**TD Global Investment Solutions**

Investor Knowledge 20 Minutes

# Assessing Climate Risk Through Stochastic Modeling


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As countries around the world grapple with extreme weather events, climate change has become a major economic risk. Canadian regulators have also heightened their focus on managing climate-related risks. In 2023, the Office of the Superintendent of Financial Institutions published its Climate Risk Management framework applicable to financial institutions, leading other pension authorities to also weigh in. “Climate change poses material and urgent financial risks and opportunities,” according to the current guidelines of the Canadian Association of Pension Supervisory Authorities on Environmental, Social and Governance considerations in pension plan management.

Several possible climate scenarios loom on the horizon, and every single one poses risks to liability-aware institutional investors such as pension funds and insurance companies. To manage these risks, investors need to have a process in place for incorporating the various climate scenarios into modeling that is specific to their plans.

# Climate Scenarios – Setting the Stage

To evaluate the potential effects of climate change and climate risk on institutional portfolios, one first needs a baseline projection of potential climate scenarios that have been developed by experts. Many organizations worldwide have produced climate scenarios. One such example are the exploratory scenarios developed by the Network for Greening the Financial System (NGFS). The NGFS is a collection of central banks and supervisory agencies working in partnership with an academic consortium to develop climate scenarios that can serve as a common starting point for analyzing climate-related risks to the economy and financial system.

When considering climate risk, the NGFS distinguishes between two types of risk: **transition risk** and **physical risk**.[1]

**Transition risks** stem from government policies, such as climate pricing, which aim to achieve certain climate objectives – and from the availability and usage of technology to carry out these policies (e.g. carbon capture). An example of how transition risk could translate into financial risk is the potential reduction in demand for non-renewable energy or higher operating costs for companies due to higher costs for non-renewables, which could suppress company earnings.

**Physical risks** fall into two categories: chronic and acute. Chronic risks result from the gradual but perpetual rise in temperature, precipitation and sea levels, which can impose higher production, shipping and insurance costs on companies. Acute physical risks stem from extreme climate events, such as severe storms, which could result in impairment of assets and goods.

## Application of Scenario Testing

Scenario testing applies shocks to economic variables in order to measure the impact on an underlying investment portfolio and/or liability. While the climate scenarios we use are longer-term in nature, projecting out to the year 2050, scenario testing can be performed over any time horizon and for any number of different shocks. For example, it is common practice to design scenarios based on historical events, such as the great financial crisis of 2008 and the dot-com bubble.

[1] While both chronic physical and transition risk are incorporated in our analysis, the current iteration of NGFS scenarios do not account for the impact of acute physical risks on economic variables.

The most recent NGFS scenarios (published in November 2023) explore seven sets of assumptions regarding how various climate objectives could evolve by 2050.

1. The net zero scenario limits global warming to 1.5°C through immediate policy action and a moderate use of technology, reaching global net zero CO2 emissions by 2050. This scenario leads to the lowest temperature and the lowest physical risk, which results in a moderate transition risk.

2. The low demand scenario is similar to net zero in terms of temperature outcome, but it also includes a behavioural shift towards lower energy demand, which leads to lower energy prices and puts less strain on the economy.

3. The assumptions of the below 2°C scenario are similar to those of the net zero scenario. However, this scenario has less rigour: for example, it assumes a slower pace of technology change. This results in slightly higher average temperatures and slightly lower transition risk than the net zero scenario.

4. The delayed transition scenario assumes policy action is delayed until 2030. This scenario has a similar temperature outcome to the below 2°C scenario at 2050, but the transition timeline is delayed and shorter. This results in higher transition risk since policy action would need to be more stringent at that point to achieve the same climate goal.

5. The nationally determined contributions scenario reflects all emission targets pledged by the countries that signed the Paris accords, regardless of whether they are supported by effective policies or not. The scenario suggests that the pledges are not sufficient to achieve the below 2°C outcome, and as a result, there is higher physical risk.

6. The current policies scenario assumes that the only climate policies are the ones currently implemented and no new climate policies are introduced. This scenario leads to the highest temperature, which results in the highest physical risk, but it has the smallest transition risk.

7. The fragmented world scenario assumes a delayed and divergent climate response, where net-zero-aligned countries reach 80% of the net zero target by 2050, while other countries remain at current policies. This results in both high transition and high physical risk.

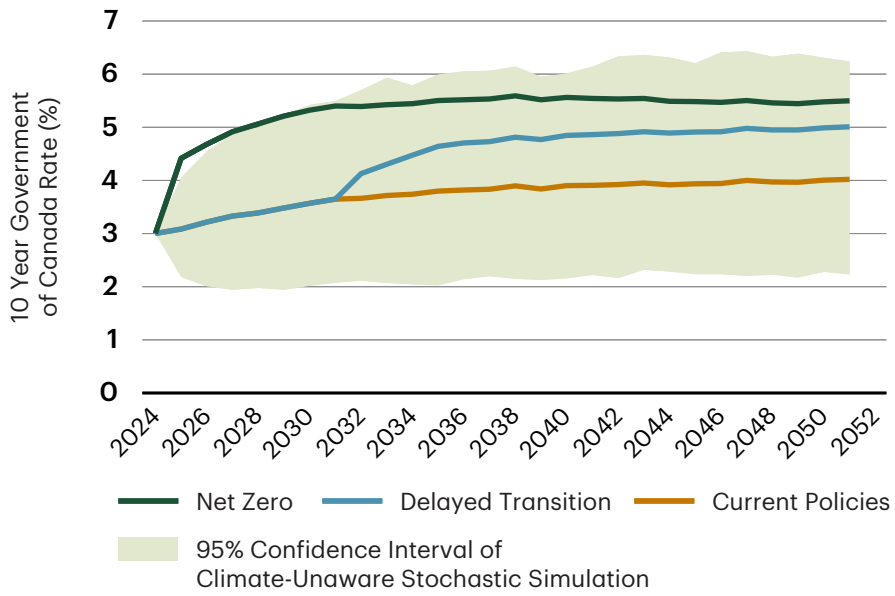
For the remainder of this article, we focus on the net zero, delayed transition and current policies scenarios to highlight how scenarios can be translated into economic results.

# Economy

# Economic Impacts

Let's start by comparing some top-of-mind factors for liability-aware institutional investors across the three scenarios relative to a climate-unaware stochastic simulation. A climate-unaware stochastic simulation is a set of projections which are agnostic to any specific climate scenario.

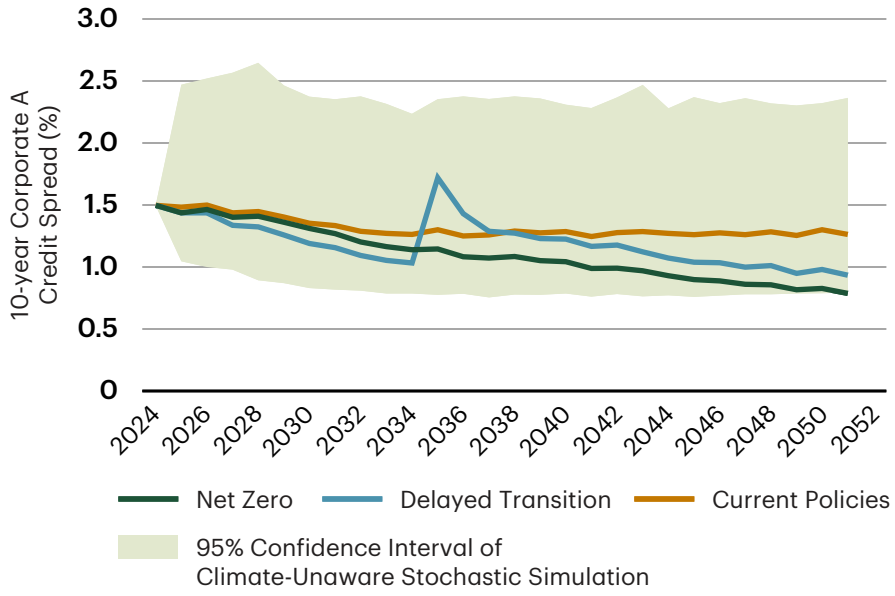
## 10-Year Government of Canada Rate




Source: TD Asset Management Inc. Dec. 31, 2023

- **Net Zero**: The 10-year Government of Canada (GOC) rate is higher in the near-term to account for inflationary pressures of the net zero transition (higher energy prices) and for higher real yields.
- **Delayed Transition**: Under this scenario, the 10-year-GOC rate follows the current policies until 2030. At this point, the rate quickly increases to account for the rise in inflationary pressures and real yields. However, real yields are not as high as those in the net zero scenario.
- **Current Policies**: Under the current policies scenario, the 10-year-GOC rate follows the median rate from the stochastic projection. This projection assumes that 10-year GOC rates revert to historical levels, which are slighly higher than observed in December 2023.

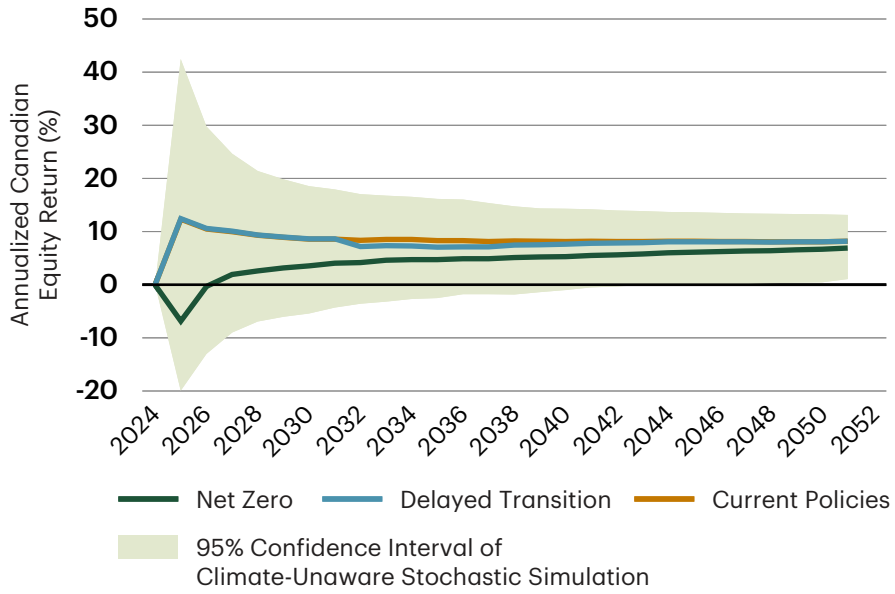
## 10-Year Corporate A Credit Spread




Source: TD Asset Management Inc. Dec. 31, 2023

- **Net Zero**: Corporate credit spreads gradually tighten following the implementation of stringent climate policies and innovation. This tightening is greater than in the current policies scenario.
- **Delayed Transition**: Credit spreads tighten until a shock is applied in 2030 and then decline, but by less than in the net zero scenario.
- **Current Policies**: Projected corporate credit spreads tighten and normalize following the current monetary cycle, but this happens to a less significant degree than in the other climate scenarios.

## Canadian Equity Returns



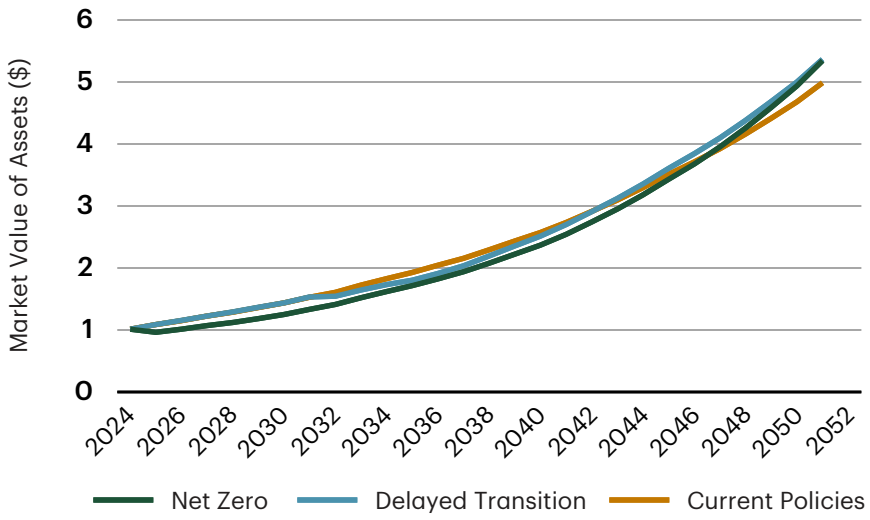

Source: TD Asset Management Inc. Dec. 31, 2023

- **Net Zero**: Canadian equities produce lower returns relative to their performance in the other climate scenarios in the earlier periods.
- **Delayed Transition**: Follows a similar pattern to the current policies scenario until the delayed transition begins.
- **Current Policies**: Returns remain steady at 7% – 8% per annum throughout the projected horizon, not being impacted by transition risk and not accounting for the higher acute physical risks.

# Translating Economic Scenarios into Liability-Aware Metrics

Now that we have reviewed some of the main economic factors in the NGFS climate scenarios, we can translate them into metrics aligned with investor-specific objectives. Below we show a projection of the assets, liabilities and funded ratio of a hypothetical pension plan with a portfolio of 50% fixed income and 50% equities[2] under the three NGFS scenarios. The results are shown in the exhibits below.

## Market Value of Assets




Source: TD Asset Management Inc. Dec. 31, 2023

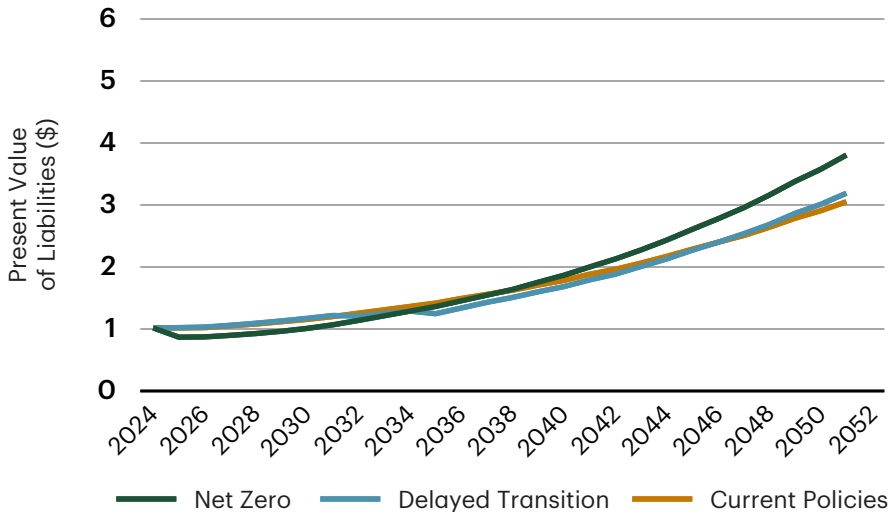
- **Net Zero**: The asset mix underperforms compared to the other scenarios during the earlier stage due to the negative equity shock and steep interest rate rise. Then it trends to longer-term comparative outperformance over 20+ years due to normalizing equity returns and higher yields earned on fixed income.
- **Delayed Transition**: The asset mix outperforms net zero over the first 10 years because there is no early equity shock. Then it underperforms due to the equity shock and inflation/yield/credit shock as the transition begins. Because of higher yields and tightening credit after the transition shock, the asset mix in this scenario eventually outperforms compared to the current policies scenario.
- **Current Policies**: Outperforms both transition scenarios because there are no climate-related shocks. However, it is eventually outpaced by the other scenarios because of the comparatively lower nominal yields.

## Inflation-Indexed Benefits and Climate Risk

Institutional investors with liabilities linked to the Consumer Price Index will also need to consider the impact of climate change on inflation. The transition to a lower carbon economy is expected to require carbon pricing regimes and other policies that will increase the cost of energy derived from fossil fuels. Higher energy prices may contribute to higher current and expected future inflation, so these higher inflation levels would drive up the cost of indexed liabilities.

[2] Market value of assets have been determined based on a hypothetical portfolio with target weights of 50% FTSE Canada Universe Bond Index, 25% S&P/TSX Composite Index, and 25% MSCI World Ex-Canada Index. Projected asset values were determined assuming monthly rebalancing to target weights and returns based on TDAM's internally developed Capital Market Assumptions.

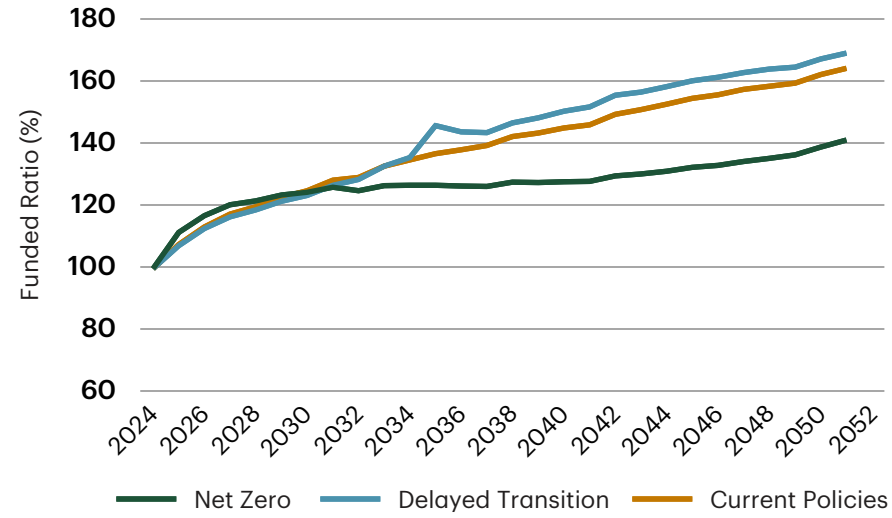
## Solvency Liability Proxy




Source: TD Asset Management Inc. Dec. 31, 2023

- **Net Zero**: Comparatively lower liabilities over the first 10 years due to the initial rise in yields and higher liabilities in the long term as a result of the higher yields and tightening spreads over the longer term.
- **Delayed Transition**: Higher liabilities than net zero over the first 10 years, followed by a drop in liabilities as a result of the shock increase in yields/ spreads created during the transition period.
- **Current Policies**: Liabilities grow at a consistent but lower rate due to lower yields, following the solvency curve used.

## Projected Funded Ratio




Source: TD Asset Management Inc. Dec. 31, 2023

- **Net Zero**: Because of the rise in yields, the liabilities are lower relative to assets and the funding position is comparatively better in the earlier periods. Funding levels fall below the other two sceanrios over time as the liability proxy grows faster due to the higher sustained yields.
- **Delayed Transition**: Lower yields early on correspond with lower funding levels. The trend reverses after the delayed transition shock.
- **Current Policies**: The funded status improves over time because the median asset returns outpace the liability growth as proxied by the sovlency curve used.

Ultimately, interest rates, inflation, credit spreads and returns on non-fixed-income type investments are major economic factors of climate scenarios. They all have considerable influence on the valuation of assets, liabilities and corresponding ratios. While we have shown pension-plan-related results under a 50/50[3] asset allocation, the process for evaluating climate scenarios would remain the same for different types of plans or allocations. The results could be materially different depending on specific allocations and plan characteristics being modeled.

As the charts above illustrate, funded ratios vary significantly across scenarios. In particular, the point of transition to net zero is characterized by a material shift in underlying macroeconomic factors, which impacts a plan's funding position. Depending on the stringency of the transition and a plan's strategic asset allocation, there could be a decrease in funded ratios, triggering funding requirements for plans that have not built up a sufficient surplus. While the funded position improves under each scenario explored for this particular sample asset mix and liability proxy, there is significant uncertainty during the transition phase.

## Conclusion

Climate risk analysis is relatively new, driven by rapid changes in regulation, reporting requirements for plan sponsors and policy decisions. The climate scenarios currently being generated are extremely long-term in nature, which limits their usefulness to strategic allocation decisions. However, having a process for including broad economic scenarios into plan-specific modeling will allow institutional investors to remain nimble in the face of climate uncertainty. ■

[3] Market value of assets have been determined based on a hypothetical portfolio with target weights of 50% FTSE Canada Universe Bond Index, 25% S&P/TSX Composite Index, and 25% MSCI World Ex-Canada Index. Projected asset values were determined assuming monthly rebalancing to target weights and returns based on TDAM's internally developed Capital Market Assumptions.

# Climate Analytics



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