SOLVENCY WORKSTREAM OF THE CLIMATE AND RESILIENCY (EX) TASK FORCE
Tuesday, Nov. 29, 2022
12:00 – 1:30 p.m. ET / 11:00 a.m. – 12:30 p.m. CT / 10:00 – 11:30 a.m. MT / 9:00 – 10:30 a.m. PT

ROLL CALL

Kathleen A. Birrane, Vice Chair
George Bradner
David Altmaier
Gary D. Anderson
Rajesh Bhandula

Maryland
Connecticut
Florida
Massachusetts
New York

Trey Hancock
Scott A. White
Mike Kreidler
Amy Malm

Tennessee
Virginia
Washington
Wisconsin

NAIC Support Staff: Dan Daveline

AGENDA

1. Opening Comments - Commissioner Kathleen A. Birrane (MD)

2. Company Experience and Utilization of Climate Scenario Analysis
   - Liberty Mutual-Rakhi Kumar & Kelly Hereid
   - Equitable-Aaron Sarfatti

3. Any Other Matters

4. Adjournment
Liberty Mutual’s Approach to Climate Risk

November 29, 2022

Rakhi Kumar, Senior Vice President, Sustainability Solutions & Business Integration, Office of Sustainability
Kelly Hereid, Ph.D., Director of Catastrophe R&D, Corporate ERM
Extremes

Catastrophe Models

Economy

Integrated Assessment Models

Future

Climate Models
Integrated Assessment Models

Catastrophe Models

Extremes

Economy

Future

Climate Models

Tough nut to crack
The financial sector has discovered climate models

Calls for the integration of climate science into risk disclosure and decision-making across many levels of economic activity has leap-frogged the current capabilities of climate science and climate models by at least a decade.

_Fiedler et al., Nature Clim Ch, 2021_
Catastrophe Risk in a Changing Climate
Climate Attribution

Climate Understanding

After Carbon Brief
Climate Attribution

Climate Understanding

Everything that matters to insurance

After Carbon Brief
We can use these
To inform our view of these
Deploy a flexible toolbox for managing uncertainty

Direction + Magnitude

Neither Direction / Magnitude

Scenario  Sensitivity  Normative
Sea level rise and surge

Hurricane rainfall

Hurricane frequency
Coastal Flood Return Periods will Shorten

Current 1 in 20 yr vs. 2050 1 in 5 yr
Current 1 in 250 yr vs. 2050 1 in 100 yr
Critical Thresholds

1 in 100 year Return Period Depths

Flood Depth (ft)
- < 1 in
- 1 - 6 in
- 6 in - 1 ft
- 1 - 2 ft
- 2 - 4 ft
- 4 - 6 ft
- 6 - 8 ft
- > 8 ft

Levee Locations
Exposure Locations

New Orleans, Louisiana
In this paper, the authors review the state of the science regarding what is known about tropical cyclone frequency.

The state of the science is not great.

Sobel et al., 2021
A normative approach allows individual insurers to define climate change risk appetites and estimate a point in time when they can expect ‘unacceptable’ levels of risk.

Rye et al., Nature Clim Ch, 2021
Tail impact from Increasing Major Hurricanes

% Departure from Regional Guidance (TVaR)

% Change in Major Hurricanes

Focus on subperils that drive loss

Translate to actionable metrics for the business
Not one scenario, but an exploratory range of possibilities, from likely to extreme.

Translate to actionable metrics for the business.

Tail impact from Increasing Major Hurricanes

% Change in Major Hurricanes

% Departure from Regional Guidance (TVaR)
Tail impact from Increasing Major Hurricanes

% Change in Major Hurricanes

% Departure from Regional Guidance (TVaR)

Translate to actionable metrics for the business

Assess risk appetite via [capital allocation, profitability, etc.] metrics
Takeaways

Understand climate + built environment

Examine extreme hazards by scientific confidence + impact

Big risk handling

Translate science to action on the ground
Understanding the Drivers of Climate Transition Risk
Combining Systems Level (Top-Down) & Portfolio Level (Bottom-Up) Scenario Analysis Approaches

**Time Horizons for Systems Level & Portfolio Level Scenario Analysis**

As time horizons extend into the future, the analysis becomes increasingly exploratory in nature.

- 5 years (2025)
- 10 years (2030)
- 15 years (2035)
- 30 years (2050)
- 50 years (2070)

**Enterprise-Level**
- Systems Level Approach
- Global impact assessment with regional and sector assessment
- Agnostic of Liberty specific assets/liabilities/portfolios

**Business-Level**
- Portfolio Level Approach
- Analyzes portfolio level impact
- LMI to conduct climate scenario assessment on portfolios

Businesses can leverage insights from the 30- and 50-year enterprise level 'horizon scan' scenario impact assessments to help inform strategy.
The Network for Greening the Financial System (NGFS) designed a set of hypothetical Climate Scenarios that explore a range of plausible outcomes. The Climate Scenarios provide a common reference point for understanding how climate change (physical risk) and climate policy and technology trends (transition risk) could evolve in different futures.

### High Transition Risk

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Assumptions</th>
</tr>
</thead>
</table>
| Divergent Net-Zero              | • Assumes net-zero CO₂ emissions by 2050 and limits warming to 1.5°C  
• Assumes considerably high transition risks, due to quickened energy transition pace and policy variation, but overall results in the lowest physical risks |
| Net-Zero 2050*                  | • Assumes net-zero by 2050 and limits warming to 1.5°C  
• Assumes coordinated and stringent climate policies and innovation |
| Delayed Transition              | • Assumes global annual emissions do not decrease until 2030 with strong policies needed to limit warming to below 2°C  
• Assumes new climate policies are not introduced until 2030 and the level of policy action differs across countries and regions |
| Below 2°C                       | • Assumes net-zero CO₂ emissions by 2070 and limits warming to 1.7°C  
• Assumes that globally coordinated climate policies are introduced immediately, resulting in relatively low physical and transition risks |
| Nationally Determined Contributions (NDCs) | • Assumes continued progress towards a moderate climate ambition resulting in a steady decline in emissions and warming of ~2.5 – 3°C  
• Assumes moderate to severe physical risks |
| Current Policies*               | • Assumes emissions grow until 2080 resulting in ~3°C of warming and severe physical risks  
• Assumes existing climate policies remain in place with no additional strengthening |

NGFS models are made up of 3 Integrated Assessment Models or IAMs (GCAM, MESSAGEix-GLOBIOM, and REMIND-MAgPIE) and 1 econometric model (NiGEM). The IAMs generate the general transition pathways per scenario, while the NiGEM model creates estimated macro-economic impacts.

*Note: Net-Zero and Current Policies scenarios were not considered realistic options based on evidence from the 6th IPCC report and are therefore not being reviewed.

Source: Network for Greening the Financial System
The Network for Greening the Financial System (NGFS) v3 Update

- In September of 2022, the NGFS published an updated version of their climate scenarios. The new version includes the following:
  - Fiscal and monetary policy modeling changes and increased sophistication in modelling, which significantly alter projected GDP impact vis-à-vis NGFS v2
  - Policy updates related to COP26 commitments and other climate related policies as of March 2022
  - Updates to GDP and population growth projections
  - Improved sectoral and technological models
  - Included a new methodology to integrate acute physical risk

- Observations based on analyzing results from v2 vs. v3:
  - Significant difference on GDP impact attributed largely to fiscal modeling changes – eg runaway inflation/ interest rates – based on feedback from Treasuries
  - Magnitude of year-on-year changes are further evidence that we are still in a learning and development phase when it comes to climate transition risk modelling – the information can be leveraged to set broad strategic direction but should not be relied upon to measure exact impact of transition on financial/ insurance portfolios
US GDP Impact from Climate Change - Comparison Between v2 and v3 of the NGFS Scenarios Using GCAM Model Outputs

Below 2C | NiGEM GDP USA

Delayed Transition Change | NiGEM GDP USA

Divergent Net Zero | NiGEM GDP USA

NDCs | NiGEM GDP USA

Source: Office of Sustainability Scenario Analysis
While the scenario parameters and model updates are important, these graphs illustrate that model choice is equally important.

Since the IAMs have different solutions methods, they can produce highly variant outputs for the same variable – as can be observed in the Divergent Net Zero scenario.
Insights from Our Scenario Analysis Exercise

Better understanding of transition risks impacting companies

- The most immediate source of climate-related transition risk facing companies is stemming from Policy changes followed by Reputational risk.
- Policy change is also impacting Market related transition risk, but multiple models indicate market changes are still 5-10 years away.
- Technology transition risk is evolving at a rapid pace but is not likely to disintermediate existing businesses in the short term; they provide areas of strategic opportunities that should be explored.

Coordination not commonality is the way forward

- Time horizons of transition risks varies by region as they are based on different and sometimes divergent policy commitments made by countries (e.g., EU committed to net zero by 2050, China by 2060, India by 2070).
- US policy approach supports innovation and brings a positive opportunity lens to strategic planning; The EU disclosure-based policy approach is seen as a ‘stick’, which focuses companies on measurement and disclosure and embeds a risk aversion approach to transition planning.

Energy dependency/ independence will influence policy design

- Pace and shape of policy transition is informed by economic dependencies on the primary energy sector (coal, oil, natural gas) from an infrastructure, production and export perspective.
- Over the next decade all transition pathways rely on a combination of fossil fuels AND renewable technologies to power the global economy.

Divergent, regional energy transition pathways should be expected

- Regional-specific energy transition pathways will impact preference for the type of renewable investment & strategy, further challenging a one-size-fits-all approach to decarbonization.

Source: Office of Sustainability Scenario Analysis
Aggregate Portfolio Findings

- Among the different forms of climate risk, Liberty Mutual Investment’s portfolio is most exposed to transition risk.
- Liberty Mutual’s internal analysis was conducted by calculating market valuations at various points in time using NGFS climate scenario details.
- In addition to highlighting areas of elevated risk, a key takeaway is that Liberty’s investment portfolios climate risk was muted largely due to portfolio concentration in highly rated fixed income instruments. Where Liberty does hold exposure to impacted asset classes, exposures are minimal.

### Portfolio Impacts per Scenario

<table>
<thead>
<tr>
<th></th>
<th>Accelerated</th>
<th>Orderly</th>
<th>Disorderly</th>
<th>No Action</th>
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<tbody>
<tr>
<td><strong>5</strong></td>
<td>Green</td>
<td>Blue</td>
<td>Green</td>
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<tr>
<td><strong>10</strong></td>
<td>Green</td>
<td>Blue</td>
<td>Medium Green</td>
<td>White</td>
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<td><strong>15</strong></td>
<td>Green</td>
<td>Blue</td>
<td>Medium Green</td>
<td>White</td>
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</table>

**Assumptions**

- Scenario analysis measures total mark-to-market losses over 5, 10, 15 years assuming no other change to portfolio positions.
- If needed, transition risk estimates were based on:
  - Public equivalents for private positions
  - Sector aggregates for Structured, PE, O&G, Non-IG Illiquid, and others
- Physical risk is considered negligible for 15-year (or less) horizons

Source: Liberty Mutual Investment Scenario Analysis
Asset Class Level Findings

- Not surprisingly, in all scenarios except No Action, Natural Resources is the most negatively impacted. Because there is relatively low exposure in Liberty’s portfolio the total projected loss from this asset class is not significant.
- The second highest projected losses by asset class are in equities given.
- Leveraged Loans and High Yield bonds are also a potential areas of loss, carrying more climate risk than comparable Investment Grade exposures.
- Losses in Investment Grade Corporate Bonds are small. However, where losses arise, they are driven by Oil & Gas, Airlines, and Electric Utilities.
- Liberty’s aggregate investment exposure is relatively muted due to high concentrations in Investment Grade Fixed Income that are not particularly sensitive to climate risk.

### Specific Asset Class Impacts per Scenario

<table>
<thead>
<tr>
<th>Asset Class</th>
<th>5 Accelerated</th>
<th>5 Orderly</th>
<th>5 Disorderly</th>
<th>10 Accelerated</th>
<th>10 Orderly</th>
<th>10 Disorderly</th>
<th>15 Accelerated</th>
<th>15 Orderly</th>
<th>15 Disorderly</th>
<th>15 No Action</th>
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<tr>
<td>Investment Grade Bonds</td>
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<td>High Yield Bonds</td>
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<td>Public Equity</td>
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<td>Private Equity</td>
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<tr>
<td>Structured Products (Non-Agency)</td>
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<td>Private Credit</td>
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<td>Natural Resources</td>
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<tr>
<td>Leveraged Loans</td>
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**Key**
- Low Risk
- Medium Low Risk
- Medium Risk
- Medium High Risk
- High Risk

Source: Liberty Mutual Investment Scenario Analysis
NAIC Meeting – Climate Risk

November 29, 2022
Origins of Equitable Holdings climate risk analytical efforts

**Background and objectives**

- Financial sector stakeholders, including NY DFS, set expectations to integrate climate stress testing into risk management and business frameworks in the past years.

- Our preliminary assessments from 2021 indicated that climate risk *standalone* is unlikely to constitute a material portion of our risk profile.

- Consequently, our objective in 2022 was to incorporate climate risk within our risk policy with a minimalist implementation – albeit with an openness to expand should we find the risks to be more material or if industry analytics improve.

- Outside of stress testing, climate impact remains a material commercial topic for our insurance and asset management businesses, both offensive and defensive.

**Guiding principles for 2022**

- **Integrate climate risk into Risk Policy**
  - Establish process to managing our climate change risk
  - Conduct materiality assessment based upon stress testing
  - Integrated results into ORSA given regulatory prominence

- **Focus on major asset classes**
  - Focused on major asset classes and overall portfolio-level risk
  - Public corporate bonds (transition risk) and CMLs (physical)
  - Others risks deemed “too remote” or non-quantifiable, including US mortality

- **Stepwise build-out with “minimum viable product”**
  - Build analytics in step-wise fashion: “Start simple”
  - Minimum viable product status with pragmatic models
**Key messages**

1. Climate-related initiatives are pervasive across the Equitable enterprise, though risk and capital management constitute only a narrow portion of the aggregate effort.

2. Climate is a known but tertiary contributor to aggregate our Investment risk exposure, with traditional macroeconomic risks decidedly more prominent; we observe no data to support climate impact to mortality.

3. Climate risk investment analytics remain immature with leading models reliant upon multiple layers of untested and uncalibrated assumptions.

4. Equitable use of a “limits only” approach to mitigate climate-driven investment risk reflects the (a) limited maturity of climate analytics and (b) tertiary status of climate contribution to investment risk.

5. Equitable GA investment decisions utilize our internal rating system and integrate measures of climate change including but are not limited to carbon intensity.

6. We anticipate a gradual evolution of climate investment risk measures driven more by regulation than actual risk measures – and (aspirational) greater standardization of climate risk investment models.
Climate-related initiatives are pervasive across the Equitable enterprise, with risk and capital only a narrow portion of the aggregate effort.

### Considerations for climate risk at Equitable Holdings

#### An entire set of climate-related initiatives

- **ESG Disclosure Standards**
  - Published our first environmental, social and governance (ESG) report
  - Aligned with the Sustainability Accounting Standards Board (SASB) and the Taskforce on Climate-related Financial Disclosures (TCFD)

- **Responsible Investing**
  - Issued an FABN to fund ESG projects (5bps cost save)
  - Signed “The Principles for Responsible Investment (PRI)”
  - Integrated ESG into our investment philosophy

- **AB’s Climate Strategy**
  - Announced commitment to achieve net zero emissions
  - Partnered with leading climate organization
  - Built portfolios to pursue financial goals while also achieving ESG, including climate-related objectives

- **Risk Management**
  - Climate stress testing for certain investments in the General Account portfolio
  - Limit framework based upon climate-related potential loss integrated in Risk Policy

#### Why

- **Defense**
  - Purpose to avoid sanctions from proxy advisors and other public shareholder groups

- **Commercial growth**
  - Desire to grow AuM by establishing presence in growing ESG investing wave

#### Risk and capital efforts – <2% of total resources
Climate is a known but tertiary contributor to aggregate our Investment risk exposure, with traditional macroeconomic risks decidedly more prominent.

Our results indicate that the aggregate investment risk position within the insurance company is significantly greater than the provisional stress losses from climate risk realization.

Composition of required Economic Capital
As of 12/31/2021; Ins Op

- Total EC
- Interest rate risk
- Equity risk
- Volatility risk
- Credit risk
- Insurance risk
- Operational risk

Total EC
$9.0 billion

Illustrative comparison of Equitable’s capitalization by risk factor
Investment Risk EC vs. Provisional Climate Stress Loss

- Equity risk
  - $2.7 billion
- Credit risk
  - $2.0 billion
- Climate risk
  - $0.3 billion

(1) Based upon the post-diversified combined contribution of both credit risk and equity risk
(2) Credit risk comprises GA invested assets, reinsurance and derivative counterparties
(3) Equity risk includes open equity exposure and general account private equity
Climate risk investment analytics remain immature with leading vendor models reliant upon multiple layers of untested and uncalibrated assumptions

Equitable assessment of leading vendor climate risk model:

- **Climate Modeling**: Assess expected risks under forward-looking climate scenarios
- **Economic Impacts**: Convert climate projections into forecasts of economic impact
- **Company & Asset Analysis**: Map geolocations and sector impacts to individual counterparties and assets
- **Financial Risks**: Translate into financial risks via security valuation model and portfolio risk models

Equitable conclusions of leading model:

- “Merton” model structure is sensible and intuitive
  - Link climate risk to credit risk by assessing probability of default (PD) impacts
  - Change in PD based upon a Merton-like framework relying on conditional climate variables
- Calibration and documentation is inadequate
  - Statistical evidence for calibration is scant
  - Documentation “very light” or non-existent
- Preliminary results appear unusual
  - Examples: Singapore Airlines (“highly rated”) set to 20% chance of default in 5 years due to climate alone

As industry experts remain at an early stage of translating climate-related risks into robustly quantifiable investment risk, our view is to leverage those results to aid in refining our internal stress tests

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(1) See appendix slide on adjusted probability of default for climate risk realization
Equitable uses a “limits only” approach to mitigate climate investment risk. Reflects limited maturity of climate analytics and tertiary risk status.

**GA assets**
- Exposure confined to our GA investment portfolio
- Focused on major asset classes

**% allocated to climate risk**
- Based on 19 climate relevant sectors for corporate bonds
- Granularity of flood risk using county level data

Limit approach is used for “difficult to quantify” risks to ensure such risks cannot destabilize company.

**Corporate bond limit**
- Limit compared against max stress loss across 3 climate scenarios
- Consider both transition risks and physical risks to climate change
- Assume transition risk to be bi-directional

**“Transition risk” stress test**
- Shock parameters inferred from Bank of England estimates defined as a 1-in-100 Value-at-Risk
- Scenarios in sync with climate targets set by Paris Agreement for 2022-2050

**CML Limit**
- Limit compared against a probabilistic outcome (extreme value theory)
- Cover flood risk because flooding has historically been a major source of physical risk in the U.S.

**“Physical risk” stress test**
- Approach developed by the UN Environment Finance Initiative ("UNEP FI") pilot group under guidance provided by Acclimatise, a leading climate software company

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1. Provisional climate stress loss dominated by a sudden disorderly transition scenario.
Our investment philosophy integrates climate risk to deliver value over an extended period, thereby enhancing the quality of our portfolio.

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Strategic Asset Allocation</th>
<th>Tactical Asset Allocation</th>
<th>Security selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity (2% of GA)</td>
<td>Modest</td>
<td>De minimis direct impact</td>
<td></td>
</tr>
<tr>
<td>Mostly private equity</td>
<td>Industry/strategy allocation mostly reflects diversification goals</td>
<td>Investments managed predominantly by private equity managers or ABS managers; these managers likely integrate climate risks, among others, in investment decisions</td>
<td></td>
</tr>
<tr>
<td>Fixed income / debt (98% of GA)</td>
<td>De minimis direct</td>
<td>Most significant</td>
<td></td>
</tr>
<tr>
<td>Mix of bonds, ABS, CMLs</td>
<td>High level allocations driven by liability profile / ALM considerations, and general views of “fitness” of asset class for life insurer balance sheets</td>
<td>Industry/strategy allocation mostly reflects diversification goals</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Modest</td>
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</tbody>
</table>

**Note:** We have engaged a GHG emission vendor, Antea, to support measurement of the climate impact across our GA, starting with public corporate and sovereign bonds. The initial application is disclosure, not investment management, but applications pertinent to investment decision may evolve.
Appendix
We completed the development of a stress testing and exposure limit framework as per our commitment disclosed in last year’s ORSA

<table>
<thead>
<tr>
<th>Key considerations</th>
<th>Description and purpose</th>
</tr>
</thead>
</table>
| **Scope**          | • Confined to our investment portfolio because this is the only source of material exposure  
                     • Focused on investments in climate-sensitive companies |
| **Asset Class**     | • Focused on major asset classes and based upon 19 climate relevant sectors / categories  
                     • Current scope covers more than half of our fixed income GA assets including public corporate bonds and CMLs  
                     • Granularity of flood risk assessment using county level data |
| **Risk Factor**     | • Consider both physical risks to climate change and transition risks  
                     • Assume transition risk to be bi-directional in order to reflect the risk of more rapid or more gradual transitions than markets anticipate to a low carbon economy  
                     • For physical risk, the scope of the stress tests to the CML portfolio covers flood risk because flooding has historically been a major source of physical risk in the U.S. |
The stress loss on public corporates is based upon the product of the shock parameter for each climate relevant sector and the portfolio’s exposure to that sector.

Overview of the methodology for assessing changes in public corporates portfolio’s MV:

**Climate scenarios**
- Based on 3 scenarios including (a) a sudden, disorderly transition, (b) a long-term, orderly transition and (c) no transition
- In sync with climate targets set by Paris Agreement for 2022-2050

**Portfolio of public corporate bonds**
- Run holdings through the Paris Agreement Capital Transition Assessment (“PACTA”) tool to determine portfolio’s exposure to climate relevant sectors
- Broadly aligned with Bloomberg Industry Classification System (BICS) revenue data
- Overall, we elected 19 climate-relevant sectors that will undergo shocks under transition and physical risks
- Shock parameters in line with research and estimates published by Bank of England
- Translated into a simple equity and bond shock defined by scenario and capturing transition risk and physical risk realization
- Originally informed using a DCF-type analysis that captures the differences in future profits between baseline and the climate scenario
- Impacts based on a) the scenario-defined changes in the value of holdings in each sector and b) the portfolio’s exposure to holdings in each climate relevant sector
- Shocks are applied consecutively, first for transition risks and then for physical risks
Recap of our climate stress tests
Public Corporate Bonds

Main results:

EQH GA well within risk limits for climate stress testing

- 19% of the GA corporate bonds portfolio’s exposure subject to climate relevant sectors
- Potential overall loss is in the range of [0.5%; 0.7%]
- Potential loss in absolute terms no larger than $0.1bn across any climate relevant sub sector and less than $0.2bn in aggregate for the high-carbon split

Main caveats:

Industry modeling practices remain in infancy

- The stress tests will be further refined as novel approaches are available
- This analysis rests on several unvetted assumptions that affect results materially, reflecting the immaturity of climate analysis - these will be monitored

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<table>
<thead>
<tr>
<th>Scenario Name</th>
<th>Key Assumptions</th>
<th>Temperature Rise</th>
<th>Year of Impact</th>
<th>Change to the Public Corp Portfolio’s MV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario A</td>
<td>Sudden disorderly transition following rapid global action</td>
<td>Below 2°C by 2100</td>
<td>2022</td>
<td>-0.66%</td>
</tr>
<tr>
<td>Scenario B</td>
<td>Long-term orderly transition in line with Paris Agreement</td>
<td>Well below 2°C by 2100</td>
<td>2050</td>
<td>-0.55%</td>
</tr>
<tr>
<td>Scenario C</td>
<td>No transition and a continuation of current policy trends</td>
<td>Exceeding 4°C by 2100</td>
<td>2100</td>
<td>-0.56%</td>
</tr>
</tbody>
</table>

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- Climate scenarios defined based on interpretations of the climate targets set by the Paris Agreement
- Scenarios A and B assume that the Paris Agreement targets are broadly achieved
- Shocks parameters reflect the potential impact on the market valuations to the 1-in-100 Value-At-Risk (“VaR”) measure under the climatic scenarios
Our climate risk stress testing for public corporates show that the General Account is well within provisional investment risk limits.

Assets by climate risk by climate-relevant sector and sub-sector - chart shows the climate sector level bond VaR under Scen. A, B and C. Alert / limits set at $250M / $350M per sub sector and $500M / $700M for the high/low carbon split.

Note: Bond VaR under a given scenario can take negative values, as climate scenarios can be beneficial for some sectors.
Our methodology to assess climate-related risks to CMLs due to future flooding events was developed by the UN Environment Finance Initiative (“UNEP FI”) pilot group.

Overview of the methodology for assessing changes in CML fair values:

Physical Risk scenario

- **Changes in flooding events**
- **Define shocks to property values**
- **Measure new LTVs and ‘risk to property value’**
- **Establish relationship between spread and LTV**
- **Compute the potential change in CML fair value**

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- We use a probabilistic approach using flood risk maps by county defined with a 1 in 500 year return period from First Street.
- The output measures the 30-year cumulative flood likelihood of properties at risk of flooding per county in the U.S.
- Changes in environmental factors are captured based on guidance from the Intergovernmental Panel on Climate Change’s (IPCC) Representative Concentration Pathway (RCP) curves.
- The 30-year cumulative likelihood is mapped to a property value shock.
- Empirical evidence indicates that experience of extreme events can reduce property values between 5% and 20%.
- A direct relationship between the 30-yr probability and the property shock with guidance indicated in First Street technical documentation to define the ‘medium’ risk level.
- Data on future return periods for flooding events are converted into ‘encounter probabilities’.
- The encounter probabilities are multiplied by the estimates of changes in property values.
- The results are aggregated, to calculate the ‘risk to property value’.

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Portfolio of Commercial Mortgage Loans

- We employ the AXA IM pricing relationship between spread and LTV ratios by property type.
- We use a non-linear function to estimate the spread impact for each CML in the portfolio.
- We use change in spreads and credit spread duration to obtain the change in CML fair value.
Recap of our climate stress tests
Commercial Mortgage Loans

Main results:
Analysis shows a limited impact from flooding events

- Potential credit losses in the range [0.09%; 0.18%]
- Utilizes flood risk map quantifying frequency of flooding events from river, rainfall, storm surge and coastal sources
- Reflects changes in flood risk over the next 30 years under the 4°C conservative climate change scenario (Scen. C)

Main caveats:
Assumptions are based on high level estimates

- Stress tests use high-level, albeit severe, estimates of potential changes in property values
- The low frequency of extreme flooding events plays a critical role in quantifying the overall impact
- Ignores other extreme events (cyclones, wildfire, heat)
- Flood risk maps defined by county, but individual counties can cover large areas with varied climate change effects

<table>
<thead>
<tr>
<th>Range of Stress Tests</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood Return Period</td>
<td>1 in 500 years</td>
<td></td>
</tr>
<tr>
<td>Change in Future Flood Frequency</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Average Age to Maturity</td>
<td>10yr</td>
<td></td>
</tr>
<tr>
<td>Encounter Probability</td>
<td>2.20%</td>
<td></td>
</tr>
<tr>
<td>Property Shock (&quot;Medium&quot; Risk Level)</td>
<td>-10% -20%</td>
<td></td>
</tr>
<tr>
<td>Risk to CML MV (%)</td>
<td>-0.09% -0.18%</td>
<td></td>
</tr>
</tbody>
</table>

- Conservative stress test methodology assuming no insurance coverage
- Produced also a “worst case” version of the stress test estimated at -1.01%
  - using a higher flood return period of 1 in 100 years, and increased the change in future flood frequency to 25%
  - But we recognize that this outcome is an overestimation of the risk of flooding
The low impact from flood risk on our CML portfolio is because our largest exposures are not concentrated in flood zones, and those in such zones are relatively disperse.

Visual representation of the potential credit loss in both absolute and relative basis:
"Best Case Upper" Stress Test: Potential Credit Loss for the top 30 County in USD million (left axis) and % of MV (right axis)
What are the major assumptions in our climate stress testing framework?

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asset class coverage</strong></td>
<td>• The current framework covers public corporate bonds and CMLs but does not provide portfolio exposure values associated with other financial instruments, such as sovereign bonds</td>
</tr>
<tr>
<td><strong>Portfolio “runoff”</strong></td>
<td>• To consider the impact under the climatic stress, we measure risk against the “runoff” of our investment portfolio remains constant i.e., we examine the instantaneous sensitivity analysis on today’s investment portfolio with no adjustments thereto</td>
</tr>
<tr>
<td><strong>New investments or reinvestments</strong></td>
<td>• Any effects on new investments or reinvestments are not included in the analysis even under the climate scenarios that play out to 2050 or 2100</td>
</tr>
<tr>
<td><strong>Equity to credit relationship</strong></td>
<td>• The impact of climate change to corporate bonds is more complex than the impact it may have on equities, and that there are different views on how those impacts interplay</td>
</tr>
<tr>
<td><strong>Extreme event modeling</strong></td>
<td>• The approach to the CML portfolio is based upon low frequency events, where the occurrence of the extreme events can be significantly altered by climate change in the future</td>
</tr>
<tr>
<td><strong>Flood risk map by county</strong></td>
<td>• The geographical areas are limited by county, but some counties can cover a disproportionate amount of land, while climate change effects are not necessarily confined by those borders</td>
</tr>
</tbody>
</table>
We anticipate stress loss on risky assets due to the occurrence of defaults or climate effects to follow a different distribution profile.

**Credit risk**

**Inputs**
- Probability of default
- Loss given default
- Correlation of defaults

**Calculations**
- Loss function based on instrument type
- Loss percentile

**Capital Charge**
- Economic Capital
- Based on VaR or CTE

**Climate risk**

**Inputs**
- Climate scenarios
- Climate risk exposure

**Calculations**
- Economic impact
- Financial risk impact

**Capital Charge**
- Climate stress loss

Risky assets can incur total losses after a certain level of defaults have occurred (e.g., case of subordinated CLOs).

Realization of climate changes act primarily as a “shift” in valuation and haircut in prices.

(1) See appendix slide on adjusted probability of default for climate risk realization — commonly modeled based upon a Merton-style framework that consists in a “shift” in the counterparty’s asset values.
Vendor models have developed a Merton-like framework to theoretically ground the calculation of climate scenarios to probability of default (PD) impacts.

Climate risk is measured as the change in default loss under a climate scenario:

\[
\text{Adjusted} \text{ for climate risk realization using a Merton-style framework that consists in a “shift” in the counterparty’s asset values}
\]

- Stressed loss is the amount expected to lose under a Very Severe event
- Probability of default of issuer under a Very Severe event
- Ultimate loss as a % of exposure at time of default
- Expected outstandings at the time of default
Thank you