THE Frontier Line

Thought leadership and insights from Frontier Advisors

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Climate change impacts for long-term investors

How will long-term portfolio returns be affected by different climate change scenarios?

FRONTIER ADVISORS

Frontier Advisors

Frontier Advisors has been at the forefront of institutional investment advice in Australia for over two decades and provides advice over more than $250B in assets across the superannuation, charity, public sector and higher education sectors.

Frontier's purpose is to enable our clients to generate superior investment and business outcomes through knowledge sharing, customisation, client empowering technology and an alignment and focus unconstrained by product or manager conflict.

Climate Change

In this edition of The Frontier Line, we take a preliminary view of what the scale of climate change impacts for institutional investors might be over the medium to long term and discuss some of the (possible) implications for Trustees and members. This follows the agreement signed at the Conference of Parties (COP21) in Paris in December 2015 and further signs this issue will be increasingly important to consider in the construction of investors' portfolios.

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Climate change

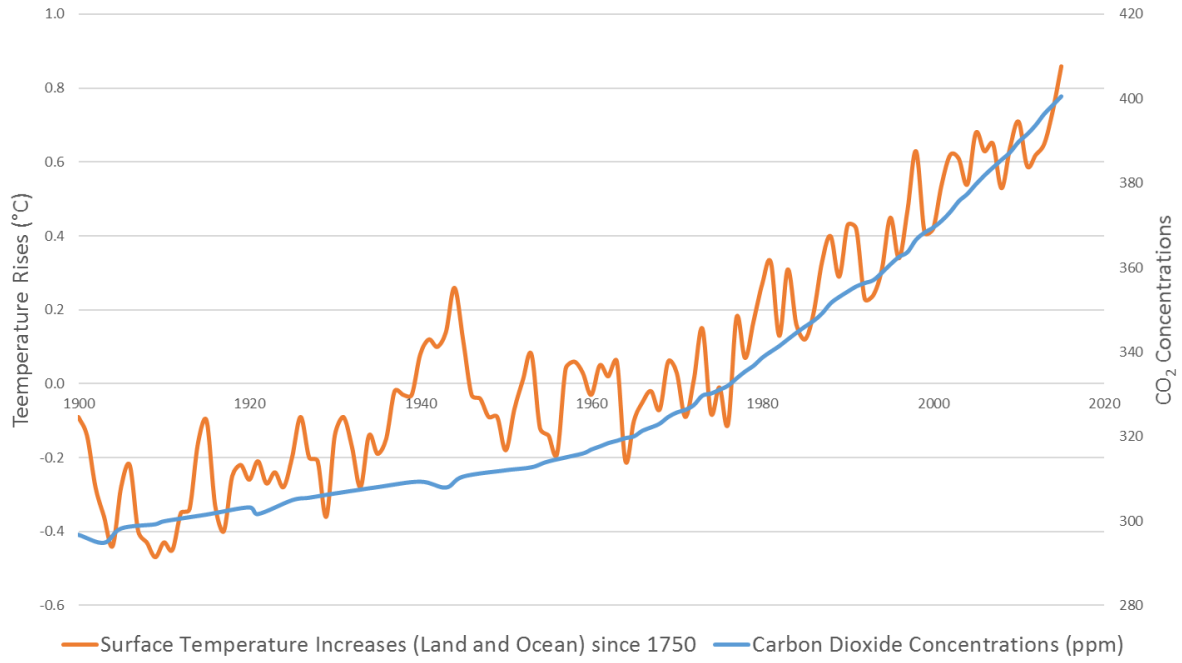
"We are the first generation to feel the impacts of climate change, and the last generation to be able to do something"

Barack Obama, August 2015

There are lingering bastions of doubt about climate change, but we at Frontier acknowledge climate change is a real and increasing concern and that there is sufficient scientific evidence the vast majority of impacts are human-induced. It is becoming increasingly recognised that a decarbonisation of the economy is required to tackle the problem. The statement by Obama neatly summarises an aspect of the problem that is quite devilish; not adequately dealing with climate change entails passing on a legacy to future generations that becomes more difficult and expensive to solve (and beyond certain thresholds is likely to be irreversible).

In simplistic terms, increasing the concentration of greenhouse gases (GHGs) like CO2 will result in increases in atmospheric temperatures as the GHGs have a blanketing effect on solar radiation that reaches the Earth's surface. Chart 1 shows that global temperatures have been increasing since the advent of the Industrial Revolution and this is aligned with rapidly increasing levels of human emissions.

Chart 1: CO_2 concentrations and temperature rises



Other physical impacts expected to result from climate change include, but are not limited to, the following:

more frequent and intense weather events including floods, droughts and fires;

- acidification of oceans leading to disruption of marine food chains and destruction of coral reefs;
- sea level rises and coastal inundation from storm events;
- disrupted hydrological flows and increased water stress;
- increasing risks of crop failure and vector-borne diseases; and
- increased risk of biodiversity loss.

The range and intensity of impacts will differ across global regions but most of these outcomes are directly of concern to Australia. There is an element of unpredictability in all this but there has been a clear increasing trend in catastrophic weather events. Added to this is the risk of reaching certain trigger events, which could result in more severe and irreversible climate impacts. For example, the disintegration of the Arctic permafrost would result in increased methane emissions with serious repercussions.

Investors are becoming increasingly concerned about the potential impacts of climate change on their portfolios and are considering policies and processes to put in place now to address these future concerns.

The Climate Change Module

There are several ways which investors can assess and address climate change issues and at Frontier we can support clients in all these endeavours. Risk management and consideration within investment policy is one area of focus and as a result we have developed an analytical tool that allows for climate change within the asset allocation process. This Climate Change Module is located within Frontier's globally recognised Partners Platform suite of tools as an extension of the existing Strategic Asset Allocation (SAA) module within Prism. It provides guidance on the possible impact of different climate change scenarios on long-term asset class returns.

Climate models and economic impacts

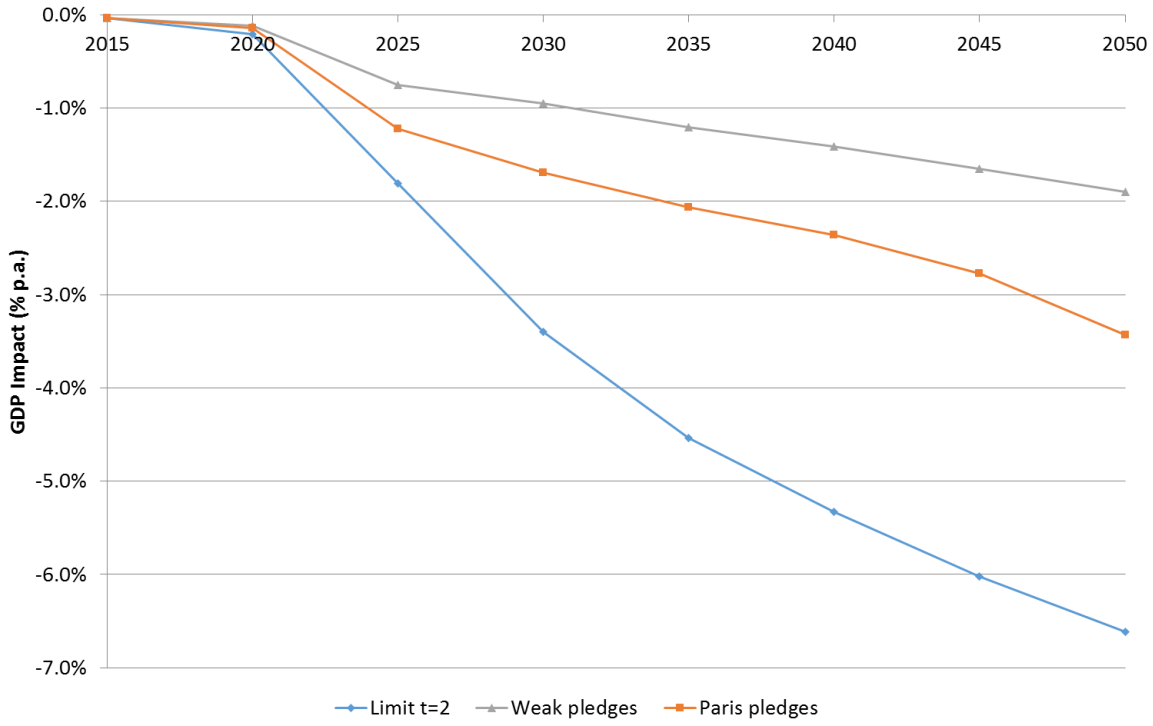
The first step in modelling climate change impact is to determine linkages between the physical impacts and economic outcomes from climate change. This is a very complex process to model, however there are various researchers that have been developing and refining models for several years and we rely on their work. We have researched a number of these and have adopted the models developed by Prof W Nordhaus and FEEM (the WITCH model) for damage costs and mitigation costs respectively. We have also calibrated some of their results to more recent modelling performed by the OECD. These choices were made primarily on the basis of transparency behind the models, having a track record over time (which shows a commitment to refining them with new information) and their relevance to current policy settings. These models all have similar features in that they all use fairly conventional assumptions about baseline economic and population growth across regions and countries. Carbon emissions are projected under different policy regimes and there are assumptions made about the marginal cost of switching to lower carbon sources of energy. Some of the models, like WITCH include more detail on how the total energy portfolio is expected to change, how energy demand is impacted and at a regional/country level. These emissions scenarios are assumed to impact on the status of the climate (primarily referenced by temperature increases) over time. In turn, these changes in climactic status are modelled to have physical impacts that will, by and large, have a negative economic impact. There are more detailed and granular models than the ones we have adopted (Computable Generalised Equilibrium models or CGEs), but these are designed for other purposes.

We have set out a few scenarios that are defined essentially by broader policy responses to climate change. They entail different emissions pathways to 2050 which are often cast in terms of physical objectives (i.e. "limiting temperature increases to 2 degrees" etc.).

1. Base (No Action) – there is no policy response to climate change and the asset return projections are performed on the basis that there is no climate change.
2. Weak pledges – there is relatively weak policy action to 2030 on the basis of the Copenhagen accord, but "optimistic" buy-in from non-participatory countries after 2030. The trajectory of decarbonisation continues on a similar path beyond 2030.
3. Limit t=2 – policy action that limits global average temperature rises to 2 degrees (based on median estimates, so that avoiding a breach of the limit is not guaranteed). Emissions follow an "optimal" pathway.
4. Paris – policy action based upon the aggregate pledges made by countries at the recent Paris conference, with a continuing trend in emissions beyond 2030.

With every scenario, an economic cost relative to "business as usual" is projected. The move to a decarbonised economy will inevitably involve greater expenditure on energy production and services to deliver the same output (though there is an important role for energy efficiencies to be deployed) and a diversion away from non-energy sectors. These mitigation costs will be a drag on economic growth. The higher the emissions (and therefore temperature increases), the greater the economic costs will ultimately be from physical impacts. Chart 2 shows the expected loss of GDP under different emissions scenarios.

Chart 2: Mitigation and damage costs: different climate change policies



There is a trade-off between mitigation and damage costs. However, this trade-off is only partly apparent during the period represented to 2050, as mitigation costs are expected to predominate under stronger policy action. However, the damage costs are expected to escalate in the second half of the century under a weaker emissions reduction regime.

Regional and sector impacts

Mitigation costs and damage costs will differ across countries and regions and also across industries. The relative cost burdens vary from model to model and this is particularly notable in estimating damage costs for sectors such as agriculture. Industries that are energy intensive (and particularly with regard to carbon intensity) will be prone to higher costs, but this will also depend on the degree of substitutability and the ability to pass on costs to consumers. Mitigation costs are generally lower in developed nations, due to their access to alternative technologies but will also be heavily dependent upon their natural resource endowment.

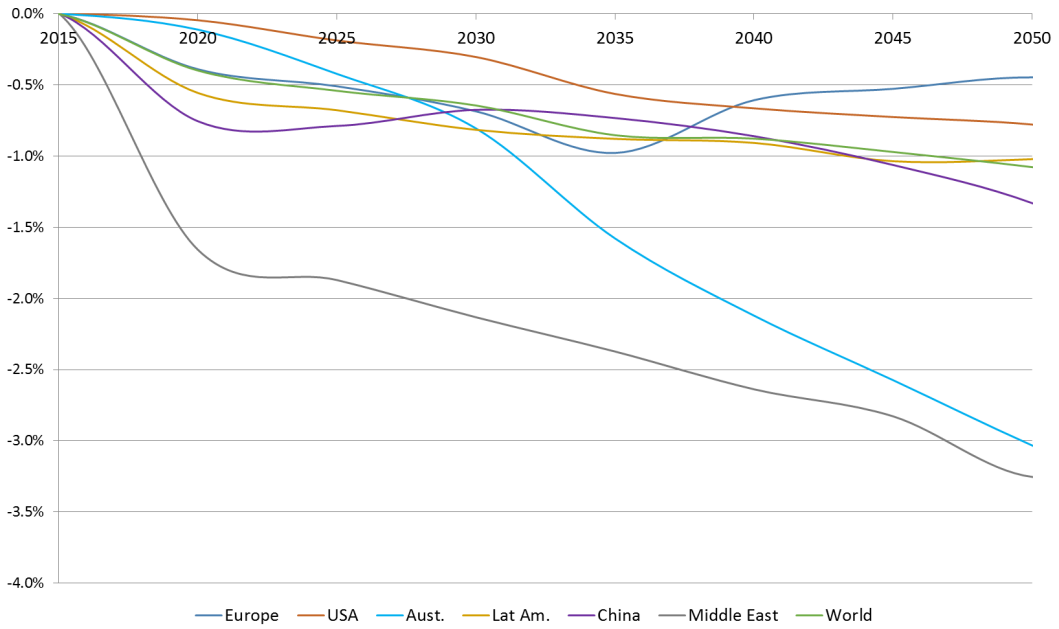
For most emerging economies, the transition to a low carbon economy would appear to be more expensive due to their relative lack of access of alternative technologies and the relative scale of future energy demand. Some emerging economies are also highly dependent on fossil fuel exports. However, there is some acceptance for the view that emerging economies did not create this problem and therefore should be subject to more modest emissions reduction targets.

Charts 3 and 4 show some projections on the mitigation and damage costs respectively, for different regions and countries to 2050 based on an emissions pathway similar to the Weak Pledges scenario. The damage costs are modelled to diverge from 2040 onwards (this divergence would be more pronounced, in a scenario where there is a lesser global effort to abate emissions).

These costs are influenced by the rate of decarbonisation as well as the absolute levels of reduction which differs from country to country.

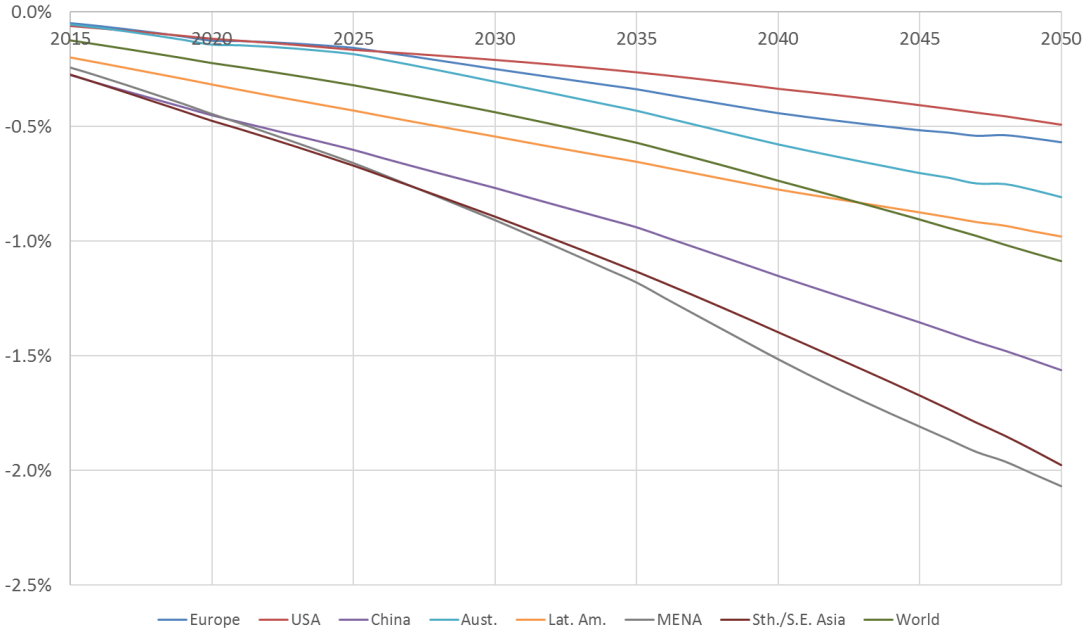
In doing so, we have allowed for differential impacts between regions, which is based on the current sectoral composition of each regional economy. Future enhancements to the module could allow for differences between economic activity at the national level and on listed markets; and that earnings for listed companies are not bounded by domicile.

Chart 3: GDP impacts from mitigation by region - “Weak Pledges” scenario



Sources: WITCH model, OECD, Frontier

Chart 4: GDP impact from damages by selected region to 2050 - “Weak Pledges” scenario



Sources: Nordhaus, OECD, Frontier

Other considerations

There are several factors which can almost be assured of occurring but where timing and magnitude cannot be predicted. These are treated as fixed in the module and could significantly alter the mitigation and damage costs from climate change. These include:

- technological breakthroughs, relating to energy storage, costs of renewables or other energy technologies that permit their relatively rapid deployment at scale and competitive cost;
- environmental shocks - the type of trigger events referred to in the previous section which could shift the status of the climate quite abruptly;
- interaction with other environmental factors - an example is water scarcity or stress, driven by increases in human consumption and a likely shift in the distribution of rainfall from climate change impacts;
- externalities to GDP measurement. An example would be biodiversity loss caused by climate change;
- pricing schemes and international linkages - the extent to which emission prices are applied in different regions and the linkages and offsets across schemes.

Economic impacts to asset class returns

We have set out that climate change is likely to impair economic growth relative to a "business as usual" case. The difference between the scenarios is the pace and the scale of these impacts.

Climate change will influence all asset class returns as reductions in GDP growth will reduce interest rates and earnings growth.

Asset class returns are modelled in a state of long-term equilibrium. This does not currently allow for how market sentiment could play a part in investor responses to climate change, nor likely repricing of assets as the lower growth impact of climate change is recognised (e.g. bond returns initially benefit from lower interest rates).

Return impacts are marginally higher for emerging markets than for developed markets, and slightly higher for Australian equities relative to developed markets. This reflects the higher GDP impacts on emerging markets, both in terms of mitigation and damage costs as projected by the OECD. This comparison is set out in Table 1.

Table 1: Average return expectations (2015 to 2050) - Listed Equities

Asset Class	Base	Limit t=2	Weak Pledges	Paris Pledges
Australian equities	8.25%	8.00%	8.15%	8.11%
International equities (DM- unhedged)	8.25%	8.06%	8.21%	8.17%
Emerging markets	9.75%	9.52%	9.68%	9.66%

Impacts on portfolios

The Climate Change module has been developed to complement Frontier's existing SAA and DAA modules within Prism. While the definition of asset classes is quite broad, there are still a large number of asset classes within Prism. The exposure of some asset classes (e.g. Absolute Return Strategies) to climate change factors is difficult to gauge at this point. Therefore we have made some simplifying assumptions outside the primary asset classes of cash, bonds and equities. Future enhancements to the module could include more detailed modelling for specific asset classes.

We have modelled a broadly representative balanced portfolio consistent with a default or MySuper option. Prism allows users to model whatever portfolio is entered. We have modelled the return impacts of these portfolios from 2015 for 15 and 35 year periods respectively. The charts below show the different average returns of the portfolios over the holding periods.

Chart 5: Balanced portfolio returns (2015 to 2030) projected climate change scenarios

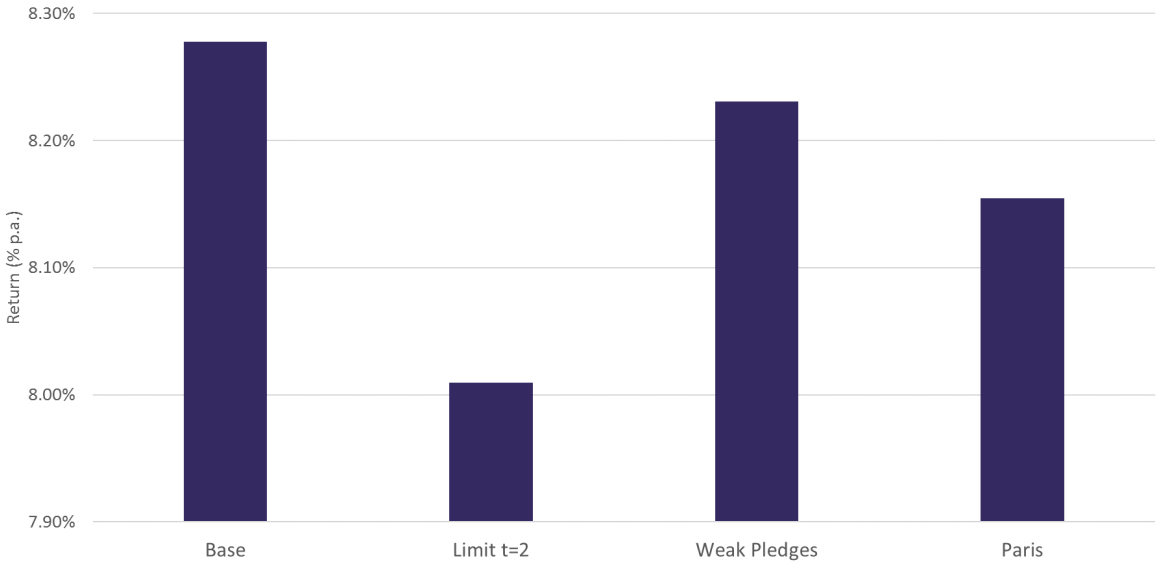
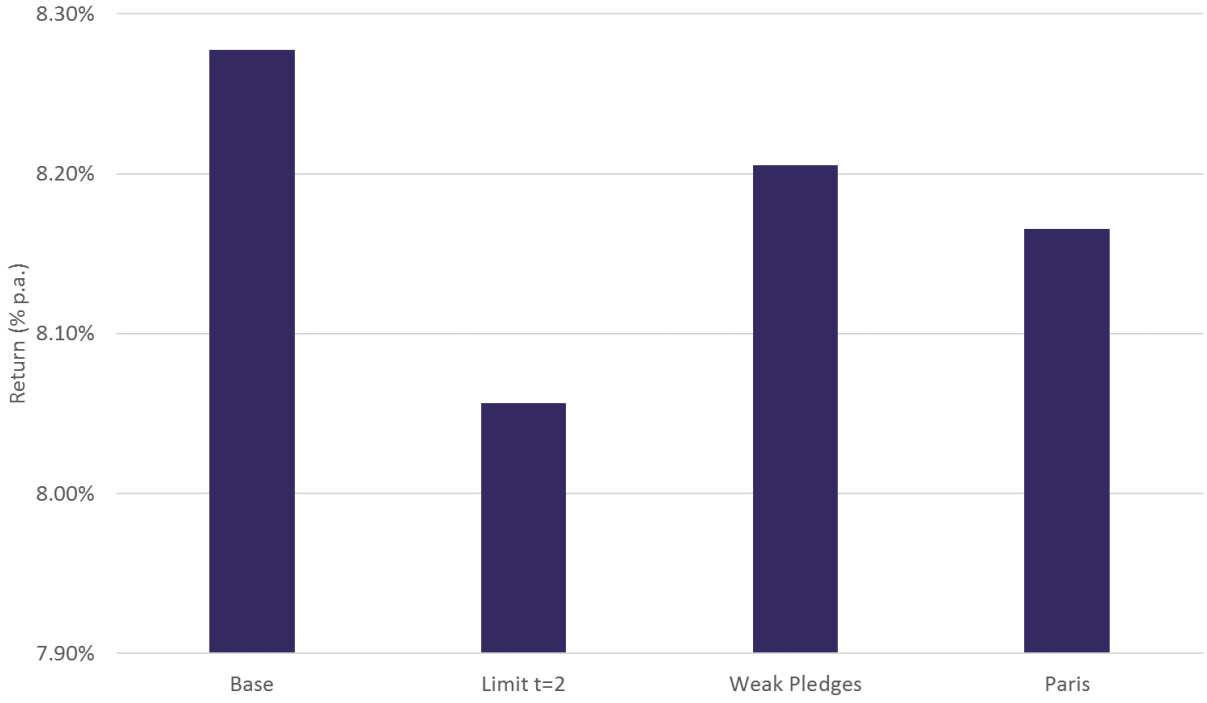


Chart 6: Balanced portfolio returns (2015 to 2050) projected climate change scenarios



The results show reductions in portfolio returns relative to current expectations. This is in line with our comments earlier about negative economic impacts being unavoidable. The reductions in returns are quite modest at this stage. Some comments in summary about these return outcomes are:

- the return reductions are higher under the Limit t=2 scenario. This is because the mitigation costs are expected to be more significant than damage costs over the whole projection period;
- the return reductions for the Weak Pledges and Paris scenarios relative to the Base Case are relatively modest over all projection periods. This reflects the fairly modest impact of mitigation costs.

One of the key messages from an asset allocation perspective, is that climate change is expected to negatively impact returns across the spectrum of asset classes. This seems reasonable in a broader perspective given the pervasive impacts that it is likely to have.

There will be opportunities for investors to make tilts within sectors and to select managers that invest with an understanding of how climate change impacts companies and securities within their opportunity set.

While the return reductions seem slight in proportion to the Base Case, this represents a significant difference to the retirement balance of a fund member accruing their entitlements over the period of projection.

We have assumed an element of short-sightedness in assigning terminal values to assets in 2050. The damage costs are expected to accelerate after 2050 but the module does not allow for these expectations in the modelled asset pricing.

Paris conference – key takeouts

The Paris conference was a welcome development; at last there is a cohesive agreement on climate change action with 195 national governments signing on.

Nations have pledged emission reduction targets to 2030 (some will be in effect to 2025 but these will have to reset in 2020). These are in most cases expressed in terms of a percentage cut in emissions from an earlier baseline. However, some are expressed in terms of emissions per unit of GDP (e.g. China) or in terms of energy efficiency (other developing countries). These reflect the differential aspects of countries in terms of mitigation costs, development needs and historical emissions.

Countries are bound to submit to five yearly reviews of their targets and how they are progressing towards them. These are based on agreed methodologies developed by the IPCC.

However, there is still some clarification required on methodologies widely adopted for emissions relating to land use, land use changes and forestry.

There is a commitment to provide USD $100 billion per annum from 2020 to 2030 (with review of the amount then) from developed to developing countries for low carbon investment. There is also provision for further financial and technical assistance in the deployment of low carbon technology and bolstering adaptation.

Frontier is proud to be a signatory to The Paris Pledge which means we have committed to play our part in supporting the objectives of the Paris Agreement to limit global temperature rises to less than 2 degrees Celsius. Find out more about the Paris Pledge here bit.ly/FA_ParisPledge

There is no reference to integrating carbon trading schemes within the Agreement, so this will need to occur through other bi-lateral or multi-lateral arrangements in the meantime. Currently there are carbon pricing schemes in 40 different countries (though some are implemented at regional levels only), so there is scope for further expansion in this area.

The pledges are not legally binding and this has been cited by some critics as a weakness of the Agreement. In addition, countries can exit the Agreement with notice. The five yearly reviews (the first one in 2023), are compulsory, and countries must submit to report globally on their progress towards targets.

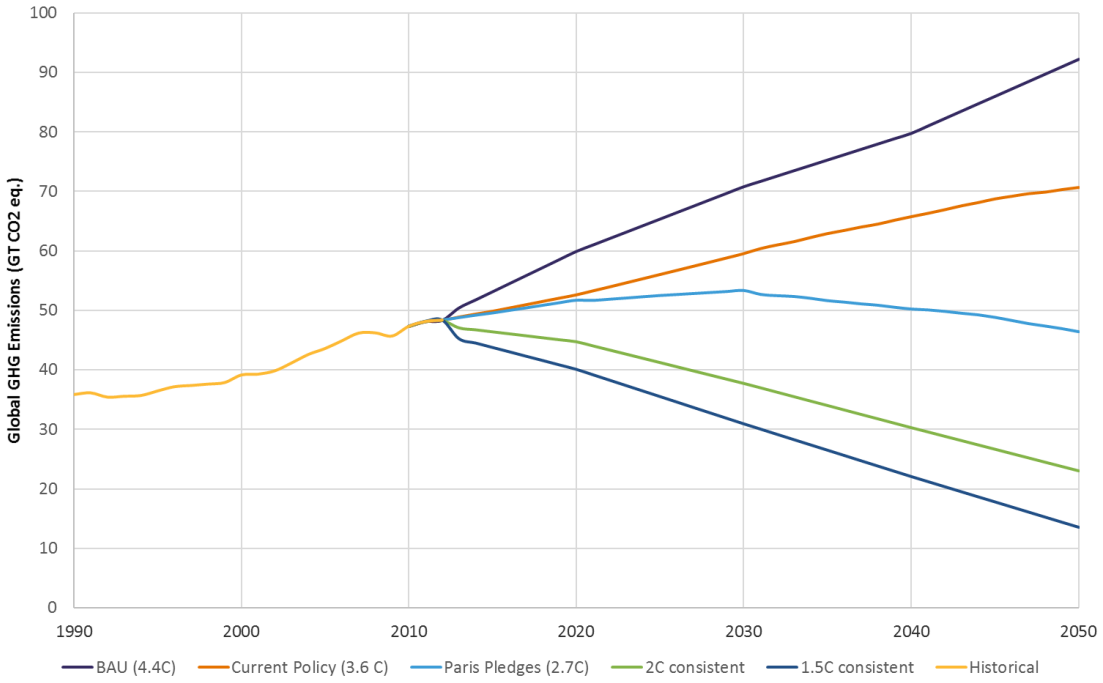
The Agreement contains overarching objectives to limit temperature rises to below 2 degrees and make efforts to contain temperature rise within 1.5 degrees. Given that the current INDCs are estimated to put emission pathways at best on a trajectory towards 2.7 degree rises, these seem optimistic. However, the provision for more progressive targets to be set with each review at least puts into place a structure to move towards these objectives. Table 2 summarises in very basic terms the pledges made by some countries of interest.

Table 2: COP21 – Pledges by key countries weights

Country/Region	Reduction Target	Base Year	Target Year
Australia	26%-28%	1990	2030
China	60-65%	2005	2030
India	33-35%	2005	2030
Japan	26%	2013	2030
EU-28	40%	1990	2030
Russia	25%-30%	1990	2030
USA	27%	2005	2025

The level of improvement by intention on a country by country basis is mixed, though in aggregate it appears as if the combined effect of the pledges would be to moderately reduce emissions below pre-COP21 pledges. However, there is still a significant gap between that and what is likely to be required to limit temperature rise to 2 degrees. The following chart shows the global emission trajectories implied by the pledges in aggregate, and compared to both pre-existing policy settings and that implied by the 2 degree temperature limit. The figures in brackets in the legend refer to the median estimate of temperature rises to 2100 under each of the scenarios.

Chart 7: Emission pathways of different policy scenarios (median estimates)



Source: Climate Action Tracker

The final word

Climate change is a significant risk to the economy and investments. Investors with a long-term investment horizon need to consider the impacts climate change could have on investment returns. The recent COP21 Agreement at Paris is a positive development.

However, there is currently a regulatory gap between what has been pledged at the Paris conference and the aspirational targets set there. Engagement by investors on climate change with companies they invest in, with asset managers, with policy makers, with all stakeholders, is an important means of addressing this gap. In the near term, the Australian Federal and US presidential elections later this year could be important signposts for the direction each country takes to addresses climate change.

The Frontier Climate Change Module is a constructive initial step as part of a longer-term deliberation over what climate change means for asset allocation. The return expectations modelled suggest modest reductions from climate change impacts over both medium term and longer term periods. This is driven by the models predicting damage costs occurring predominantly in the second half of the century after the Module's projection period which extends to 2050. This creates the somewhat perverse outcome that returns are more negatively impacted in more active climate change response scenarios as the mitigation costs are higher. However, stronger policy responses will reduce the expected damage costs in the second half of the century and beyond.

There are a large number of potential enhancements that can be incorporated into the Climate Change Module and Frontier will be working with our clients to implement this in the future. Some possible enhancements could include:

- different sectoral impacts;
- more granular and customised analysis of client portfolios;
- estimating the impact of climate change "shocks", either through regulatory changes, catastrophic weather events or shifts in the broader scientific consensus on the expected physical impacts;
- estimating the volatility of returns under climate change scenarios and the impact this might have on portfolio construction;
- accounting for fossil fuel exposures in typical balanced portfolios and the value of client portfolios at risk under different scenarios; and
- accounting for positive climate change investments, such as renewable energy;

We hope the Climate Change Module engenders discussion of the issue and its significance for investors. We look forward to being involved with investors on that journey, and encourage your feedback and suggestions.

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About Frontier Advisors: Frontier Advisors is one of Australia's leading asset consultants. We offer a range of services and solutions to some of the nation's largest institutional investors including superannuation funds, charities, government / sovereign wealth funds and universities. Our services range from asset allocation and portfolio configuration advice, through to fund manager research and rating, investment auditing and assurance, quantitative modelling and analysis and general investment consulting advice. We have been providing investment advice to clients since 1994. Our advice is fully independent of product, manager, or broker conflicts which means our focus is firmly on tailoring optimal solutions and opportunities for our clients.

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