The Case for Assessing the Impacts of Climate Change on Macro-economic Indicators Used by Institutional Investors
This report was prepared by a team of authors from Climate Finance Advisors (CFA) and Ortec Finance (OF). Contributing authors to this report include Lisa Eichler (OF), Andrew Eil (CFA), Linda Knoester (OF), James O’Connor (CFA), Karen Piñeros (CFA), Stacy Swann (CFA), and Willemijn Verdegaal (OF). We also thank Luca Bongiorno (OF), Shuen Chan (Sustineri), Sheldon Cheng (CFA), Sophie Heald (Cambridge Econometrics), Agnes Magnusson (OF), Alan Miller (CFA), and Christina Stanton (CFA) for their invaluable contributions.

Climate Finance Advisors, Benefit LLC

Established in 2015 as a mission-driven Benefit LLC, Climate Finance Advisors (CFA) is a women-owned consulting and advisory firm that works at the nexus of private investment and climate change. We advise a range of investors and investment seekers to bring to fruition low-emissions, resilient solutions in the context of a warmer planet. We help to integrate climate considerations into investment decision-making, portfolio management, financial products, services, and policies.

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Summary

Institutional investors, like all investors, rely on their research and analysis to uncover material information in order to improve investment strategies and attain higher returns. The effects of climate change have already had material effects on macro-economic indicators often used by institutional investors in Asset/Liability Management (ALM) and Strategic Asset Allocation (SAA). Incorporating the effects into investment strategy should therefore be a key component for predicting asset performance as climate impacts become more tangible for investment returns. A macro-level understanding of the effects of climate risks and opportunities on economic growth and asset class performance is now required for pension funds, insurance companies, endowments, and closed- and open-end investment funds to optimize their Asset/Liability Management and Strategic Asset Allocation strategies.

A focus on ALM and SAA begins with an understanding that climate risks and opportunities will not only affect individual companies, but will also fundamentally impact how the economy performs as a whole – the macroeconomy.

There are two potential systemic drivers of macroeconomic climate impacts: changes to our systems of investment, production, and consumption required for the transition to a low-carbon economy, and local and global damages resulting from climate change, including chronic shifts (such as rising average temperatures, droughts, and rising sea levels) and acute (e.g., extreme) events, which collectively can impact the financial system via economic, social, political, and financial pathways. The former implies the need for major changes in economic activities responsible for emissions of CO₂ and other greenhouse gases, while the latter requires investments in measures to create a climate-resilient economy. Climate-related impacts can be relatively well understood at the level of an individual asset or company through the application of climate-related data and analytics, but their impacts on the macro-economy, which in turn will affect investment environments, are equally important.

Such macroeconomic or systemic effects have implications for financial performance which are highly relevant for institutional investors. By using a range of warming and climate scenarios, risks and threats to financial returns caused by macro-economic shifts can be managed, and a myriad of investment opportunities can be identified. Climate-related scenario analysis can enable an asset manager to make better investment decisions, whether using active or passive strategies, and meet their investment mandate or to outperform benchmarks. In addition, some institutional investors have sustainability mandates; using a macro-level tool to understand which sectors are key to addressing climate change will help these investors shift funds to meet their sustainability goals and, in some cases, regulatory mandates.

This paper highlights the importance of taking systemic, macroeconomic climate-related risks and opportunities into account when making strategic investment decisions and how investors are able to act on insights gained from such analysis. Four types of institutional investors are examined in this paper, each of which has slightly different ALM and SAA strategies given how they invest, their overall risk appetites, and investment horizons.

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ASSET/LIABILITY MANAGEMENT (ALM)

Tools and techniques used by institutional investors to minimize exposure to market and liquidity risk whilst achieving their profit objectives through holding the optimum combination of assets and liabilities.


STRATEGIC ASSET ALLOCATION (SAA)

Approach towards portfolio construction which involves following a particular strategy and setting return targets within asset classes (e.g. equity, fixed income, or alternative investments) and portfolio rebalancing.

Finance Management, 2019. SAA
SCENARIO ANALYSIS FOR SYSTEMIC CLIMATE RISK

KEY TAKEAWAYS

- Climate change is an imminent threat, already manifesting in profound economic and social impacts.

- Climate risks are far-reaching and have the potential to be systemic in nature. The degree to which transition and physical risks will manifest depends largely upon choices made by human societies in the near term; we have very limited time to curb global warming.

- Physical and transition climate risks have implications for macroeconomic performance as measured by conventional economic indicators -- GDP growth, interest rates, unemployment, government deficits, consumer spending, and business investment, among others.

- Macroeconomic performance and its drivers offer insight into current and future capital market performance. Societies' various choices for addressing climate change thus have repercussions, creating divergent macroeconomic and market performance pathways and scenarios that institutional investors can analyze and use in decision making and ALM and SAA approaches.

- Investors should consider climate change and the low-carbon transition as potentially material risks to their portfolios, and thus integrate climate risk assessment into investment decision making and portfolio management. In particular, it is important for

<table>
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<th>Institutional Investor</th>
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<td></td>
<td>Returns</td>
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<td>Assets affected</td>
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<td>✓</td>
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<td>Insurance Companies</td>
<td>Fixed Income</td>
<td>Low</td>
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<td>✓</td>
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<td>Equity Alternative</td>
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<td>Endowments*</td>
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<td>Long</td>
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<td></td>
<td>Equity Alternative</td>
<td>Mixed</td>
<td>Short to Medium</td>
<td>✓</td>
</tr>
</tbody>
</table>

* Endowments liabilities refer to use of resources on a voluntary basis

TABLE 1

Adapted from Key Investment Parameters of Institutional Investors. Adapted from Climate Finance After COP21: A Roadmap of Effective Finance Commitments and Needs, InvestorWatch, Ian Callahan, 2015.

Risk Appetite: amount or level of risk an investor is willing to take to meet the expected returns. Risk appetite varies from low, mixed and high.

Investment Horizon: length of time investors expect to hold portfolio allocations. The investment horizon varies from short, medium and long.
investors to incorporate climate risk for more accurate portfolio return assumptions and to adjust their asset allocation accordingly.

- Both the low-carbon transition and climate-resilient economy present many opportunities for attractive investment. The decarbonization of the economy, and likewise the management and monitoring of climate risks, are already ushering in new generations of low-emissions, climate-resilient goods, services, technologies, business models, and infrastructure.

- A top-down approach to integrate macroeconomic impacts from climate change can capture the systemic nature of climate risks that are not identified in currently dominant bottom-up metrics and methodologies to assess risks which focus on individual assets, companies, and securities. The top-down and bottom-up approaches to climate scenario analysis are complementary.

- Macro-economic scenario analysis which integrates climate scenarios has unique value to different classes of institutional investors, helping each to identify climate-related weaknesses in portfolio management assumptions and address these vulnerabilities in risk management and risk-adjusted return maximization.

- Being informed of the climate impacts on macro-economic scenarios can yield better risk-adjusted returns as well as other benefits such as improved strategic positioning and risk management, better positioning for regulatory compliance, and greater alignment with values of investors and other social stakeholders.
Institutional Investors Should Take Note: Climate Risk is Here

The climate change threat is no longer a specter of the future – it has arrived. Its effects are already being felt around the world, from floods\(^1\) and wildfires\(^2\) in the U.S. to storms in Mozambique\(^3\) and droughts in South Africa.\(^4\) In the World Economic Forum Global Risk Report, climate-related threats dominate – both in terms of impact and likelihood. Over a ten-year horizon, extreme weather and climate policy failures are seen as the gravest threats.\(^5\) Record greenhouse gas concentrations in the Earth’s atmosphere have led to the period between 2015 and 2018 being confirmed as the hottest on record.\(^6\) The situation may be even direr than expected; while nations around the world set emission targets to limit global warming to ‘well below’ 2°C, self-reinforcing feedbacks that will accelerate warming might already be triggered at 1.5°C or 2°C warming.\(^7\)

These climate impacts can have serious ramifications for serious ramifications for the macro-economy. Apart from the potential social loss (in the form of deaths, health impacts, loss of jobs and housing), these climate hazards can result in physical damage and loss of assets, rising insurance costs, disruptions to supply chains and operations, changes in resource/input prices, and changes in demand for products and services. Munich Re estimated that climate and weather-related disasters cost the global economy over US$320 billion in 2017.\(^8\) In the U.S., climate change cost estimates include: US$117 billion for coastal property loss from sea level by 2060 (and over US$1 trillion by the end of the century),\(^9\) considerable reductions in labor productivity due to extreme heat, and losses in crop yields of 50% to 70% by 2100.\(^10\) Weather and climate disasters have already cost the U.S. over US$400 billion in damages from 2017-2018,\(^11\) and will likely continue to be a factor in corporate bankruptcies.\(^12\) The transition to low-emissions fuels, land use, production processes, and business models will likewise continue to cause widespread disruption, from fossil fuel companies and utilities to sectors as disparate as transportation and agriculture. Recent examples highlight impacts on beverage companies, pharmaceuticals, hotels, and tourism – virtually every imaginable business. (See the inset text box below for more detail on climate risk.)\(^13\)

At the same time, these potentially significant shifts in the global economic and financial systems and in our physical environment present enormous opportunities for resilient investment,\(^14\) indeed opportunities that will lead to large macro-scale benefits for societies and industries that adapt quickly.

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**LATEST DEVELOPMENTS – INVESTORS AND POLICYMAKERS ACTIONS TO ADDRESS CLIMATE RISK**

Climate risk management and disclosure have recently captured the attention of policymakers, central banks, financial regulators, and financial industry groups. A range of initiatives have driven climate considerations in investing to the forefront of agenda in financial policy, regulation, and corporate best practices. One of the most relevant is the Task Force on Climate-related Financial Disclosures (TCFD), initiated in 2015, which provides recommendations for voluntary and consistent climate-related financial risk disclosures in mainstream filings. The TCFD defines two broad categories to consider:

**Physical Risk:** climate hazards which can physically impact the operations of underlying assets, logistics and supply chains, and markets, which in turn can have an impact on an asset’s financial performance.

Physical risks resulting from climate change can be event-driven (acute) or longer-term shifts (chronic) in climate patterns. Physical risks may have financial implications for organizations, such as direct damage to assets and indirect impacts from supply chain disruption. Organizations’ financial performance may also be affected by changes in water availability, sourcing, and quality; food security; and extreme temperature changes affecting organizations’ premises, operations, supply chain, transport needs, and employee safety.

**Acute physical risk:** Event-driven risks, including increased severity of extreme weather events, such as cyclones, hurricanes, or floods.

**Chronic physical risk:** Longer-term shifts in climate patterns, such as changes in precipitation patterns and sustained higher temperatures, that may cause sea-level rise or chronic heat waves.

**Transition Risk:** Impacts from the shift away from a low-carbon economy. Transitioning to a lower-carbon economy may entail extensive policy, legal, technology, and market changes to address mitigation and adaptation requirements related to climate change. Depending on the nature, speed, and focus of these changes, transition risks may pose varying levels of financial and reputational risk to organizations.

Moreover, national, subnational, and international bodies have all undertaken to improve the dissemination of material information on climate risks. For instance, the Bank of England (BoE) and the Network for Greening the Financial System (NGFS) offer guidance, best practices, standards, common methodologies, terminology on disclosures, and risk management.
Assessing the Impacts of Climate Change on Macroeconomic Indicators Matters

The effects of climate change can be observed in macroeconomic indicators (see list of examples) for countries and the global economy. Physical climate impacts (i.e., physical risk) and the efforts to limit (mitigate) global warming (i.e., transition risk) will increasingly and directly affect regions, countries, and industries, causing aggregate impacts to economies as a whole as well as on the expected return from investments. Changes in import/export relationships, productivity, employment, and even population due to climate-related risks and opportunities will impact potential GDP growth, household incomes, government budgets, and industry growth. Investors regularly analyze macroeconomic indicators to form predictions on the overall business cycle; using these predictions, they allocate assets based on how asset classes typically perform at that stage of the business cycle.

As the physical climate hazards and the low-carbon transition associated with climate change leave a growing imprint on macroeconomic variables, investors will need to understand the exposure and vulnerability of different economies, and indeed the global economic system, to these hazards, and respond accordingly. Identifying and assessing these risks as well as the attendant investment opportunities will be increasingly important for predicting long-term returns for asset classes. Minimizing, or at least understanding, the exposure to these impacts is necessary for optimal portfolio asset allocation and to maximize expected return for a given level of risk. Figure 1 illustrates how a wide range of physical climate events can impact the macro economy in diverse ways, influencing market performance and institutional investors’ strategies.

Furthermore, it is no longer tenable to cite uncertainty surrounding global warming as a reason for excluding it from financial projections. Although the timing of physical events

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**EXAMPLES OF MACROECONOMIC INDICATORS POTENTIALLY IMPACTED BY CLIMATE CHANGE:**

- Gross Domestic Product (GDP)
- Balance of Trade
- Employment
- Government budgets
- Consumer spending
- Business investment

**FIGURE 1.** Impacts from Physical Climate Hazards at Macroeconomic and Market Levels, CFA
is uncertain, temperatures are rising and warming is locked in. While the localized, near-term picture for most physical climate change events may seem uncertain, long-term global warming effects are likely much more predictable than long-term market forecasts. Figure 2 illustrates the certainty and uncertainty of the timing of climate warming, climate-related physical events, markets performance and macroeconomic indicators.

Currently, many investors – including institutional investors with long time horizons – do not consider climate change factors, much less integrate them into their projections of macroeconomic conditions and portfolio returns. Even those who do, may not take a robust and consistent approach to considering various plausible scenarios for the impacts on the macroeconomy of physical climate change events and society’s response to the climate challenge across sectors, asset classes, and geographic regions. Real-world economic scenario modeling can help to assess systemic climate risk on different asset classes in a consistent way, leading to more prudent asset and liability management and robust risk management through strategic asset allocation strategies. For example, Figure 3 shows how GDP growth and productivity may be impacted by temperature changes.
Assessing systemic climate risks and applying scenario analysis, a top-down approach from the macroeconomic perspective, is complementary to bottom-up, or asset-based, approaches. Currently, most investors who manage climate risk do so via individual security selection, i.e. understanding a company’s exposure to climate change risks through its operations and supply chain. Asset-based climate risk management calls for engaging with and potentially divesting from individual companies and other holdings. In this way, some of the climate-related risk can be mitigated. However, incorporating an understanding of effects on the economy, as GDP and inflation are impacted by climate change, completes the picture.

Each of the approaches enable investment managers’ analysis to become ‘climate-informed’. Top-down systemic climate risk scenario analysis enables investors to be ‘on the right route’ (i.e., make sound decisions on a SAA/ALM level) while bottom-up climate risk scenario analysis enables investors to make optimal decisions ‘along the chosen route’ (i.e., invest in companies that fare better under a specific global warming pathway).
Investment Allocation Considerations of Institutional Investors Against the Backdrop of Increasing Climate Risks

Institutional investors not only have more options for investing than many other investors; they also have larger pools of capital to manage and deploy, requiring sophisticated strategies for diversification, hedging, and return targeting. These objectives are typically met through strategic asset allocation (SAA) – typically responsible for up to 90% of the variability in portfolio returns over time\(^1\) – and asset/liability management (ALM), an essential tool for institutions with large and/or well-defined long-term liabilities. Although there are restrictions (e.g., pension funds and endowments cannot short-sell shares and some may have more voluntary restrictions), institutional investors generally have more choice in SAA.

Institutional investors also frequently have long-term horizons, making their return targeting particularly sensitive to macroeconomic projections and thus, climate effects. The macroeconomic effects resulting from climate-related risks will filter through the financial system unevenly, with implications for SAA and ALM. While some financial variables may affect all asset classes in a consistent way, many climate change impacts exhibit economic effects that vary by region, by sector, and also vary by asset and sub-asset class. For example, the low-carbon transition leads to stranded fossil fuel assets, which will affect equities in that industry more than fixed income (as creditors are more senior than shareholders in the capital hierarchy). Another asset class that is at particular risk is real estate, which shows sensitivity to both transition and physical risks. In a top-down methodology, (sub-)asset classes that are sensitive to GDP changes show most impact.

Sectoral and regional impacts can leave a trail of macroeconomic consequences, both positive and negative. Transition to a lower-emission economy will benefit certain industries and countries that have invested in producing this technology. Conversely, economies that are highly dependent on fossil fuel exports (especially ones that rely on fossil fuels with higher marginal costs, such as tar sands) will be negatively affected.\(^2\) If there is no longer demand for fossil fuels or other carbon-intensive products due to a transition to a low-carbon economy, then companies providing those fuels and products will likely lose value. This will negatively impact investors in those companies, but it will also affect other entities dependent on the value created by those companies. Local real estate, banks, retail, construction, and even the countries’ government debt could all be affected. It is noteworthy that value destruction is caused by a demand shock (demand for the fuel decreased) and so is mostly independent of any domestic action that may have been taken to bolster the industry.

Of course, integrating climate considerations into macro-economic scenarios is only a top-down approach for institutional investors to consider the impacts of climate change on their investments. Applying climate analytics to assess climate risks on specific asset classes will be important for institutional investors’ SAA and overall portfolio diversification. The increased diversity of investment options open to institutional investors can help investment managers achieve higher risk-adjusted returns. As different asset classes are affected by climate change and the attendant macroeconomic ripple effects in disparate ways (see Table 2. Macroeconomic Climate Considerations by Asset Category (CFA)), investors will need to scrutinize those impacts on their portfolios as well as the implications for asset allocation strategy. The distinct characteristics of different asset classes viewed through a climate change lens are explored below.
EQUITIES

Equity market performance is highly correlated to economic growth and is, in fact, a leading indicator of economic health. Consequently, climate impacts on GDP have a direct effect on the performance of equities. Generally, equities provide a natural hedge against inflation (conversely, fixed income is more sensitive to inflation and interest rates). Analysis of predicted macrotrends for countries or industries based on climate change effects could help investors better choose countries or industries in which to invest. Additionally, equities are also quite sensitive to secular trends in industry profitability. Industries and markets threatened by the low-carbon transition or sensitivity to weather may underperform. Some institutional investors are able to short-sell equity positions (borrowing shares to immediately sell with the promise to replace the shares in the future). Short-selling would be an effective strategy if an investor predicts poor financial performance in an industry or poor economic performance for a country based on factors including adverse climate change effects.

FIXED INCOME

Fixed income of all varieties tends to be quite sensitive to interest rates as well as to the creditworthiness of issuers. For all classes of debt, climate change can have effects on returns and even capital preservation.

- **Government** – Sovereign bonds issued by national governments to fund national budgets are typically the least risky in a given country since they are backed by the credit and the tax base of the issuing government. The economic vulnerability of a country to the effects of climate change, as shown by predictions of macroeconomic indicators, is an important consideration for investors in sovereign debt. In addition to the national GDP impacts, bonds are sensitive to changes in interest rates, which in turn are affected by inflation (central banks adjust interest rates to control inflation).

- **Municipal** – There are two primary types of municipal bonds (munis), i.e., debt issued by subnational governments (particularly in the United States): general obligation and revenue bonds. General obligation (GO) bonds are backed by the full faith and credit of the issuing state or city, while revenue bonds are typically for infrastructure and are backed by the revenue generated by the specific project. Like sovereign debt instruments, investors in munis would be well-served by considering a subnational issuer’s economic
vulnerability to the effects of climate change. Revenue bonds are highly dependent upon the solvency of the project or public company that issued the debt. The financial performance of toll infrastructure and utilities, two frequent issuers of revenue bonds, can be adversely impacted by a range of climate change effects.

- **Corporate** – Corporate debt typically offers a higher yield since it is a debt obligation of a company to be paid from operating income rather than tax receipts. In the event of bankruptcy, however, debts will be paid before any residual company value is allocated to shareholders. Therefore, if climate change is predicted to disproportionately affect a particular industry or a particular company, debt instruments of that industry/company combination will be a safer alternative to equity investments. However, the creditworthiness of issuers of corporate debt in sectors or markets vulnerable to physical and/or transition risks may erode, resulting in declining bond prices and potentially defaults.

**ALTERNATIVE INVESTMENTS**

Alternative investments as a class are highly heterogeneous, ranging from real assets and private companies to commodities, currencies, and derivatives. While often useful as a hedge against poor market performance or other financial performance risks, alternative assets can concentrate or increase risks, often in ways that are difficult to measure or predict. Alternative assets will only grow in importance if climate change depresses returns on fixed income and equities, though extensive expertise is required to invest in them prudently and profitably.

- **Real Estate Investment Trusts (REITs)** – REITs are the most frequently used investment vehicle for institutional investors to invest in real estate. They are comprised of a pool of commercial and/or residential real estate assets that pay out income to investors. As the real estate market is highly correlated with certain economic indicators (e.g., GDP growth, personal income, building permits), predictions on these can help investors better evaluate REIT investments. Such evaluations can look at geography, sector focus, or overall predicted returns of the real estate market in order to determine how much of their investment portfolio to allocate to this sector, particularly given real estate’s vulnerability to effects of climate change such as sea level rise, storms, and flooding.

- **Private Equity Funds** – Private equity (PE) funds offer potentially higher returns due to the fund managers’ expertise, higher risk tolerance, and access to illiquid assets, as well as the growth rates of particular industries or company development stages. Because many PE funds focus on early stage technology companies, PE firms may be well-placed to take advantage of the transition to a low-carbon economy. However, private equity is in no way shielded from the macroeconomic and systemic risks threatening publicly-listed companies in the same industries and markets.

- **Hedge Funds** – Hedge funds offer investors potentially higher returns due to their flexibility in using different financial instruments and investing in so-called alternative assets, and due to their managers’ expertise at understanding and timing many aspects of financial markets. Hedge funds also frequently employ investment strategies that have low or inverse correlations to the market. In this way, hedge funds can be relatively resilient to shocks or crises, presumably inclusive of those related to climate change, though historically their performance has been uneven.

- **Foreign Exchange** – The value of a country’s currency is tied to interest rates, economic growth, and balance of payments. Investors focus on the spot market (current exchange
rate) or the futures market (standardized contracts of exchange of one currency for another at a specified future date). With predicted climate change effects on macroeconomic indicators layered into other analysis on a country’s economic growth, investors can use this relevant information to buy the currencies of countries they predict to fare better in a climate change scenario. In addition, since foreign exchange investing involves betting against one currency and on another, it may allow them to increase returns from selling the currency of a country predicted to have more economic effects from climate change.

- **Commodities** – Similar to currencies, commodities are traded on the spot (current price) or futures (standardized contracts for a particular commodity at a specified future date). As commodities generally have a predictable correlation with economic indicators, predicting economic growth under different climate scenarios can help with allocations to commodity investment strategies that are positively or negatively correlated with that growth. Also, many commodities are highly dependent on supply from a few countries or demand from a few countries and thus understanding those countries’ economic vulnerability to climate change can better inform investment decisions.

### The Importance of Climate-related Scenario Analysis for Institutional Investors

How should institutional investors go about assessing their climate-related risks? Expert opinion, reflected in the work of the Bank of England, the NGFS and the TCFD (described on page 5), among other guides, recommends that businesses and investors integrate and use different climate-related scenarios to help them manage climate-related financial risks and exposure in portfolio and investment decision making.

Scenario analysis has always been an important tool in both the financial modeling world, as well as in the climate science world; climate-related financial scenarios bring them together. Broadly speaking, “a scenario is a possible evolution of future outcomes (e.g. returns, market growth, etc.), consistent with a clear set of assumptions” (Brunn and Solo, 1993). Much of the uncertainty surrounding climate change lies in the political, social, and financial choices that humans make in the decades ahead, more so than in the physics of global warming, which is well-established to result from already locked-in emissions. Distinct from the geophysics of climate change, the political economic uncertainty gives rise to multiple plausible future worlds (e.g., one with a rapid transition to low-carbon energy sources, another with continued reliance on fossil fuels, etc.), each with its own set of macroeconomic drivers related to climate change. Climate-related scenarios refer to the economic and financial future we predict based on the assumptions about those choices.

The Bank of England sets out several reasons why climate scenario analysis is distinctive from traditional financial scenario analysis. See Table 3.
Climate-related scenario analysis implies assessing multiple different warming scenarios, assessing the impacts of warming expected under those scenarios on the financial performance of assets in sectors and geographies, and using such analysis to inform investment decision making, including ALM and SAA. Different scenarios are associated with different plausible temperature trajectories until 2100, each with a different set of risks. A scenario in which warming is limited to 1.5°C will require rapid and far-reaching transitions across all sectors of the global economy. Such a scenario thus poses heightened transition risks and opportunities, while it minimizes physical risks. On the other hand, a scenario where warming reaches 4°C or more by 2100 may have limited impact on the viability of emissions-intensive business models in the short term, but will lead to severe physical risks and risks of ecological and economic collapse.

Taking different climate-related scenarios, the variability in macroeconomic performance and the composition of that performance are stark. Figure 4 provides portfolio-specific insights for a demo set-up of a representative pension fund. The two figures provide portfolio-level insights and clearly show that the different climate pathways are expected to impact economic and financial risk drivers in distinct ways, per time horizon (with 1.5°C orderly, 1.5°C disorderly, baseline or "B," and 4°C scenarios denoted).

**TABLE 3.** Distinctive Elements in Climate Scenario Analysis (Bank of England 2018)

<table>
<thead>
<tr>
<th>Distinctive Elements in Climate Scenario Analysis</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Far-reaching in breadth and magnitude</td>
<td>The financial risks from physical and transition risk factors are relevant to multiple lines of business, sectors and geographies. Their full impact on the economic system may therefore be larger than for other types of risks, and is potentially non-linear, correlated and irreversible.</td>
</tr>
<tr>
<td>Uncertain and extended time horizons</td>
<td>Although the likelihood of impacts occurring is increasing, the timing of financial risks materializing is uncertain, particularly for acute impacts (chronic impacts from climate change may be foreshadowed). Investors may believe that the full financial impacts from climate risks will crystallize outside of many current business planning horizons (tragedy of the horizon). Moreover, using historical climate data is not a good predictor of future risk (e.g., historic means and historic relationships between economic variables—including output, prices and interest rates—may not hold in a higher warming pathway scenario).</td>
</tr>
<tr>
<td>Foreseeable nature</td>
<td>While the exact outcome is uncertain, there is high degree of certainty that financial risks from some combination of physical and transition factors will occur.</td>
</tr>
<tr>
<td>Dependency on short-term actions</td>
<td>The magnitude of future impact will, at least in part, be determined by the actions taken today. This includes actions by governments, financial market participants, and a range of other actors.</td>
</tr>
</tbody>
</table>

**FIGURE 4.** Investment return of a representative pension fund’s portfolio in different climate pathways and time buckets (based upon modeling by Ortec Finance, 2019)
**Macroeconomic benefits of the 1.5°C scenario:** It is of interest to note that an orderly transition to a 1.5°C scenario is preferable to business as usual, even in the short term. In the longer term, it becomes clear that a 4+°C scenario is the least favorable in terms of risk/return considerations, even less favorable than a disorderly transition scenario. It is predicted that a disorderly transition will result in a potential financial shock, likely followed by recovery. For a higher warming scenario, the macro-economy is likely to be permanently damaged. While in the 1.5°C orderly scenario there will be losses resulting from transition risk, the winners will likely outweigh the losers. The net global effect in that case would be positive. Therefore, the net impact on a well-diversified investment portfolio is also likely to be positive. Cambridge Econometrics’ and Ortec Finance’s modeling (see Figure 5) shows that an orderly transition to a 1.5°C scenario is likely to have a neutral or a slightly positive effect on global equity performance relative to the climate-uninformed baseline (i.e., a modeled future that does not account for climate change), whereas the physical impacts under a higher warming pathway negatively affect equity returns. Consequently, most institutional investors have an interest in their societies’ pursuit of the 1.5°C scenario.

Integrating financial and climate scenario analysis enables investors to gain forward-looking insights with regard to their portfolios’ exposure to climate risks and opportunities under different global warming pathways. Such insights are crucial for a full understanding of how the various transition and physical risk drivers impact economic growth and financial returns in order for investors to integrate these considerations into ALM and SAA. Given that climate change impacts are different in the future than in the past, a backward-looking SAA approach will likely not be a good predictor of future market developments. A scenario-based approach considering different plausible climate futures may be more appropriate to capture a wider range of outcomes, and is increasingly being recognized by central banks and regulators as part of the fiduciary duty of institutional investors.

**FIGURE 5.**
Projected cumulative world equity return in a 1.5°C orderly transition pathway and a 4+°C warming pathway, relative to a climate-uninformed baseline, i.e., projections of financial market performance without consideration for climate impacts (Ortec Finance, 2019)
Figure 6 illustrates how investors who use ALM strategies should consider different climate change scenarios in order to more accurately predict the growth of their assets and thus the match between assets and liabilities over time. In addition, for some of these investors, climate scenarios may also have an impact on the liability side that should be considered.

Climate-informed Financial Decision making for Institutional Investors Based on Insights from Climate Scenario Analysis

Climate-informed decision making provides institutional investors with a range of benefits. The value generated by incorporating climate considerations into strategic investment decision making, inclusive of climate scenario analysis for institutional investors and asset managers, are fivefold, ranging from improved risk management and better returns against a climate-uninformed baseline, to better preparedness for regulatory requirements and demands from investors and civil society.

1. Insights into risks and opportunities per climate pathway and time horizon: Investors better understand how returns per asset class and per region are either positively or negatively affected by climate-related risks and opportunities per climate change pathway, and how they differ depending on the time horizon considered. Investors can make better-informed predictions on which regions, sectors, and asset classes are well positioned to benefit from a transition or may be most at risk, allowing for potential increased risk-adjusted returns. Furthermore, investors might allocate to different asset classes to reduce risk or take advantage of opportunities, e.g., green bonds or other investments in low-carbon and climate-resilient investments.

2. Robust investment decision making: By introducing climate-related risks and opportunities into strategic investment decision making, climate is treated as a standard risk driver. This causes the whole organization to integrate this risk in a systematic fashion. Strategy becomes aligned with more operational decision making.
3. **Improved risk management**: As noted above, the observation that climate change presents divergent scenarios has a corollary: the world faces a range of widely divergent macroeconomic pathways. The uncertainty surrounding which scenario will manifest compounds the risks of climate change and the low-carbon transition themselves. Prudent and considered integration of climate change scenario analysis can improve risk management, a seminal element of fiduciary responsibility.

4. **Preparedness for disclosure and regulatory compliance**: The scenario analysis framework allows investors to disclose their climate-related risks in a forward-looking, objective and quantified way. This facilitates asset managers’ compliance with regulatory and voluntary disclosure requirements, as well as other climate risk management requirements that may emerge in the future.

5. **Values alignment and positioning for civic engagement**: Scenario analysis can help assess whether a chosen strategic asset allocation is in line with ESG values and targets. For example, when an investor has pledged to align with the Paris Agreement, it is important to test whether their portfolio would be resilient under a strong transition scenario. Because a world of orderly transition to below 1.5°C warming is preferable to higher global warming scenarios for both investors and society. Institutional investors might wish to use outcomes of a systemic climate risk analysis to engage civically with stakeholders in industry, government, and society at large. This would promote a strong response to the climate challenge, as an orderly transition to below 1.5°C warming is preferable to higher global warming scenarios for both investors and society at large.
Notes and References

1 References to a “low carbon economy” are often understood narrowly to refer to replacement of fossil fuels by wind, solar, and other non-carbon-based energy sources. However, there are a much wider range of potential measures to reduce greenhouse gas emissions such as reducing methane leaks from natural gas pipelines, replacement of HFCs used as refrigerants, and biological sequestration of carbon in soils and forests, all of which can result in macroeconomic impacts.


7 “WMO Confirms Past 4 Years Were Warmest on Record” World Meteorological Organization, 7 Feb. 2019, public.wmo.int/en/media/press-release/wmo-confirms-past-4-years-were-warmest-record.


14 https://image.fmglobal.myriskmanagement.com/lib/6e6715707065017e7612/m/1/2a1b47e6-9eba-4e35-810a-c6f710484458.pdf


16 Although some short-term effects are relatively certain including more intense hurricanes and rainfall.


19 https://www.camecon.com/blog/estimate-global-value-stranded-fossil-fuels/assets/

20 The forward market has been omitted since it is mostly used by companies to hedge foreign exchange exposure through tailored, OTC instruments.

21 Again, the forward market has been omitted since it is mostly used by companies to hedge commodity volatility through tailored, OTC instruments.


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