HEALTH WEALTH CAREER

PREPARING PORTFOLIOS FOR TRANSFORMATION

ASSESSING THE PROSPECTIVE INVESTMENT IMPACTS OF A LOW CARBON ECONOMIC TRANSITION

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EXECUTIVE SUMMARY

This paper aims to help the growing number of investors committed to or considering committing to the Divest Invest pledge[1] as a means of addressing climate change risks, by assessing the potential impacts of aligning a portfolio with the pledge from an investment risk/return perspective. The paper considers the potential impact of positioning an investment portfolio for a transition to a low carbon economy by shifting assets away from traditional approaches — which typically include exposure to fossil fuels and other carbon-intensive industries — and tilting toward fossil fuel-free (ex-FF) or sustainable alternatives.

Although there are many different ways an investor can manage climate change-related risks or reduce portfolio exposure to carbon, all driven by their own beliefs, this paper focuses specifically on the approach adopted by Divest Invest signatories — namely, divesting from fossil fuel reserve owners and reinvesting in climate solutions (that is, positively allocating capital to areas aligned with the transition to a low carbon economy).

The paper considers the following key questions:

- What financial impact does investing in fossil fuel-free or sustainable investments across different asset classes have under a climate change scenario consistent with a +2°C outcome (the baseline goal of the Paris Agreement)?

- If a transition to a low carbon economy does occur, do these assets exhibit a "Low Carbon Transition (LCT) premium," and if so, what is the best way to measure it?

The analysis uses Mercer's climate change scenarios and risk framework, developed as part of its Investing in a Time of Climate Change research,[2] to determine the impact of reducing exposure to carbon through divestment of fossil fuel reserves and targeting climate solutions under **two different scenarios** modeled over a 35-year timeframe:

1. **Efficient Market** — a scenario using Mercer's standard asset class assumptions and assuming no sensitivity to climate change (i.e., no exposure to Mercer's climate change risk factors: Technology, Resource Availability, Impact of Physical Damages and Policy [TRIP factors]).

2. **Transformation** — a scenario equivalent to a +2°C outcome, representing strong policy developments and increasing investment in low carbon technology.

[1] The Divest Invest pledge can be found here.

[2] www.mercer.com/ri/climate-change-study.

We focus on the outcome under a +2˚C scenario relative to an efficient market. Although many other climate change scenarios representing different warming outcomes could also be considered,[3] these fall outside the scope of this paper on the basis that the relatively swift low carbon economic transition that the Transformation scenario represents aligns best with the theory of stranded assets, which underpins many financial arguments supporting fossil fuel divestment and/or investment in climate solutions.

The analysis considers **three approaches to portfolio positioning** under each of the scenarios:

1. **Base** — assumes a typical asset allocation for a US foundation based on current approaches

2. **Divest** — assumes the same US foundation has taken the decision to divest from fossil fuel reserve owners (within equities)

3. **Divest Invest** — assumes the same US foundation has taken the decision to divest from fossil fuels and allocate to sustainability-themed equivalents across a range of asset classes

In undertaking our modeling, we have had to make several simplifying assumptions, and these are discussed in full in the Appendix. Key assumptions informing our assessment are summarized as follows:

Mercer has defined and modeled the following **"fossil fuel-free" and sustainability-themed asset classes:**

Sustainability-Themed Asset Class	Parent Asset Class	Directional Change in Sensitivity to Climate Change Risk Factors Relative to Parent			
		T	R	I	P
Developed "Fossil-Free" Equity	Developed Equity	=	=	=	+
Sustainable Equity	Developed Equity	+	=	=	+++
Green Bonds	Investment Grade Credit	+	=	=	+
Sustainable Private Equity	Private Equity	++	=	+	+++
Sustainable Infrastructure	Infrastructure	+	=	++	+

These differ from their equivalent parent asset classes only in terms of sensitivity to Mercer's climate change risk factors (that is, all other risk/return characteristics are held constant).

[3] For example, within its Investing in a Time of Climate Change framework, Mercer has also developed scenarios representative of climate pathways of +3˚C (Coordination) and +4˚C (Fragmentation).

- The existence of any LCT premium or penalty is a function of the sensitivity of a given asset class (or mix of asset classes) to identified climate change factors, such as Mercer's TRIP factors, and the expected strength of these risk factors in a +2˚C climate change scenario. For emphasis, any resulting LCT premium or penalty is scenario-specific (and therefore is not equivalent to other investment risk factors [for example, inflation, liquidity] that would apply across scenarios).

- Ex-FF is assumed to reflect the exclusion of fossil fuel reserve owners from relevant regional public equity portfolios.[4] We recognize that there is no standard definition of what constitutes fossil fuels in the industry and that many companies outside the energy sector (where most fossil fuel reserve owners reside) are significant users of fossil fuels and may also be notably impacted by climate change risk.

Key **findings of our assessment**, over a 35-year period, are summarized as follows:

- Under a Transformation scenario, the ex-FF and sustainable variants exhibit improved expected return outcomes versus their parent asset classes (that is, the ex-FF and sustainable variants exhibit an **LCT premium** under a Transformation scenario; as noted above, this premium is scenario-specific and would not be exhibited under all climate scenarios).

- The LCT premium runs from 20 bps (for US Equity ex-FF vs. US Equity) to roughly 200 bps (for sustainable private equity vs. private equity) under the Transformation scenario.

- Although the investment returns of US and international equities ex-FF are still expected to be negative under a Transformation scenario, the loss is much less pronounced than for the equivalent parent asset classes, which maintain exposure to fossil fuels. Reducing fossil fuel exposure in public equity does appear to offer some protection against stranded asset risk.

- At the portfolio level, the strong climate change mitigation seen under the Transformation scenario will come at a cost to the Base portfolio and increases portfolio risk, whereas the Divest portfolio is more insulated from the impact of climate change (that is, divestment proves beneficial under a scenario that envisions a +2˚C outcome). The Divest Invest portfolio, on the other hand, sees a higher expected return under a Transformation scenario than do the other portfolios modeled, suggesting that it is beneficial to reduce exposure to fossil fuels and invest in sustainable assets if a client envisages a +2˚C scenario and believes markets are not pricing in such a scenario today.

In comparing the portfolios, we found the following impacts on investment returns:

	RETURN IMPACT (by Portfolio Relative to Base, Efficient Market Outcome)		
	Base	Divest	Divest Invest
Efficient Market	=	=	=
Transformation	–	+	++

[4] The MSCI ACWI Fossil Free Index excludes all fossil fuel reserve owners and reduces the overall weight of the index versus the ACWI by about 7.5% as of April 15, 2016 (Source: MSCI ESG Research, Inc. Fossil Fuel Divestment: A Practical Guide; September 2016).

We note that these results reflect expectations that under a Transformation scenario there is a supportive political and technological environment for the transition to a low carbon economy. To support development of this analysis, we conducted a broad-based review of existing literature on the impacts of social or environmental divestment and sustainable investment on investment risk/return. Key **findings of our literature review** are summarized as follows:

- Although it has sometimes increased tracking error versus benchmarks and impacted risk/return outcomes in the short term, **divestment based on social or environmental criteria need not negatively impact long-term risk-adjusted return expectations**. This is contrary to popular belief that divestment necessarily entails a return penalty since it involves limiting the investable universe, which flies against a principal tenet of Modern Portfolio Theory (MPT).

- **Considering environmental, social and governance (ESG) factors in investments can improve financial outcomes on a risk-adjusted basis.** This is underpinned by a growing base of evidence linking various measures of ESG quality with the financial outperformance of companies.

These findings helped inform our assumptions and support the findings of our assessment of the impacts of climate change on the **Divest** and **Divest Invest** portfolios.

Our **methodological approach** for developing the results of this modeling exercise relied on asset allocation modeling techniques described in Mercer's prior research[5] and is framed by the following inputs:

- Portfolio asset allocation
- The sensitivity of each asset class to Mercer's TRIP factors
- The projected climate change scenario as estimated in the Mercer model

By comparing the results of the scenario outcomes modeled for each portfolio, we are able to quantify the potential impact of a swift transition to a low carbon economy on asset class and portfolio performance, isolating what we call an LCT premium (or penalty).

The future of climate mitigation action (including global/regional climate policy and continued technological advancement) is uncertain, and we can expect to see a variety of advancements and setbacks on this front in the short term. It should be clear that the LCT premium (or penalty) identified for some asset classes is scenario-specific, with the most significant values resulting from policy and technology shifts in the Transformation scenario. It should also be noted that other climate outcomes are possible: The Transformation scenario is a +2°C scenario consistent with the baseline goal of the Paris Agreement, although this goal will be influenced by global ambition (for example), the Paris Agreement also includes a reference to a more desirable +1.5°C outcome) and political realities (for example, the country emission commitments submitted going into Paris are not yet sufficient to meet a +2°C goal). Other scenarios may warrant further consideration if they are deemed more likely or important from a risk management perspective by fund decision-makers.

[5] www.mercer.com/ri/climate-change-study.

We note that there are a number of limitations to this analysis. For instance, it suggests an asymmetric assessment of carbon risk pricing — either it is priced in or it is mispriced and fossil fuel-exposed stocks will underperform over time. This positioning is deliberate, as, on balance, we think it is more likely that carbon risk is underpriced today than either fairly priced or overpriced. However, we recognize there is a lack of consensus on the extent to which markets are pricing long-term risks like climate change in valuations today.

It should also be noted that this analysis ignores the potential fixed costs associated with transitioning a Base portfolio to a Divest or Divest Invest portfolio, which would vary on a case-by-case basis. Furthermore, our analysis assumes traditional assets could be transitioned to ex-FF or sustainable equivalents immediately, which may not be practical today, given the availability of investable products in the marketplace.

Given these limitations, we expect some of the findings highlighted in this paper to be viewed with skepticism. Specifically, we expect our view that divestment from fossil fuels does not involve a penalty in either of the scenarios modeled may be criticized on the basis of MPT, which is underpinned by the Efficient Market hypothesis and mathematically supports diversification over concentration. Most asset allocation modeling tools in use today are based on MPT and heavily influence/inform most strategic- (total portfolio-) level investment decisions. This speaks to the power of quantitative modeling techniques and their ability to reduce complex systems into more readily interpretable numbers. However, we believe that the full complexity of economies and markets cannot be measured or captured purely in mathematical models and that these models, especially at the strategic- (total portfolio-) level, benefit from qualitative supplementation.[6]

To this end, our climate change modeling methodology is a first and unique attempt to marry a complex risk, which would otherwise be treated qualitatively, into an existing quantitative risk assessment framework to make it more approachable from a risk management standpoint. Ours will not be the only method of assessing climate change risk in portfolios, and we welcome the advent of other approaches. In striving to be "roughly right rather than precisely wrong,"[7] we do not profess that the quantitative values we have developed using our climate change modeling approach are "correct"; but we do believe they are directionally appropriate and offer useful insights that can inform climate change risk management decisions.

For more details on our modeling approach, see the Methodology and Analysis Limitations (sub) sections.

[6] Adopting such a "broader perspective on risk" is consistent with the direction of travel in the wider economic community since the financial crisis. For more information on this subject, see Mercer's prior research: Ignorance Isn't Bliss…The Risks Your Portfolio May Be Ignoring (2015).

[7] Generally attributed to John Maynard Keynes.

2
INTRODUCTION

This paper attempts to answer the following key questions:
What financial impact does investing in ex-FF or sustainable asset classes have under certain climate change scenarios? Specifically, if a transition to a low carbon economy does occur, do these assets exhibit a LCT premium, and if so, what is the best way to measure it?

These questions rest on a backdrop of strident debate in the investment industry around the merits of divesting from fossil fuels and investing in climate solutions.

Fossil Fuel Divestment and Climate Change Risk Management
There is no uniform definition of "fossil fuels" in use today. Some organizations limit their definition to companies in the Carbon Underground 200™.* Some define the sector more broadly to include all reserve owners, as in this paper. Others extend the scope even further to include midstream/downstream operators and, in some cases, fossil fuel–fired utilities.

There are also ways other than divestment from fossil fuels and reinvestment in climate solutions to address climate change risk in portfolios. For a more fulsome discussion of these options, see Mercer's prior research:

- **Fossil Fuel Investments Under the Spotlight** (2015) recognizes that some institutional investors are under increasing pressure to disclose, if not divest, their fossil fuel holdings. This paper outlines possible approaches other than divestment that investors can take to reduce climate change risk.
- **An Introduction to Low Carbon and Fossil Free Passive Equity** (2016) provides an overview of the three broad categories of low carbon indices — broad market optimized, best in class and "ex-FF" along with a summary of the likely investor suitability and appeal of the different approaches.

* http://fossilfreeindexes.com/research/the-carbon-underground.

Divestment has long been a controversial topic and practice in the investment industry. For decades, some institutional investors around the world — encouraged by stakeholders — have chosen to divest from specific asset classes, sectors or companies on ethical and/or financial grounds. The fossil fuel divestment campaign is still very much alive today and represents one of the most significant divestment campaigns on record.

Beyond espousing the adverse moral implications of investing in products that are precipitating climate change, divestment campaigners argue that fossil fuel investments expose institutional investors to the risk of "stranded assets," implying that when industry and/or government act to effect a swift transition to a low carbon economy, many fossil fuel reserves will be sharply devalued. In such a scenario, it also holds that companies in carbon-intensive industries will face margin pressure due to an increasingly high (whether implicit or explicit) price on carbon emissions, which will be required to offset the environmental/social costs associated with activities that are precipitating climate change.

Although this argument has some merit, and although new scholarship on fiduciary duty indicates that "failing to consider long-term investment value drivers, which include environmental, social and governance issues, in investment practice is a failure of fiduciary duty,"[8] there are reasons for investors to take a more nuanced approach to managing climate change risks in their portfolios. Investment professionals often push back against divestment pressure, given a number of theoretical and practical issues with taking such a relatively blunt action in a fiduciary context. Most notably, practitioners typically argue that divestment limits the investable universe, which, according to MPT, inherently reduces long-term risk-adjusted return potential.[9] In addition, investors may prefer to stay invested in fossil fuel companies in order to engage with management and influence change.

Similarly, investors have been grappling with how best to profit from investments in **"climate solutions,"** defined here broadly as technologies that reduce greenhouse gas (GHG) emmissions or improve the resilience of assets against physical climate impacts. Investors harbor many different views on how to position such investments within a portfolio (that is, as a hedge against deterioration in fossil fuel–intensive assets, as a pure source of alpha generation within a thematic portfolio, or as some combination of the two). Questions also persist about the size/diversity of the opportunity set and the ability for investors to access this return theme across asset classes. Past attempts to capitalize on climate solutions have also been hampered by overexuberance (for example, early stage clean tech underperformance in the mid-to-late 2000s[10]) and regulatory risk (as in Spain[11]). This being said, the historical record describing such solutions is limited in breadth and depth, making it difficult to draw any meaningful conclusions about likely prospective performance.

[8] United Nations Principles for Responsible Investment, et al. Fiduciary Duty in the 21st Century; 2016.

[9] We recognize, in addition to risk and return profile changes, divestment typically entails a number of quantifiable fixed costs involved with altering investment management arrangements to comply with newly imposed divestment criteria (for example, setting up separately managed accounts in which screened commingled funds do not presently exist, additional licensing fees for ESG data to implement screens, trading/transaction costs). We do not address these costs in this paper, though they should constitute a key component of any thorough divestment cost-benefit analysis.

[10] http://www.cambridgeassociates.com/wp-content/uploads/2014/02/B-Cambridge-Associates-Clean-Tech-Company-Performance-Statistics.pdf.

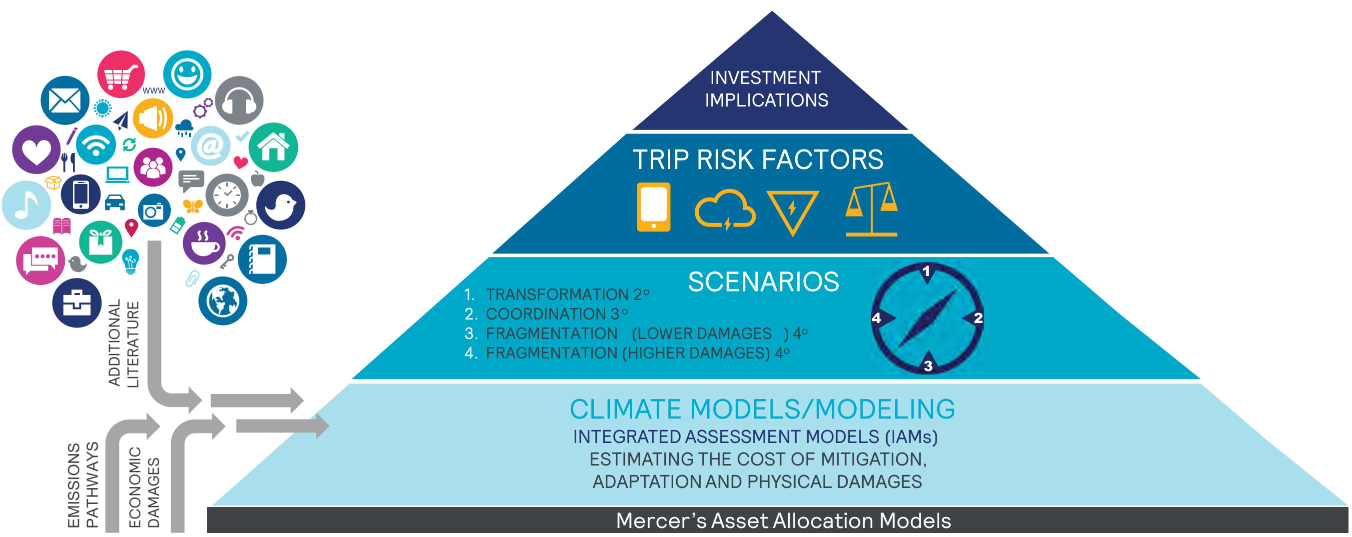
[11] http://www.nytimes.com/2013/10/09/business/energy-environment/renewable-energy-in-spain-is-taking-a-beating.html.

To understand the impact of fossil fuel divestment or investment in climate solutions on portfolio risk/return, practitioners naturally first turn to the historical record, though the question remains as to the extent to which past data can be relied on to make long-term predictions regarding the future impacts of climate change — a phenomenon that has not yet fully manifested and has no comparable proxy in history. It is also unclear to what extent markets are currently pricing climate change into valuations and what potential large changes in policy, technology and weather patterns may unfold over the coming years and decades. Given these challenges, it is helpful for investors to utilize a scenario framework to look forward and ask "What if?"

TRIP CLIMATE CHANGE MODELING FRAMEWORK

To provide investors with a credible means of estimating the potential future impact of climate change on their portfolios, Mercer developed its TRIP climate change modeling framework. This framework is described in detail in Mercer's 2015 report Investing in a Time of Climate Change and summarized here for ease of reference.

Figure 1: Mercer Climate Change Investment Risk Modeling Framework Summary



Source: Mercer

To develop this modeling framework, we started with detailed research into the prospective economic impacts of climate change at the industry sector and asset class levels. This included running several integrated assessment models (IAMs) and undertaking an extensive review of scientific literature, including the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). This research, combined with feedback from our investor sponsors,[12] informed the development of four climate change scenarios and four climate change risk factors.

[12] Mercer's Investing in a Time of Climate Change report was sponsored by 16 investor partners representing $1.5 trillion in assets. This research benefited from the input of approximately 30 consultants across the Mercer organization, consultants at sister companies NERA and Guy Carpenter, and 13 external expert advisors. All partner names are provided in the public report.

The scenarios developed were meant to reflect plausible outcomes and represent a global and broad consensus view of how +2˚C, +3˚C and +4˚C[13] futures may unfold. Ultimately, the +4˚C scenario was split into two — lower and higher damages — to reflect uncertainty regarding the potential physical impacts of climate change under such extreme warming.

Please note that, for the purposes of the analysis featured in this report, we have solely focused on the Transformation scenario rather than also including the two other scenarios considered in Investing in a Time of Climate Change— Coordination and Fragmentation, which are associated with +3˚C and +4˚C outcomes, respectively. This is because results generated under the Efficient Market and Transformation scenarios proved to be the extremes of the range of outcomes generated, and the relatively swift low carbon economic transition the Transformation scenario envisions aligns best with the theory of stranded assets, which underpins many financial arguments supporting fossil fuel divestment and/or investment in climate solutions.

Figure 2: Climate Change Scenarios

	Mitigation	Percentage Fossil Fuels*	Emissions Peak	Temperature Change**
Transformation	Strong	<50%	After 2020	+2°C
Coordination	Substantial	75%	After 2030	+3°C
Fragmentation	Limited	85%	After 2040	+4°C

* As % of energy mix by 2050.
** By 2020, since the preindustrial era.

Once we developed the above scenarios, we addressed the fact that climate change is not one risk but rather a diverse basket of risks that manifest in different ways. These risks can be categorized into two camps — physical risks and transition risks — and the two are inversely related, meaning physical risks increase in significance if a transition to a low carbon economy does not occur, and vice versa. These risks are also time-dependent — physical risks, though occurring now to an extent, are not expected to cause significant economic damage, even under our most aggressive warming scenario, until after the time frame analyzed (35 years). We identified two transition and two physical risks that are captured by the TRIP acronym, as described in Figure 3.

[13] Temperature increase expected by the year 2100 above preindustrial average.

Figure 3: Climate Change Risk Factors

TECHNOLOGY (T)

The rate of progress and investment in the development of technology to support the low carbon economy.

The technology factor captures technological advancement and the opportunity for increased efficiency through technological change.

The speed, scale and success of low carbon technologies, coupled with the extent of transformation and disruption of existing sectors, or development of new sectors, are key considerations for investors.

RESOURCE AVAILABILITY (R)

The impact of chronic weather patterns (e.g., long-term changes in temperature or precipitation).

Resource availability is a new aspect being added to the previous Mercer study to identify how changes to the physical environment might impact investments reliant on the use of resources, such as water and agricultural resources at risk of becoming scarcer or, in some cases, more abundant over the long term as a result of changes to weather patterns. The impacts on agriculture, energy and water are key.

IMPACT OF PHYSICAL DAMAGES (I)

The physical impact of acute weather incidence (i.e., extreme or catastrophic events).

This factor can be interpreted as the economic impact of climate change on the physical environment, caused largely by changes in the incidence and severity of extreme weather events.

Examples include damage to property caused by flooding as a result of sea level rises, damage caused by hurricanes and damage caused by wildfire.

POLICY (P)

Collectively refers to all international, national and subnational regulation (including legislation and targets) intended to reduce the risk of further man-made climate change.

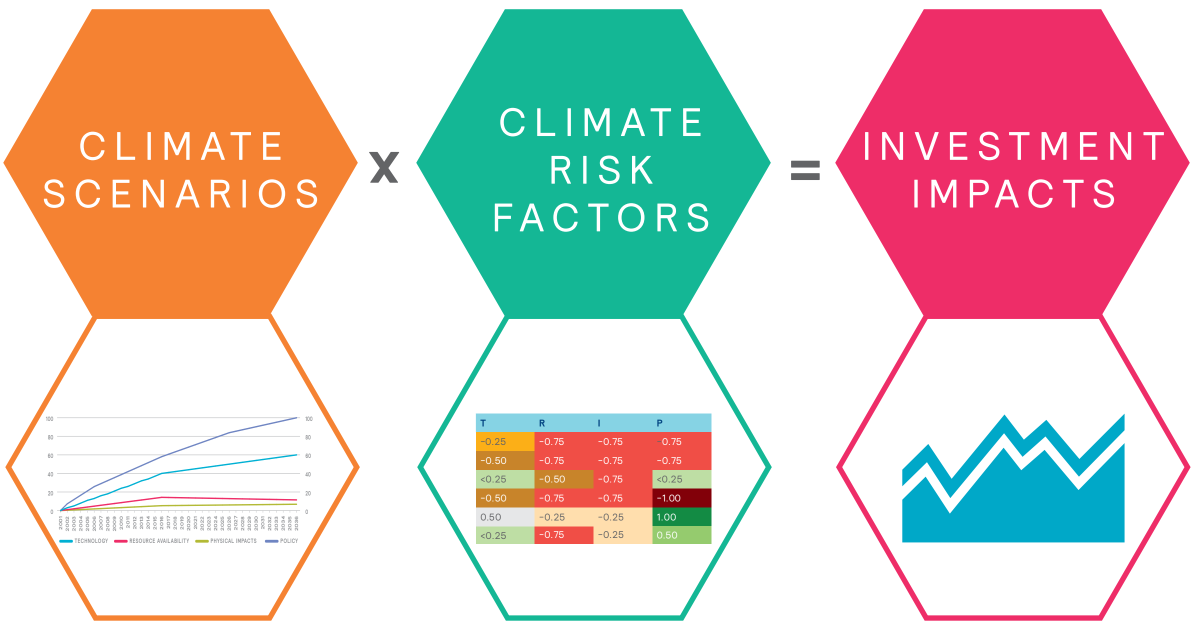
This factor can be interpreted as the level of coordinated ambition of governments to adopt and adhere to policies and regulations to reduce greenhouse gas emissions.

Examples of climate-related policy include greenhouse gas (GHG) emissions targets, carbon pricing, subsidies and energy-efficiency standards.

Policies can be classified into those that focus on the supply side (by encouraging the substitution of high-emission products with lower-emission alternatives) and those that focus on the demand side (by reducing demand for high-emission products).

To embed the TRIP modeling framework into our existing asset allocation model, we quantified each input. Asset classes and industry sectors were each assigned relative TRIP factor sensitivities on a scale of -1 to +1. Under each scenario, the relative influence of each risk factor in each model year was further quantified. Using these inputs and stochastic simulation techniques, we are able to quantify the impact of climate change and produce results for portfolios both with and without the TRIP factors activated.

Figure 4: Climate Change Risk Modeling Process



Source: Mercer

DIVESTMENT ANALYSIS FRAMEWORK

To answer the questions stated in the Introduction section, we employ the TRIP modeling framework as described above to estimate the return impact on sustainable iterations of core asset classes, including US and international equities, investment grade credit, infrastructure and private equity.

These asset classes are analyzed as part of the following three portfolio approaches, each of which has been modeled after the typical asset allocation of a small (<$101 million) US foundation:

1. No action taken to address stranded asset risk (Base Portfolio)

2. Divest from fossil fuels in public equity (Divest Portfolio)

3. Divest from fossil fuels in public equity and at the same time invest in assets with a sustainability focus (Divest Invest Portfolio)

We then run these portfolios through our asset allocation model under two scenarios and compare the results.

1. The first scenario is based on our standard US capital market assumptions. We refer to this scenario herein as the Efficient Market scenario, because it presumes climate change is already fully priced by markets and no opportunity exists for investors to add alpha from a low carbon economic transition.[14]

2. The second scenario applies our Transformation scenario, which estimates the impact of a low carbon transition resulting in a +2˚C climate outcome (and assumes this shift is not currently being priced by markets). This scenario involves sufficient climate policy action and technological advancement to create divergent performance between sustainable assets and their nonsustainable counterparts.

The remainder of this report is structured as follows: Section 2 describes the findings from our literature review, which covers papers from 2012 through 2016. In Section 3 we describe the methodology employed in more detail, noting the link between climate change scenarios, asset class sensitivities to the TRIP factors and portfolios. Section 4 investigates the results from our analysis at both the asset class and portfolio levels, before our conclusions are formed in Section 5.

[14] Similarly, we assume in this scenario that there is no penalty associated with investments in sustainable assets. This is consistent with the mixed evidence from literature that suggests that investing in sustainable assets is unlikely to detract from performance.

3
EVIDENCE FROM LITERATURE

In order to help inform the assumptions for our asset allocation analysis, we surveyed existing literature on the subjects of Socially Responsible Investment (SRI) and ESG investment to determine whether either approach to investing has had an appreciable impact on portfolio risk and returns historically. We divided our literature review into two categories:

1. The first category focuses on the risk and return impacts of SRI approaches. Such approaches typically utilize negative screens to avoid investing in controversial companies or industries primarily on ethical grounds (other approaches, including positive screening and active ownership, do this too). Given that SRIs focus on divestment, this literature serves as a partial basis for understanding the financial impact of divestment, both generally speaking and specifically related to fossil fuels.

2. The second category focuses on the risk and return impacts of ESG investment approaches. Such approaches typically utilize ESG integration or the thoughtful consideration of ESG factors alongside financial factors as a means of informing investment decisions. As ESG investors aim to capture upside and protect downside by considering the ESG performance of security issuers, any financial impact of this approach could be attributable to pricing changes related to sustainability. Herein we apply the results of our survey of ESG investment performance assessments as a proxy for estimating climate change investment performance impacts. Although we recognize climate change is one of many ESG issues, the relatively small subset of investment performance assessments that explicitly address the environmental factor or climate change independently shows similar results to those focused on ESG more generally, underscoring our confidence in this approach.

In this context, we treat SRI and ESG investment approaches as distinct and part of a spectrum of related approaches, though we acknowledge the growing overlap between the two and the many alternate uses of the SRI acronym.[15]

Impact investment — a third category of responsible investment approaches — is another channel through which investors can access sustainable opportunities. It is instructive to think about impact investments as thematic ESG investments made with the explicit intention of achieving an environmental or social outcome alongside a financial performance outcome. To this end, the ability to track and report on such environmental and social outcomes is integral to impact investment and is the reason such investments have historically been made largely in private markets, where access to the "nonfinancial" information of owned companies can typically be higher.[16] Generally speaking, the findings of our literature review related to ESG investment can be considered applicable to impact investment, but research that specifically and robustly addresses the financial performance of impact investments is sparse, and thus we do not draw formal conclusions on this point.

[15] For example, Sustainable and Responsible Investment; Sustainable, Responsible and Impact; etc.

[16] Impact investments are also often small-scale and local in nature, an additional reason for them to be unlisted.

The full extent of our literature review is presented in the Is There a Divestment Penalty (SRI)? and Is There a Sustainability Premium (ESG)? subsections in the Appendix. In summary, we find the following:

- On balance, literature reviewed suggests **there does not appear to be a performance penalty over the long term from the application of SRI criteria generally, or fossil fuel screens specifically, despite the reduction in the number of eligible investments these actions entail**. This said, SRI portfolios may deviate in the short term— in terms of both tracking error and returns, from broader market-based portfolios, and these deviations are influenced by the size of the SRI exclusion and the optimization techniques used to rebalance screened portfolios.

- **The majority of academic studies reviewed point to a positive relationship between ESG factors and performance, empirically supporting the existence of a sustainability premium.** In addition, this conclusion appears to hold and potentially even strengthen for individual ESG factors (for example, the environmental factor) when viewed independently rather than in conjunction, although we recognize that other factors may have a role in explaining observed excess returns otherwise attributed to ESG. We also note that much contemporary analysis relies on past return data and that some concerns were raised by researchers about ESG data quality.

4
METHODOLOGY

Based on the research summarized in the prior section and on prior research conducted by Mercer on the prospective impact of climate change on investor portfolios,[17] we developed a novel framework for the assessment of a potential LCT premium (or penalty) associated with various climate-related investment approaches. This differs from the sustainability premium discussed in the prior section insofar as the focus of our model is on climate change, an integral environmental issue, rather than on ESG factors generally speaking.

Although some studies point to potentially positive excess returns from the positive environmental performance of companies, these are often focused on historical analysis. As climate change foretells fundamental changes to the environment, we may well expect fundamental changes to historical risk/return patterns by virtue of break points and/or gradual shifts in political, technological or physical regimes in the long run. There is also a wide divergence of possible climate outcomes.

As such, Mercer suggests the LCT premium, at least from a climate change perspective, should not be based exclusively on a historical regression analysis, which is typically used as a starting point for general factor analysis where some stationarity in distributional patterns is assumed based on long-term data series. Instead, Mercer suggests the LCT premium may be estimated or implied by the difference between the returns of standard versus sustainable or fossil fuel–free asset classes under different prospective climate change scenarios run over a reasonably long horizon (in this case, 35 years).

Dependent on the appropriate variables, the LCT premium under this framework becomes a function of:

- The projected climate change **scenario**
- The sensitivities of **asset classes** to the TRIP risk factors
- The asset class mix of a given **portfolio**

Please note that, this analysis was conducted on a gross-of-investment-management-fees basis and ignores the potential fixed costs associated with transitioning a Base portfolio to a Divest or a Divest Invest portfolio, which would vary on a case-by-case basis. Furthermore, our analysis assumes traditional assets could be transitioned to ex-FF or sustainable equivalents immediately, which might not be practical in some cases today, given the availability of investable products in the marketplace. See the Analysis Limitations subsection for more detail on the methodology.

[17] www.mercer.com/ri/climate-change-study.

SCENARIOS

Scenario 1: Efficient Market
For the purposes of this paper, we first model what we refer to as our Efficient Market scenario. It is represented by the results of our asset allocation model without the application of any climate change risk factors and refers to our standard US capital market assumptions. It is assumed in this scenario that all assets are properly priced and no return premium or penalty is associated with investing in either –ex-FF or sustainable asset classes. This scenario was chosen because the literature on this topic is generally inconclusive, although we found investing in sustainable assets in general does not detract from performance (assuming those assets are relatively broadly diversified across sectors), and that opinions vary as to what extent the market is currently pricing climate change generally, much less whether it is considering any specific scenario.

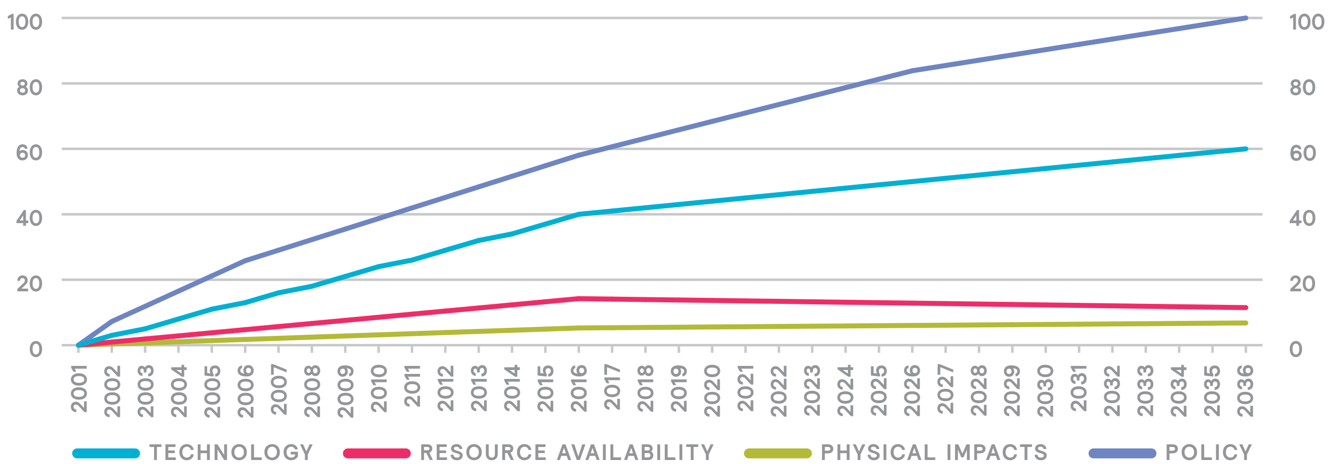
Scenario 2: Transformation
We also conduct an analysis using our +2˚C, or Transformation, scenario with the TRIP factors applied. Transformation was chosen because this is the scenario in which policy and related technological advancements are significant enough to create noticeably divergent performance between standard and sustainable or ex-FF assets.[18] The potential for this scenario to unfold underpins most stranded asset arguments, so comparing it with the Efficient Market scenario outcomes offers a sound basis for quantifying the potential future impact of divestment and/or sustainable investing on portfolio risk and return. This scenario is described in more detail in the following table:

Transformation	
Ambitious and stringent climate change policy and mitigation action put the world on a path to limiting global warming to 2°C above preindustrial temperatures by the end of this century.	
Climate perspective	This scenario reflects an ambitious climate policy agenda and is a critical benchmark. From a scientific perspective, it avoids dangerous climate change, with international climate policy supporting the transformation to a low carbon economy. However, it is a challenging goal to reach. If a Transformation scenario is to occur, time is certainly of the essence, and the actions by countries to fulfill the terms of the Paris Agreement over the coming years will be a crucial signpost as to its likelihood.
Investor perspective	Where change is fast, near-term and significant, investors that have not considered the risks posed by climate change are likely to be caught off guard. A Transformation scenario could cause significant shorter-term market volatility (that is, in the months and years until 2020). Investors that have considered and positioned for the risks and opportunities posed by increased action on climate change should be better positioned than those that have not considered such risks, and they would be expected to benefit from first-mover advantage relative to their peers.

[18] In preparing this analysis, we also tested our +4˚C, or Fragmentation, scenario, whereby the findings were similar to those in efficient markets, implying that a swift transition is required to induce a noticeable LCT premium or penalty.

In our model, climate scenarios are translated into quantifiable terms via a numerical script that defines the relative importance of each TRIP factor in each scenario. The Transformation scenario envisions a relatively gradual on-ramp of climate policies to effect emission reductions and an analogous, though less severe, uptick in technological advancements, as can be seen in the scale and slope of the T and P factor curves in Figure 5. Other pathways to a +2˚C climate outcome could certainly be envisioned (for example, more aggressive policy action during any of the next 35 years, resulting in a more jagged/abrupt P curve), a subject ripe for future research.

Figure 5: Transformation Script – Relative Influence of TRIP Factors Over Time



Source: Mercer

ASSET CLASSES

Mercer expanded its existing research and tools by adding TRIP factor sensitivities for several new sustainable and —ex-FF asset classes. These asset classes and a description of their TRIP factor sensitivity assignments are included in Figure 6. For similar descriptions of other traditional asset classes, please refer to our original study.[19] The sensitivity values for these new and all preexisting asset classes are included in Figure 8.

Figure 6: Sustainable Asset Class TRIP Factor Sensitivity Descriptions

Asset Class	Asset Class Parent	Description of Climate Sensitivity
Ex-FF Equity	Global/ International Equities	Ex-FF equities are expected to be more insulated from the potential impact of climate change policy than are parent asset classes and to be slightly better positioned to capture a premium from technological innovation to support climate mitigation and adaptation. The presumed sector weights for global allocations broadly follow those of the MSCI ACWI Fossil Free Index, which excludes all fossil fuel reserve owners, thereby reducing the overall weight of the index versus the ACWI by about 7.5%.[20]
Sustainable Listed Equity	Global/ International Equities	Sustainable equities are expected to capture upside from a low carbon transition through greater exposure to climate change solutions providers. For this reason, positive sensitivity to T is deemed higher than for parent equity asset classes, and sensitivity to P is assumed to be positive rather than negative as for parent asset classes.
Green Bonds	Investment Grade Credit	The green bond market is currently dominated by government/supranational issuances,[21] but the universe is rapidly evolving. We expect to see more corporate issuance going forward, which is why we have pegged the asset class to investment grade credit for this exercise. Although we would expect sovereign/supranational issuers to be largely insulated from climate change impacts, we expect corporate green bonds to be issued by organizations that have, in general, proactive climate risk management practices overall; thus, we have assigned slightly positive T and P sensitivities. The slightly negative sensitivities to R and I are similar to those for investment grade credit.
Sustainable Infrastructure	Unlisted Infrastructure	Sustainable infrastructure consists of a broad range of projects and solutions, including renewable energy, that would be expected to perform well in a strong policy environment and/or with significant technological innovation and investment. The positive T and P signals for the parent asset class are strengthened in this instance. Due to the relative insulation of renewable energy and other sustainable infrastructure from physical climate events (for example, from the expected growth of distributed energy and the ability to situate facilities away from coasts), the I factor is made less negative than it is for infrastructure.

[19] www.mercer.com/ri/climate-change-study.

[20] MSCI ESG Research, Inc. Fossil Fuel Divestment: A Practical Guide; September 2016 (data cited as of April 15, 2016).

[21] According to the January 2015 Fact Sheet for the Barclays MSCI Green Bond Index, 70% of the index-eligible universe is government-related.

Asset Class	T	R	I	P
Developed Market Global Equity	<0.25	>-0.25	>-0.25	>-0.25
Emerging Market Global Equity	<0.25	-0.25	-0.5	<0.25
Developed Fossil Free Equity	<0.25	>-0.25	>-0.25	>-0.25
Sustainable Equity	0.25	>-0.25	>-0.25	0.25
Low Volatility Equity	0.00	>-0.25	>-0.25	>-0.25
Small Cap Equity	<0.25	>-0.25	>-0.25	>-0.25
Developed Market Sovereign Bonds	0.00	0.00	0.00	0.00
Investment Grade Credit	<0.25	>-0.25	>-0.25	>-0.25
Green Bonds	<0.25	>-0.25	>-0.25	>0.25
Multi-Asset Credit	0.00	0.00	>-0.25	0.00
Emerging Market Debt	0.00	>-0.25	>-0.25	<0.25
High Yield Debt	0.00	>-0.25	>-0.25	>-0.25
Private Debt	0.00	0.00	0.00	0.00
Global Real Estate	<0.25	0.00	-0.75	<0.25
Private Equity	<0.25	>-0.25	-0.25	>-0.25
Sustainable Private Equity	0.40	>-0.25	>-0.25	0.25
Infrastructure	0.25	>-0.25	-0.50	<0.25
Sustainable Infrastructure	0.40	>-0.25	>-0.25	0.25
Timber	<0.25	-0.75	-0.50	0.25
Agriculture	0.25	-1.00	-0.50	0.25
Hedge Funds	0.00	0.00	0.00	0.00

Negative — Positive

The TRIP factor sensitivities for some ex-FF or sustainable asset classes appear to be the same as for their parent asset classes, though this is due to rounding. In each ex-FF or sustainable asset class, the T and P factors are higher than for the parent asset classes. Given the relatively short range of the TRIP factor scale — from -1 to +1 — small variations in values can result in meaningful return impacts over time, especially for the T and P factors, which are significant in the Transformation scenario.

PORTFOLIOS

The three portfolios used for this research are all based from the average portfolio for a private foundation in the US with less than $101 million in assets.[22] The Base portfolio is explicitly tied to this average portfolio, with no adjustments made for ex-FF or sustainable assets, whereas the Divest and Divest Invest portfolios take notable departures. The Divest portfolio allocates all of its US and international equities to —ex-FF asset classes. The Divest Invest portfolio does the same, though it also allocates a portion of its international equity to sustainable assets and migrates its investment grade credit, infrastructure and private equity allocations to sustainable versions as well.

Please note that, some of the allocations envisioned for these model portfolios, such as the allocation to green bonds in the Divest Invest portfolio, may not be advisable or achievable today, given the relatively nascent state of the market for such securities and a limitation of readily accessible fund options (for example, comingled vehicles with low minimums). However, as the markets for such securities continue to grow — green bond issuance, for instance, has grown substantially in recent years[23] — we do expect fund availability to increase apace, making such allocations more feasible.

We should also note that, although not addressed specifically here, other means of reducing carbon exposure exist beyond fossil fuel divestment. For instance, a number of investors have made significant equity allocations recently, tracking low carbon indices[24] as a means of addressing climate change risk. In making individual allocation decisions, institutional investors should consider the full range of climate change risk management options available to help them align their portfolio with the organization's values and protect the portfolio's long-term value.[25]

[22] N=43; 2014 Council of Foundations – Commonfund Study of Investment of Endowments for Private and Community Foundations; http://www.cof.org/news/council-foundations-commonfund-study-reports-lower-foundation-returns-compared-previous-year.

[23] See https://www.climatebonds.net for details on the growth of the green bond market.

[24] For instance, http://www.calstrs.com/news-release/calstrs-commits-25-billion-low carbon-index and http://osc.state.ny.us/press/releases/dec15/120415.htm.

[25] For a more fulsome discussion of low carbon and ex-FF equity investment options, see https://www.mercer.com/our-thinking/an-introduction-to-low carbon-and-fossil-free-passive-equity.html.

Figure 7: Asset Allocation for Model Portfolios

Asset class	1) Typical Small, Private US Foundation Base Portfolio	2) Fossil Fuel-Free (Ex-FF) Divest Portfolio	3) Ex-FF, Including Sustainable Assets Divest Invest Portfolio
US Equity	35%	0%	0%
US Equity Ex-FF (US)	0%	35%	35%
International Equity	13%	0%	0%
Sustainable International Equity	0%	0%	7%
International Equity Ex-FF	0%	13%	6%
Emerging Market Equity	5%	5%	5%
Private Equity	3%	3%	0%
Sustainable Private Equity	0%	0%	3%
Hedge Funds	12%	12%	12%
High Yield Debt	4%	4%	4%
Emerging Market Debt	1%	1%	1%
Real Estate	4%	4%	4%
Infrastructure	1%	1%	0%
Sustainable Infrastructure	0%	0%	1%
Timber/Agriculture	1%	1%	1%
Developed Market Govt. Bonds	5%	5%	5%
Investment Grade Credit	10%	10%	0%
Green Bonds	0%	0%	10%
Cash	6%	6%	6%
Total Assets	**100%**	**100%**	**100%**
Total Growth Assets (Public, Private Equity, Hedge Funds, High Yield, Emerging Market Debt)		**73%**	
Total Real Assets (Real Estate, Infrastructure, Timber/Agriculture)		**6%**	
Total Defensive Assets (Investment Grade Fixed Income)		**21%**	

As we have considered the appropriate scenarios, asset classes and portfolios to include, the next section summarizes the results.

[26] Although several global (inclusive of emerging markets) ex-FF and sustainable equity products exist, product availability exclusively in emerging markets is quite limited, which is why we have not developed ex-FF or sustainable variants of this asset class for this exercise. This represents an area for product innovation, because the carbon intensity of the MSCI Emerging Markets Index is nearly twice as high as the same measure for the MSCI ACWI Fossil Free Index as of December 31, 2015. See https://www.msci.com/documents/1296102/1636401/MSCI_IndexCarbonFootprintMetrics_Q1+2016.pdf/84265752-83ed-4988-8462-731fa06aadc2

5
RESULTS

We ran the three proposed portfolios through two scenarios using our probabilistic asset allocation modeling tools. This produced six sets of portfolio-level results, which are outlined in the following sections. We start by describing the results produced at the individual asset class level before we move on to the total portfolio-level results. We note a key takeaway from both sets of results is the extent to which they are scenario-specific.

ASSET CLASS RESULTS

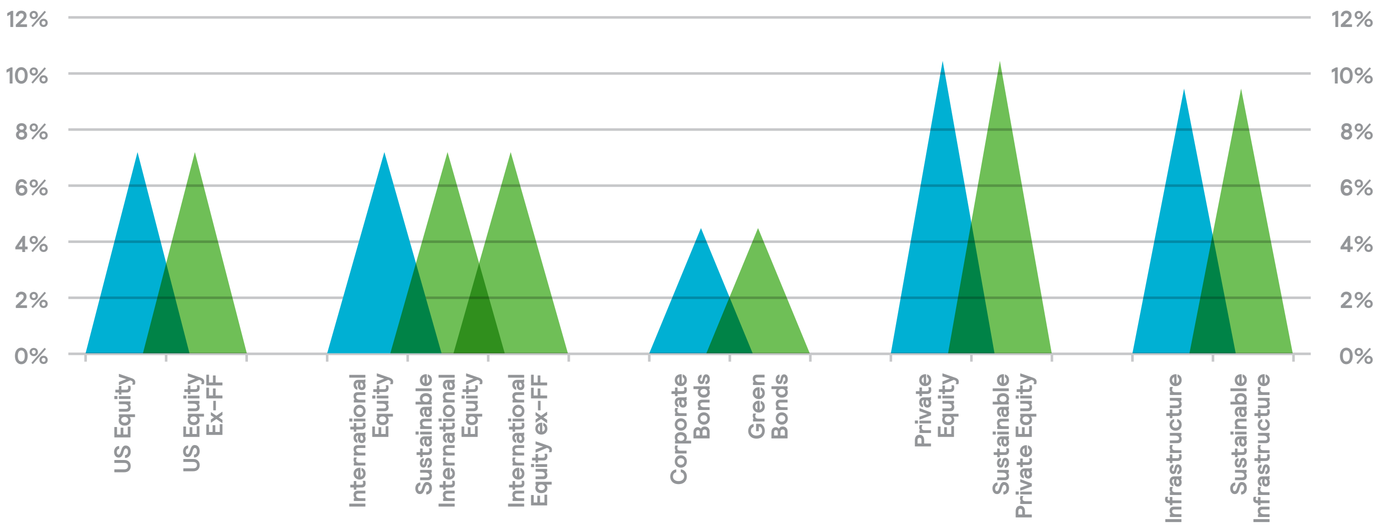
Efficient Market Scenario

In the Efficient Market scenario, asset class returns for ex-FF asset classes are expected to be equivalent to those of standard asset classes. For ex-FF portfolios, this is by virtue of the evidence from literature we reviewed, which indicates that a divestment penalty does not necessarily exist over the long term, despite the reduced stock universe (presuming "reasonable" levels of divestment [that is, generally less than 10% of the investible universe[27]]). Stated otherwise, investors that choose to screen out fossil fuels (or other controversial sectors/companies from their portfolios) have the ability to rebalance or optimize their remaining exposures to reflect desired risk/return characteristics. Although increased tracking error may result from screens in the short run, over a 35-year period such as that modeled for this exercise, we do not expect any appreciable risk or return differences.

Under the Efficient Market scenario, sustainable asset classes are assumed to be invested on a diversified sector basis, similar to the broader market, such that the beta is close to 1. Although, in theory, managers could invest in any number of concentrated stocks or sectors, we make no assumptions on stock or sector concentration and assume the betas offset, as in theory sustainable assets could either add or detract from returns, and the literature is inconclusive. Treating these sustainable asset classes the same way as parent asset classes under the Efficient Market scenario has the added benefit of allowing us to isolate the impact of our TRIP factors, which we use as a means of estimating an affiliated LCT premium.

[27] For reference, the energy sector represented just under 7% of the MSCI ACWI Index as of October 31, 2016 (Source: MSCI).

Figure 8: Returns for Traditional and Ex-FF/Sustainable Asset Classes — Efficient Market Scenario



Source: Mercer

As can be seen in Figure 8 above, under the Efficient Market scenario we assume there is no difference in return between standard assets (blue cones) and sustainable or ex-FF assets (green cones). This would be consistent with the literature, in that there is unlikely to be a return penalty, but also that the evidence on a return premium is, as yet, inconclusive. Please note that these forward-looking annual return estimates are provided on a geometric basis, over 35 years.

Transformation Scenario

Under the Transformation scenario, returns for the traditional asset classes will, in general, be lower than they are under the Efficient Market scenario (Figure 8), as a result of the transition to a low carbon economy (with the notable exception of infrastructure).

Under Transformation, returns for traditional asset classes will, in general, be lower than for sustainable assets as a result of expected policy and technology impacts' positive influence on the latter, although a large range of potential outcomes can reasonably be expected for both climate policy and technology over the 35-years forecast. Thus, the actual size of the LCT premium will depend on the magnitude of policy and technology impacts and is therefore prone to some forecasting error.

The existence of an LCT premium is a function of the asset class, its sensitivities to distinct climate change factors and the strength of these risk factors in a +2˚C/Transformation scenario.

We also note the following:

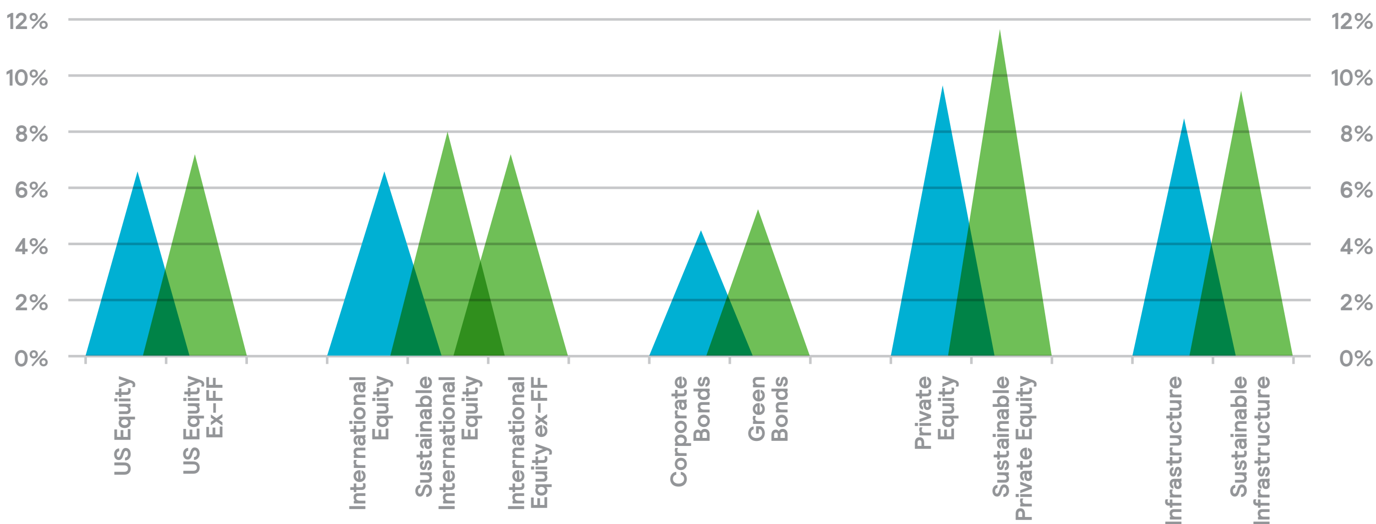
- Investing in ex-FF assets can marginally improve return, compared with standard assets. At the same time, we expect the risk impact to be relatively limited. In some cases, as in listed equities, the risk can slightly reduce as relatively risky sectors, such as energy, are removed.

- Further concentration into sustainable assets (public or private) can increase potential reward under a stringent climate policy environment.

• The findings are directionally consistent with the findings of previous forward-looking macroeconomic literature (EIU, CITI, 2015) that imply climate change is presently underpriced in markets today and thus an LCT premium may exist.

It should be clear that the premium is scenario-specific and, as calculated for the Transformation scenario, it represents the maximum potential benefit from policy and technology. The Transformation scenario is a +2˚C scenario. The Nationally Determined Contributions submitted by individual countries, along with their signatures, to the 2015 Paris Climate Agreement are collectively insufficient to meet this goal,[28] which is why this premium is unlikely to be priced in as yet.[29]

Figure 9: Returns for Traditional and Ex-FF/Sustainable Asset Classes — Transformation



Source: Mercer

Note: Figure 9 is provided for illustrative purposes only; the actual size of any LCT premium achieved will vary depending on the magnitude of actual climate policy and technology advancements over the projected 35 years.

PORTFOLIO RESULTS

Having examined the asset class impact under different scenarios, we now turn our attention to the three portfolios we identified earlier, representing a typical US foundation with assets less than $101 million.

Efficient Market Scenario

Using our standard US capital market assumptions, which assume climate change is already fully priced by markets, the annual estimated return for a typical foundation (in the Base portfolio) is expected to be 7.1% with a 13% standard deviation. Via linear extrapolation of expected returns, a $1 million portfolio would reach just over $11 million in total value over the next 35 years. However, given the portfolio's risk profile, return values year over year are likely to be quite volatile. Investing in fossil free or sustainable assets does not make any difference here, as these asset classes are assumed to have similar returns and risks in this scenario.

[28] http://newsroom.unfccc.int/unfccc-newsroom/indc-synthesis-report-press-release.

[29] Note that under a Fragmentation scenario (or +4˚C scenario, which was separately tested), the premium largely disappears. A small premium remains due to technological advancements that continue, even in the absence of strong policy action. Aperio Group. Building a Carbon-Free Equity Portfolio (2016).

Figure 10: Portfolio Objectives — Efficient Market Scenario

Estimated Annual Portfolio Risk/Return Metrics	Efficient Market		
	Base	Divest	Divest Invest
Return[1]	7.1%	7.1%	7.1%
Risk[2]	12.8%	12.8%	12.8%
Return/Risk	0.56	0.56	0.56
Value of $1M in 35 Years[3]	$11.03M	$11.03M	$11.03M

[1] Geometric mean return over 35 years.
[2] Standard deviation over 35 years. Note that we do not assume different risk levels for strategies specifically to reflect their fossil fuel exposure.
[3] Mean returns compounded linearly over 35 years for each portfolio.

Transformation Scenario

Under the Transformation scenario, because of lower asset class returns in general, the portfolio return reduces for the Base portfolio. However, an allocation to ex-FF or sustainable assets improves the return for the Divest and Divest Invest portfolios versus the Base portfolio. Overall, the return-to-risk ratio is highest in the Divest Invest portfolio when efforts to limit global temperature increases to 2˚C have been enacted.

The best- and worst-performing portfolio on each metric in the dashboard below have been highlighted green and red, respectively, for reference.

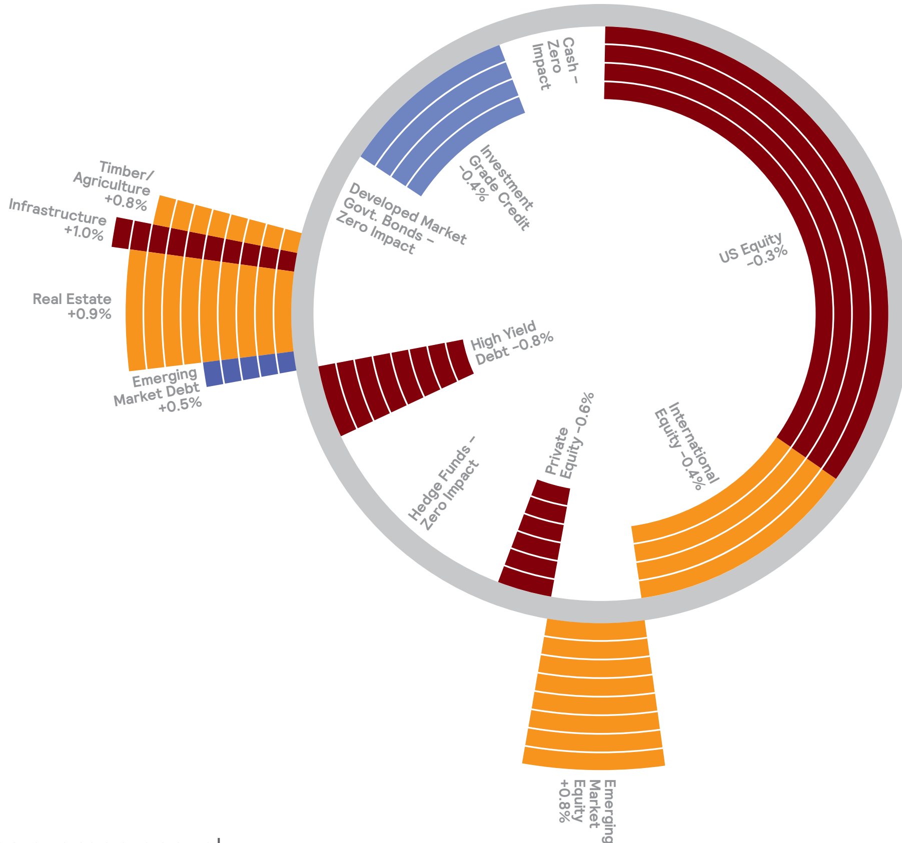
Figure 11: Portfolio Objectives — Transformation

Estimated Annual Portfolio Risk/Return Metrics	Transformation		
	Base	Divest	Divest Invest
Return[1]	7.0%	7.1%	7.3%
Risk[2]	13.0%	12.9%	12.9%
Return/Risk	0.54	0.55	0.57
Value of $1M in 35 Years[3]	$10.68M	$11.03M	$11.78M
Improvement over Base Scenario	NA	3.3%	10.3%

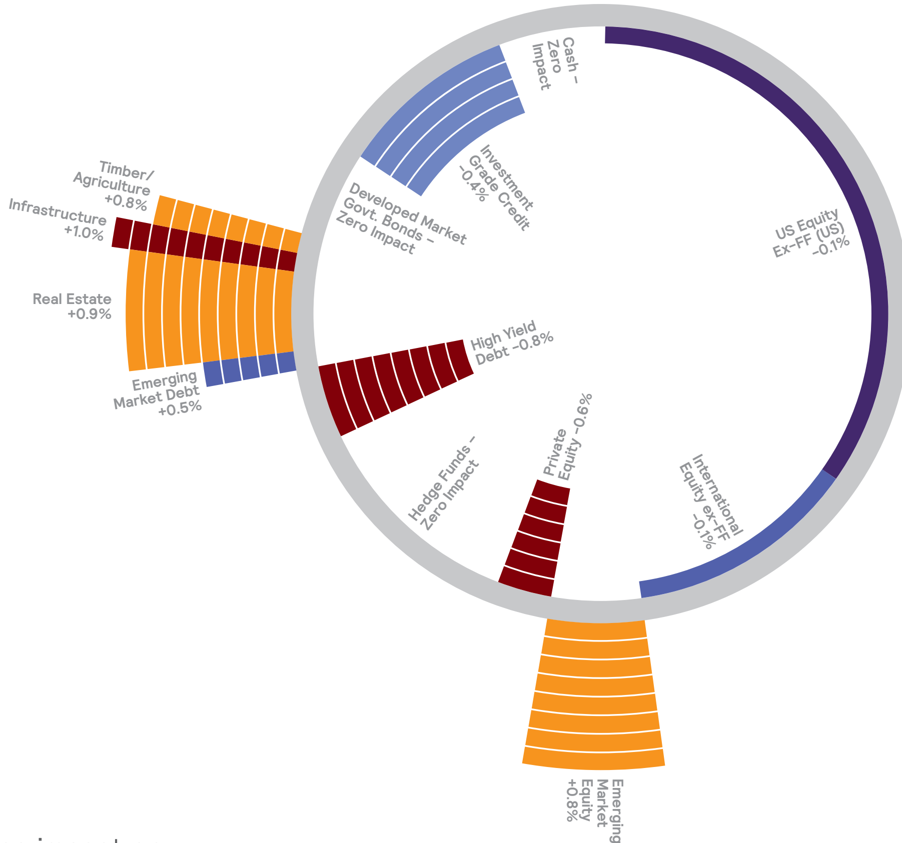
[1] Geometric mean return over 35 years.
[2] Standard deviation over 35 years. Note that we do not assume different risk levels for strategies specifically to reflect their fossil fuel exposure.
[3] Mean returns compounded linearly over 35 years for each portfolio.

Figure 12 compares each portfolio's performance in the Transformation scenario against its performance in the Efficient Market scenario. These circle charts enable a quick visual portfolio attribution analysis — asset class bars moving toward the center of the circle represent negative relative returns, whereas those moving outward represent positive relative returns. The size of the allocation to each asset class (as a percentage) is represented by the width of each asset class bar. Our related findings are discussed in the box beside each portfolio chart.

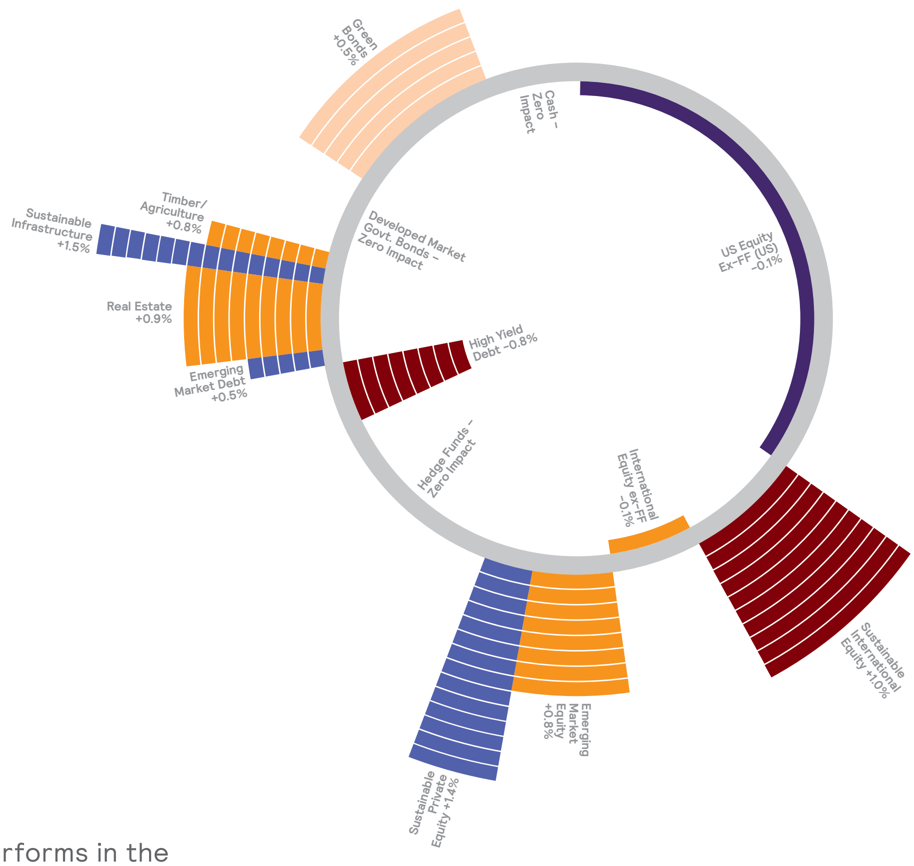
Figure 12: Mean Expected Annual Return Impact by Asset Class Over 35 Years — Transformation Scenario



The **Base** portfolio suffers a 10 bps average annual return loss under the Transformation scenario versus the Efficient Market scenario (a roughly 3% cumulative portfolio loss with annual expected returns extrapolated on a linear basis). This loss is attributable mainly to the portfolio's large allocation to US and international equities, which are expected to see a 30–40 bps drag on average annual returns over 35 years. Allocations to emerging market equity and real assets (inclusive of real estate, infrastructure and timber/ agriculture) provide some positive return benefit to offset losses felt elsewhere. Risk increases nominally.



The Transformation scenario has no impact on overall return in the **Divest** portfolio. Stated otherwise, divestment from fossil fuels in the equity asset classes largely insulates this portfolio from negative impacts associated with a low carbon transition. This represents an improvement versus the performance of the Base portfolio under the Transformation scenario. The difference between the two portfolios is observable in the circle chart to the right, which shows the US and international equities ex-FF asset classes suffering only a 10 bps drop in average returns versus 30–40 bps in the Base portfolio.



The **Divest Invest** portfolio outperforms in the Transformation scenario over the Efficient Market scenario by a 20 bps margin annually and almost 7% cumulatively over 35 years. This increase in returns is attributable largely to the portfolio's allocations to sustainable asset classes, which are expected to outperform in the Transformation scenario by 100–150 bps over the Efficient Market scenario. Only high-yield debt and the ex-FF equity allocations in this portfolio experience negative returns under the Transformation scenario. Risk increases nominally.

- In summary, although the portfolio impact of climate change can at first appear marginal in terms of return and risk, it can potentially have a meaningful impact on the probability of the portfolio meeting its long-term return and risk objectives, especially if the current low-yield environment persists.

- Investing in ex-FF assets improves portfolio return and risk, compared with the Base portfolio, because some carbon-intensive assets — which would be lower-returning and more volatile under the Transformation scenario — are removed. As a result, the Divest portfolio performs similarly in both scenarios modeled, implying that divesting from fossil fuels in public equity is not expected to adversely affect returns in either scenario.

- Under the Transformation scenario, investing in sustainable assets can increase probabilities of meeting returns, although it is more risk-neutral for listed markets and more risk-seeking if allocations are concentrated in sustainable private markets. If a favorable policy and technology scenario is envisaged leading to a +2°C outcome, then ex-FF and sustainable assets are expected to benefit, whereas traditional assets with exposure to fossil fuels and carbon-intensive industries will suffer.

6
CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Climate change represents a potentially material risk for investors, but it challenges typical investor risk assessment methods and risk management applications, given the time horizon over which it is expected to unfold and the complexity of its potential economic impacts. Many efforts made to date to understand the potential impact of climate change on portfolios have relied on historical regression analysis for quantification. However, the merits of this approach rely on the persistence of historical trends, whereas climate change is unprecedented in history, as are the industrial and political shifts it is likely to eventually engender. Existing long-term, forward-looking analyses are few and far between, and those that do exist are typically macro in scope and thus do not provide investors with particularly useful metrics.

To address this issue, we set out to develop an experimental, forward-looking framework for quantifying the impact of climate change on investment portfolios. The result of this exercise was Mercer's proprietary climate change modeling approach, which we developed in conjunction with 16 institutional investors in 2015, enabling climate change impacts to be quantified at the total portfolio, asset class and industry sector levels for the first time. The research highlighted in this report builds on this framework, establishing new ex-FF and sustainable asset classes to inform the quantitative assessment of various climate change risk management approaches and their likely future portfolio impacts.

Mercer suggests the existence of a LCT premium to be a function of the sensitivity of a given asset class (or mix of asset classes) to identified climate change factors, such as Mercer's TRIP factors — Technology, Resource Availability, Physical Impacts and Policy — and the expected strength of these risk factors in a +2˚C climate change scenario. Under such a Transformation scenario, returns for traditional asset classes are expected, in general, to be lower than those of sustainable assets, as a result of expected positive policy and technology impacts on the latter, although a large range of potential outcomes can reasonably be expected for both climate policy and technology advancements over the 35-year forecast.

The Divest portfolio — an average small US foundation portfolio with diminished exposure to fossil fuels — is largely insulated from the negative impacts of the economic transition needed to achieve a +2˚C outcome, experiencing higher expected returns than the Base portfolio, but with similar risk. The Divest Invest portfolio, which has diminished fossil fuel exposure and allocations to sustainable assets, exhibits an improved risk/return profile and increased portfolio returns compared to the more traditionally managed foundation Base portfolio. These findings suggest that if a favorable policy and technology scenario is envisaged, leading to a +2˚C outcome, then both fossil fuel divestment and sustainable investment should be considered by investors to improve portfolio results.

RECOMMENDATIONS

Our broader research suggests divestment is not the only option available to investors concerned with climate change risk. When assessing the potential to divest and/or invest in sustainable asset classes, a holistic approach should consider the potential impact of a portfolio action on the following factors:

- **Risk** — impact on absolute risk and tracking error
- **Return** — impact on asset class return and portfolio performance
- **Reputation** — impact on investor reputation and stakeholder expectations
- **Cost** — transition/opportunity cost incurred by divesting from carbon-intensive assets or investing in sustainable assets, and differences in manager fees going forward

An appropriately nuanced approach acknowledges the economic future may be drastically different from the past, resulting in differential performance among industry sectors and asset classes over different time horizons and across diverse portfolios.

A Sustainable Growth Framework

Understanding the impact of climate change on strategic asset allocation is important. However, it is just one step among a host of others that investors should consider in making their portfolios resilient to the impacts of a material, long-term ESG risk like climate change. In addition, investors should consider the following actions to ensure their beliefs, policies and portfolios are all positioned for success in the face of such unprecedented change:

- **Governance:** Recognize climate change explicitly within investment beliefs, investment and/or ESG policy documents, voting and engagement guidelines, investment monitoring report templates and external stakeholder reports.
- **Bottom-up portfolio risk assessment:** In addition to the top-down analysis highlighted herein, asset owners should consider conducting a carbon footprint of their public equity and corporate debt portfolios. Such an exercise may also entail a deep dive of sector biases in active equity and debt portfolios. This information can yield valuable information for engagement with fund managers and owned companies, as well as reveal concentration risks. We also recommend a geographic environmental assessment of real asset holdings.
- **Active ownership:** Using the information gleaned from various portfolio risk assessments, engage with managers and securities issuers on the potential risks identified as priorities in the Mercer TRIP analysis. Risk reduction potential could be achieved through ESG and climate due diligence, as well as voting/engagement processes.
- **Allocation to sustainability:** Opportunities cover both climate mitigation and adaptation themes, including low carbon investments, clean energy, water, agriculture and broad sustainability.

Investor tools and approaches for assessing, managing and reporting on climate-related risks and opportunities are quickly advancing. We hope this research makes a helpful contribution to the industry landscape and encourages investors to think more about how decisions to divest from fossil fuels or invest in climate solutions could influence their portfolio outcomes under various climate change scenarios.

7

APPENDIX

IS THERE A DIVESTMENT PENALTY (SRI)?

Socially Responsible Investing (SRI) approaches typically involve the exclusion of securities from a portfolio based on ethical concerns and utilize criteria relating to a company's products, activities or policies to implement these exclusions (negative screening). Many investors are concerned that such exclusions may have a negative impact on an investment portfolio's risk-adjusted returns over the long term. According to the principles of Modern Portfolio Theory (MPT), a reduction in the investment universe will diminish diversification and thereby reduce the average expected return (for a given level of risk) of a portfolio relative to one that does not have these exclusions.

This section reviews the available academic literature to evaluate whether there has been evidence of lower investment returns due to the application of exclusionary criteria, including divestments from fossil fuels.

A recent report by Aperio (2016) looked at the impact of fossil fuel divestment on portfolio risk by excluding carbon industries from standard equity market indices and optimizing the remaining securities to more closely mimic index returns. Back tests were run for major indices in Australia, Canada, the US and globally, over periods varying from 11 to 25 years.[30] The analysis focused specifically on tracking error (TE), which indicates how closely the returns of the screened portfolios follow their respective indices. The authors found that an exclusion of carbon industries did not negatively influence the index tracking portfolio's return potential and that the impact on overall risk was less than expected. The strategies also evidenced relatively low TE versus the relevant benchmarks (0.75% for the screened global index). This was mostly consistent across regions, although markets like Canada, with high sector concentrations (20.6%) in oil, gas and consumable fuels, showed more significant TE (2.91%).

Research commissioned by Newton (2016) explored the impact of applying "sin screens" (on tobacco, alcohol, weapons, pornography and gambling) and fossil fuel screens on investment portfolios.[31] The analysis covered 10,000 stocks in 28 developed and emerging markets, and 1,283 US bond issues over a sample period from 2004 to 2015. The study revealed that whereas sin screens had generally reduced

[30] Aperio Group. Building a Carbon-Free Equity Portfolio (2016).

[31] Newton Investment Management. The Impact of Ethical Investing on Returns, Volatility and Income (2016).

returns (by 0.3%–0.5% per annum for developed markets) and increased volatility (by 0.3%–0.4% per annum for developed markets) over the period studied, there was not a significant impact from fossil fuel screens on portfolio returns or volatility. Although these are high-level observations across markets, there were significant variations in measured results between regions, individual screens and time periods. Moreover, portfolios were simply market value-weighted after the application of screens, so no optimization techniques were used to attempt to minimize TE.

The above research reviews negative screening; however, SRI is also associated with "positive screening," whereby stocks are selected based on how well they rate on nominated ESG criteria. Common positive screens include measures of energy efficiency, environmental management or employment standards. This approach further narrows the universe of eligible investments and therefore also raises questions about portfolio efficiency. A number of studies have analyzed the performance of SRI indices that utilize both negative and positive screens against traditional broad market indices. Several such studies are summarized below.

TIAA-CREF (2014) compared the performance profiles of five leading US SRI equity indices with two US broad market equity indices, the Russell 3000 and the S&P 500.[32] The analysis showed no statistical performance differential over a 10-year period between the SRI indices and the two broad market benchmarks, thereby indicating that entering SRI screening criteria into security selection does not necessarily introduce a performance penalty. In addition, the SRI indices had similar risk profiles as the broad market indices, with comparable Sharpe ratios and standard deviation measures. The analysis did, however, show that over the short term, there were statistically significant TE differences between the SRI indices and broad market benchmarks.

Managi, Okimoto and Matsuda (2012) compared conventional stock indices in the US, the UK and Japan with SRI indices (over five-to-seven-year periods), concluding that "adding social screening constraints during the selection process does not create or destroy any extra financial return."[33] Specifically, their study did not find any statistical differences between the means and standard deviations of the general indices and the SRI indices across all three regions.

RBC (2012) also performed a review of empirical literature comparing the performance of SRI indices with traditional market indices.[34] Although the evidence was somewhat mixed, the majority of studies indicated minimal differences in long-term returns.

On balance, literature reviewed suggests that, at a minimum, there does not appear to be a performance penalty over the long term from the application of SRI criteria generally or fossil fuel screens specifically, despite the reduction in the number of eligible investments these actions entail. This said, SRI portfolios may deviate in the short term, in terms of both TE and returns, from broader market-based portfolios. These deviations are influenced by the size of the SRI exclusion.

[32] TIAA-CREF. SRI: Delivering Competitive Outperformance (2014).

[33] Managi S, Okimoto T, Matsuda A. Do Socially Responsible Investment Indexes Outperform Conventional Indexes? (2012).

[34] RBC Global Asset Management. Does Socially Responsible Investing Hurt Investment Returns? (2012).

IS THERE A SUSTAINABILITY PREMIUM (ESG)?

We reviewed key literature in this section to ascertain whether consideration of ESG factors has a material positive impact on performance, at both the portfolio and company levels. We refer to this as a "sustainability premium."

A 2015 study by the Morgan Stanley Institute for Sustainable Investing compared the performance of actively managed sustainable mutual funds and sustainable separately managed accounts (SMAs) in the US with their traditional peers' performance in the same asset class over a seven-year period.[35] The findings revealed that both equity and fixed income sustainable mutual funds displayed returns in line with or above the median returns of comparable traditional funds, on both absolute and risk-adjusted bases over time. Equity SMAs performed in line with their traditional peers on a risk-adjusted basis, but returns slightly lagged their peers' on an absolute basis. The study concluded that "sustainable investments often exhibit favorable return and risk characteristics compared with their traditional peers."

Deutsche Asset & Wealth Management and the University of Hamburg[36] conducted a broad meta-study in 2015, supported by the Principles for Responsible Investment, which examined more than 2,000 academic studies published since 1970 on the relationship between ESG and corporate financial performance (CFP).[37] The review found that an overwhelming share (62.6%) of the meta-studies examined revealed a positive correlation between integrating ESG into the investment process and performance. Interestingly, the review also supported the following additional conclusions:

- From an asset class perspective, the positive relationship between ESG and CFP is stronger for non-equity asset classes, such as bonds and real estate.
- ESG is particularly effective in emerging markets and North America.
- It is more beneficial to focus on environment, social and governance independently than to apply combinations of ESG.
- Isolating the environmental factor itself, which entails a greater focus on energy efficiency and GHGs, resulted in a positive correlation.

We should note concerns have been raised about the possibility that a sustainability premium could be attributed to factors other than ESG (such as style, industry or size). For example, a 2013 review by Deloitte[38] cited research that suggested outperformance of certain ESG indices may be better explained by factors other than ESG. The review also noted that incorrect methodology or poor quality data may have led to a mistaken inference of a positive historical relationship between ESG and performance. Deloitte referred to two review papers that found adjusting research methodologies resulted in findings over the longer term that the average impact of ESG on financial performance was minimal.

[35] Morgan Stanley Institute for Sustainable Investing. Sustainable Reality (2015).

[36] Deutsche Asset & Wealth Management. ESG & Corporate Financial Performance: Mapping the Global Landscape (2015).

[37] "CFP" is defined in the report as accounting-based performance, market-based performance, operational performance, perceptual performance, growth metrics, risk measures and the performance of ESG portfolios.

[38] Deloitte. Finding the Value in Environmental, Social and Governance Performance (2013).

In contrast, a 2015 MSCI study revealed that a material portion of the outperformance of its two systematic ESG strategies (ESG Tilt and ESG Momentum) over an eight-year period could not be explained by style factors and therefore may be attributable to ESG signals.[39] Furthermore, analysis by RobecoSAM (2015) isolating a sustainability factor (calculated from their comprehensive sustainability database) revealed that such a factor exhibits low correlation with other common risk factors.[40]

Academic literature that explores the relationship between companies and sustainable business practices also suggests a positive relationship. A 2015 meta-study jointly undertaken by Arabesque Partners and Oxford University surveyed 200 sources and determined the following:

- 88% of studies found that companies with robust ESG practices demonstrated better operational performance

- 90% of the cost of capital studies showed that firms with good sustainability standards had lower costs of capital

- 80% of reviewed studies indicated that the financial market performance of companies is positively influenced by solid sustainability practices.[41]

It therefore concludes that investors should take sustainability into account to achieve better risk-adjusted performance.

In addition to the above analyses focused on the evidence base at the company level, other research has attempted to ascribe an overall value to climate change risk on a macroeconomic basis. Specifically, the Economist Intelligence Unit (2015)[42] estimates that the mean value at risk to the global economy from climate change from the perspective of a private investor is $4.2 trillion. This suggests “that private investors are overvaluing manageable assets today by 3% of their current value” and climate change is not yet being fully priced by markets. This can also be used to infer the inverse — if some assets are being overvalued, then others focused on facilitating a low carbon transition may be undervalued.

Citi (2015) also calculates a value at risk measure, though it focuses on the cumulative “lost” GDP from the impacts of climate change rather than the present value of such damages. Citi expects this loss to be in the range of “0.7%–2.5% of GDP to 2060, equating to $44 trillion on an undiscounted basis.” Citi then takes this analysis one step further by calculating the mitigation costs needed to achieve a +2˚C outcome and dividing those costs by avoided GDP losses to derive an implied return on investments in mitigation, in general, “of 1%–4% at the low point in 2021, rising to between 3% and 10% by 2035.” These are broad “social return” figures that make no distinction between asset classes and are based on avoided cost rather than value added, so they are not directly comparable to return estimates used in this analysis. However, they do imply the existence of a premium for investments in low carbon technologies.

[39] Nagy Z, Kassam A, Lee LE, MSCI. Can ESG Add Alpha? (2015).

[40] RobecoSAM. Smart ESG Integration: Factoring in Sustainability (2015).

[41] Arabesque Partners, University of Oxford. From the Stockholder to the Stakeholder: How Sustainability Can Drive Financial Performance (2015).

[42] Economist Intelligence Unit, Vivid Economics. The Cost of Inaction: Recognizing the Value at Risk From Climate Change (2015).

In summary, the majority of academic studies reviewed point to a positive relationship between ESG factors and performance, empirically supporting the existence of a sustainability premium. In addition, this conclusion appears to hold and potentially even strengthen for individual ESG factors (for example, environmental) when viewed independently rather than in conjunction, although we recognize other factors may have a role in explaining observed excess returns otherwise attributed to ESG. We also note much contemporary analysis relies on past return data and that some concerns were raised by researchers about the data quality.

ANALYSIS LIMITATIONS

To complement stochastic asset liability modeling, we typically encourage clients to consider a range of deterministic economic scenarios. Such analysis can be used to consider the robustness of a particular investment strategy in the face of stressed market conditions. For defined benefit pension schemes, scenario analysis can also help quantify any benefit to funding levels from potentially more "positive" scenarios, such as those where treasury yields rise or equities perform strongly.

This rationale extends to climate change scenarios. As with other forms of investment modeling, the climate change–specific scenario assessment featured in this report is subject to uncertainty introduced at several levels, including A) the overall construct of our modeling approach, B) the specific assumptions made and C) the time horizon over which the analysis is performed:

A) Although we believe our climate change modeling framework is an extremely valuable tool for supporting related investment decisions and remains unique in the industry, we recognize that it has certain limitations. First of all, the framework is deterministic in nature, meaning it describes only a limited number of climate change scenarios out of a theoretically infinite range of possibilities. Additionally, the risk factors we identified to assess the impacts of climate change are presumed to be mutually exclusive (that is, have no overlap in their real world expression), comprehensive (that is, represent the full range of potential climate change risk factors), and independent (that is, uncorrelated), which may not be the case.

B) Although we believe the assumptions made to inform these assessments are well-supported by industry research and our own expert judgment, they are, in the end, assumptions and may thus be inaccurate. Specifically, we have assumed that our sector and asset class TRIP factor sensitivities, which were assigned based on robust research, represent the relative vulnerability of each industry sector and asset class to each climate change risk factor, and that the relative significance of each risk factor determined in each scenario is appropriate.

Furthermore, particularly difficult tasks for investors are identifying and managing structural changes, which can occur gradually or rapidly with uncertain timing. The greater the level of change, the more disparity between the winners and losers, and today's "giants" often become tomorrow's "dinosaurs," as those that fail to adapt are left behind. Such changes can create new industries at the expense of existing industries.

It remains very difficult to capture long-term, forward-looking changes within quantitative investment modeling processes, and although we know that, in practice, long-term, sustainable global economic growth is not going to follow the same path as historical economic growth, we have not sought to reflect these uncertain future structural changes within our investment modeling. Therefore:

Industry classification is based on today's definition. We have not made allowance for new industries and/or any reclassification that would be expected as markets reflect the adaptation to a low carbon economy.

We have not attempted to forecast changes in the regional composition of global equity indices. However, over the period modeled to 2050, we would expect certain nations currently classified as emerging markets to be reclassified as developed markets.

a. **There is a "negative bias" to the heat maps (that is, more red than green) as a result of our analysis being based on a starting point of today.** We recognize that opportunities will be created and that across different industries and regions there will be winners and losers, as some companies will adapt business models accordingly and others will not. Within industries and sectors, there will continue to be different supply and demand drivers, including those industries where overall sensitivity may be neutral.

b. **The pricing of climate change by markets is unknown.** Although existing literature implies climate change is underrepresented in current approaches to company and market valuation, sources are sparse and findings on this subject are collectively inconclusive. Thus, the Transformation scenario may overlap to an extent with our standard Efficient Market view if indeed markets are currently pricing a low carbon transition today.

C) This document summarizes Mercer's views on the long-term (35-year) outlook for asset class and portfolio risk/return outcomes. One of the key challenges for investors in considering the risks and opportunities posed by climate change is the disconnect between the timeframe of investors and climate change impacts. Thirty-five years is very long term from an investment perspective; typically, strategic investment advice is based on a modeling period of 10 years, and investment managers make investment decisions on a three-to-five-year — or shorter — time frame. However, physical climate change impacts become increasingly apparent post-2050, and climate models focus on the next century, extending out to 2300 and beyond, making 35 years look short term from a climate change perspective.

This said, the further forward we look, the greater the uncertainty, and it is difficult to justify investment modeling beyond our chosen 35-year horizon. Although the timeframe of investment decision-making does not align well with the timeframe of physical climate change impacts, there are nearer-term actions that investors can take and signposts that investors can monitor to better understand future climate change–related developments. The views expressed in this report can also be relevant for reflecting long-term market views in determining appropriate asset allocation (and sector allocation within asset classes) in the face of climate change, though we do not expect clients to make frequent tactical changes to their asset allocation based upon these views. The views expressed are provided for discussion purposes and do not provide any assurance or guarantee of future market returns.

Much of the commentary in this section is not specific to this analysis but rather derives from research conducted by Mercer previously and described in the Investing in a Time of Climate Change report.

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