to embed climate change risk into asset-allocation processes:** Climate change can have a significant impact on the performance of a portfolio mix over the long term, with the primary source of risk resulting from uncertainty about climate policy and its associated adjustment costs. The findings of this study show that for most asset classes, the impact of climate change varies significantly across different scenarios, contributing as much as 10% to portfolio risk for a representative asset mix. This supports the need for a clear climate policy framework as well as ongoing analysis to build these risks into asset-allocation models.
- 2. Need to look beyond macroeconomic impacts:** The Grantham LSE/Vivid Economics analysis showed that the potential impact of climate change on GDP, interest rates and inflation across the scenarios magnifies beyond 2050 but will not be the driving force behind investment risks before then. Mercer's analysis indicated that the source of investment risk over the coming 20–30 years will result from increased uncertainty about new technology, physical impacts and climate policy (called the TIP™ factor risk framework).
- 3. Need to think about diversification across sources of risk:** To varying degrees, traditional asset allocation techniques optimise portfolio exposure based on assumptions about the risk, return and correlation between asset classes

where diversification across assets is sought. An additional tool for this analytic approach is to think of SAA in terms of diversifying across sources of risk, rather than via asset classes per se. This means utilising a factor risk approach to supplement asset-allocation decision making.

- 4. Need to be more forward looking:** Climate change requires forward-looking analysis and cannot rely on the traditional technique of modelling historical asset-class relationships. This means utilising tools such as scenario analysis.
- 5. Need to go beyond quantitative analysis:** Qualitative factors need to be embedded into the decision-making process. SAA decision-making processes rely heavily on quantitative analysis, whereas much of the investment risk around climate change requires the exercise of judgement about how things might develop in terms of the science of climate change, the policymakers' response and the types of technologies that may or may not prosper.
- 6. Need to review assumptions regarding market risk:** Past periods of economic transformation have been associated with a significant change in the realised equity risk premium (ERP)<sup>3</sup> over time, ranging from destructive war-time periods to positive periods of substantial efficiency improvements arising from a growing service sector and innovations in IT. Assumptions regarding the ERP should therefore be reviewed in light of the potential impacts of climate change on the process of economic transformation that may occur in the transition to a low-carbon global economy.

<sup>3</sup> Broadly defined, the ERP represents the compensation for taking on equity risk versus a risk-free rate.



## A new framework has been developed to unravel climate change uncertainties

Our goal in this project was to develop a framework to put around climate change that will assist institutional investors in their risk management and SAA processes.

The study's time horizon focused on the potential investment impacts out to 2030. The reason for this is that while strategic investment decisions may be reviewed on an annual basis, they are typically set with a 10+ year horizon in mind. The time path of potential impacts out to 2050 was also considered, to provide investors with a sense of how things might evolve.

The key questions to address are:

1. **What investment risks and climate change issues must institutional investors take into account as part of their strategic decision-making processes?**
2. **What impact could climate change have on different asset classes and regions?**
3. **What actions can institutional investors take?**
4. **What are the messages for climate change policymakers?**

Our framework is built on three elements:

- Developing factors to represent the investment impacts of climate change and linking these factors to the key drivers of different asset returns
- Developing climate-change scenarios and an understanding of how climate change and asset classes may respond in each hypothetical scenario
- Building a simple quantitative framework to test the relationships established in the factor analysis and to decide whether any investor action is appropriate

To better analyse the investment impact of climate change, Mercer developed the TIP™ risk factor framework (Figure 1) to examine which factors drive asset-class returns into the following three areas:

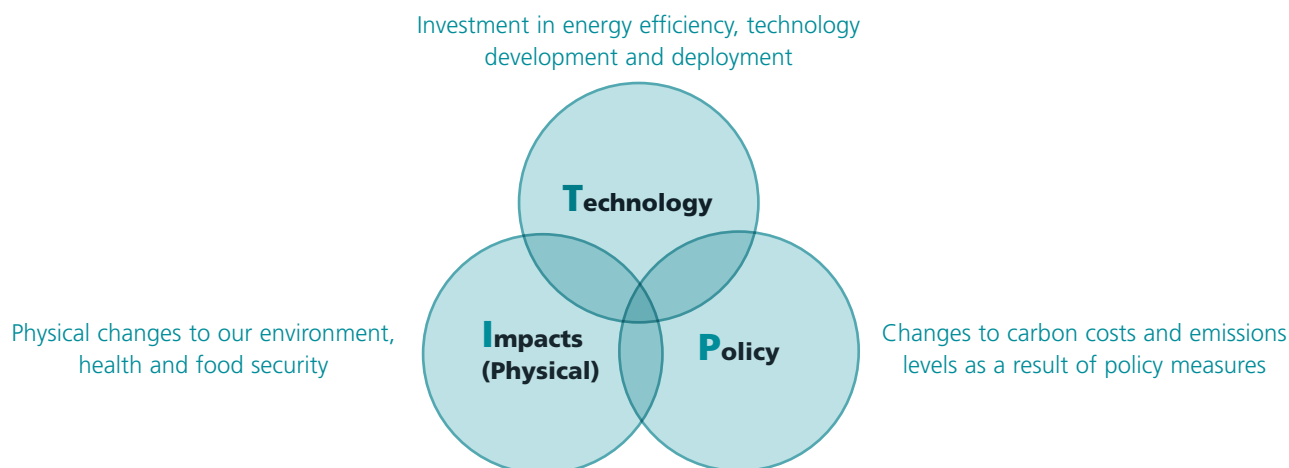
- **Technology (T)** – broadly defined as the rate of progress and investment flows into technology related to low carbon and efficiency, which are expected to provide investment gains
- **Impacts (I)** – the extent to which changes to the physical environment will affect investments (negatively)
- **Policy (P)** – the cost of climate policy in terms of the change in the cost of carbon and emissions levels that result from policy, depending on the extent to which it is coordinated, transparent and timely

These factors are interdependent; hence, the framework cannot be viewed in a linear way. Each factor is a key consideration in future asset performance.

### Highlights Figure 1

**TIP™**=Technology, Impacts and Policy

Factor risk approach to evaluate climate change investment impacts



Source: Mercer





Our goal was not to produce a quantitative analysis that leads to a statistically optimal portfolio for all investors. Indeed, given the uncertainties, we believe that such an aim is unrealistic. Instead, the framework is intended to help investors gain additional insight into the risks within their current investment policies and decide how best to try to manage the added risks arising from climate change.

In considering how climate change might have an impact on a portfolio's asset mix from now until 2030, four scenarios were developed, the key features and outcomes of which are summarised below. The scenarios do not represent a forecast of the future and should not be interpreted in a probabilistic way; rather, they provide a framework for considering the key climate change drivers from an investment perspective over the coming decades. A broad indication as to which scenario is more or less likely to have an impact is indicated in Table 1 (on page 10) to provide some general guidance for interpretation. The likelihood was based on discussions among Mercer, Grantham LSE/Vivid Economics and the Research Group.

- **Regional Divergence** – Some regions (EU and China/East Asia) demonstrate strong leadership in responding to the need to reduce emissions and act locally, with policy mechanisms ranging from market-based to regulatory solutions. Other regions (Russia) fail to respond and continue their high levels of emissions. Some regions (US, India/South Asia and Japan) fall somewhere in the middle, with local initiatives and measures associated with high policy implementation risk. Overall, this scenario involves a high degree of economic transformation and investment in some regions, but the level of uncertainty increases for investors due to the disparate nature of the policy responses across the different regions, increasing market volatility.
- **Delayed Action** – Business as usual (BAU) continues until the year 2020, when rapid policy measures will be introduced that will lead to significant shifts in behaviour that raise the cost of fossil fuel usage dramatically (such as a global carbon tax) and quickly reduce emissions. There is a high degree of economic transformation led by public sector regulation rather than by private sector innovation; this will

necessitate relatively high levels of adjustment costs to comply with the new regulations. After the introduction of regulatory changes, the level of uncertainty regarding climate policy will decline, creating a stronger investment backdrop.

- **Stern Action** – This scenario has been named to reflect the policy response advocated by Nicholas Stern, author of the *Stern Review* (2007). It is the most aggressive scenario in terms of policy response and private-sector innovation. It suggests that there will be swift agreement to a global framework and a very high level of coordination in policy efforts internationally, resulting in a high degree of economic transformation across the global economy, with new investment opportunities as well as risks. The uncertainties are lower than for the other scenarios, as investors are able to predict the pathways of policies with a reasonable degree of confidence, as policies are implemented in a very transparent and orderly manner internationally. This scenario will be associated with a higher economic cost, in order to achieve the level of abatement in emissions; however, the GDP impact is expected to be secondary in driving asset-class returns within our report's time horizon. Less uncertainty for investors about climate policy and new technology investments will be the major drivers of positive transformation.
- **Climate Breakdown** – The status quo prevails in terms of policy, business and consumer behaviour. With continued reliance on fossil fuels, carbon emissions remain high and there is little economic transformation. The investment impacts are hard to predict, although the risk of catastrophic climate-related events increases significantly over time, reaching critical levels towards the end of this century. This scenario brings potentially very high risks for investors over the long term, particularly for regions, assets and sectors that are most sensitive to the physical impacts of climate change.





## Highlights Table 1

Key features and potential outcomes of the climate scenarios to 2030

Scenario	Global policy response	Carbon cost (in 2030)	Emissions levels (now to 2030)
Regional Divergence <i>(Most likely)</i>	<b>Divergent and unpredictable</b> – Framework agreed to succeed Kyoto Protocol – Targets announced of medium ambition	Cost of carbon \$110/tCO <sub>2</sub> e in all countries in this study (EU, US, China/East Asia and Japan) except India/South Asia and Russia	50 Gt <sup>4</sup> CO <sub>2</sub> e emissions per year in 2030 (equivalent to -20% from BAU)
Delayed Action <i>(Close second in likelihood)</i>	<b>Late and led by hard policy measures</b> – Strong mitigation, but only after 2020, when sudden drive by major emitting nations results in hasty agreement – Very little support to vulnerable regions on adaptation	Cost of carbon \$15/tCO <sub>2</sub> e to 2020, then dramatic rise to \$220/tCO <sub>2</sub> e globally (not unanticipated by the market)	40 Gt CO <sub>2</sub> e emissions per year in 2030 (equivalent to -40% from BAU)
Stern Action <i>(Much less likely)</i>	<b>Strong, transparent and internationally coordinated action</b> – Generous support to vulnerable regions for adaptation	Cost of carbon \$110/tCO <sub>2</sub> e globally (anticipated by the market)	30 Gt CO <sub>2</sub> e emissions per year in 2030 (equivalent to -50% from BAU)
Climate Breakdown <i>(Least likely)</i>	<b>BAU; no mitigation beyond current efforts</b> – Very little support to vulnerable regions for adaptation	Cost of carbon \$15/tCO <sub>2</sub> e limited to the EU Emissions Trading Scheme regional schemes and implicit cost of carbon estimates	63 Gt CO <sub>2</sub> e emissions per year in 2030 (equivalent to BAU)

Source: Grantham Research Institute LSE/Vivid Economics

<sup>4</sup> "Gt" refers to gigatonne, which equals 1,000 million tonnes of CO<sub>2</sub>e emissions.



Key findings of climate change impacts on investments

**1. Climate change increases investment risk:** Climate change increases the uncertainty and event risk that could have an impact on the realised returns for risky assets across the scenarios, with higher risk resulting from inefficient policy (see Table 2).

**2. Technology investments could accumulate to \$5 trillion by 2030:** The private-sector response to changing environmental conditions, new technology and policy measures may produce a substantial number of new investment opportunities. According to Grantham LSE/Vivid Economics, by 2050 fossil-fuel use could decline by as much as two-thirds under Stern Action. Figure 2 shows the shift in energy demand and

Highlights Table 2

Impact of scenarios on source of investment risks

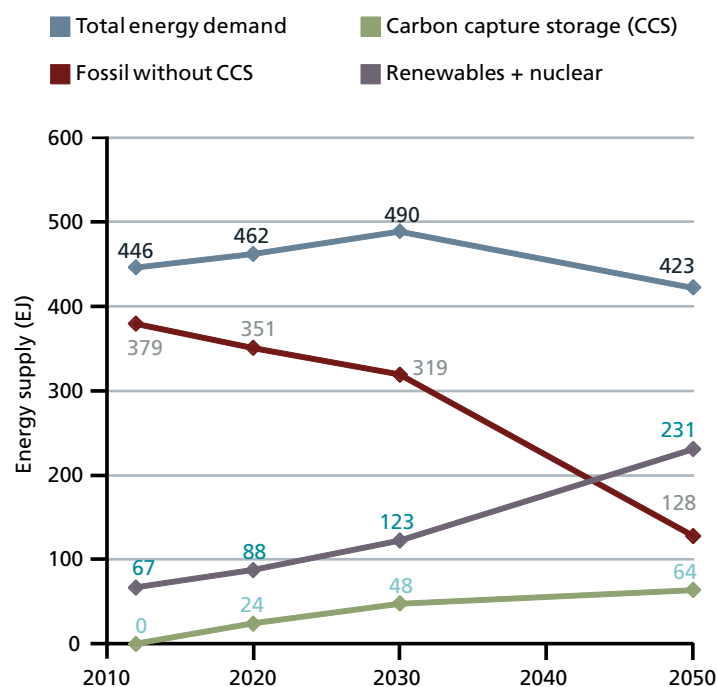
Scenario	Fundamental factors	Market factors	Climate change factors		
	Economic cycle Inflation	ERP Volatility	Technology	Impact	Policy
Regional Divergence	Unchanged	Higher volatility	High dispersion of capital inflow into low-carbon investments; leading countries include the EU and China	Higher risk of future impact costs due to slower reduction in emissions	Higher uncertainty and potentially higher reward for some assets due to regional disparity in climate policy
Delayed Action	Higher inflation Higher interest rates	Higher volatility Lower realised ERP	Business as usual (BAU) investment in low carbon until 2020 when policy measures stimulate flows	Higher risk of future impact costs due to delay in policy response	Higher uncertainty around policy until 2020, then dramatic U-turn reduces policy uncertainty
Stern Action	Unchanged	Lower volatility Higher realised ERP	Clarity on climate policy stimulates strong capital flows into low-carbon solutions	Lower risk of future impact costs due to reduction in emissions	Policy clarity at the global level reduces investment uncertainty
Climate Breakdown	Unchanged	Unchanged; risk of higher volatility	Higher risk attached to low-carbon technology investments due to policy inaction	Higher impact risks due to lack of policy action, rising future costs and market pricing in future policy shift	BAU climate policy (unchanged from today's measures)

Source: Mercer

supply under Stern Action. About two-thirds of the shift is attributable to lower overall energy demand, primarily due to improvements in energy efficiency, while the remaining third results from supply-side changes. Mercer estimates, based on International Energy Agency data, suggest that additional cumulative investment in efficiency improvements, renewable energy, biofuels, and nuclear and carbon capture and storage (CCS) could expand in the range of \$3 trillion to \$5 trillion by 2030 across the mitigation scenarios examined in this study. This presents meaningful investment opportunities that are still in their infant stages.

### Highlights Figure 2

Renewables and nuclear overtake fossil fuels, in Stern Action scenario, by 2050



Source: Grantham LSE/Vivid Economics, based on Edenhofer et al (2009)

### 3. Impact costs could accumulate to \$4 trillion by 2030:

Grantham LSE/Vivid Economics have estimated that the cumulative economic cost of changes to the physical environment, health and food security across the climate scenarios could be in the range of \$2 trillion to \$4 trillion by 2030, with costs rising the greater the delay and the less well-coordinated the policy response. Most adaptation costs come from infrastructure (for example, transport and coastal zone protection, such as flood defence) sectors; though in Africa, water supply and agriculture comprise more than half of all costs (see Figure 3).

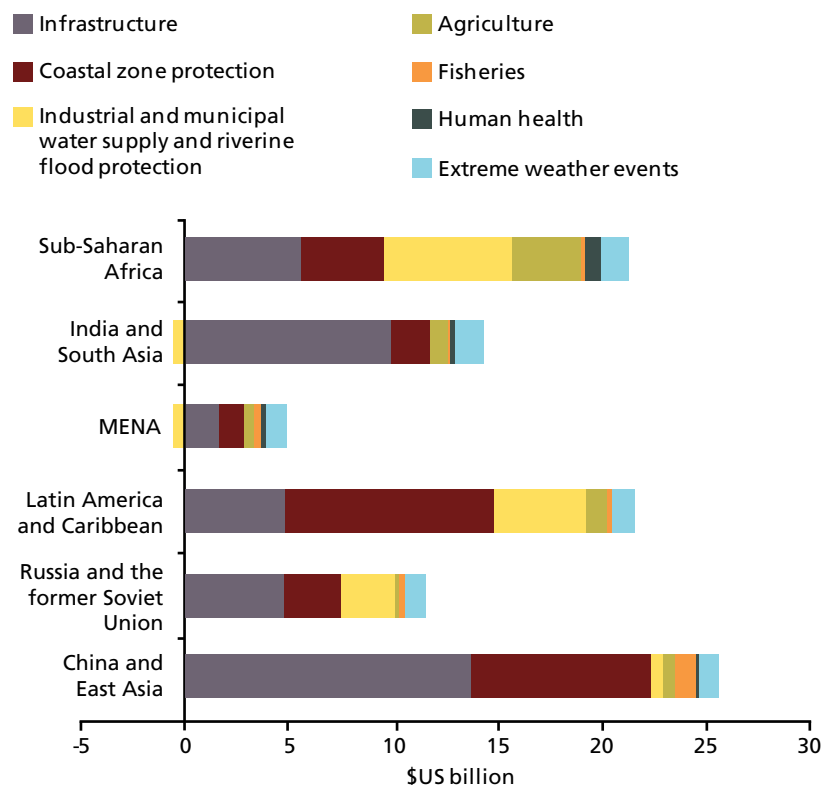
Perhaps the most important issue that is not reflected in these estimates is the impact of climate change in the longer run. Since many of the greenhouse gases emitted today (particularly CO<sub>2</sub>) might still reside in the atmosphere until 2100 and beyond, emissions reductions are required in the short term in order to avoid them. As a result, consistent with the Stern Review (2007), the cost of climate change will rise rapidly after 2050.

It is also important to bear in mind that the direct, economically realised costs of climate change may reflect only a fraction of total costs incurred, particularly in developing countries. Property insurance, for example, is much more extensive in the industrialised world than it is in developing countries, such that many losses in the latter may be uncompensated but nevertheless real. By way of illustration, costs incurred from the Pakistani flood damage in 2010 were calculated to be up to \$43 billion. Climate damage is therefore an important risk for institutional investors to manage, both in terms of asset sensitivity and in terms of influencing policy outcomes to mitigate, and adapt to, these risks.



### Highlights Figure 3

Adaptation costs in 2030 for Climate Breakdown scenario



Source: Grantham Research Institute/Vivid Economics calculations, based on World Bank (2009a)

**4. Policy measures could increase the cost of carbon emissions by as much as \$8 trillion cumulatively, by 2030:** The future cost of carbon emissions increases the longer the policy delay and the less well-anticipated and coordinated the policy action is. Grantham LSE/Vivid Economics has estimated that the cost of carbon could be \$110/tCO<sub>2</sub>e to \$220/tCO<sub>2</sub>e by 2030 across the mitigation scenarios, compared to the current EU Emissions Trading Scheme (ETS) price equivalent

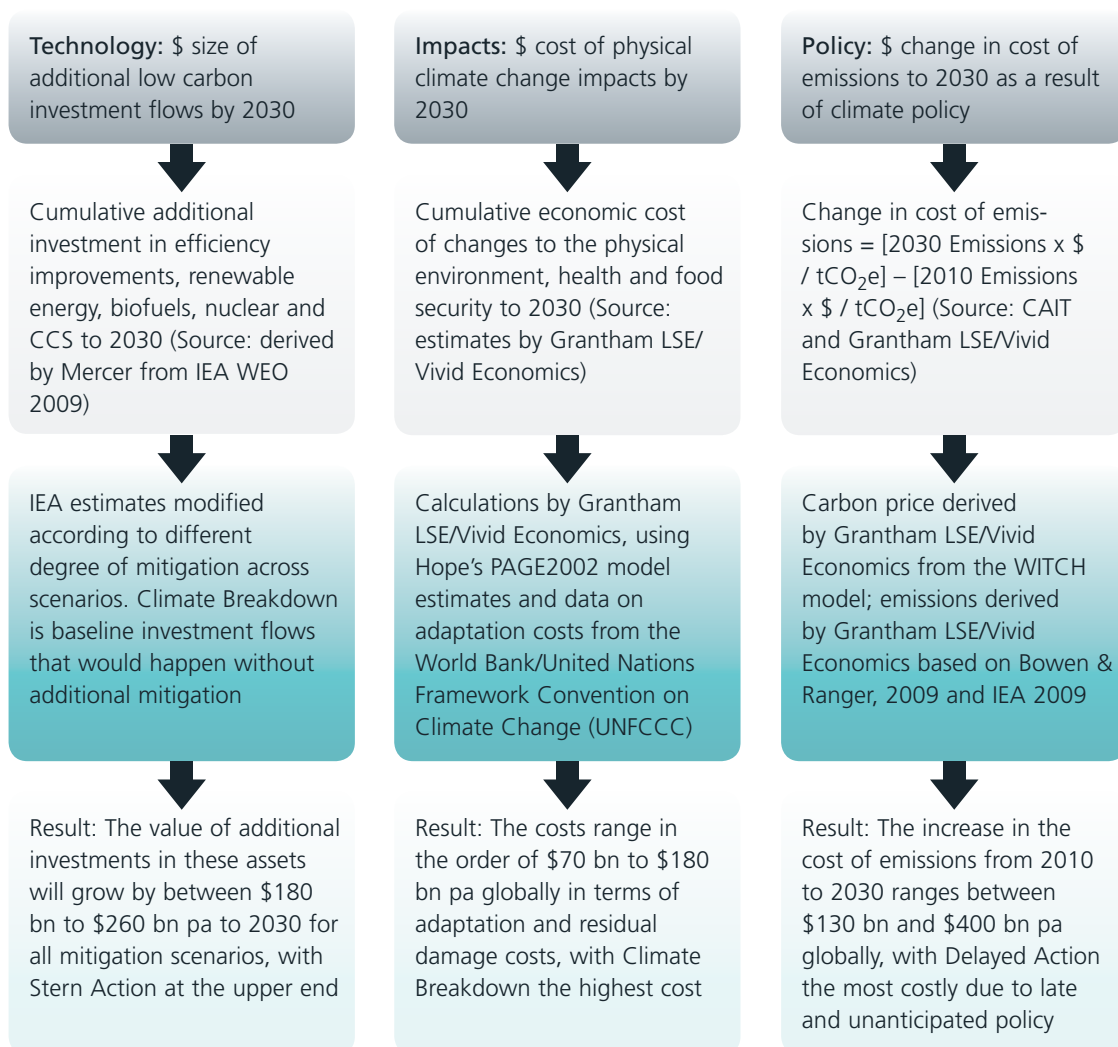
of approximately \$15/tCO<sub>2</sub>e. These costs may be explicit in the market or implicit costs that affect operating costs outside of emission trading schemes.<sup>5</sup>

<sup>5</sup> For a discussion of the implicit price of carbon and estimates, see Vivid Economics, *The Implicit Price of Carbon in the Electricity Sector of Six Major Economies*, October 2010, available at <http://www.interactivemediarelease.com/ogilvy/ClimateInstitute>.



## Highlights Figure 4

Climate change risks – **TIP™** framework formulation



Source: Mercer. The factors have been discounted to the net present value using a 3% discount rate. This was chosen based on a composite of global 10-year bond yields as at October 2010.



**5. Infrastructure, private equity, real estate and some commodities are highly sensitive to climate change:** The results of the asset-class impacts are summarised in Table 3, where the overall sensitivity of each asset-class to the climate-change TIP™ risk factors is presented in the highlighted section at the top of the table, with the direction of the impact (positive, negative or neutral) denoted by the colour.

**6. Sustainable assets could act as a hedge:** As Figure 5 highlights, sustainable assets perform comparatively well across the mitigation scenarios compared to core assets.<sup>6</sup> The exception to this is Climate Breakdown, which is not surprising, as this assumes no further progress on policy from where we are today. Exposure to sustainable-themed equities, efficiency/renewables in listed and unlisted assets, timberland and agricultural land could therefore improve the resilience of a portfolio mix across the climate scenarios.

### Highlights Table 3

TIP™ factor risk sensitivity and direction of impact for asset classes

Sensitivity of the impact: where L = Low; M = Moderate; H = High; VH = Very high sensitivity to the combined climate change factors.

Direction of the impact: where ■ = Positive; ■ = Neutral; and ■ = Negative. Agriculture = agricultural land; RE = real estate; Infra = infrastructure; EME = emerging-market equity; EMD = emerging-market debt; LBO = leveraged buyout; VC = venture capital.

	Listed equities				Fixed income			Commodities		RE	Private equity			Infra	
	Global equity	EME	Sustainable equity	Efficiency/renewables	Global fixed	EMD	Inv grade credit	Agricultural land	Timberland	Unlisted	LBO	VC	Efficiency/renewables	Core, unlisted	Efficiency/renewables
Sensitivity	L	M	H	VH	L	M	L	H	H	H	M	H	VH	H	VH
Regional Divergence	<span style="color: orange;">■</span>	<span style="color: orange;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: orange;">■</span>	<span style="color: orange;">■</span>	<span style="color: orange;">■</span>	<span style="color: orange;">■</span>	<span style="color: orange;">■</span>	<span style="color: orange;">■</span>	<span style="color: orange;">■</span>	<span style="color: orange;">■</span>	<span style="color: green;">■</span>	<span style="color: orange;">■</span>	<span style="color: green;">■</span>
Delayed Action	<span style="color: red;">■</span>	<span style="color: red;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: orange;">■</span>	<span style="color: red;">■</span>	<span style="color: red;">■</span>	<span style="color: orange;">■</span>	<span style="color: green;">■</span>	<span style="color: red;">■</span>	<span style="color: red;">■</span>	<span style="color: red;">■</span>	<span style="color: green;">■</span>	<span style="color: red;">■</span>	<span style="color: green;">■</span>
Stern Action	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: orange;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>	<span style="color: green;">■</span>
Climate Breakdown	<span style="color: orange;">■</span>	<span style="color: red;">■</span>	<span style="color: red;">■</span>	<span style="color: red;">■</span>	<span style="color: orange;">■</span>	<span style="color: red;">■</span>	<span style="color: orange;">■</span>	<span style="color: red;">■</span>	<span style="color: red;">■</span>	<span style="color: red;">■</span>	<span style="color: orange;">■</span>	<span style="color: orange;">■</span>	<span style="color: red;">■</span>	<span style="color: red;">■</span>	<span style="color: red;">■</span>

Source: Mercer. Sustainable equity = broad multi-themed listed equity companies that generate a substantial proportion (typically more than 25%) of their earnings through sustainable activities. Efficiency/renewables assets = both listed/unlisted sustainability themed assets whose core activities are theme specific and more concentrated in terms of exposure than are broad sustainability equity. This includes (but is not limited to) energy efficiency, low energy transport, renewable energy, bioenergy, carbon capture and storage, smart grid, water supply, usage and management, waste management, hydro energy and geothermal, to name a few.

<sup>6</sup> "Sustainable assets" refer to investments that generate a substantial proportion (typically, more than 25%) of their earnings through sustainable activities. At its broadest level, sustainable investment seeks to support sustainable economic development, enhance quality of life and safeguard the environment. This includes sustainable themes such as energy efficiency, low energy transport, renewable energy, bioenergy, carbon capture and storage, smart grid, water supply, usage and management, waste management, hydro energy, geothermal and biofuel, to name a few.

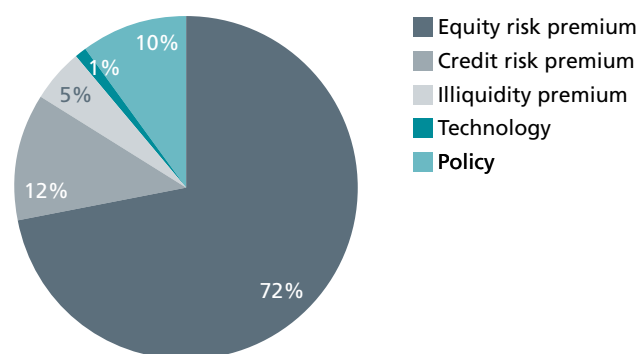
- 7. Climate policy is a significant contributor to portfolio risk:** Understanding the exposure of a portfolio to the underlying return drivers is a key component of strategic decision making, which is what Figure 6 attempts to measure through incorporating TIP™ factor risks alongside more traditional risk factors for a representative portfolio. The existence of risk exposure does not necessarily imply lower returns, as exposure can be associated with superior returns under different market conditions. The aim is to unravel the sources of portfolio risk and diversify across the return drivers, as opposed to simply diversifying between asset classes.

Using Mercer's proprietary Growth Portfolio Toolkit (GPT), the example is calculated on a hypothetical but representative portfolio of a typical asset mix, with allocation of 34% developed large-cap equities, 13% emerging-market equities, 18% global government bonds, 26% investment-grade credit and 9% property.<sup>7</sup> As can be seen, most of the risk comes through the ERP, as the portfolio has a high exposure to equities. This can be improved by allocation to a wider range of assets, as we will see later in this report.

The results show that the climate policy (P) factor of the TIP™ framework contributes 10% to portfolio risk in this example, with technology (T) contributing just over 1% risk. Impact risk (I) does not appear as a contributor to risk. This can be explained by the small allocation to climate-sensitive assets included in this example that have a higher sensitivity to impact risks (real estate, infrastructure and commodities), along with the evidence pointing to a lower variability in the impact risk factor to 2030 (with risks increasing considerably beyond 2050).<sup>8</sup>

## Highlights Figure 5

Contribution to risk for representative portfolio mix



Source: Mercer

- 8. Allocation to sustainable equities, efficiency/renewable assets, timberland and agriculture land could improve portfolio resilience:** Below is an illustrative example of the potential impact of these asset-class sensitivities on a portfolio mix, based on optimisation to a nominal return of 7%<sup>9</sup> that allows for allocation to a wider set of assets. As can be seen, in the Delayed Action and Stern Action scenarios a sizeable allocation to some of the climate-sensitive assets (up to 40% of the total portfolio) is suggested. Opportunistic investments in the Regional Divergence scenario will also be beneficial in the leading regions. Importantly, the risk associated with each scenario varies, too, reflecting the higher level of uncertainty associated with the Delayed Action scenario (14% risk) compared to the Stern Action scenario (9% risk). Climate Breakdown is quite similar to the default case, as it is essentially BAU out to 2030, although future risks will increase dramatically in Climate Breakdown beyond 2050 – hence, a longer horizon would produce more notable differences.

<sup>7</sup> The approach underpinning the growth portfolio toolkit and factor risk approach to asset allocation are explained in the Methodology section (on page 93). Also see Hawker G. "Diversification: A Look at Risk Factors" (2010), available at <http://www.mercer.com/referencecontent.htm?idContent=1378620>. For further explanation of the impact risks, please refer to "Mapping Evidence to Scenarios" on page 75.

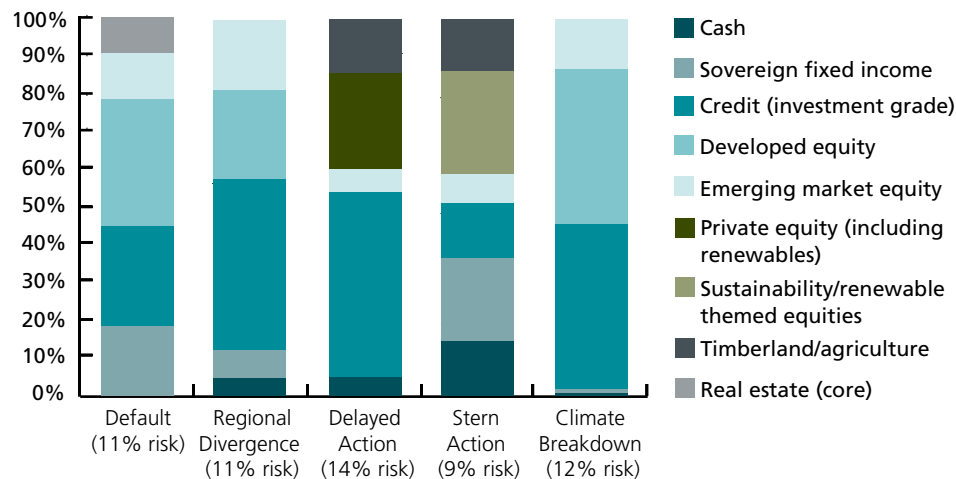
<sup>8</sup> For further explanation of the impact risks, please refer to "Mapping Evidence to Scenarios" on page 75.

<sup>9</sup> The chart shows the optimal portfolio to target nominal return of 7% in each scenario compared to the neutral scenario that does not take climate-risk impacts into account. Risk refers to the standard deviation in returns. The results should not be used to imply that the most appropriate portfolio to meet these objectives is exactly as shown. This will depend on factors such as an institution's existing asset mix, cash rate for the country in which the investor is based, funding position, degree of risk appetite, investment restrictions and any changes to the assumptions made for risk/return and correlations that may be considered appropriate and potentially have a significant impact on results. For example, while infrastructure is not included within the allocations shown in the chart, an allocation to infrastructure may be appropriate based on the rationale provided in this report and the specific opportunities available for investment.



## Highlights Figure 6

Portfolio to target 7% (nominal) return



Source: Mercer

**9. The EU and China are set to lead the low-carbon transformation:** The regions that are best placed to lead the climate change transformation are those that pre-emptively find alternative sources of energy, improve efficiency, reduce carbon emissions and invest in new technology. Indicators of current and future investment flows and policy measures out to 2030 suggest that the “leaders” are likely to be the EU and China/East Asia (see Table 4, with sensitivity at the top and direction denoted by the colour). The potential for low-carbon transformation in the US is also significant in the best-case scenario of Stern Action, but a political impasse on climate change suggests it may lag in the other mitigation scenarios, with “improver” countries, including Japan and India/South Asia, coming through.

While the “do nothing” (Climate Breakdown) scenario may appear to have lower risk than the Delayed Action scenario across the regions, that is because this study focuses on the investment impacts over the next 20 years when the policy

costs will need to be absorbed. Grantham LSE/Vivid Economics point out that the physical impact costs, as well as the policy adjustment costs, will rise substantially in the Climate Breakdown scenario beyond 2050 in the absence of any action.





## Highlights Table 4

TIP™ factor risk sensitivity and direction of impact for regions

■ = Positive; ■ = Neutral; and ■ = Negative in terms of the direction of the impact for investments for each region.

TIP sensitivity	EU	US	Japan	China/East Asia	Russia	India/South Asia
Sensitivity	Moderate	High	Moderate	High	Moderate	Moderate
Regional Divergence	■	■	■	■	■	■
Delayed Action	■	■	■	■	■	■
Stern Action	■	■	■	■	■	■
Climate Breakdown	■	■	■	■	■	■

Source: Mercer assessment as per aggregate estimates, using T, I and P data available at the regional level. Direction of impact derived through a qualitative process.

## 10. Health impacts and population migration risks are underestimated:

These risks can potentially have an impact on long-term liabilities and affect assumptions around mortality rates. At present, the evidence available is not sufficiently strong to draw meaningful conclusions. The health effects will be both positive and negative, and the timing in which they will become pronounced is uncertain. The research on population migration impacts is sporadic and qualitative, and further research will be required to evaluate the potential impact on pension fund liabilities. Grantham LSE/Vivid Economics highlight that the existing studies omit potentially important sources of mortality, including malnutrition and deaths from extreme events. So they are likely to underestimate the increases in illness and death between now and 2050.

## Actions for institutional investors to consider

Institutional investors can respond to the findings of this study in a number of ways. The most important step will be to consider climate change in strategic discussions of long-term investment risks and opportunities. The framework is not intended to provide a simplistic “tick box” solution for investors to apply in a mechanistic way but to help provide a better understanding of the driving forces behind climate

change, the sensitivity of asset classes and regions to these drivers, and the uncertainties that remain, opening the way to further debate and discussion among investment decision makers.

Given the high level of uncertainty associated with climate change, we caution against optimising portfolio holdings to any one scenario presented in this report. Actions to consider:

**1. Understand the risks associated with climate change and embed these into asset-allocation policies.** Monitor the evidence related to climate change in terms of technology, impacts and policy, and discuss what features of the climate scenarios are emerging and what this means for your investments. This could be built into your annual strategic review and risk management assessments.

**2. Evolve and transform portfolio mix.** Rather than optimising to any one scenario as presented in this report, investors could consider a gradual rebalancing of a portfolio towards climate-sensitive assets that are also tilted towards the sustainability theme across infrastructure, private equity, real estate, timberland and agricultural land. This could help to diversify across the sources of investment risk (including climate change) and improve portfolio resilience across the mitigation scenarios.



3. **Allocate to sustainable assets.** An additional response might be an allocation to sustainable investments across both listed and unlisted assets. This could be viewed as a hedge against some of the risks around climate change, particularly climate policy. The risks and opportunities within each asset class, as highlighted in this report, could be used as an initial guide for the selection of the type of investments that might feature in a well-diversified portfolio.
4. **Consider a wider pool of passive options.** Where portfolios are passively managed, consider investing in a wider pool of products against different (environmental) indices to better capture the potential upside and/or help mitigate the risks of climate change. Passive equity investors should consider the index constituents and the weighting attached to sustainability issues when considering benchmarks for their investments. They can also exercise their ownership rights through voting and engagement on climate-change issues, either directly, through third-party agencies or via the provider of the passive index product, where appropriate. Under both the Delayed Action and Stern Action scenarios, for example, an allocation to sustainable equities appeared as part of the portfolio mix.
5. **Engage with active fund managers.** This will help to ensure that your portfolio is better positioned for responding to the uncertainties in a way that helps reduce the risk of being too late, reactive and costly. Ask your fund managers to specify key criteria and pressure points that they will measure and integrate into their investment processes. This might include an ongoing assessment of climate policy developments, cost-of-carbon scenario analysis, the impact of technology flows on risks and opportunities, and an evaluation of any possible risks from climate damage, including on assumptions regarding expected returns such as the ERP.
6. **Engage with companies.** Institutional investors should engage with companies in which they are invested on climate risk management issues to proactively manage the risks. This will include requests for improved disclosure of emissions levels, environmental impact assessments, as well as full disclosure and reporting of sustainability management policies and practices. This can be undertaken collaboratively through initiatives such as the Carbon Disclosure Project, the Water Disclosure Project, the UN Principles for Responsible Investment, or through investor groups such as the Institutional Investors Group on Climate Change (in Europe), the Investor Network on Climate Risk (in the US) and the Investor Group on Climate Change (Australia/New Zealand), to name a few. It could also be undertaken through third-party engagement agencies, via fund managers that are delegated with the management responsibility or, where the assets are managed internally, through asset owners, who can engage directly with investee companies on these issues.
7. **Engage with policymakers.** This study showed that climate policy uncertainty is a notable source of risk for investors over the coming 20 years, contributing as much as 10% to risk for a representative portfolio. Stretching further into the future, the longer the policy delay, the higher the impact costs will be for investors. It is therefore crucial for institutional investors to engage with policymakers on the specific details of policy plans and measures as part of their risk management process, to help protect and enhance the long-term value of the assets they oversee. This should go beyond high-level motherhood statements and should be appropriately resourced and focused on targeting specific policy measures at the local and global levels, to actively manage the policy risk that climate change produces.
8. **Support ongoing research.** Consider areas for further research and look for collaborative opportunities to support these endeavors with academics, policymakers and relevant experts. Some ideas include the following:
  - **Continue to evaluate the impact of climate change on strategic decision making.** This study developed a framework with which to examine climate change and its potential

impact on long-term risks/returns across asset classes and regions. However, institutional investors need to apply the results to their portfolios to evaluate the risks they face and internalise the framework into their decision-making processes. This will also involve supporting the development of new tools and approaches as the climate change data and evidence changes over time.

- **Spend time exploring the best way to build exposure.** The implementation of the findings of this study at the asset-class and regional levels needs to be carefully considered in terms of the right vehicle to use and the preferable approach to take. It is essential for institutional investors to spend time considering ways to allocate to the opportunities across the asset classes in a cost-effective and prudent manner. This means exploring the costs and benefits of investing in funds, fund of funds, co-investments or public-private sector partnerships, and/or making direct investments in projects.
- **Monitor the scientific evidence on the physical impacts of climate change.** The range of uncertainty in projecting long-term climate impacts is wide ranging due to many unknowns in the causal chain of climate impacts. For example, if tensions over water resources increase due to droughts, the result could be social pressures leading to changes in governments, migration and conflict. Costs could easily be much greater than the range estimated in this report. Investors therefore need to monitor new scientific evidence and social pressures related to climate change.
- **Research the impact on pensions of population migration.** This study highlighted the lack of research on the potential impact of climate change on population migration, including what regions will be most affected, how governments are likely to respond and what implications may arise for pension funds around the world. Research of this kind, with the participation of the actuarial community, would enable better analysis of the impact of climate change on liabilities than is currently available.



## Messages for policymakers

The key messages for policymakers from this study are:

- 1. Policy is crucial for mobilising capital.** The policy environment is one of the key factors that investors will consider when deliberating about climate change, as it will be an important signal for future investment in technology-related opportunities and also potential risks associated with changes to the physical environment. Indeed, the risk that investors will attach to such investments under a clear and well-coordinated policy framework is considerably lower than a late or disparate policy approach.
- 2. Make policies clear, credible and coordinated.** Policy design needs to be clear, credible and well-coordinated internationally to attract institutional assets and to help reduce risk premiums assigned to riskier investments. A high level of policy uncertainty will increase volatility and lead investors to demand a higher risk premium on their investments than would otherwise be the case.
- 3. Delay now, pay (more) later.** Our Delayed Action scenario predicts that most core assets will suffer as a result of unforeseen and dramatic policy action. If this situation emerges, investors will demand a higher cost of capital in the future as risk aversion rises. The investment impact of this scenario is negative for all countries/regions – as the future cost of carbon rises, the longer the delay will be, meaning there will be no long-term winners from a delayed response (although some countries may pose a greater investment risk than others). Many investors may be reluctant to invest in low-carbon opportunities until the policy framework is in place, potentially increasing the required rate of return on such investments in the intervening period.







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