



Climate Change Challenges

Climate change scenarios and their impact on funding risk and asset allocation

September 2018

Executive Introduction

Man-made climate change is one of the biggest threats facing our world today. Governments have made commitments to reduce greenhouse gas emissions to limit its damaging effects. To meet these commitments, more aggressive policy action and a rapid shift away from fossil fuel use will be necessary. This may well cause considerable disruption, increasing costs and reducing growth globally, while raising the risk of a global recession.

Pension funds, as long-term investors, could find themselves exposed under many of the potential future scenarios around climate change. The long-term effects of untempered climate change are likely to be highly damaging, but the economic transformation required to deal with the challenges could also cause pain in the near term for those that are unprepared.

The Paris Climate Change Agreement aims to strengthen the global response to the threat of climate change by limiting the global temperature rise to well below +2°C above pre-industrial levels by 2100. The scientific consensus is that keeping the global temperature rise below this level will help avoid the worst effects of climate change.

Climate Change Tracker, an organisation dedicated to tracking policy action since 2009, estimates that the current implementation of policies worldwide will still lead to global temperature increases in excess of +3°C. Even if existing pledges were fully met, the global temperature rise would still be well above the danger limit. This puts our planet and society at risk from more severe climate change effects before the end of the century.

To remain below the +2°C target, CO₂ emissions need to begin falling and be close to zero by 2070, with net emissions turning negative thereafter. Consequently, to achieve this target, more ambitious goals than those set out in the Paris agreement are needed; these include international regulation of carbon emissions, development of green technologies and a rapid shift away from fossil fuels in favour of renewable energy sources.

Under different green scenarios, where global collaboration manages to act to address the challenges, there is still the likely threat of a shock from climate regulation changes that could lead to large losses across pension funds' portfolios in the near term. The implications of the alternative 'no mitigation' scenario is that while some of the near-term pain is avoided, delayed action simply defers the pain and the final cost will be far higher, putting future generations and investors' returns at risk.

The risks from climate change are much greater over the long run than over the next decade. However, the window for limiting emissions and avoiding disastrous change is narrow. Under different climate change scenarios there is scope for economic pain at some point on the road, either near or far.

This report considers four alternative scenarios (from no mitigation to smooth transition to a green economy) and their potential impact on assets and pension scheme funding levels. These scenarios can be used to provide context to discussions on climate change and gives another perspective on risk when looking at investment strategy and asset allocation.

Pension funds, insurers and other financial institutions will need to consider how likely they are to be impacted by climate change and decide how they will manage the material financial risks and future challenges over multiple timeframes. Scenario analysis can be used to help trustee boards and corporate treasurers to consider a

range of climate change outcomes, and to better understand how their assets and liabilities are likely to be impacted. This analysis can be used to stress test investment strategy and make informed funding and investment decisions. This allows for better planning for future conditions, which will hopefully lead to a brighter future.

Summary

Man-made climate change is one of the biggest threats humanity faces today. The effects of climate change are already evident with more erratic weather patterns, more severe weather events and greater environmental degradation.

The systemic risks posed by climate change and the policies implemented to tackle them will fundamentally change economic, political and social systems and the global financial system. They will impact every asset class, sector, industry and market in varying ways and at different times, creating both risks and opportunities for investors. It is therefore a worthwhile exercise to consider how events might unfold and the possible implications.

We consider four potential climate change scenarios (covering a broad spectrum of outcomes) and their potential impact on assets and pension scheme funding levels, as follows:

- The **green regulation scenario** considers the impact of immediate, coordinated action to tackle climate change using taxes and regulation.
- The **forced green scenario** explores the impact of delayed action for five years, with governments eventually forced to address

greenhouse gas emissions due to increasing extreme weather events.

- The **green skies scenario** shows how rapid advancement of green technology, private innovation and tiered environmental regulation and greenhouse gas taxes could achieve a smooth transition to a low carbon world.
- A **no mitigation scenario** considers the potential impact of climate change if insufficient sustainable policy action is undertaken to manage global temperatures effectively over the next 10 years.

We contrast these scenarios against our **base case scenario**, which is based on long-term return views of what is currently priced into the market. The market does not appear to be expecting a bad climate change outcome. For this reason, the base case scenario assumes that the worst effects of climate change do not come about, as the effects are not as damaging as first thought and that some progress is made to limit greenhouse gas emissions and global warming.

Table 1 summarises the macroeconomic and asset impacts under our climate change scenarios over the long-term compared to our base case.

Table 1. Long-Term Impact of Climate Change

	Base Case <i>World events unfold in a fashion consistent with our Capital Market Assumptions</i>	Green Regulation Scenario <i>Coordinated global action is taken to immediately tackle climate change.</i>			Forced Green Scenario <i>Delayed climate action until governments are eventually forced to address greenhouse gas emissions due to increasing extreme weather events.</i>			Green Skies Scenario <i>Rapid advancement of green technologies, green finance and tiered carbon tax regulation drives a smooth transition to a low carbon global economy.</i>			No Mitigation Scenario <i>Short-term economic growth is prioritised over environmental action, which leads to dangerous levels of global warming.</i>		
	Relative to the base case:	Lower	Similar	Higher	Lower	Similar	Higher	Lower	Similar	Higher	Lower	Similar	Higher
Growth Rate	UK and global growth gradually improve. Growth is in line with long term consensus expectations.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inflation Rate	Inflation moves to and remains close to 2%, the Bank of England target, over the long term.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Fixed Interest Government Bond Yields	Nominal yields gradually rise to higher levels as there is a gradual improvement in global growth prospects.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Index Linked Government Bond Yields	Real yields gradually rise to higher levels as there is a gradual improvement in global growth prospects.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Corporate Bond Spreads	Corporate spreads stabilise at slightly higher levels and remain broadly stable.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Global Equity Returns	Equity returns are in line with our long term return capital market assumptions.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Source: Aon

The high degree of uncertainty surrounding climate change means that the final outcomes may look very different to those outlined. However, the themes illustrated in our scenarios are expected to be relevant when understanding risks and/or considering asset allocation decisions.

We continue to work with the view that enough progress will be made to mitigate and adapt to climate change, avoiding a disastrous outcome. However, we also recognise that based on current scientific information and the limited action

taken to tackle climate change so far, the risks are currently skewed towards a poor climate change outcome.

Responsible investing practices are likely to prove critical in the fight against climate change. A better understanding of asset allocation decisions will help build robust investment portfolios and pension schemes that can adapt to change and are positioned to deliver the best risk-adjusted outcomes.

Background

Climate change is the large scale, long-term shift in the planet’s weather patterns, in particular a change due to an increase in average global temperature (i.e. global warming).

The weight of evidence supports the conclusion that the world is warming. Global warming is largely the result of emissions of carbon dioxide and other greenhouse gases from human activities, including industrial processes, fossil fuel combustion and changes in land use, such as deforestation.

The consequences of failing to tackle climate change are well known and include:

- rising sea levels and coastal flooding
- more frequent heat waves
- more extreme and frequent rainfall in many regions and less rainfall in other regions
- desertification
- more destructive weather events
- vanishing ecosystems
- deforestation

- reduced agricultural yields
- costly and growing health impacts
- mass migration and increased conflict.

The 2018 World Economic Forum Risk Report prioritises global threats in terms of likelihood and impact. Climate change related risks have been growing in prominence and have been a fixture in the top five threats in terms of likelihood and impact since 2011.

Extreme weather events are ranked as the most likely risk and the second-most impactful, trailing only the use of weapons of mass destruction. Failing to adapt to or mitigate climate change and a host of other climate-connected risks including water and food crises and involuntary migration also rank in the top 10.

The risks and costs from climate change are gradually becoming more substantial. Climate change is strongly interconnected with a multitude of other environmental and social risks (see table 2), which mean that the threat from climate change is likely to become progressively larger, unless further action is taken.

Table 2. Topics Linked to Climate Change

Environmental Themes	Social Themes
<ul style="list-style-type: none"> • Water Quality • Air Pollution • Waste Management • Deforestation and Land Degradation • Chemical and Toxic Emissions • Dispersion of Clean Energy Technology • Resource Management 	<ul style="list-style-type: none"> • Energy Supply • National Security • Human Development • Population Growth • Global Changes in Demographics • Poverty and Income Disparity • Human and Labour Rights

Source: Aon

Where do we currently stand?

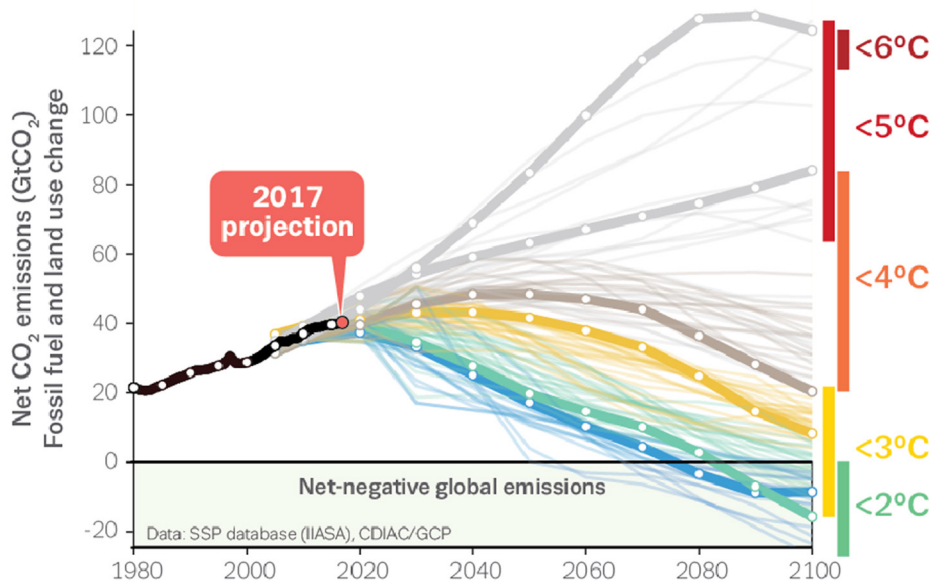
Figure 1 shows the current historical path of carbon dioxide emissions and a range of scenarios for emissions to the end of the century created by the Intergovernmental Panel on Climate Change (IPCC) and their possible outcomes for global warming.

It shows that if emissions continue on their current trend global warming is likely to be above 4°C. Even if carbon dioxide emissions remained stable at current levels global warming would likely be

above 3°C. Thus to keep global warming below the 2°C danger limit a rapid reduction in emissions is needed.

To meet the challenge of stabilising and then lowering global temperatures a radically transformed, sustainable development path is needed on the back of a clean energy technological revolution.

Figure 1. Global Warming Scenarios and the 2 Degrees Celsius Goal



Source: Global Carbon Project, IPCC

What is the current policy position?

The Paris Climate Change Agreement (COP 21) aims to limit the increase in the global average temperature to well below 2°C above pre-industrial levels (i.e. average temperatures over 1850-1900). Every country in the world, with the exception of the US, has now signed up to this agreement or become party to it.

Participants agreed to pursue policies and provide finance to lower greenhouse gas emissions and adapt to the adverse impacts of climate change. However, the agreement relies on voluntary and nationally determined targets, rather than

agreeing collective targets that are legally enforceable.

There is no legal requirement each country must meet or emissions reduction it has to achieve. Only the processes governing the reporting and review of these goals are mandated under international law.

The current pledges for carbon cuts put the world's nations on course for at least 3°C of global warming above the pre-industrial average and severe damage to the environment. However,

the Paris agreement includes guidelines for the pledges to be reviewed and ratcheted up. The hope is that over time countries increase their ambition and accelerate plans to mitigate greenhouse gases and avoid the worst outcomes.

The vital groundwork for this framework started with the Bonn climate change summit in November 2017. The aim of the summit was to

What is the investor stake?

Investors have a vested interest in climate policy because it will provide a relative level of certainty about the business environment they will operate in. It is therefore in the interest of investors to pursue proactive sustainable and responsible investing strategies that embed climate change considerations in the investment process and build in climate change resilience.

The long term impact on climate change will largely be determined by society's response to deal with climate change and the effectiveness of policies and technologies put in place.

What is certain is that climate change and the efforts made to tackle it will inevitably affect

build a consensus on the rules that will enable the Paris deal to work. It has also focussed attention on the issue of financing climate change mitigation and adaptation projects.

It is hoped that the necessary rules and finances will be finalised by the next summit, which is due to be held in Poland in December 2018.

investment returns (and hence pension funding levels) globally.

The actions taken to mitigate climate change will have different effects across asset class types. The level and timing of activity to mitigate and adapt to climate change means that returns will also differ over different time horizons.

The effects of climate change over the short and long-term are complex and will require a flexible, dynamic investment strategy. Considering different climate change scenarios helps to provide insight on some of the risks and opportunities that may arise.

Climate Change Scenarios

In our base case scenario we assume that asset returns are in line with our long-term return views of what is currently priced into the market. These implicitly assume that the worst effects of climate change do not come about, (as the effects of climate change are not as damaging as first thought) with global warming limited to between 2°C and 2.5°C above pre-industrial averages.

To achieve this scenario, the world will need to make some progress towards reducing resource and energy intensity (compared to historic rates). However, we expect progress to be uneven across regions, with developed nations making greater progress.

While this scenario assumes that progress is made at the individual country level on climate change, global coordination is assumed to be modest. There are no unified expectations regarding the future of regulation on greenhouse gas emissions. As such, the global economy only manages moderate reductions in the use of fossil fuels. Fossil fuels represent less than 65% of the energy mix by 2050 (compared with around 80% today).

Carbon capture and storage (CCS) solutions become more prevalent by the 2030s. These solutions make use of established technologies to capture, transport and store carbon dioxide emissions from power stations and manufacturing industries underground. This helps to lower annual levels of atmospheric carbon dioxide pollution.

Even so, this scenario implies that the effects from climate change are not as large as most climate scientists predict.

We consider four alternative climate change scenarios, on opposite ends of the spectrum: three Green scenarios, where the global temperature

rise is successfully limited to +2°C above pre-industrial levels, and a no mitigation scenario, where the lack of action leads to temperature rises in excess of +4°C by the end of the century.

- **Green Regulation Scenario** – *Immediate action*
- *Coordinated global action is taken to aggressively tackle climate change.*

There is growing public awareness of the risks global warming pose and the necessity to make substantial progress to tackle the problem. Increased media focus on the threats of climate change, including bad weather events (such as hurricane damage) and scientific evidence, highlight the exponential threat from climate change. This galvanises opinion and leads to governments undertaking widespread action globally.

Global policymakers coordinate action to aggressively mitigate and adapt to climate change. A high global greenhouse gas tax and carbon cap is introduced. Policymakers put in place legislation and environmental policies to expedite the shift away from fossil fuels, including the provision of substantial green finance for renewable energy initiatives.

Increased pressure from the government and activists leads to companies and pension funds making reforms (and changes to investment strategies) that properly take account of the environment. Those companies and pension funds that disregard the environment face an increase in lawsuits, incentivising compliant behaviour.

Green policies and high levels of infrastructure investment in renewable energy technologies lead to the rapid development and take-up

of green technology. New and improved agricultural technologies lead to higher agricultural yields.

The marginal costs of clean energy technologies fall rapidly, becoming price competitive with fossil fuels. The global economy's resource intensity and dependence on fossil fuels is substantially reduced, with less than half the energy mix coming from fossil fuels by 2050.

Over the first three years, the global economy experiences a period of turmoil and lower growth as the economy arduously divests away from fossil fuels. This divestment leads to just over half of coal and oil assets being written down, devalued or converted to liabilities (i.e. stranded), with substantial losses in the energy sector.

Over the intermediate-term the global economy successfully restructures toward renewables. Plans to develop and implement CCS solutions are accelerated and the necessary infrastructure and market frameworks start to be put in place by 2030. Investor confidence and global growth recover, which helps drive a market recovery.

Global growth and market returns remain strong relative to the base case in the long-term, supported by a brighter sustainable outlook and the positive spillover effects from green policy adoption. Positive spillover effects include energy independence, preserved eco-systems, green jobs, habitable green cities, clean air and water, and improved health conditions.

- **Forced Green Scenario** – *Delayed Action* – *Increasing extreme weather events over the next five years eventually force governments to address*

greenhouse gas emissions at a global level with carbon tax policies being introduced.

Although there is growing public awareness of the risks climate change poses, no material acceleration in policy action is undertaken over the next five years (until 2023). Advancement of green technologies is initially limited due to a lack of investment. Progress on new environmental regulation over 2018 to 2023 is slow.

Growing scientific evidence and improved analysis suggest the threat from climate change is accelerating. Over 2018 to 2023, the effects from increasingly extreme weather events lead to widespread public concern over climate change. Scientists and activists become more vocal convincing governments to aggressively tackle climate change.

Governments introduce policies to drive a rapid reduction in greenhouse gas emissions, including the immediate imposition of high carbon taxes and carbon caps globally. Introduction of robust regulation in 2024 and the growing threat from litigation incentivises companies to meet their environmental responsibilities. However, delayed action on reducing emissions mean that the costs of tackling the problem are higher.

The green policy measures create considerable economic disruption, hampering economic growth and hurting corporate profitability, initially leading to a global recession in 2024 followed by several years of weak growth as the transition to low carbon is made.

Policymakers put in place policies to expedite the shift away from fossil fuels, including substantial public and private funding for green technology initiatives. Regulation helps drive

take-up of renewable technologies. Carbon assets become stranded after 2023 as a result of policy and changes in market demand. The global economy's resource intensity and dependence on fossil fuels is gradually reduced, with less than half the energy mix coming from fossil fuels by 2050.

Beyond 2028, growth prospects begin to improve as the global economy successfully restructures toward renewables. A brighter sustainable outlook and the positive spillover effects from green policy adoption help drive investor and consumer confidence and global growth strengthens, bringing with it a market recovery. Long-term the shift to a green economy helps boost economic growth.

- **Green Skies Scenario** – *Balanced Action – Rapid advancement and take-up of green technologies, combined with governments providing green finance and tiered carbon tax regulation worldwide, drives a smooth transition to a low carbon global economy.*

This scenario is similar to the Green Regulation scenario except that private sector innovation and a green technology revolution, combined with government coordination, help drive progress towards tackling climate change.

Technological breakthroughs in low-carbon technologies result in clean energy technologies that drive down costs and help spur their adoption.

This enables the government to introduce an incrementally increasing carbon tax, which provides companies with an opportunity to adapt before the regulations come into full effect. New case law on the legality of

emitting carbon dioxide emissions is gradually introduced. ESG considerations are voluntarily incorporated into corporate frameworks, enforced by legal requirements.

Over the first few years, collectively tackling the core issues of climate change creates some economic upheaval, especially for industries and sectors most dependent on fossil fuels. However, the benefits from high government funding and private sector innovation, which lower the structural costs of shifting to a low carbon global economy, help drive the transition to a green economy in a balanced way.

Over the intermediate to long-term, the global economy is placed on a stronger footing and enjoys robust growth, driven by a successful restructuring towards a low carbon economy and the benefits of making the transition through both balanced regulation and corporate innovation.

- **No Mitigation** – *Limited action - The world remains focused on short-term concerns with insufficient consideration given to sustainable long-term economic policies to manage global temperatures effectively.*

The world economy remains oriented towards improving near-term economic prospects, with companies and governments taking a “business as usual” approach.

Limited consideration is given to environmental challenges. Governments and businesses rely on the (false) hope that market forces will provide engineering solutions to mitigate and adapt to climate change naturally, without worldwide government intervention.

Individual countries fail to fulfil their commitments made at the Paris Agreement, in part due to other domestic priorities. There is no coordinated global policy action to develop pricing strategies to tackle greenhouse gas emissions or encourage land use change, such as fossil fuel taxes or carbon caps. Global action to mitigate or adapt to climate change is limited and delayed.

Insufficient public and private funding for green initiatives hampers the development of new green technologies and slows the transition away from fossil fuels.

Deployment of CCS solutions is not undertaken as quickly as the base case, with fewer projects implemented by the late 2030s. Efforts to make CCS solutions more cost competitive than other low carbon technologies proves to be challenging. Furthermore, putting in place the necessary regulation, market framework and infrastructure takes longer than expected.

Policies adopted to reduce the use of fossil fuels are limited. This leads to higher demand and, consequently, higher prices, although prices are not high enough to trigger widespread substitution of fossil fuels by renewable energy sources.

Fossil fuels remain the dominant source of energy, with over 70% of the energy mix still based on fossil fuels by 2050.

Economic growth and assets returns are similar to the base case over the first few years and then become weaker, as initial environmental damage is somewhat higher.

There is growing awareness of a changing environment and the damaging effects a lack of action is having, over the intermediate-term. There is a higher incidence of damaging storms, water shortages, higher pollution levels and reduced agricultural yields (leading to higher food prices). Markets become more volatile and climate change begins to have a growing drag on economic growth and asset returns. While there is some recognition that more needs to be done, governments and markets are slow to act.

Eventually, market participants begin to fully grasp the implications of climate change and there is a growing realisation that current levels of action are inadequate. Market values price in high levels of economic damage and the irreversible loss. While more is eventually done to mitigate and adapt to global warming, the late timing of actions mean that they are less effective and more costly to implement, due to the more stringent action required and environmental damage being done. A loss of consumer and investor confidence, combined with growing damage levels, progressively weigh on growth and asset returns well beyond the next decade.

Market Impact of Climate Change Scenarios

Our scenario analysis covers more than 140 macroeconomic and investment variables. Below we provide a snapshot of some key paths from our scenarios compared against our base case.

We consider the impact on inflation, growth, bond yields and core asset returns over three time horizons; the short-term (next three years), the intermediate-term (next four to ten years) and long-term (next eleven to twenty years).

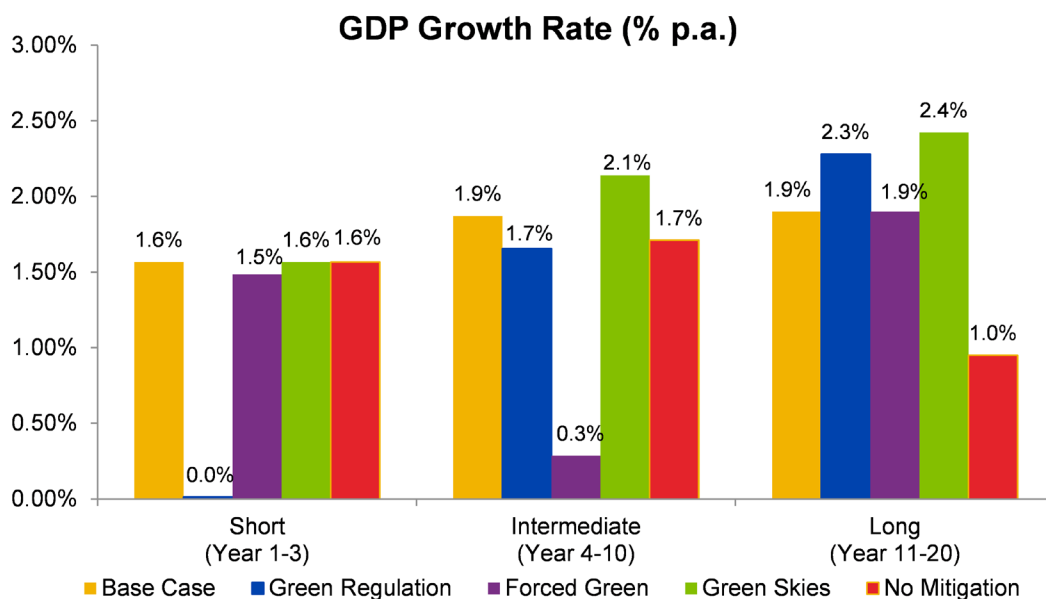
Real GDP growth

Figure 2. Real GDP Growth

The base case scenario uses Aon’s consensus forecasts for real growth over the next five years. Beyond this horizon, growth is assumed to be in line with consensus long run growth.

Figure 2 shows real GDP growth for each scenario over different time horizons.

In the green regulation scenario, the introduction of strict carbon regulation and the rapid shift away from fossil fuels worldwide hurts global growth over the short-term.



Source: Aon

Growth improves over the intermediate to long-term as the global economy successfully restructures toward renewables, achieving a brighter sustainable outlook, supported by positive spillover effects from green policy adoption.

In the forced green scenario, short-term growth is marginally lower than the base case due to more extreme weather events over the first few years.

Growth is lower over the intermediate-term as the government takes action in 2023 to reduce greenhouse gas emissions and the shift away from fossil fuels causes considerable economic disruption, which acts as a drag on growth for several years.

Over the long-term, growth prospects improve as the benefits of transitioning to a green economy begin to be felt. However, delays in tackling climate change (and the higher costs associated with these delays) mean that the net benefits to long-term growth are lower than those under the green regulation scenario.

In the green skies scenario, the combination of technological advancement and private innovation offsets the drag from tiered carbon regulation and taxation. The rapid technology led transition to a low carbon economy drives improved growth, with the enthusiastic switch to renewables delivering substantial benefits earlier than other scenarios. Growth is materially higher than the base case over the intermediate to long-term.

In the no mitigation scenario, short-term growth follows a similar pattern to the base case.

However, over time, the increasing effects from climate change and the greater uncertainty over the future outlook lead to a growing drag on growth.

The damaging effects of climate change eventually lead to stringent environmental policies in 2029, as governments try to reverse years of environmental neglect. A recession ensues due to a loss of consumer and investor confidence. However, these policies prove too little too late, with only marginal improvements in growth after these policies come into effect.

Inflation

The base case scenario uses inflation numbers based on the capital market assumptions' consensus inflation view.

Figure 3 shows the rate of inflation (based on CPI) for each scenario over different time horizons.

In the green regulation scenario, increased (carbon) taxes and an increase in production costs from the rapid shift away from fossil fuels leads to an inflation spike. Inflation remains elevated relative to the base case as the economy makes the transition to renewable energy over the intermediate-term. Inflation pressure gradually fades over time and reverts to the Bank of England's long run target of 2%.

In the forced green scenario, inflation is marginally elevated relative to the base case over the short-term due to higher costs imposed by increased extreme weather events and higher fuel prices.

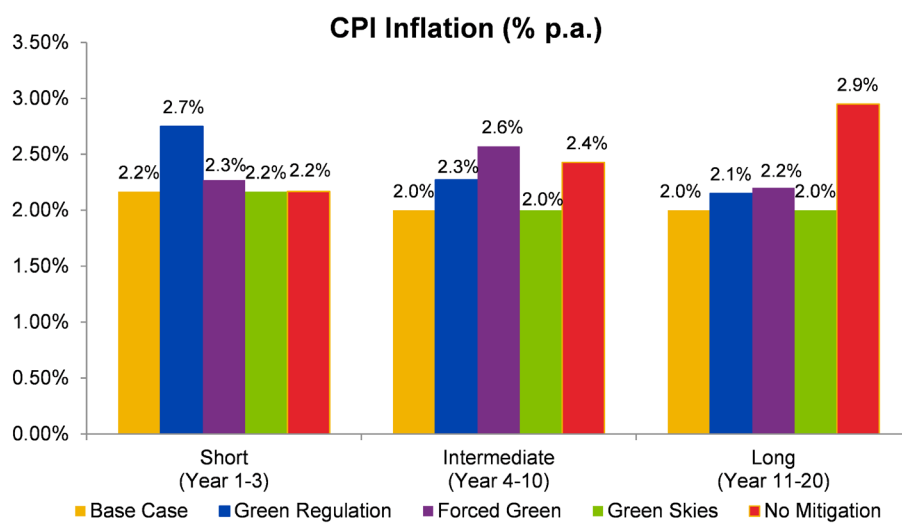
Over the intermediate term, inflation is pushed up as government regulation and high carbon taxes

drive the transition to a low carbon economy, raising costs. Over the long-term, inflation pressures gradually ease, moving back towards the Bank of England's 2% target.

In the green skies scenario, inflation is assumed to be similar to the base case.

Under the no mitigation scenario, inflation is similar to the base case over the first few years. Inflation then gradually increases as the progressive effects of environmental damage and loss of natural infrastructure raise agriculture and production costs together with increasing fuel costs.

Figure 3. Inflation Rates



Source: Aon

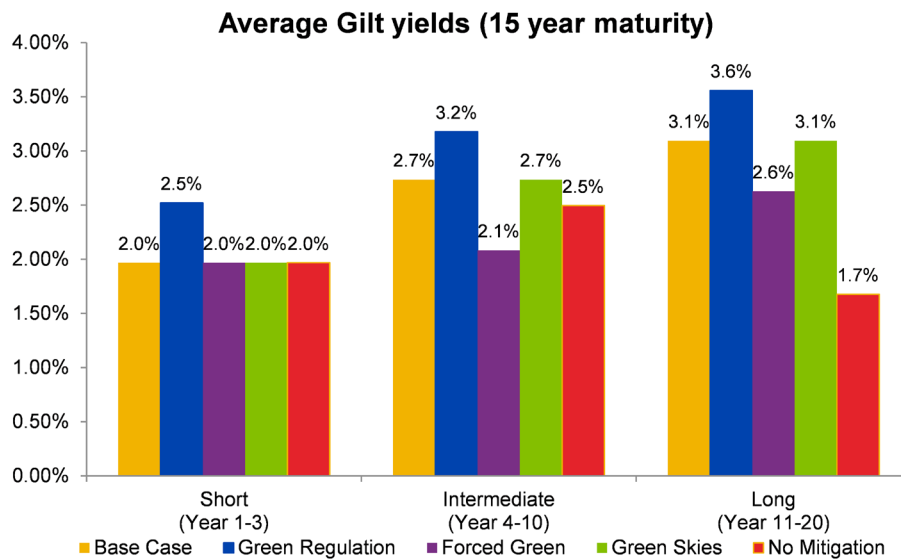
Nominal Government Bond Yields

Under our base case scenario, nominal yields are based on our central model projections, which account for implied market yields and our capital market assumptions.

Figure 4 shows the 15 year nominal bond yields for each scenario at the end of the different time horizons.

In the green regulation scenario, nominal yields are pushed higher in the short-term due to a substantial increase in borrowing by governments to finance green projects, which necessitates a rise in yields to attract funds, and the spike in inflation due to higher production costs incurred by the shift away from fossil fuels. These pressures are only partially offset by a weak economic growth environment.

Figure 4. Fixed Interest Government Bond Yields



Source: Aon

Long-term, yields remain above those in the base case due to higher levels of inflation and continued concern over debt levels.

In the forced green scenario yields remain similar to the base case over the first few years. However, as governments force a reduction in emissions and a shift away from fossil fuels, a global recession in 2024 and a drag on growth thereafter, leads to lower yields relative to the base case. Over the long-term, improved growth prospects from the shift to a green economy allows yields to gradually narrow the gap with the base case.

Yields are assumed to follow a similar path to those under the base case in the green skies scenario, as the economic drag from gradually increasing carbon regulation and taxation is balanced by rapid advancement of green technologies and private innovation.

Beyond the twenty year horizon, yields move above those in the base case due to better growth prospects.

Under the no mitigation scenario, nominal bond yields are similar to the base case over the first few years but move below those in the base case in later years, due to a comparatively weak economic backdrop.

Over the long-term, the gap with the base case gradually widens as the progressively worsening effects from climate change act as a drag on growth. This trend is only partially offset by higher inflation from progressively higher production costs.

Real Government Bond Yields

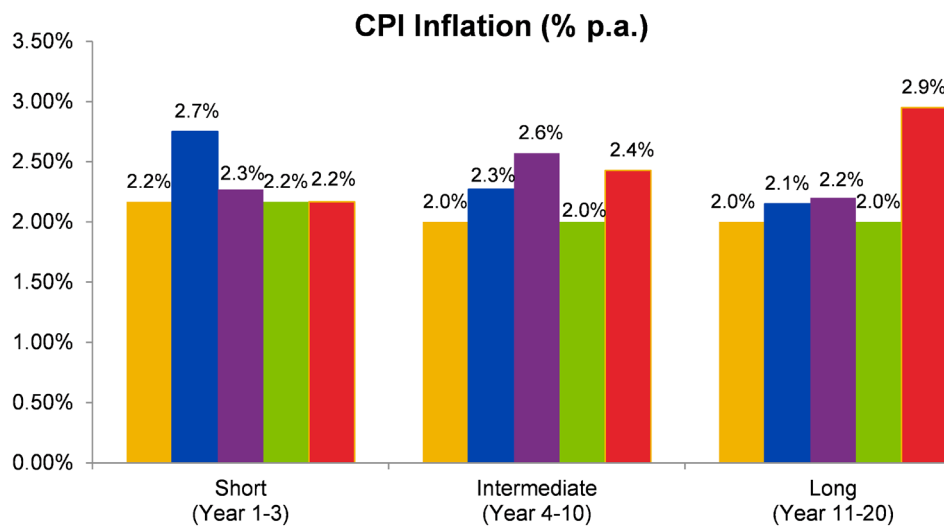
Under our base case scenario, real yields are based on our central model projections, which account for implied market yields and our capital market assumptions.

Figure 5 shows the 15 year real bond yields (relative to RPI inflation) for each scenario at the end of different time horizons.

Under the green regulation scenario, the increase in nominal yields resulting from increased borrowing more than outweighs the increased demand for inflation protection over the first few years and real yields rise slightly over the short-term.

Over the intermediate to long-term, real yields remain slightly higher due to continued concerns over debt levels. Over the very long-term real yields remain elevated relative to the base case due to better growth prospects.

Figure 5. Index Linked Government Bond Yields



Source: Aon

In the **forced green scenario**, elevated inflation leads to demand for inflation protection, which depresses yields over the short-term.

Over the intermediate term weak growth as well as high inflation keep yields lower than the base case.

Over the long-term growth levels improve and inflation moves back to the Bank of England's 2% target, allowing real bond yields to move back towards the base case.

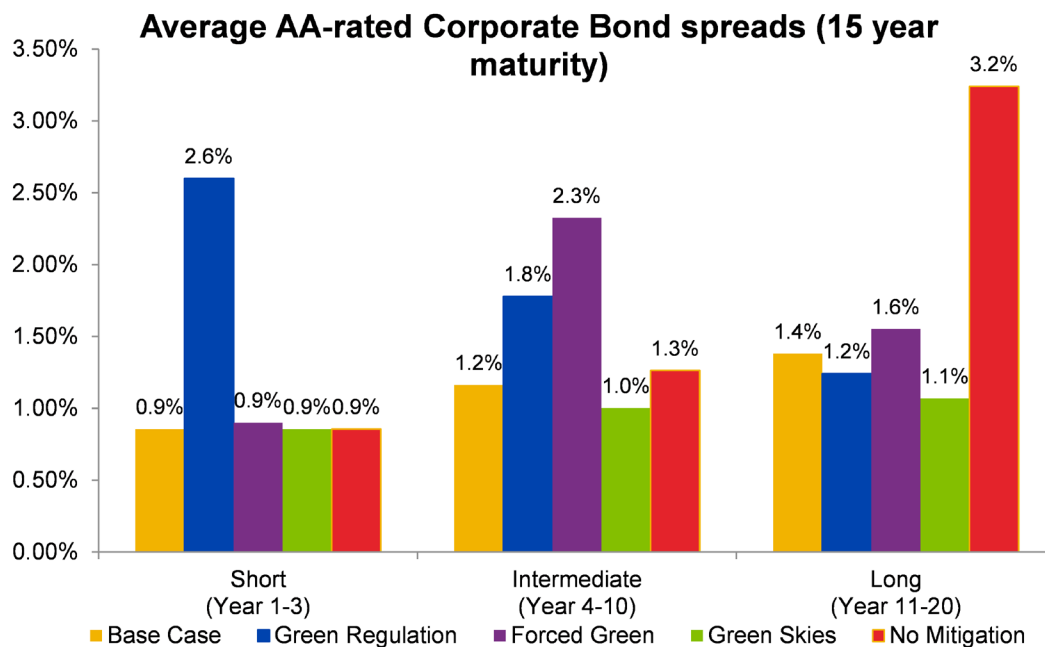
Under the **green skies scenario**, real yields are similar to the base case over the twenty year horizon. Beyond this, both nominal and real yields begin to rise relative to the base case due to improved growth prospects.

Under the **no mitigation scenario**, real yields are lower than the base case due to weaker growth and higher inflation, leading to greater demand for inflation protection. In 2029, governments try to tackle the growing problem with limited success, which acts as a further drag on growth and stokes more inflation, further depressing real yields. The gap with the base case widens over the long-term.

Corporate Bond Spreads

Corporate bond spreads, in our base case, are assumed to move in line with implied market spreads based on the latest end of quarter spot curves.

Figure 6. Corporate Bond Spreads



Source: Aon

Figure 6 shows the fifteen year AA rated corporate bond spreads for each scenario at the end of different time horizons.

In the green regulation scenario, corporate spreads initially widen over the first few years due to the increased uncertainty in the global economy. The rapid transition to clean technologies and green regulation eventually begins to boost growth and corporate spreads begin to narrow, ultimately falling below the base case long-term.

Under the forced green scenario, corporate spreads are similar to the base case over the first few years.

Over the intermediate-term, corporate spreads increase due to the recession and considerable economic disruption caused by government taxes and regulation to reduce greenhouse gas emissions and the rapid shift away from fossil fuels.

Long-term the benefits from tackling climate change lead to higher growth and improved corporate profitability, which reduces corporate spreads.

Under the green skies scenario, the growth benefits from a smooth transition to a green economy lead to slightly lower corporate spreads over time.

Under the no mitigation scenario, corporate spreads are similar to the base case over the first few years and then spreads gradually begin to rise relative to the base case as inaction on climate change leads to growing costs and weaker growth, squeezing corporate profit margins. Pressure on profit margins is further exacerbated over the long-term due to governments delayed and ineffective action in 2029 to tackle climate change, which results in elevated corporate spreads.

Global Equities

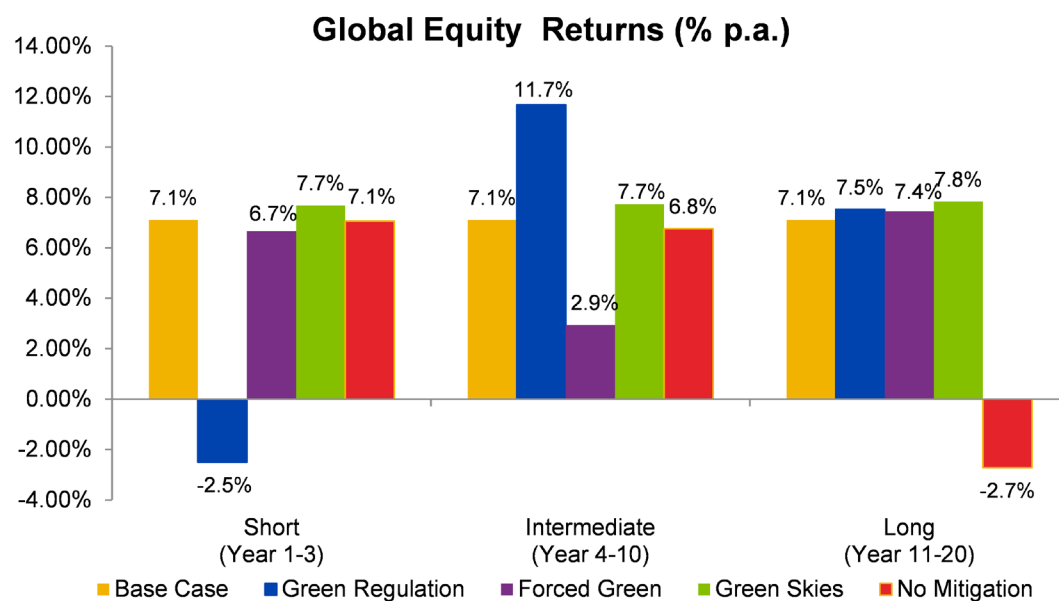
In our base case scenario, we assume that equity returns are in line with our Capital Market Assumptions, which take a forward looking view on asset returns.

Figure 7 shows annualised global equity returns for each scenario over different time horizons.

Under our green regulation scenario, the rapid shift away from fossil fuels and new regulations lead to lower growth over the first few years. Equity returns experience short-term losses as lower demand and higher production costs squeeze profit margins. Equity returns rebound relative to the base case over the intermediate-term as market participants recognise that the steps taken are working. Long-term, equity returns are above the base case, as the positive spillover effects of a green economy boost global growth.

In the forced green scenario, global equity returns over the first few years are slightly lower than the base case, due to extreme weather events impacting expected growth and depressing corporate profit expectations. Equity performance over the intermediate-term worsens as the global economy is forced to transition away from fossil fuels to renewables, which weighs on economic growth. Long-term the benefits of this transition modestly bolster equity returns.

Figure 7. Global Equity Returns



Source: Aon

Under the green skies scenario, equity returns experience small losses in the first year due to the announcement of green regulation and taxation. However, equity returns rebound in the following two years as market participants recognise that policy measures will be gradually introduced and that needed green technologies are available to tackle the problem at reasonable cost. Consequently, returns are somewhat above the base case over the first three years.

Over the intermediate to long-term, equity returns remain above the base case as the positive spillover effects from the shift to renewable energy and subsequent improvement in growth prospects improves profitability.

Under the no mitigation scenario, equity returns are similar to the base case over the first few years.

Over the intermediate-term, the adverse effects from climate change become progressively worse

as the costs from climate change begin to build. This increasingly weighs on global growth and corporate profit margins. This leads to equity returns being lower than the base case.

Long-term, the governments' ineffective actions to tackle climate change beyond 2029 and growing costs from climate change weigh on equity returns. Equity returns are substantially below those in the base case.

Developed and emerging market equity returns are assumed to broadly follow a similar pattern to global equity returns under the different scenarios. However, the magnitude of the effects are determined by their sensitivity to carbon sectors, geographical exposure to climate change risks and action taken to mitigate and adapt to climate change.

Conclusion

Our climate change scenarios are designed to be instructive rather than prescriptive. The high degree of uncertainty surrounding the impact of climate change means that the final outcome will likely be different to those outlined. However, the end outcome is likely to reflect some of the narratives described by these scenarios, providing an opportunity for investors to mitigate risks while taking advantage of opportunities, as they arise.

Table 3 summarises the impacts under our different climate change scenarios over short, intermediate and long-term horizons.

We hope that the best outcomes of climate change management will be achieved. The worst outcomes are likely to come about when society fails to take action. If society does fail to take action the final outcome may be catastrophic.

Table 3 Climate Change scenario impact

		TWENTY YEAR IMPACT													
Base Case	World events unfold in a fashion consistent with our Capital Market Assumptions events. Relative to the base case:	Green Regulation Scenario			Forced Green Scenario			Green Skies Scenario			No Mitigation Scenario				
		Lower	Similar	Higher	Lower	Similar	Higher	Lower	Similar	Higher	Lower	Similar	Higher		
Growth Rate	UK growth slows over the next two years due to Brexit and then recovers. UK and global growth is in line with long-term consensus expectations.	█	□	□	█	█	□	□	█	█	□	□	█	█	□
Inflation Rate	UK inflation remains high in the first year due to sterling weakness from Brexit. Inflation remains close to the Bank of England target of 2%.	□	□	█	□	█	█	□	█	█	□	□	█	█	█
Fixed Interest Government Bond Yields	Nominal yields gradually rise to higher levels as there is a gradual improvement in global growth prospects. Nominal yields stabilise.	□	█	█	□	█	█	□	█	█	□	█	█	█	█
Index Linked Government Bond Yields	Real yields gradually rise as there is a gradual improvement in global growth prospects	□	□	█	□	█	█	□	█	█	□	█	█	█	█
Corporate Bond Spreads	Corporate spreads stabilise at slightly higher levels and remain broadly stable. Corporate spreads remain stable.	□	□	█	□	█	█	□	█	█	□	█	█	█	█
Global Equity Returns	Equity returns are in line with our long-term return capital market assumptions.	█	□	□	█	█	█	□	█	█	□	█	█	█	█

Source: Aon

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