Exhibits 1-14 of 28 to Testimony of Rick Pope in support of HB 2601

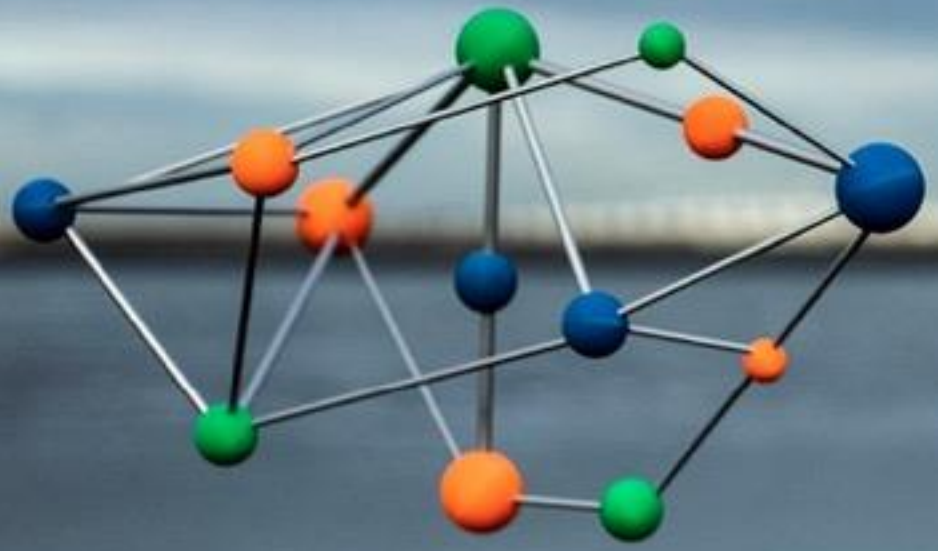
February 15, 2023

House Committee on Emergency Management, General Government, and Veterans

Climate Risk Scenario Modelling

Public equity sector deep dive

Feb 2022



Climate Scenario Analysis

Phase 2 - “What ifs”

What if… OPERF divested from its liquid-market fossil fuel investments (or any other sector)? What is the interplay between risk and return from that?

What if… we looked at the equity (listed and private) book through a deeper sector/geography revenue attribution lens? Does that give a different view and insight into implementation?

Background, scope and approach

We approached the "what if…" exercise from the perspective of developing insights for potential changes OPERF could explore.

Model:

- Both "what ifs" agreed with the team leverage the deterministic, sector-level modelling Ortec Finance (OF) has developed for public equities

Data:

- OF was provided with anonymized public equity data to allow mapping to our modelled region/sector grid. Proxies were agreed with the OPERF team
- OF also used PE and Real asset allocations summaries provided as part of the main project to inform the private assets assessment

Scope:

- OF has used its latest "Jun21" model, rather than the "Dec20" model for this work. It allows us to leverage better insights on more sectors and to differentiate the physical risk impact between different sectors (which was not included in the "Dec20" model).

Approach:

- Using the data provided, we have run our detailed sector/region model
  - 18 sectors
  - 28 regions
  - 504 time series, per scenario
- The purpose of this report is to cut through the immense detail and deliver the key insights.

Next steps:

- We had envisioned the output of this work as feeding into some of the "next steps" noted at the end of the main climate scenario presentation report.

Equity divestment from fossil-fuel exposed holding

Overview of fossil-fuel exposures | 4.4% of public equity holding

Fossil-fuel exposures = Coal | Oil and gas | Fossil-based Utilities

To give meaningful insights, we adjusted the utilities data you provided to better reflect the likely underlying profile of fuel-type exposure

- ClimateMAPS is set up to consider key economic activities that are crucial for the understanding of climate risk. The mapping exercise included some compromises, such as the mapping of utility companies to a single GICS sector.
  - However, it is likely that for a diversified portfolio the activities of electric utility companies will be spread over a few of the MAPS sector-activities.

- We adjusted the mapping as follows:
  - "Fossil-based utilities" and "Fossil-based utilities: Nuclear" were summed together
  - We then re-spread the allocation to the two sectors across: "Fossil-based utilities", "Nuclear", "Wind & Solar" and "Other low carbon electricity"
    - Which was based on country-level statistics on the energy generation mix for the countries covered.

- The net result is below
  - Combining Coal (0.1%), oil and gas (2.5%) and fossil-fuel utilities (1.4%) = 4.4%:

	Fossil-based utilities	Nuclear	Wind & Solar	Other low carbon electricity	Total
Aggregate	1.03%	1.51%	0.04%	0.04%	2.63%
Aggregate post adjustment	1.36%	0.38%	0.39%	0.49%	2.63%

Impact of replacing fossil-fuel with a “climate aligned benchmark”

Per scenario, what happens to expected returns if we replace all fossil-fuel holdings with a “Paris-Aligned” fund

Annual expected return delta (cumulative, annualized)	Horizon (yrs)		
Fossil-based equity	**5**	**10**	**20**
PO	-11.4%	-8.4%	-5.2%
PD	-16.5%	-10.9%	-6.4%
FT	-0.1%	-0.3%	-1.1%
Paris-aligned	**5**	**10**	**20**
PO	-0.3%	-0.2%	-0.2%
PD	-2.0%	-0.9%	-0.6%
FT	-0.2%	-0.6%	-2.2%

The table below shows the equity portfolio impact (relative to baseline) to 5, 10 and 20 year expected returns, which results from switching the 4.4% fossil-based public equity to an investible Paris-Aligned fund.
The significant negative impacts in the PD and PO scenarios are driven by the market pricing-in future transition impacts in the scenarios during those time windows.

Scenario **equity portfolio-level** relative impact of 4.4% switch	5	10	20
PD	0.71%	0.47%	0.27%
PO	0.41%	0.33%	0.20%
FT	0.00%	-0.01%	-0.05%

Engagement and implementation note:
Fossil-fuel entities are arguably both part of the “source” of the climate issue and part of the solution. They also potentially lose out disproportionately in the transition.

However, some investors we have worked with have investigated the impacts of divesting fossil-based utilities in a worst case of them failing to respond to engagement/reducing emissions – in order to support the portfolio NZ commitment.

The impact to low-carbon benchmarks in the Failed Transition scenario, relative to “grey” benchmarks is zero by construction as this scenario focuses on physical risk exclusively.

⇨ A low-carbon fund is not designed to mitigate physical risks.

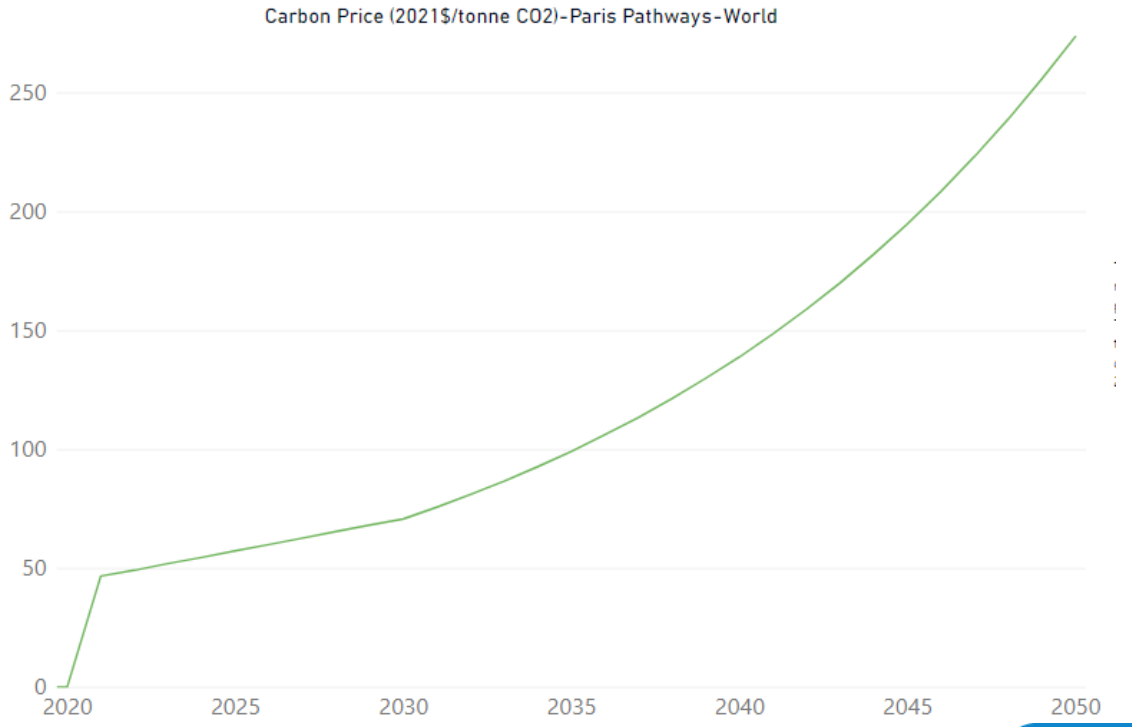
Using low-carbon benchmarks is not a silver bullet. Although these benchmarks are better positioned to address systemic transition risks by having less exposure to high-emitters/stranded assets, the construction of the benchmark can introduce other biases (by the benchmark provider)

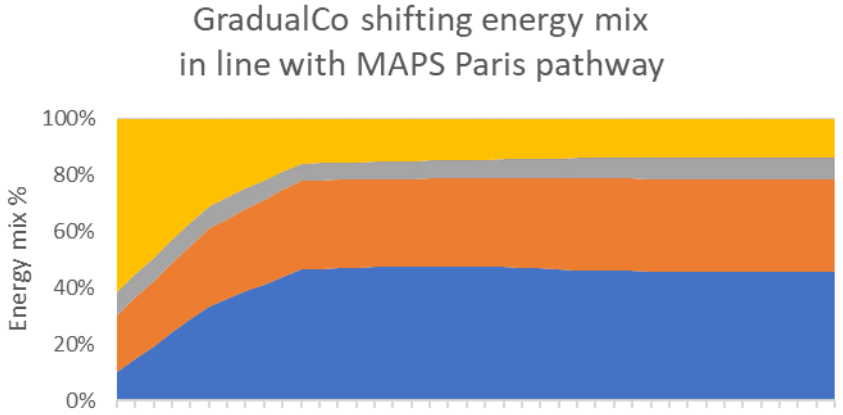
⇨ These biases can negatively impact the actual performance of the BM due to other factors.

Insights on timing of climate-transition relative to (hypothetical) utilities shifting fuel types

If energy utilities fail to rapidly invest in scaling low-carbon energy, pricing-in of transition policy could materially impact valuations

In a Paris-aligned, orderly transition, typified by the GLOBAL carbon price curve below we consider two US, diversified power companies. GradualCo will transition its energy mix at the pace required for the US energy mix to meet Paris goals. On the other hand, RadicalCo will ramp up much faster (perhaps through M&A) to reduce fossil mix to 16% with 5 years.





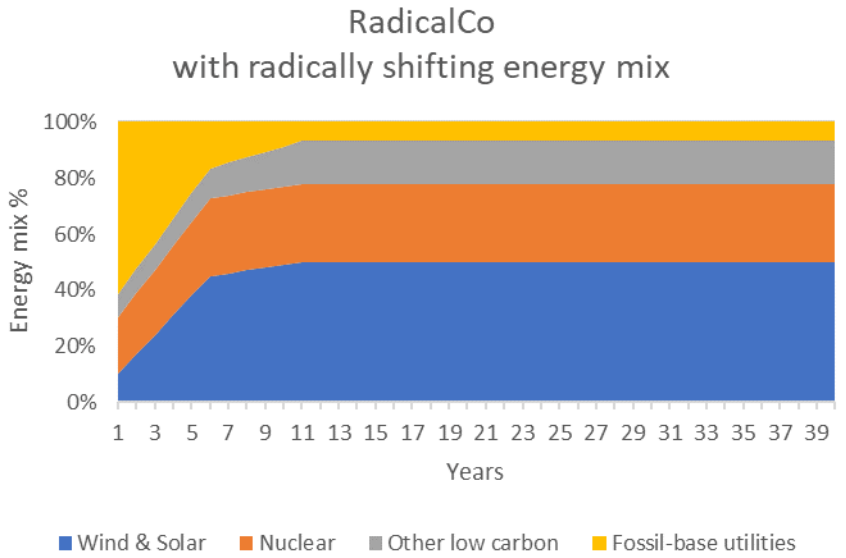


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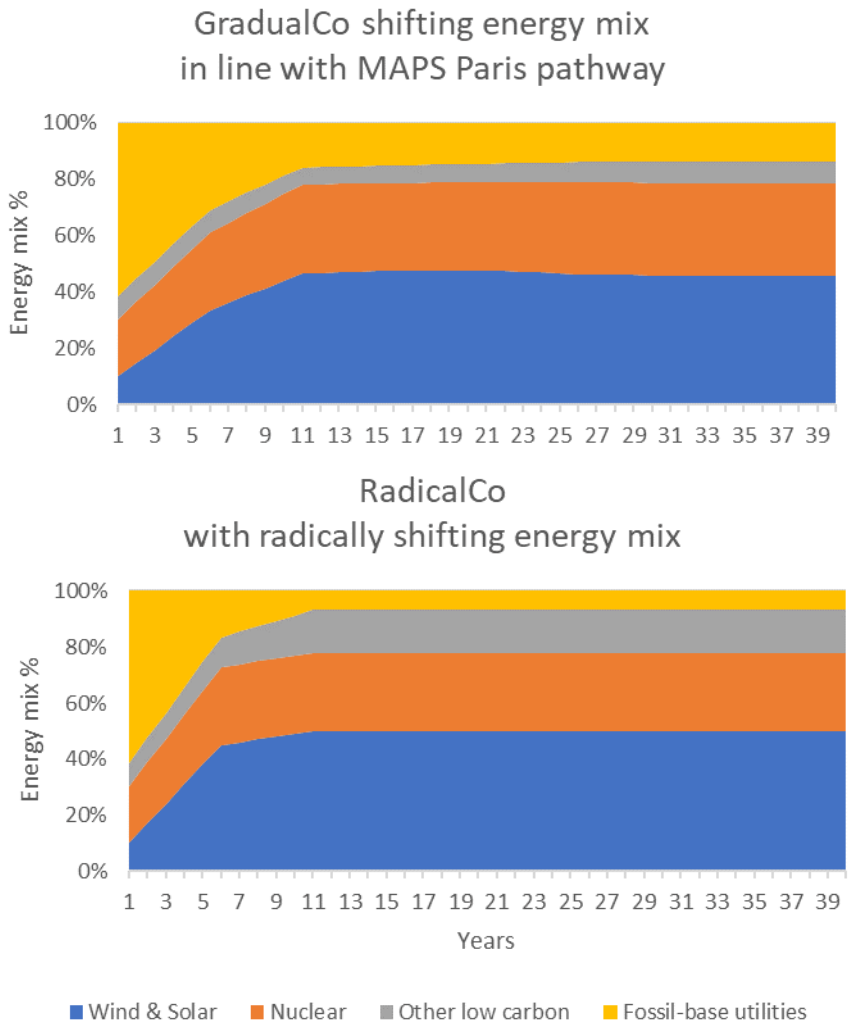
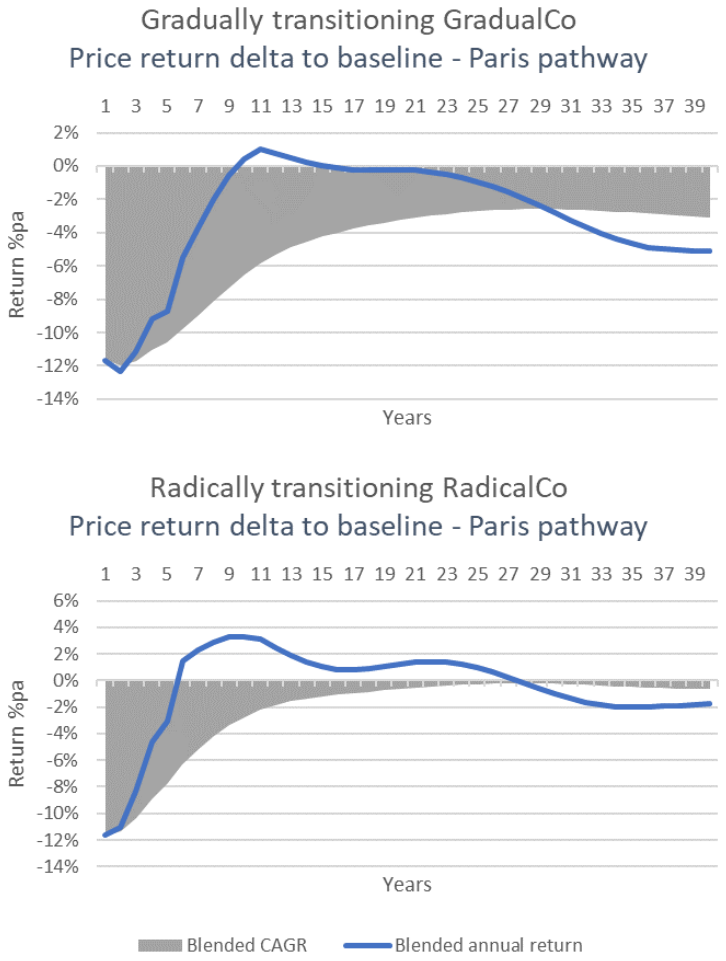
Exhibit 1 p. 7

Insights on timing of climate-transition relative to (hypothetical) utilities shifting fuel types

If energy utilities fail to rapidly invest in scaling low-carbon energy, pricing-in of transition policy could materially impact valuations





The pricing-in of transition impacts that occurs over the first 5 years impact both companies.

The model does allow for some costs to be passed through to consumers, however the market still prices-in negative impacts for fossil-based power generation.

Over the long term, RadicalCo recovers to have minimal downside relative to the baseline (shown by the grey CAGR%)

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Equity and real assets sector/region deep dive

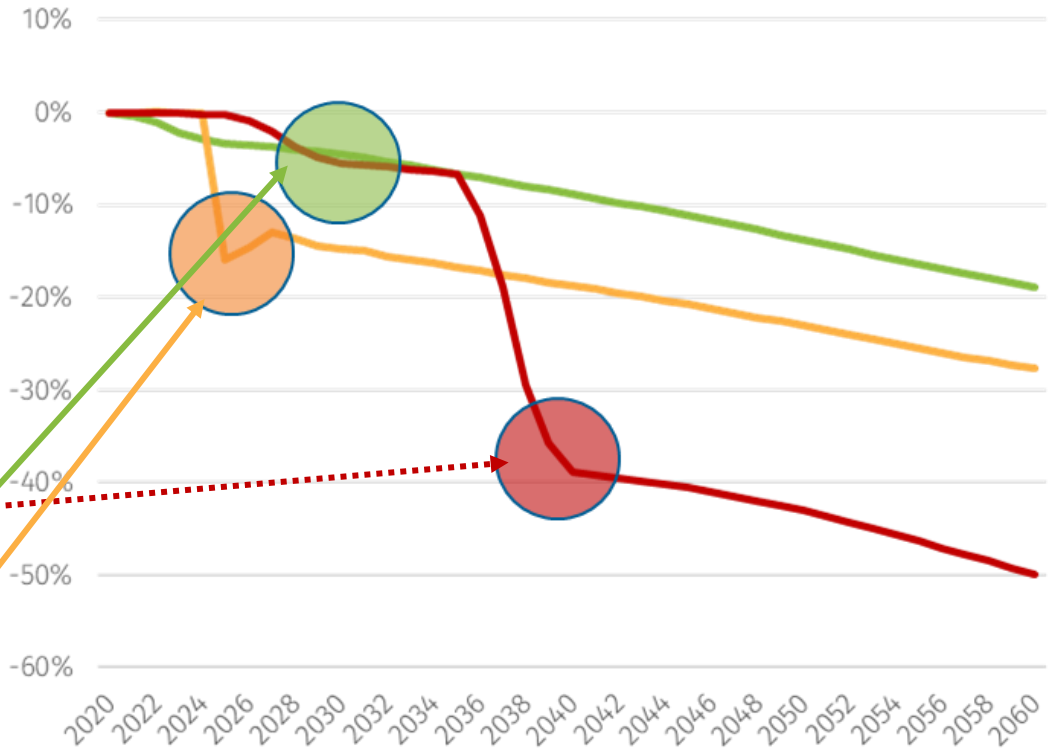
Overview of approach - Sector Risk MAPS

These results forms part of the sector-level insights, lifting useful insights from highly granular data

Sector allocation analysis:

- The premise of these insights is to divide sector/region pairs into categories of risk, based on quintiles of return impact for equity returns.
- We then overlay the portfolio allocations onto each of the sector/region pairs, and map them to the different quintiles.
- This then shows us how the portfolio is allocated to sector/regions of differing levels of climate risk exposure.
- To simplify and focus the output, we have chosen a single time horizon to measure the impacts for the different scenarios.
  - *Failed Transition:* 20y (this is after both pricing in epochs, so the full physical risk impact is captured)
  - *Pairs Orderly:* 10y (this allows time for the transition to be established and economies to stabilise)
  - *Paris Disorderly:* 5y (this is the low point of the disorderly shock and so captures the most concentrated example of transition risk).

Illustrative chart of cumulative return deltas to baseline



Overview of approach - Sector Risk MAPS

These results form part of the sector-level insights, lifting useful insights from highly granular data

Outputs and interpretation:
The main motivation of the outputs is to achieve the following:

1) A high-level appreciation of the distribution of allocation to different levels of climate risk exposure
2) An ability to help pin-point areas of the portfolio that deserve more **immediate attention in the form of detailed, stock/credit level analysis**
3) By cutting through the large volume of data the sector analysis creates, we generate efficient insights more appropriate for senior stakeholders

The portfolio allocations can also be compared to a benchmark. By default, we use MSCI ACWI as representative of the global equity market.

Data reliance:
Necessarily, we can only make inferences based on the data provided to us. Coverage % is included in the tab "SECTOR allocation risk summary"
If it has not been possible to look through into the holdings of funds, for example, then those funds will have been excluded from this analysis.
As such these outputs may provide a partial picture.

Also note that as part of the mapping exercise, pragmatic compromises may have been made.

For example, we would ideally want to reflect the region/sector-activity of economic exposure.
However, these data are typically hard to obtain, so proxies such as GICS/NACE sector may be used and/or region of domicile.
For multinational/diversified companies, the mapping may not fully reflect the scope of exposure. Which would require a more involved mapping exercise.

Remember that sectors should be more accurately thought of as economic activities.
A key example of this is that a large electricity generating company will use a mixture of fuel types to generate power.
Each of these fuels types is represented by an activity within our sector breakdown: Wind/Solar, Fossil fuels, Nuclear and other renewables.
Over the course of the green transition, we would reasonably expect the mix of these activities to shift from fossil to renewables.

A comprehensive dataset can be provided with the full sector/region impact data used for the following slides.

Example quintile grids - Sector Risk MAPS

Failed transition – 20y horizon – physical risk lens

	Consumer discr	Industrials	Health	Telecom	IT	Forestry	Financials	Consumer staples	Materials	Oil and gas	Coal and synthetic fuels	Real estate	Water supply	Other Low carbon and biofuel elec	Wind and solar	Nuclear	Fossil based utilities	Public admin and defense
China	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2	2	2	2
India	1	1	1	1	2	1	1	1	1	2	2	2	1	2	2	2	2	2
Malaysia	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2		2	2
Australia	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3		3	3
Philippines	1	1	1	1	1	1	1	2	2	3	3	2	2	3	3		3	3
US	1	1	1	1	1	1	1	2	2	2	3	2	2	3	3	3	3	3
World	1	1	1	1	1	1	1	2	2	2	3	2	2	3	3	3	3	3
Europe	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4
Indonesia	1	2	1	1	1	2	2	2	3	4	4	3	3	3	4		3	4
Spain	1	1	1	1	2	2	2	3	2	3	3	3	3	4	4	4	4	4
Taiwan	1	2	1	1	2	2	2	2	3	3	3	3	3	4	4	4	4	4
Netherlands	1	1	2	2	1	1	3	2	3	2	3	3	4	4	4	4	4	5
Japan	1	2	1	2	2	2	2	3	3	4	4	3	3	4	4	4	4	4
Thailand	1	2	1	2	2	2	3	3	3	4	4	4	4	4	4		4	4
Singapore	1	2	2	2	2	2	3	3	3	3	4	4	4	5	5		5	5
Canada	1	2	3	3	3	1	4	2	3	2	2	4	4	5	5	5	5	5
France	1	2	2	3	3	2	3	3	3	2	3	4	4	5	5	5	5	5
South Korea	1	2	2	2	3	3	3	4	4	4	4	4	4	4	4	4	4	4
Brazil	2	3	2	2	3	3	3	4	4	4	4	4	4	4	4	4	4	4
UK	1	2	4	3	3	3	1	4	4	2	2	4	5	5	5	5	5	5
Denmark	1	1	4	3	3	1	4	2	3	4	4	5	5	5	5		5	5
Italy	1	3	3	3	3	4	4	4	4	4	5	4	4	5	5		5	5
Switzerland	1	1	5	4	1	5	1	3	5		5	5	5	5	5	5	5	5
Germany	1	2	4	4	3	3	3	4	4	4	4	5	5	5	5	5	5	5
Norway	2	3	4	4	4	3	4	4	5	3	4	5	5	5	5		5	5
Sweden	1	3	5	4	3	5	5	5	3		5	5	5	5	5	5	5	5
Finland	2	4	5	5	3	5	5	5	5		5	5	5	5	5	5	5	5
Russia	3	4	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	5

Paris orderly – 10y horizon – transition risk lens

	Fossil based utilities	Coal and synthetic fuels	Oil and gas	Consumer discr	Nuclear	Financials	Forestry	Health	Public admin and defense	Real estate	Telecom	Materials	Consumer staples	Water supply	IT	Industrials	Other Low carbon and biofuel elec	Wind and solar
Australia	1	1	1	2		2	2	2	2	2	2	3	3	2	2	4	1	2
Canada	1	1	1	1	1	1	2	2	2	2	2	2	3	3	2	2	5	5
Norway	1	1	1	2		2	3	2	2	2	3	1	3	3	2	3	5	1
Switzerland	1	2		2	1	2	2	2	2	2	2	2	2	2	3	4	5	1
US	1	1	1	2	5	2	2	2	2	2	2	2	3	3	2	2	5	6
Malaysia	1	1	1	2		1	2	2	3	3	2	3	2	3	4	4	5	5
Europe	1	1	1	2	1	2	3	2	2	3	3	3	4	5	4	4	2	5
Finland	1	1		2	1	2	4	3	3	4	2	4	5	3	4	4	1	2
China	1	1	1	2	5	2	2	3	2	4	3	4	3	2	4	4	1	5
France	1	1	1	2	1	3	2	3	3	3	4	3	3	5	4	4	2	5
Germany	1	1	1	2	1	3	2	2	3	3	4	4	3	3	3	4	5	5
Netherlands	1	1	1	2	5	2	2	2	3	3	3	3	3	2	3	4	5	5
Italy	1	1	1	2		3	3	3	3	4	2	4	4	2	5	4	1	5
World	1	1	1	2	5	3	2	2	2	3	2	4	3	3	4	4	4	5
Spain	1	1	1	2	1	3	3	3	2	2	4	4	3	5	3	4	5	5
Indonesia	1	1	1	3		3	3	3	3	3	3	3	3	3	4	4	5	5
Sweden	1	1		2	1	3	4	3	3	4	4	4	3	4	5	4	1	5
Japan	1	1	2	3	1	4	2	3	3	3	4	3	5	3	4	5	5	5
Denmark	1	1	1	2		3	2	3	3	3	4	4	3	5	5	4	5	5
Philippines	1	1	1	3		3	4	4	4	2	4	4	4	5	3	4	5	5
Singapore	1	1	1	2		4	3	5	5	3	4	4	3	5	4	4	5	5
UK	1	1	1	2	5	3	5	3	3	3	5	4	5	3	5	4	5	5
Thailand	1	1	1	2		4	5	4	4	3	3	4	5	5	4	4	5	5
Russia	1	1	1	3	5	3	4	4	3	4	4	5	4	4	5	5	5	5
Taiwan	1	1	4	2	5	4	4	4	4	4	4	5	4	4	4	4	5	5
Brazil	1	1	1	5	1	5	2	5	5	4	5	4	5	5	5	5	5	5
South Korea	1	1	4	2	5	5	4	4	4	5	4	4	4	4	4	4	5	5
India	1	1	1	1	5	5	5	4	5	5	5	5	5	5	5	5	5	5

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High level insights - Sector Risk MAPS

Averaging the sector quintiles across all regions, combining results from the two transition scenarios to inform systemic transition exposure and using the failed transition to inform physical risk.

	Sector quintile score (low = worse) across all regions			
Sector/activity	Transition quintile	Physical risk quintile	Combined	RiskRank
Consumer discretionary	2.4	1.2	1.8	1
Oil and gas	1.4	3.0	2.2	2
Coal and manufactured fuels	1.1	3.4	2.2	3
Fossil based utilities	1.0	4.0	2.5	4
Forestry	3.0	2.3	2.7	5
Health	3.1	2.3	2.7	6
Financials	3.0	2.5	2.8	7
Telecom	3.3	2.3	2.8	8
Industrials	3.9	1.9	2.9	9
IT	3.7	2.2	3.0	10
Consumer staples	3.4	2.8	3.1	11
Materials	3.4	3.0	3.2	12
Real estate	3.1	3.5	3.3	13
Nuclear	2.8	4.1	3.4	14
Water supply	3.5	3.5	3.5	15
Public administration and defense	3.1	4.1	3.6	16
Other Low carbon and biobased electricity	4.1	4.0	4.0	17
Wind and solar	4.5	4.1	4.3	18

A key takeaway from this table could be a prioritization for deeper analysis of holdings within these sectors

Listed equity

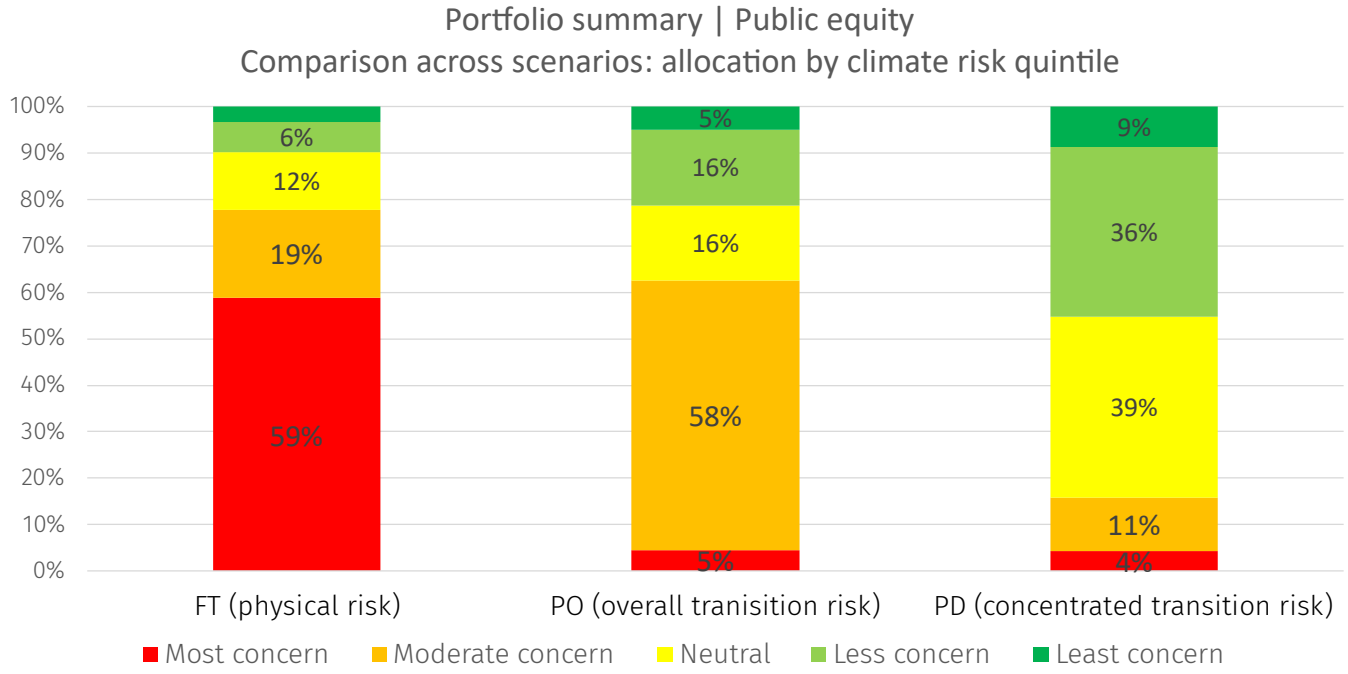
Public equity | High-level Risk MAP insights

Significant physical risk exposure, moderate overall transition risk.

The failed transition (FT) scenario highlights the physical risk exposures of the portfolio. The sectors mapped to the top 2 quintile are typically either operationally exposed to gradual physical risk (rising temperatures, changing weather patterns), extreme weather, or both. The other physical risk factor is the length and complexity of supply/value chains.

Whilst transition risk is undoubtedly more proximate. These result suggest that physical risk (and the uncertain time when it could be materially priced-in) is significant for this portfolio.

Overall, the portfolio results are similar to the global benchmark.



Using these results

We suggest that the sector-level insights from this analysis is used to "triage"/focus deep-dives into the climate-readiness of individual holdings by the asset managers and their analysts; who are best placed to make an "on the ground" assessment of the appropriateness of these holdings given your other investment objectives.

Risk MAP high climate materiality insights| Portfolio

Zooming in on the more climate exposed parts of region/sector grids, we see where portfolio allocations arise in areas that could be more systemically exposed to climate risk.

FT

20y Physical risk outlook	Sector average quintile	1.12	1.76	2.09	2.30	2.27
Region average quintile	PORTFOLIO weights	Consumer discr	Industrials	Health	Telecom	IT
1.50	China	0.8%	0.3%	0.1%	0.8%	0.2%
1.76	Australia	0.3%	0.1%	0.2%	0.1%	0.1%
1.78	India	0.0%	0.0%	0.0%	0.0%	0.0%
2.00	Malaysia	0.0%	0.2%	0.1%	0.1%	0.3%
2.00	US	6.3%	5.2%	7.5%	4.9%	13.9%
2.06	Rest of World	0.4%	0.5%	0.2%	0.3%	0.3%
2.09	Philippines	0.0%	0.0%	0.0%	0.1%	0.1%
2.33	Indonesia	0.1%	0.0%	0.1%	0.1%	0.0%
2.42	Netherlands	0.0%	0.0%	0.0%	0.1%	0.1%

Through this more detailed view, we can see the sector/region holding that are driving the quintile 1 and 2 allocations in the previous slide.

Note on conditional formatting:
Zero allocation = grey cell background
Otherwise graded yellow (low allocation) to blue (max blue hue shaded cells show the top 10% region/sector pairs across the whole portfolio.)

To highlight the top 10% of sector/regions TEXT is shown in white. A blue cell with black text isn't quite in the top 10%)

PD

5y disorderly transition outlook	Sector average quintile	1.00	1.00	1.48	2.58
Region average quintile	PORTFOLIO weights	Coal and synth fuels	Fossil based utilitires	Oil and gas	Consumer discr
1.57	Norway	0.00%	0.00%	-0.03%	0.00%
1.67	Finland	-0.04%	0.01%	0.10%	0.32%
2.00	France	-0.17%	-0.02%	0.00%	-0.33%
2.00	Russia	-0.08%	0.09%	-0.04%	0.07%
2.14	Italy	-0.04%	0.01%	0.04%	0.82%
2.17	Netherlands	0.00%	0.00%	-0.11%	-0.07%
2.22	China	0.02%	-0.04%	0.12%	-0.77%
2.38	Germany	0.00%	-0.02%	0.03%	-0.43%
2.45	Sweden	-0.01%	0.00%	0.08%	0.05%

PO

10y orderly transition outlook	Sector average quintile	1.00	1.00	1.33	2.15
Region average quintile	PORTFOLIO weights	Coal and synth fuels	Fossil based utilitires	Oil and gas	Consumer discr
2.00	Norway	0.00%	0.00%	0.00%	0.00%
2.06	Australia	-0.01%	0.04%	-0.01%	0.28%
2.11	Canada	0.00%	0.01%	0.15%	0.15%
2.18	Switzerland	0.00%	0.00%	0.24%	0.02%
2.44	US	0.00%	0.00%	1.17%	6.33%
2.47	Malaysia	0.00%	0.00%	0.08%	-0.02%

Risk MAP high climate materiality insights| Active weights

Zooming in on the more climate exposed parts of region/sector grids, we see where over/under weights vs MSCI ACWI arise in areas that could be more systemically exposed to climate risk.

FT

20y Physical risk outlook	Sector average quintile	1.12	1.76	2.09	2.30	2.27
Region average quintile	ACTIVE WEIGHT	Consumer discr	Industrials	Health	Telecom	IT
1.50	China	-0.77%	0.05%	-0.25%	-0.15%	-0.14%
1.76	Australia	0.15%	0.02%	-0.04%	0.06%	-0.01%
1.78	India	-0.08%	-0.04%	-0.07%	-0.01%	-0.21%
2.00	Malaysia	-0.02%	0.24%	0.08%	0.08%	0.26%
2.00	US	-0.72%	1.51%	-0.33%	-1.77%	-2.13%
2.06	Rest of World	0.15%	0.28%	-0.07%	0.08%	-0.11%
2.09	Philippines	0.03%	-0.01%	0.00%	0.06%	0.06%
2.33	Indonesia	0.05%	0.04%	0.06%	0.04%	0.01%
2.42	Netherlands	-0.07%	-0.09%	-0.08%	0.03%	-0.18%

Through this more detailed view, we can see the over/under weights relative to MSCI ACWI for sector/region holding that are driving the quintile 1 and 2 allocations in the previous slide.

Note on conditional formatting:

Zero allocation = grey cell background

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PD

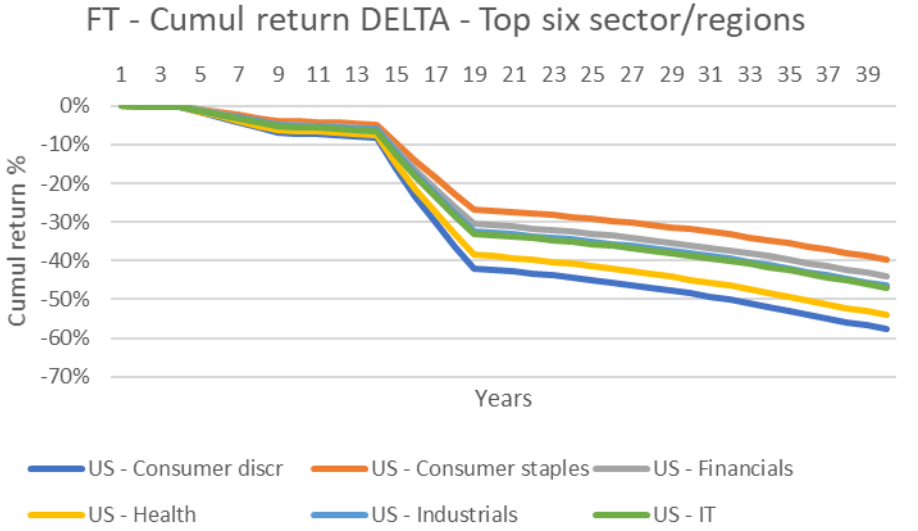
5y disorderly transition outlook	Sector average quintile	1.00	1.00	1.48	2.58
Region average quintile	ACTIVE WEIGHT	Coal and synth fuels	Fossil based utilitires	Oil and gas	Consumer discr
1.57	Norway	0.00%	0.00%	-0.03%	0.00%
1.67	Finland	-0.04%	0.01%	0.10%	0.32%
2.00	France	-0.17%	-0.02%	0.00%	-0.33%
2.00	Russia	-0.08%	0.09%	-0.04%	0.07%
2.14	Italy	-0.04%	0.01%	0.04%	0.82%
2.17	Netherlands	0.00%	0.00%	-0.11%	-0.07%
2.22	China	0.02%	-0.04%	0.12%	-0.77%
2.38	Germany	0.00%	-0.02%	0.03%	-0.43%
2.45	Sweden	-0.01%	0.00%	0.08%	0.05%

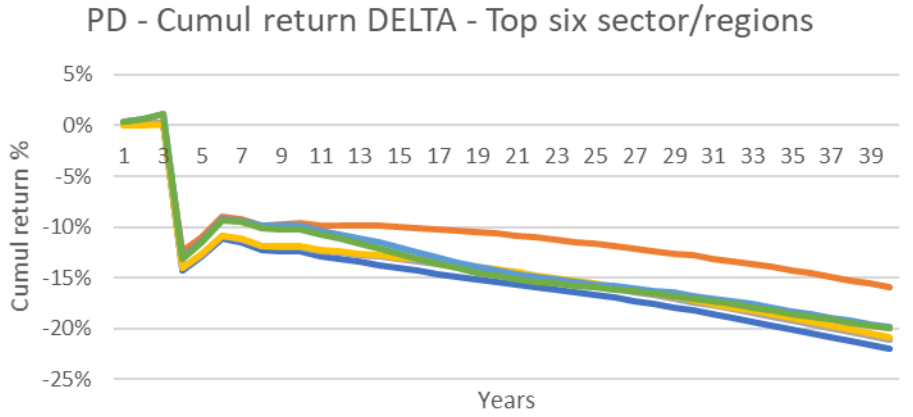
PO

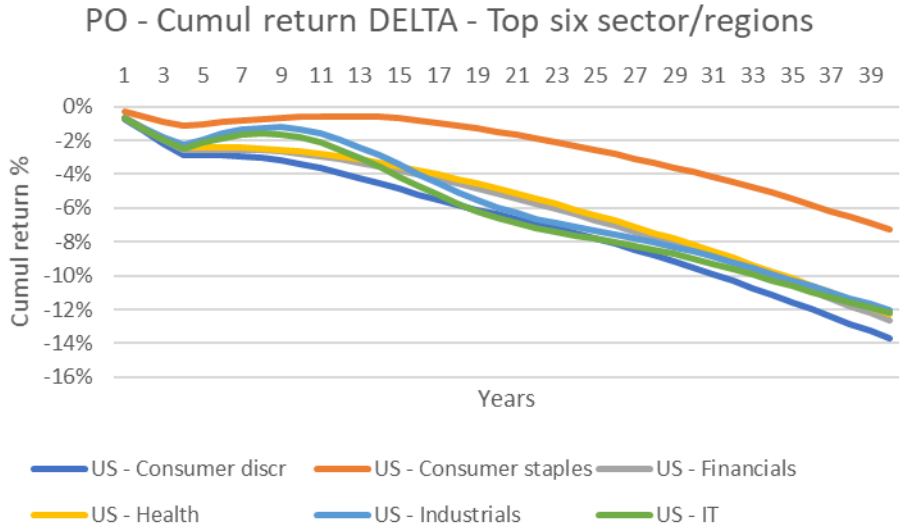
10y orderly transition outlook	Sector average quintile	1.00	1.00	1.33	2.15
Region average quintile	ACTIVE WEIGHT	Coal and synth fuels	Fossil based utilitires	Oil and gas	Consumer discr
2.00	Norway	0.00%	0.00%	-0.03%	0.00%
2.06	Australia	-0.04%	0.03%	-0.04%	0.15%
2.11	Canada	-0.13%	-0.03%	-0.11%	0.04%
2.18	Switzerland	0.00%	0.00%	0.24%	-0.10%
2.44	US	-0.82%	-0.38%	[illegible]%	-0.72%
2.47	Malaysia	0.00%	-0.01%	0.08%	-0.02%

Sector line charts for most material sector/regions

The six most material sectors show a reasonable spread of impacts. These sectors are in the “sectors of concern” for physical risk, but are less significant for transition risk.







The most material region/sector allocations in the public equity portfolio are:

Region - Sector	Allocation (as % of public equity)
US - IT	13.9%
US - Health	7.5%
US - Consumer discr	6.3%
US - Financials	5.8%
US - Industrials	5.2%
US - Consumer staples	4.3%

Private equity

Mapping for PE sector allocations

- To facilitate the mapping, we collapsed the data provided to us:

STRATEGY		SECURITY		REGION		Actual Weight	TMT	INDUSTRIAL	BUS SERV	CONSUMER	HEALTHCARE	FIG
Venture/Growth	16%	Equity - non-control	100%	North America	37%	5.8%	44%	3%	3%	21%	17%	12%
				Europe	14%	2.2%	37%	1%	9%	13%	21%	19%
				Asia	47%	7.4%	26%	2%	2%	44%	21%	5%
				Latin America	2%	0.3%	30%	3%	3%	22%	23%	18%
Buyout	78%	Equity - control	100%	North America	68%	52.7%	31%	16%	13%	15%	15%	11%
				Europe	26%	20.2%	20%	15%	16%	21%	12%	16%
				Asia	4%	3.1%	18%	18%	10%	32%	11%	11%
				Latin America	2%	1.6%	11%	20%	11%	35%	12%	12%
Distressed Debt	7%	Distressed debt	100%	North America	70%	4.7%	20%	20%	7%	20%	20%	13%
				Europe	25%	1.7%	20%	20%	8%	20%	20%	13%
				Asia	5%	0.3%	20%	20%	10%	20%	20%	10%
				Latin America	0%	0.0%	0%	0%	0%	0%	0%	0%

- To a format that is consistent with input grid for our sector analysis tool:

	Telecom	Industrials	Consumer discretionary	Consumer staples	Health	Financials
US	19.9%	9.4%	12.2%	4.9%	9.6%	7.3%
Europe	5.2%	3.3%	6.0%	2.4%	3.2%	3.8%
China	2.5%	0.8%	2.6%	2.2%	2.0%	0.8%
Brazil	0.3%	0.3%	0.5%	0.3%	0.3%	0.2%

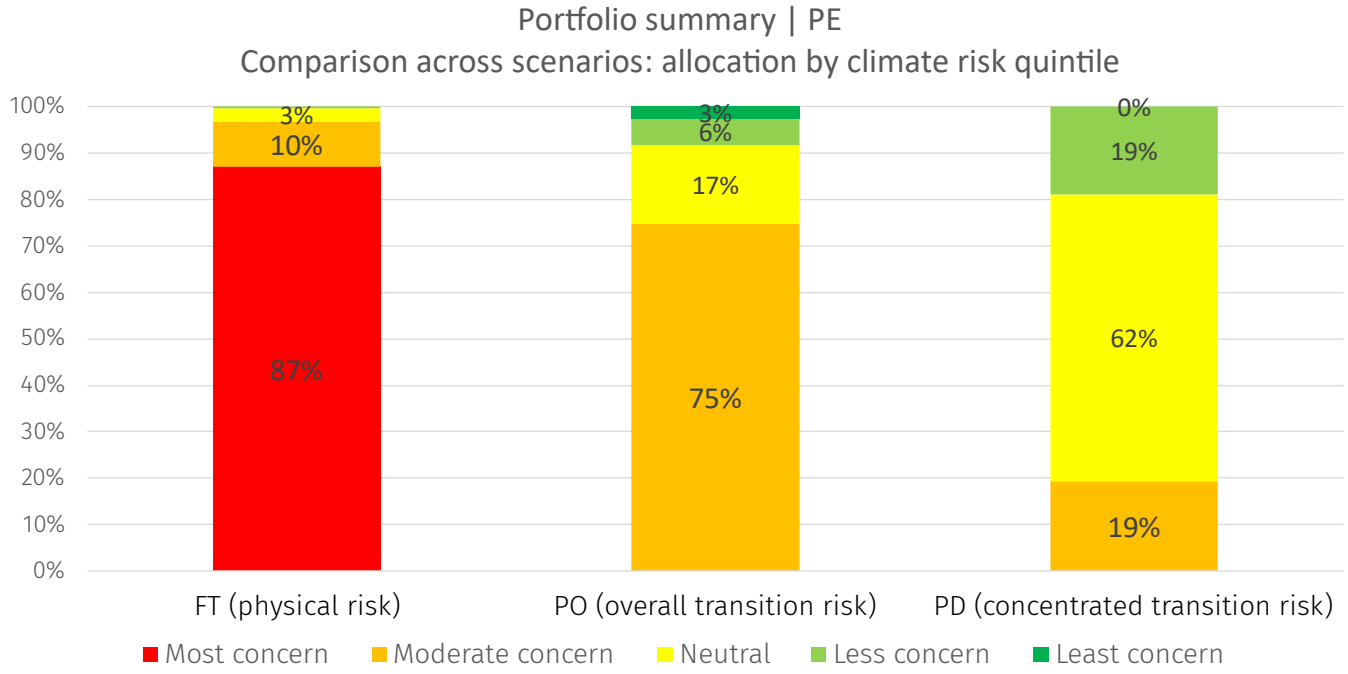
PE | High-level Risk MAP insights

Significant physical risk exposure, moderate overall transition risk.

More so than for listed equity, the failed transition (FT) scenario highlights the physical risk exposures of the PE portfolio. The sectors mapped to the top 2 quintile are typically either operationally exposed to gradual physical risk (rising temperatures, changing weather patterns), extreme weather, or both. The other physical risk factor is the length and complexity of supply/value chains.

Whilst transition risk is undoubtedly more proximate. These result suggest that physical risk (and the uncertain time when it could be materially priced-in) is significant for this portfolio.

The illiquidity of this asset class suggest that climate risk should be considered as part of deal due diligence, since exiting positions can take significant time.



Using these results

We suggest that the sector-level insights from this analysis is used to "triage"/focus deep-dives into the climate-readiness of individual holdings by the asset managers and their analysts; who are best placed to make an "on the ground" assessment of the appropriateness of these holdings given your other investment objectives.

Risk MAP high climate materiality insights| PE

Zooming in on the more climate exposed parts of region/sector grids, we see where portfolio allocations arise in areas that could be more systemically exposed to climate risk.

FT

20y Physical risk outlook	Sector average quintile	1.12	1.76	2.09	2.30	2.27
Region average quintile	PORTFOLIO weights	Consumer discr	Industrials	Health	Telecom	IT
1.50	China	2.6%	0.8%	2.0%	2.5%	0.0%
1.76	Australia	0.0%	0.0%	0.0%	0.0%	0.0%
1.78	India	0.0%	0.0%	0.0%	0.0%	0.0%
2.00	Malaysia	0.0%	0.0%	0.0%	0.0%	0.0%
2.00	US	12.2%	9.4%	9.6%	19.9%	0.0%
2.06	Rest of World	0.0%	0.0%	0.0%	0.0%	0.0%
2.09	Philippines	0.0%	0.0%	0.0%	0.0%	0.0%
2.33	Indonesia	0.0%	0.0%	0.0%	0.0%	0.0%
2.42	Netherlands	0.0%	0.0%	0.0%	0.0%	0.0%

Through this more detailed view, we can see the sector/region holding that are driving the quintile 1 and 2 allocations in the previous slide.

Note on conditional formatting:
Zero allocation = grey cell background
Otherwise graded yellow (low allocation) to blue (max blue hue shaded cells show the top 10% region/sector pairs across the whole portfolio.)

To highlight the top 10% of sector/regions TEXT is shown in white. Aa blue cell with black text isn't quite in the top 10%)

PD

5y disorderly transition outlook	Sector average quintile	1.00	1.00	1.48	2.58
Region average quintile	PORTFOLIO weights	Coal and synth fuels	Fossil based utilitires	Oil and gas	Consumer discr
1.57	Norway	0.0%	0.0%	0.0%	0.0%
1.67	Finland	0.0%	0.0%	0.0%	0.0%
2.00	France	0.0%	0.0%	0.0%	0.0%
2.00	Russia	0.0%	0.0%	0.0%	0.0%
2.14	Italy	0.0%	0.0%	0.0%	0.0%
2.17	Netherlands	0.0%	0.0%	0.0%	0.0%
2.22	China	0.0%	0.0%	0.0%	2.6%
2.38	Germany	0.0%	0.0%	0.0%	0.0%
2.45	Sweden	0.0%	0.0%	0.0%	0.0%

PO

10y orderly transition outlook	Sector average quintile	1.00	1.00	1.33	2.15
Region average quintile	PORTFOLIO weights	Coal and synth fuels	Fossil based utilitires	Oil and gas	Consumer discr
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2.11	Canada	0.0%	0.0%	0.0%	0.0%
2.18	Switzerland	0.0%	0.0%	0.0%	0.0%
2.44	US	0.0%	0.0%	0.0%	12.2%
2.47	Malaysia	0.0%	0.0%	0.0%	0.0%

Real assets

Mapping for Real asset sector allocations

- To facilitate the mapping, we collapsed the data provided to us, aggregated over both equity and debt:

	Utilities	Transport	Renewables	Power	Digital	PPPs	O&G mid	O&G up	Metals & Mining	Timberland	Agriculture
North America	6.3%	4.4%	5.3%	7.0%	5.8%	2.5%	11.7%	15.2%	3.6%	4.1%	3.7%
Europe	2.7%	1.6%	2.1%	1.3%	4.5%	0.2%	1.8%	0.1%	0.5%	0.0%	0.2%
Asia	1.2%	0.8%	0.9%	0.3%	1.2%	0.0%	0.9%	0.0%	2.8%	0.0%	0.0%
Brazil	0.5%	0.6%	0.8%	0.0%	1.0%	0.0%	0.5%	0.0%	1.0%	0.0%	0.2%
World	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.8%	0.0%	0.0%

- Into a format that is consistent with input grid for our sector analysis tool*:

	Fossil based utilities	Nuclear	Other Low carbon and biobased electricity	Wind and solar	Industrials	IT	Public admin and defence	Oil and gas	Materials	Forestry	Consumer staples
US	7.9%	0.9%	0.5%	5.9%	4.4%	5.3%	5.8%	2.5%	26.9%	3.6%	4.1%
Europe	1.7%	0.2%	0.5%	3.0%	1.6%	2.1%	4.5%	0.2%	1.9%	0.5%	0.0%
China	0.9%	0.0%	0.2%	1.1%	0.8%	0.9%	1.2%	0.0%	0.9%	2.8%	0.0%
Brazil	0.1%	0.0%	0.6%	0.9%	0.6%	0.8%	1.0%	0.0%	0.5%	1.0%	0.0%
World	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.8%	0.0%

*this included “respreading” the power and utilities allocation as described on slide 5

ORTEC FINANCE

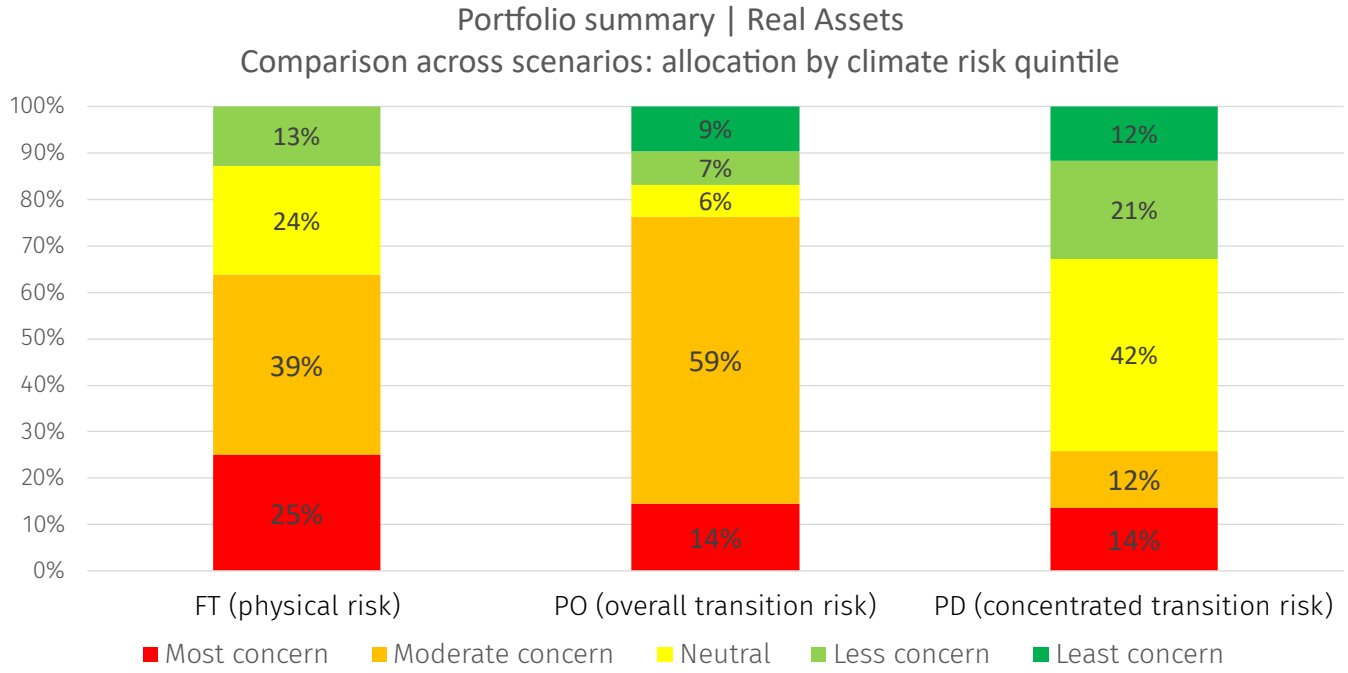
Real assets | High-level Risk MAP insights

Moderate physical risk exposure, moderate overall transition risk.

Compared to the other two portfolios, the risk profile distribution is more balanced across physical and transition risk, and with less extreme allocations to “concerning” sectors.

There remains, however c.60% (physical risk) and c.75% (transition risk) of holdings falling in the upper two quintiles. Perhaps indicating valuable areas to focus any more detailed assessments.

The illiquidity of this asset class suggest that climate risk should be considered as part of deal due diligence, since exiting positions can take significant time.



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Risk MAP high climate materiality insights | Real assets

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2.00	Malaysia	0.0%	0.0%	0.0%	0.0%	0.0%
2.00	US	0.0%	4.4%	0.0%	0.0%	5.3%
2.06	Rest of World	0.0%	0.0%	0.0%	0.0%	0.0%
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2.45	Sweden	0.0%	0.0%	0.0%	0.0%

PO

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2.44	US	0.0%	2.2%	2.2%	0.0%
2.47	Malaysia	0.0%	0.0%	0.0%	0.0%

Disclaimer

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the inputs provided by you, the client.

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Oregon Investment Council

Update on Environmental, Social, Governance Initiatives

September 8, 2021

OREGON STATE TREASURY

Agenda:

- Introduction
- Contract with climate consultant for portfolio analysis
- Formal integration of ESG into private equity and other manager due diligence

Climate Consultant Engagement

- Latest step in Treasury's work to better understand climate risks to portfolio and formalize ESG factors into our investment decision-making
- Climate work in ESG space is continuously evolving
  - Improved tools to identify stranded assets, evaluate portfolio carbon footprint, model potential outcomes based on application of transition risks
- Climate risk as systematic risk could have broad economic impact
  - Staff already works with investment managers and consultants to better understand climate risk at the individual asset level
  - Understanding climate risk at the **total portfolio level**, with an emphasis on forward-looking metrics, requires outside help offering complex tools & econometric analyses that account for uncertainty and interconnectivity of factors being modeled

New Consultants: Manifest Climate & Ortec Finance

Manifest Climate ("Manifest")

- Toronto-based, interdisciplinary climate strategy firm
- Provides educational services and bespoke consulting services, such as helping clients to define and implement a climate governance & risk management framework

Ortec Finance ("Ortec")

- Headquartered in Rotterdam
- Designs and applies modeling solutions for asset-liability management, risk management, and climate risk
- Has partnered with Cambridge Econometrics and uses their global, macro-econometric model as input

Climate Impact Analysis: Project Phases

1. **Education sessions.** Manifest is facilitating three Climate Change Education sessions with Investment Division and other Treasury staff (syllabus on slide 6).
2. **Scenario modeling.** Ortec modeling will use indices based on OPERF's investment allocations. The proxy mix will run through Ortec's analytic engine to generate estimated scenario outcomes (see slides 7-8 for info on Ortec's analysis and illustrative output).
3. **Output interpretation.** Assisted by Ortec, Manifest will help Treasury interpret output from the modeling, specifically the prospective risks & opportunities for OPERF due to physical and transition responses to climate change.

Climate Consultant

Education: Learning Objectives

- Explore what climate change is and its importance to financial markets
- Understand the global climate policy drivers and ecosystem of international bodies
- Understand action on climate change by financial markets and regulators
- Introduction to climate scenario analysis
- Begin to understand how climate change poses risks and opportunities for asset owners
- Recognize the difference between and need for climate adaptation and mitigation
- Explore risk and opportunity exposure pathways in industry context
- Begin to identify information needs between asset owner and asset manager
- Different types of climate scenarios and scenario analyses used today
- How financial and non-financial companies can use climate scenario analysis

Climate Consultant
Analysis

ORTEC FINANCE

ORTEC – E3ME

EXAMPLE INPUT POLICIES

- Carbon/energy tax, emission trading schemes
- Renewables subsidies, feed-in tariffs
- Technology investment subsidies
- *And many other policy levers*

EXAMPLE OUTPUTS

- GDP
- Sector output
- Inflation and prices
- CO2 emissions
- Electricity generation mix
- Technology mix by emissions intensive sector
- Employment
- Oil and gas prices
- *And many others indicators, available on request*

Combining well-established climate science with respected econometric and financial modelling

Input Data & Assumptions

Orderly & Disorderly transition risks/opportunities
(policy and technology drivers)
Gradual physical risks & extreme weather risks.

MACRO-Economic Model (cambridge econometrics)

Are mapped onto macro-economic interactions worldwide
to generate climate pathway specific GDP-shocks
(Compared to climate-uninformed baseline outlook).
Per country/sector, per year, which informs.

STOCHASTIC Financial Model (ORTEC FINANCE)

Translating climate-GDP shocks over time to 600+ financial and economic variables via stylized facts based on historic relations.
Per country/sector, per year.

Systemic Climate Risk - Aware Scenarios Sets

Paris Orderly Transition | Paris Disorderly Transition | Failed Transition

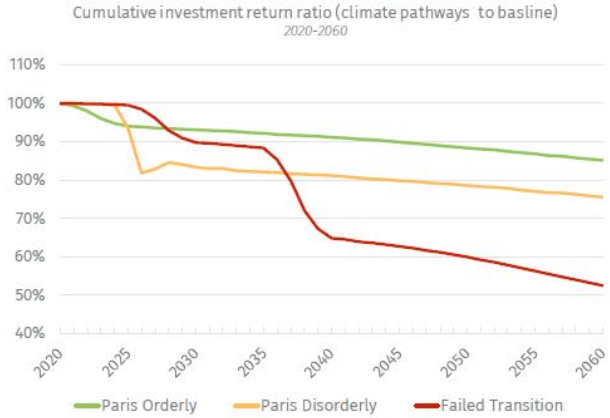
To deliver systemic climate risk-aware economic and financial outlooks up to 2060, differentiated per country/sector, per year.

OREGON STATE TREASURY

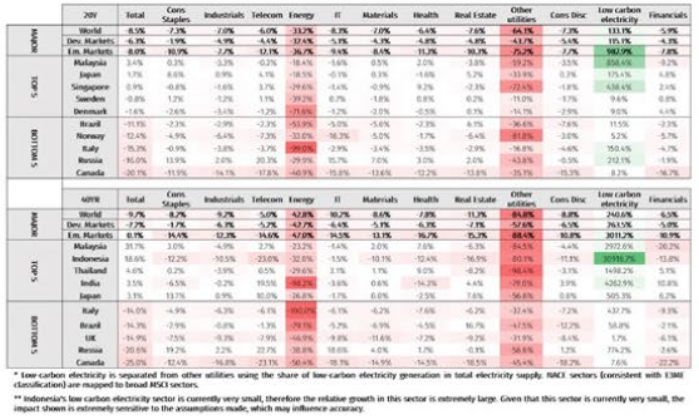
Climate Consultant

Illustrative Output, Portfolio-Specific Financial Projections

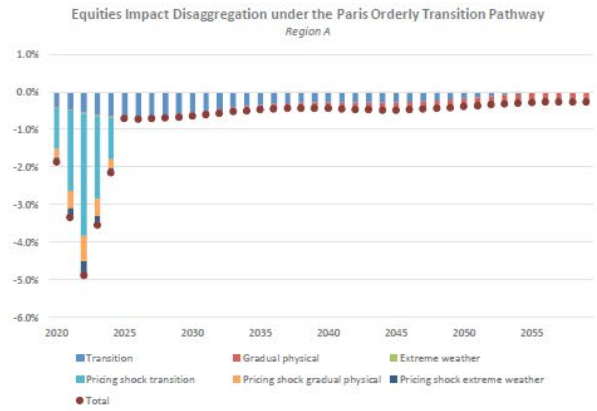
Total Portfolio Impacts

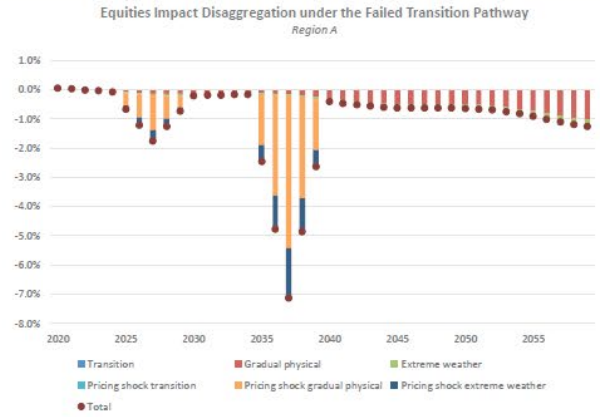


Sector-Region Heatmaps: Cumulative Returns - Public Equities



Disaggregation to climate risk factors





OREGON STATE TREASURY

Exhibit A

Statement of Work

A. Consultant's Services. The Consultant will provide expert guidance to Client, and the Oregon Investment Council (which sets investment policy for the Fund), as further described below. Specifically, Consultant shall, with respect to OPERF:

1) Assess physical and transition risks of climate change and the impact on the investment portfolio;

2) Provide scenario modeling and stress testing to identify total portfolio risk, identify asset class vulnerability to physical & transition risks, and assess the impact on investment return expectations;

3) Identify outsized risks and recommend opportunities to reduce portfolio risk;

4) Provide trustee and staff education on the topic and engage with asset class teams for more targeted and specific assessments of portfolio holdings;

5) Provide iterative what-if analysis that can address and highlight the significance of individualized terms of investments; and

6) Provide near and long-term risk assessment under varying climate and transition scenarios.

7) A complete recommendation and analysis presentation to the Client staff shall be conducted.
8) Provide such other related consulting services as reasonably requested by Client.

Deliverables:

	Description	Fee	Consultant party anticipated to provide the Deliverable	Due By Date
1	Education for Oregon Investment Council members and Client staff	$14,200.00	Manifest Climate	December 31, 2021
2	Modelling to assess physical and transition risks	$79,600.00	Ortec Finance	December 31, 2021
3	Further scenario and "what if" work	$16,000.00	Ortec Finance	December 31, 2021
4	Workshops to develop use cases	$22,000.00	Manifest Climate	December 31, 2021
5	Logistics and project support	$13,000.00	Manifest Climate	December 31, 2021

View Message

Subject: Public Records Request :: R000209-011222
Body:

Request for Public Records

REQUESTER	Rick Pope
DATE	July 12, 2022
REFERENCE NO.	R000209-011222

You submitted the following request for public records:

"Any documents in the possession of the Oregon Investment Council and the Oregon State Treasury that relate to assessments of or responses to climate-related financial risk to assets held in investment funds as defined in ORS 293.701

"Climate-related financial risk" means material financial risk posed by the effects of climate change, including intense storms, rising sea levels, higher global temperatures, economic damages from carbon emissions, and other effects due to public policy on climate change, shifting consumer attitudes or changing economics of traditional carbon-intense industries.

Please note the request includes materials, working papers and emails of members of the Oregon Investment Council as well as of employees of the Oregon State Treasury.

I would like to consult in advance about the reasonable parameters of word searches for responsive electronic documents."

Hi Rick,

Thanks for your patience with this request and the approach we have taken to focus on the deliverable from the consulting company. We have conferred with the contractor that produced the report. This contractor has certified that the information summarized below constitutes contractor trade secrets. Trade secrets are exempt from disclosure under ORS 192.345(2). In this case, the contractor is asserting the exemption due to the

particular formulas/methodology used that separate its work product from competitors. The trade secret information has been redacted from the report, which is now available to you with the redactions in our Public Records Center.

Please also note that there was some inadvertent misnumbering in the contractor's final report. Specifically, the final report did not include the following slide numbers (the numbers on the lower left of the page): 3, 6, 10, 14, 18, 27, 28, 29. Also, two slides are numbered 39.

- Slide 12: Page deleted [The Impact of Climate risk on OPERF's portfolio]
- Slide 32: Removed data from table, color-coding of cells retained, retained total fund impact data
- Slide 33: Removed data from table, color-coding of cells retained, retained total fund impact data
- Slide 34: Removed data from table, color-coding of cells retained, retained total fund impact data
- Slide 35: Removed data from table, color-coding of cells retained, retained total fund impact data
- Slide 37: Removed y-axis labels
- Slide 40: Removed data from table, color-coding of cells retained, retained top line World impact data
- Slides 41-43: Pages Deleted [Paris Orderly, Cumulative Return – Public Equities, 10, 20 & 40 years, respectively]
- Slide 44: Removed data from table, color-coding of cells retained, retained top line World impact data
- Slide 45-47: Pages Deleted [Paris Disorderly, Cumulative Return – Public Equities, 10, 20 & 40 years, respectively]
- Slides 48-49: Pages Deleted [Failed Transition, Cumulative Return – Public Equities, 5 & 10 years, respectively]
- Slide 50: Removed data from table, color-coding of cells retained, retained top line World impact data
- Slide 51: Page Deleted [Failed Transition, Cumulative Return – Public Equities, 40 years]
- Slide 52: Page Deleted [Sector Insights…]
- Slide 55: Page Deleted [Focusing on companies with well-aligned business practices….]
- Slide 60: Deleted bottom chart [2) investigate composition of portfolio if optimized…]
- Slide 74: Page Deleted [Risk/return analysis of portfolio constituents…]
- Slide 75-78: Pages Deleted [Sectorial impacts – Paris Orderly…]
- Slide 82: Page Deleted [Risk/return analysis of portfolio constituents…]
- Slide 83-86: Pages Deleted [Sectorial impacts – Paris Disorderly…]
- Slide 90: Page Deleted [Risk/return analysis of portfolio constituents…]
- Slide 91-94: Pages Deleted [Sectoral impacts – Failed Transition…]

If you have any questions or need additional information, please feel free to contact us. If you disagree with Treasury's redactions, you may contact the Oregon Public Records

Advocate at 503-378-5228. The Advocate provides mediation services related to public records requests. You may also petition a circuit court to review Treasury's decision as provided in ORS 192.427.

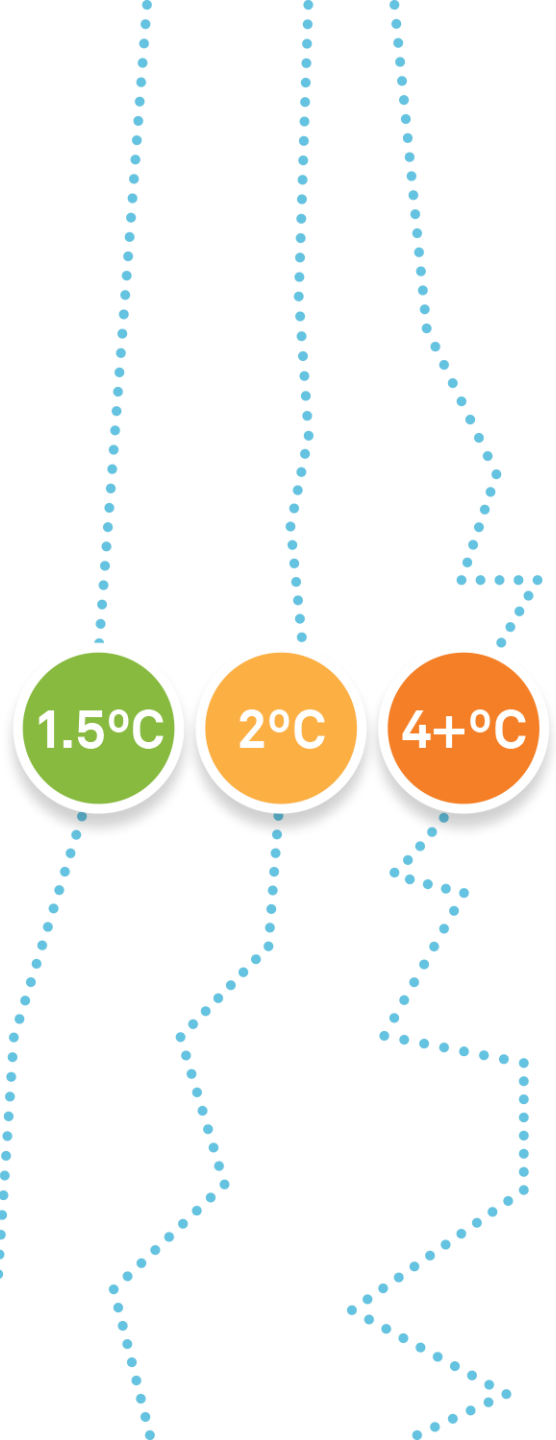
Sincerely,
Treasury Public Records Team
867 Hawthorne Ave. SE | Salem, OR 97301-5241

CLIMATE MAPS

Oregon Treasury

Climate Scan Report

October □0□1



ORTEC FINANCE

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Table of Contents

Climate risk exposure | OPERF investment portfolio

□□e view from 10,000 feet

1. Lower return expectations across all assets due to negative climate impact over time.

Over the next 20 years, **all three climate scenarios see lower growth expectations** compared to a baseline. This poses a material risk to both scheme balance sheets and future contribution/funding needs.

2. Worst outcomes come in a Failed Transition due to physical risks.

Globally, the **physical risks** experienced when **transition to a greener economy fails, have the most significant impacts** (63% lower US GDP by 2100). **Notably, by 2037 OPERF's portfolio value in the Failed Transition scenario is significantly down compared to an orderly low-carbon transition.** In a Failed Transition, by 2060 your asset portfolio value is expected to c.20% lower than baseline.

3. Transition risk impacts may occur sooner than most expect.

On the other hand, a **transition scenario** – even a disorderly one – **enables global economies to stabilize** once the transition has been completed. There is hope, and this demonstrates the need for investors to engage with companies and sovereigns on the transition whilst also positioning their portfolios well in the interim.

In the near future, transition impacts are generally positive in Europe. In contrast, the US is more negatively impacted than many other countries due to fossil fuels exports and other high-emitting activity currently being a significant contributor to GDP. Relative to the baseline, in a disorderly transition scenario, high exposure to the US economy contributes to OPERF's portfolio reducing in value by roughly 8% over the next 5 years.

4. Climate risk changes the Strategic Asset Allocation (SAA) landscape as climate impacts affect long-term expectations.

Risk-adjusted returns vary across assets, pathways and time horizons. In general, **cash & corporate bonds are more resilient whereas the least resilient asset classes are listed/private equities and properties** due to their sensitivity to pricing-in shocks and market over-reaction.

Compared to a typical globally-exposed pension scheme, **your portfolio's current climate risk exposure is relatively more vulnerable** due to a exposure to sensitive regions, sectors, and asset classes.

Climate change is likely to see strongly differentiated risk/return at a sector level. As such, future SAA/ALM decisions may benefit from sector-level differences being captured in the analysis.

Exhibit 5 p. 3

Key Takeaways | Both short-term and long-term risk is material

Outlook

In the near future, the portfolio could suffer in particular from losses if a disorderly climate transition transpires.

The longer it takes for coordinated policy action on climate, the more radical and disruptive it is likely to be for markets.

The pricing-in of physical risk is likely to come many years or decades ahead of direct impacts. The Failed Transition scenario shows **your current portfolio experiences significant impacts from a failed transition by the middle of the 2030's** as inevitable future physical damage is priced-in.

US

The US represents c.70% of OPERF's allocation exposure (using data received and proxies agreed with you and noting that allocation exposure is not the same as economic exposure). **The US economy is negatively exposed to both physical and transition-related climate risks under all pathways**. The country's position as a net fossil fuel exporter, with low energy efficiency, low carbon pricing and high sensitivity to market sentiment shocks make it highly exposed to transition risks. At the same time it is already experiencing severe extreme weather challenges (both "wet" and "dry") which will only worsen with increasing temperatures, even under the transition scenarios.

So what?

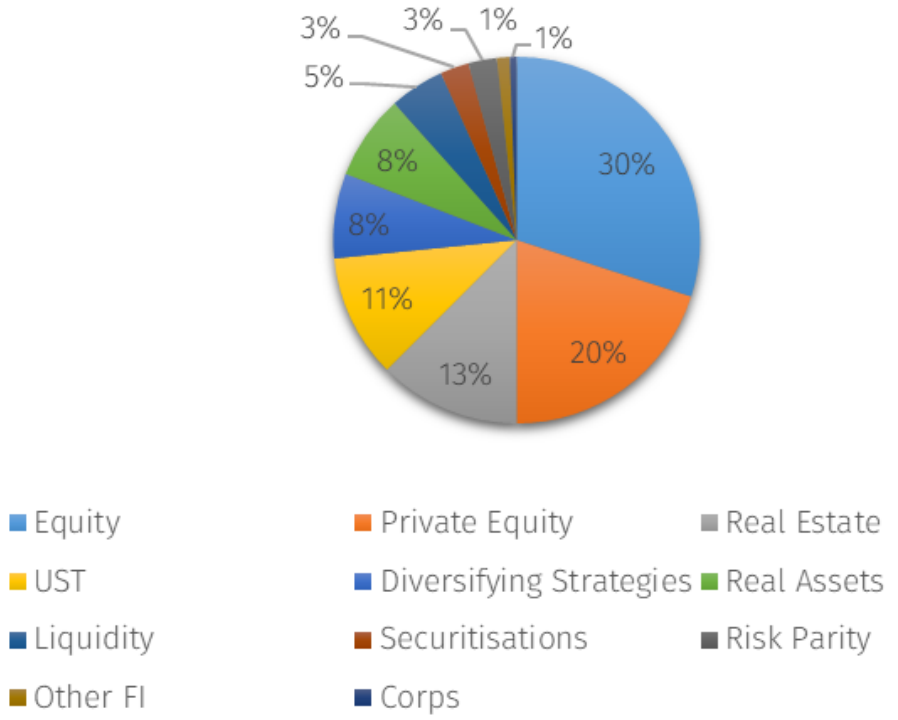
Across all pathways, there is significant differentiation between the likely experiences of different countries, sectors and asset classes. We recommend that using this analysis, you could work with your fund managers and advisors further integrating climate into your investment process. For example:

- Identify the "**hotspots**" of risk, for closer inspection by risk- and asset-managers
- **Consider SAA/ALM actions** to balance de-risking, scheme investment objectives and budgetary considerations
  - For example a "climate-informed" SAA exercise
    - Consider rotation away from transition-sensitive sectors/geographies whilst resilience testing asset de-risking in mitigating climate risk
    - Careful, climate-risk informed choice of longer term, illiquid assets
- Consider if fund benchmarks are **incentivizing fund managers to align their funds with your objectives**/risk appetites in the light of this study?
- Where segregated mandates are a used, then **careful mandate design** will be crucial to appropriately managing climate risk and **taking risk-conscious advantage of the coming economic shifts**. For example maturity caps on debt issued by climate-exposed sectors and climate-aware KPIs for total return funds.
- Potential next steps are expanded upon later in this report with suggestions for different elements of the investment process.

Exhibit 5 p. 4

The fund's asset allocation

- Below are asset class and geographic summaries of the allocations we modelled. These were based on data provided by OST and then mapped to our model. Where proxies were required these were agreed with the team.
- In many ways the allocations are typical of other large pension funds open to members and accruing benefits. The significant domestic bias is also typical of pension funds around the world.



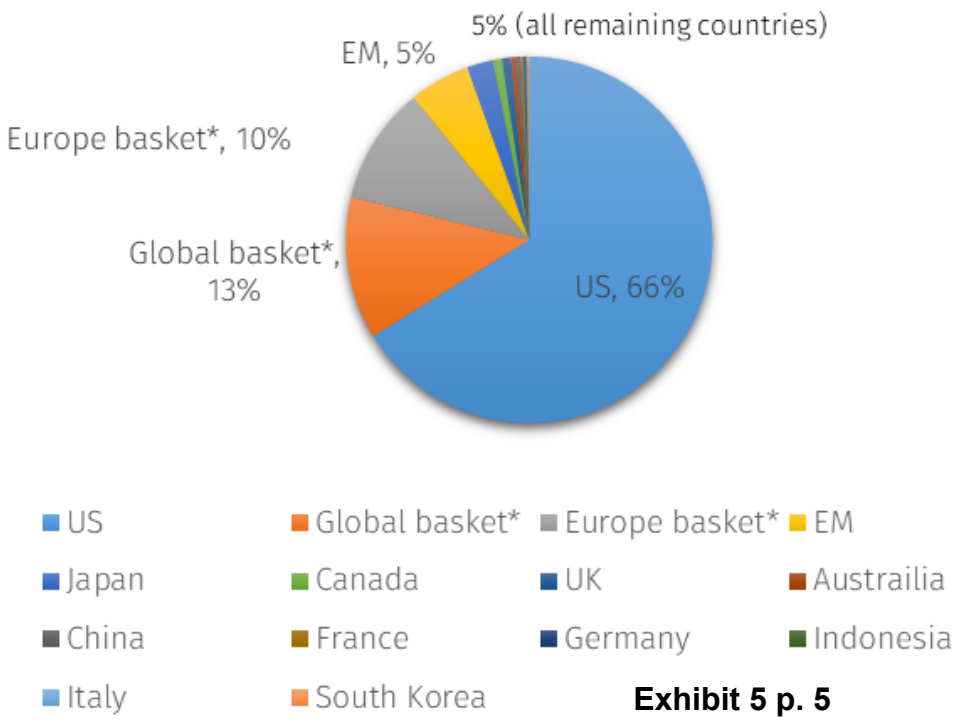


Exhibit 5 p. 5

Climate scenarios at a glance

We consider **three plausible climate pathways** that explore potential future climate policies, interventions, and consequences of the world failing to mitigate climate change.

Scenarios cannot cover all possible outcomes, and are not mutually exclusive. There is no meaningful or practically useful way to give a probability of a scenario coming to fruition. These scenarios were selected to identify portfolio weak spots that aid decision making to respond to climate risk.

These "what if" climate change scenarios focus on two interdependent climate risk drivers:

- **Transition risk** focuses on the impacts (risks/opportunities) of *policy / technology uptake* towards a low-carbon economy
- **Physical risk** focuses on changes in the natural system attributable to global warming, i.e. sea level rise, frequency and severity of extreme weather events.

Paris Orderly Pathway

- **Large transition impact** due to policy measures & technology drivers
- Transition is assumed to occur as smoothly as possible
- **Market pricing-in** dynamics occur smoothed out over the 2020-2025 period
- **Physical impacts** occur up to 1.5/2°C which are greater than today but still much less than under a Failed Transition

In line with: Emissions ≈ IPCC **RCP 2.6**

Average temp increase of 1.6°C by 2100.

97% probability of limiting warming to 2°C and c.29% probability of limiting to 1.5°C.

Tests exposure to the risks/opportunities from the systemic drivers of an orderly transition and locked-in physical risk

Paris Disorderly Pathway

- **Large transition impact** due to policy measures & technology drivers
- Transition has disruptive effects on financial markets with **repricing** followed by a sudden **sentiment shock** and stranded assets in 2024 / 2025
- **Physical impacts** occur up to 1.5/2°C which are greater than today but still much less than under a failed transition

In line with: Emissions ≈ IPCC **RCP 2.6**

Average temp increase of 1.6°C by 2100.

97% probability of limiting warming to 2°C and c.29% probability of limiting to 1.5°C.

Shows resilience of the portfolio to sudden transition triggering a market dislocation centred on high emitting stocks

Failed Transition Pathway

- **Limited transition impact -** economies follow the business-as-usual track without **additional** new policy measures
- **Severe physical impacts** occur and continues to increase over time – both **gradual physical** changes, as well as more frequent and severe **extreme weather events**
- **Markets price-in physical risks** up to 2050 by end of this decade, and price-in post-2050 physical risks from the mid-2030s onwards

In line with: Emissions ≈ IPCC **RCP 6.0**

Expected global warming by 2100 **3.8°C**

The main focus of this scenario is physical risk, results show the exposure to plausible, severe climate change impacts

Exhibit 5 p. 6

Some guiding principles for using these results

The modeling was performed using benchmarks, tailored to reflect the asset allocation of the OPERF portfolio.

Unless stated otherwise, results are shown relative to a baseline that does not make an explicit allowance for the paradigm-shifting changes that our scenarios consider. Instead the baseline is conditioned on historic relationships and long-term views based on current market conditions.

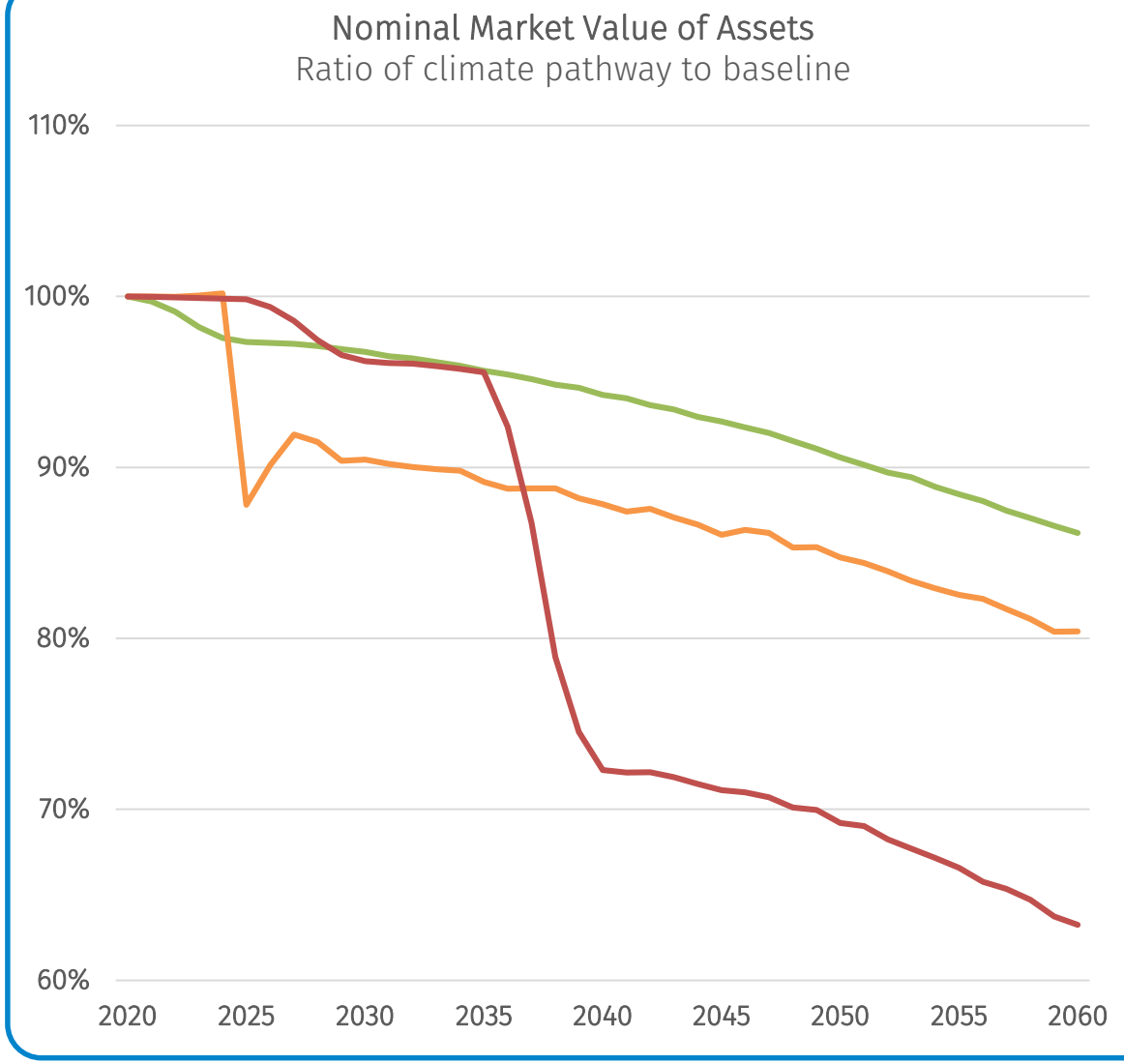
The scenarios have been constructed as diligently as possible. However, climate science is intrinsically subject to significant uncertainties. So scenarios are best viewed as a pressure test for the portfolio, probing for climate-risk weak spots.

Interpretation notes

- Focus on direction and magnitude vs exact numbers
  - Overlay these results on your views/knowledge of individual holdings
  - Results are shown relative to the baseline
- Many climate-financial relationships are non-linear
- Physical risk impacts are likely underestimated
- Climate change scenarios focus on two interdependent climate risk drivers:
  - Transition risk focuses on the impacts (opportunities/risks) of policy/technology uptake towards a low-carbon economy
  - Physical risk focuses on changes in the natural system and impacts on natural catastrophe severity/frequency and resource availability
  - It is entirely plausible that the future holds a mixture of the effects that we model

OPERF investment portfolio performance

The figure below shows the **ratio of cumulative impacts** relative to baseline over the next 40 years.



Comments

- While the overall performance of the fund remains positive in absolute terms, all scenarios project **lower returns** and impede the value of assets. The Paris scenarios limit the impacts on the fund mainly thanks to their **mitigated physical risks** exposure.
- In the **short run**, OPERF's assets are vulnerable to **transition risks**. The Paris Disorderly Transition Pathway is particularly impactful in the short term due to the sudden repricing of assets in 2025. The disruptive transition causes financial markets to **overly react and inflict long lasting damage** to the return performance.
- In the **longer run, physical risks** are the main contributor of climate-related risk. The Failed Transition Pathway is particularly detrimental to the Treasury due to the large exposure to US assets across the different asset classes.

Exhibit 5 p. 8

Redacted

Geographic exposure – country rankings

To help us make sense of the drivers for country exposure this section considers the main levers of regional differences before examining our "rankings" of countries by

- Scenario
- Key economic variables
- Equity performance

Exhibit 5 p. 10

Portfolio exposure – geographic lens

Whilst a strong domestic bias is typical of many pension funds, at a systemic level the US is more exposed to climate risk than many other countries.

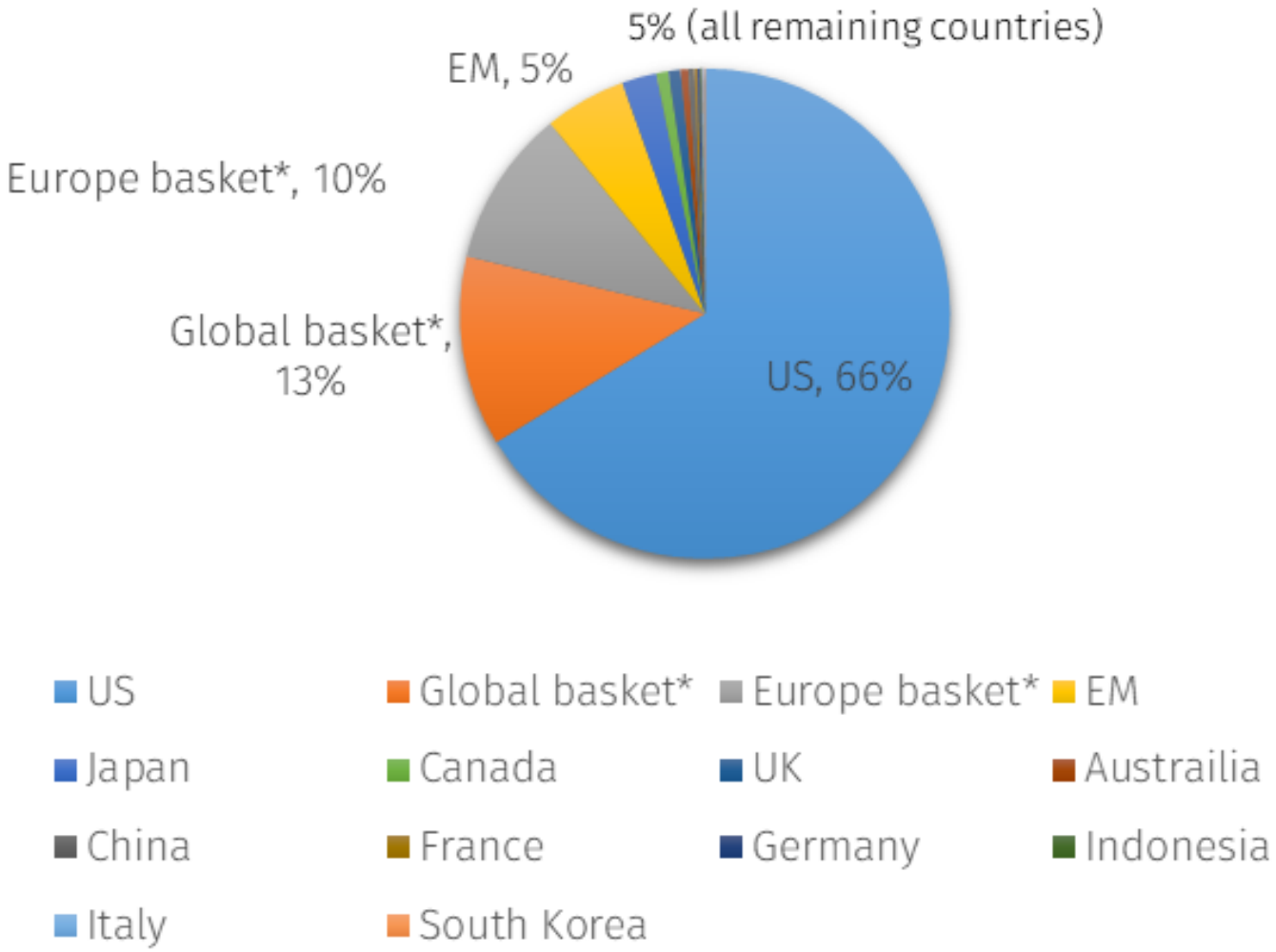
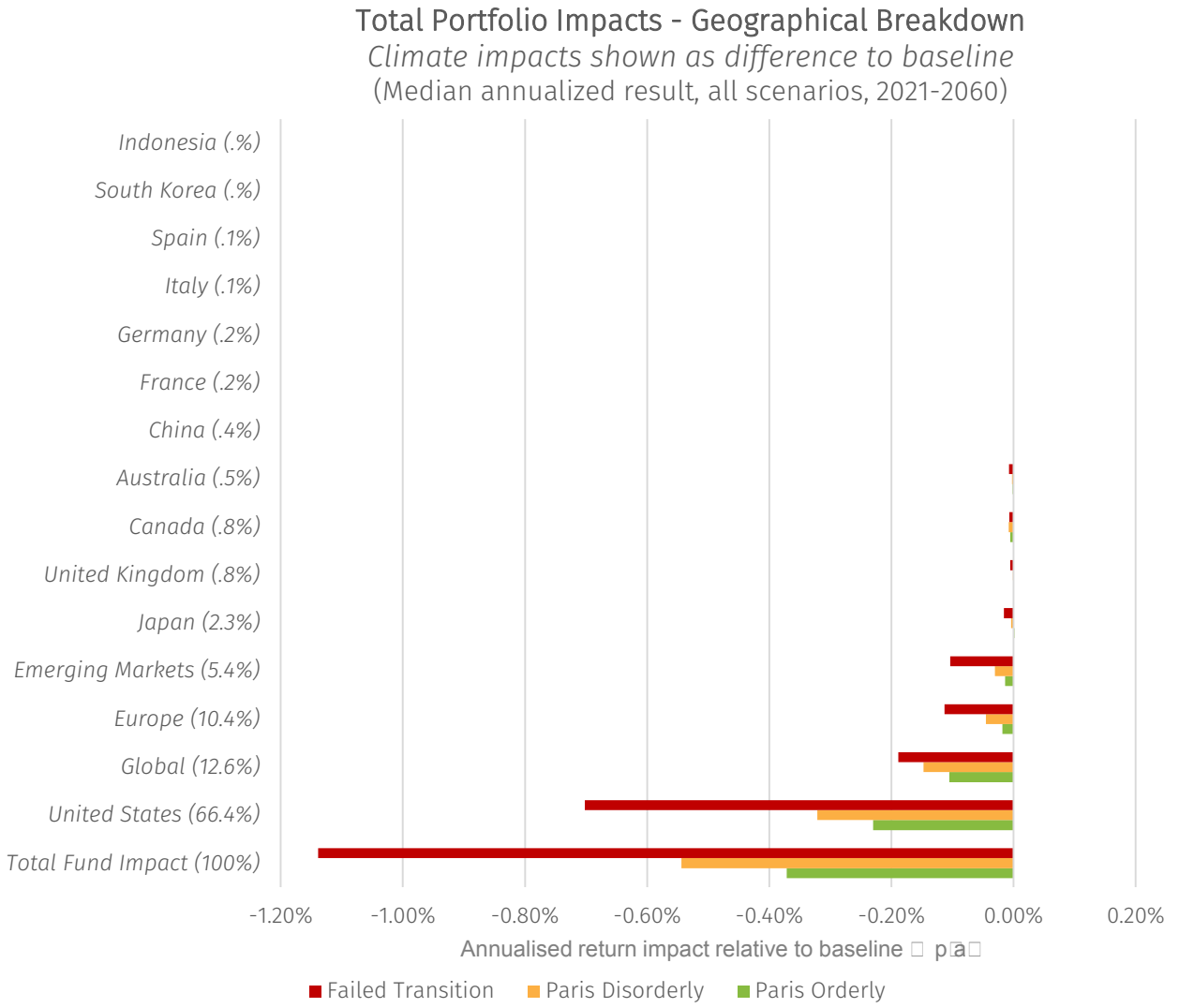


Exhibit 5 p. 11

Country attribution of total climate risk impacts – all assets

Across all asset classes, US and EM exposures drive total impacts slightly larger than justified by allocations



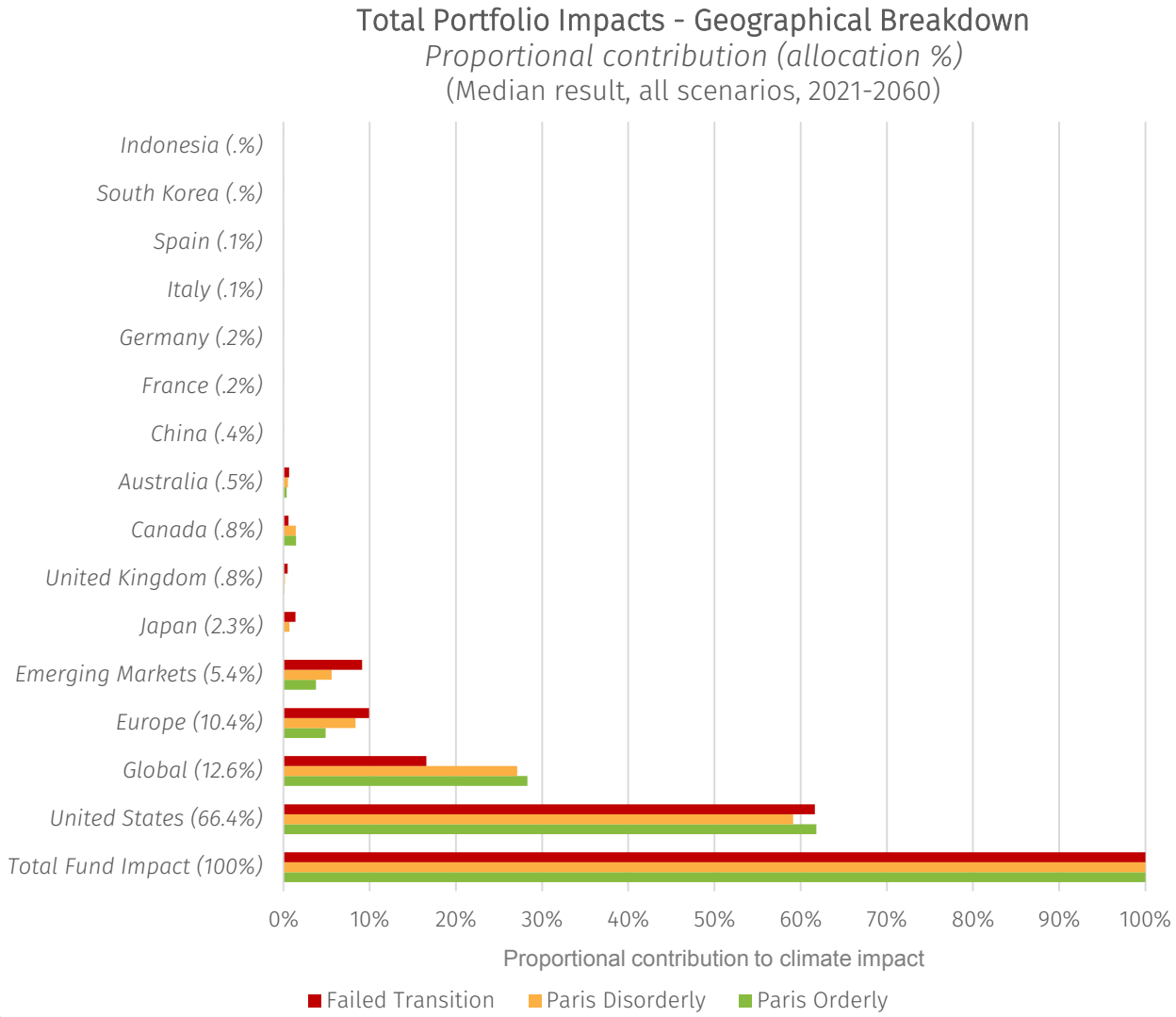
Comments

- Main source of risk comes from the large exposure to US assets.
- The top 3 regions (US, EU, EM) account for most of the risks in the fund across all scenarios.
- Given its unique geographical situation, and allowing for the relative benefits of USTs the US contributes it's fair share of climate risk in the Failed Transition and Disorderly scenario. However, without USTs the picture is very different.
- Despite its much lower allocation, EM is a large contributor of physical risks under a Failed Transition in particular.

Exhibit 5 p. 12

Proportional country attribution – all assets

Across all asset classes, US and EM exposures drive total impacts disproportionate to their allocations



Comments

- By re-framing the contributions as a % of total and comparing to allocated capital, we can see which regions produce more climate risk than their fair share.
- The most striking here are US (all scenarios), Global basket (transition) and EM (physical risk – failed transition).
- Note that if we removed the dampening effect of USTs from the US bucket, it would be contributing c.70%-80% of the risk – somewhat in excess of the proportional capital allocated.

Exhibit 5 p. 13

Key transition risk drivers explaining regional performance differences

Key Transition Risk Drivers	Impact Narrative	Example Countries
Level of carbon price	The higher it is, the more the region benefits from investments in low-carbon technologies.	Europe
Net importer/exporter of (high marginal production cost) fossil fuels	Exporters tend to be worse off, importers tend to be better off.	Brazil/Malaysia vs. Canada/US/Saudi Arabia/Norway
Weight of energy sector in local stock market	The higher the weight, the more negatively impacted.	Canada, Norway
Relative energy efficiency of the economy	If energy efficient, then investments in energy efficiency (driven by carbon price) boost economic performance.	Europe
Carbon revenue recycling	The higher the carbon price, the more scope for a lowering of VAT / income tax which boosts household incomes. Households are buffered from increasing energy prices.	Europe
Sensitivity to sentiment shock	Some countries are historically more sensitive than others to market shocks.	USA
Investment stimulus	Positive GDP impact in those countries where transition investments are taking place.	China, Netherlands, Finland, Sweden, Turkey
Consumer spending stimulus	Positive GDP impact in those countries where consumer spending in transition activities is taking place.	UK, Europe, New Zealand
Stimulus combined with debt repayment	Initial positive GDP impacts; then decrease in GDP in later years.	Italy, Switzerland

Exhibit 5 p. 14

Key physical risk drivers explaining regional performance differences

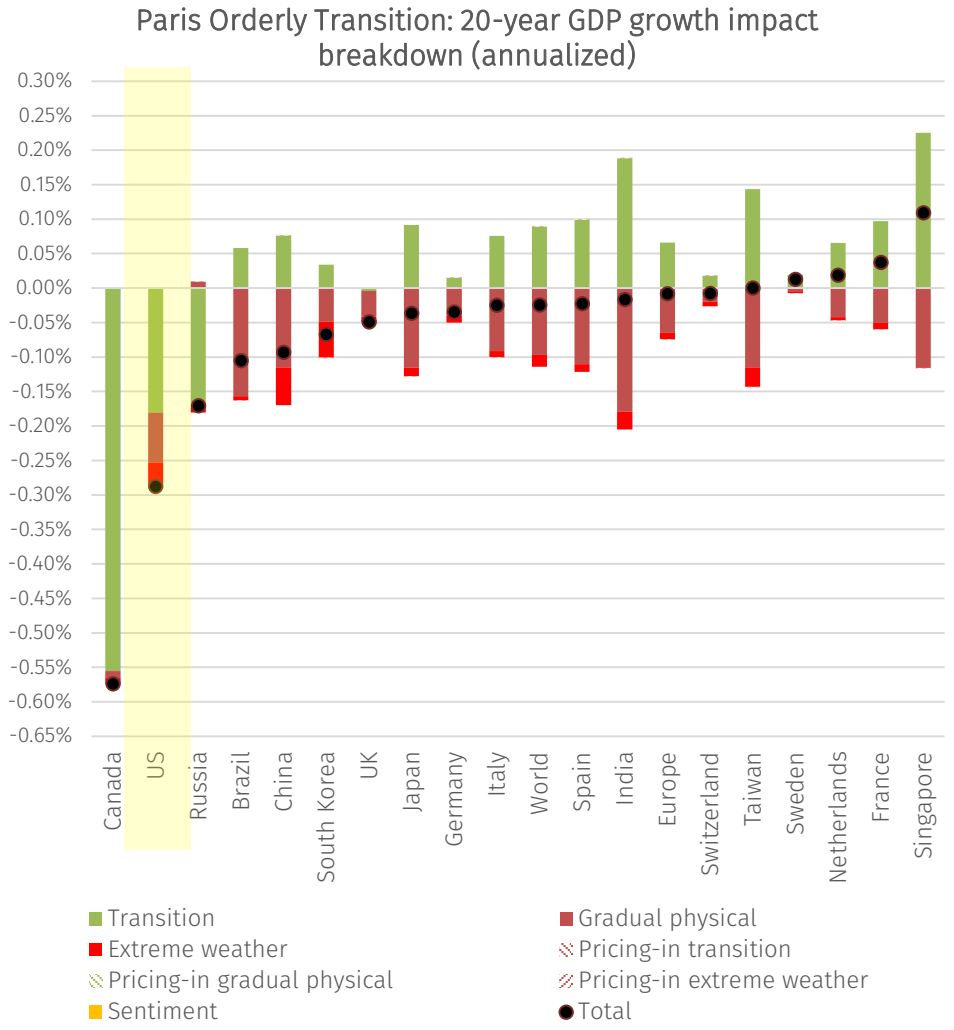
Physical Risk Drivers	
Latitude effect	Countries closer to the poles are currently still less exposed, but warming at faster rates. Countries closer to the equator are already more exposed, with temperature having non-linear impact on productivity.
Current temperature	Countries with current average temperatures below ~5°C (such as Finland and Russia) experience initial positive GDP growth impacts from warming, while countries with high average temperatures experience large negative impacts on GDP growth (e.g. India and Saudi Arabia).
Sensitivity to physical impacts	Decreasing land, labor and industrial productivity in regions that are relatively more exposed to physical impacts.
Sensitivity to economic amplification	Countries with a lower economic coping capacity to buffer extreme weather losses (if they start to occur more frequently)

Exhibit 5 p. 15

How do other countries rank in terms of climate impacts?

GDP shocks: Transition scenarios expose countries to risks and opportunities.

- After Canada, the US is the most **negatively** impacted country under both transition pathways.
- Singapore, France, the Netherlands, Sweden and Spain are most **positively** impacted under a transition scenario.



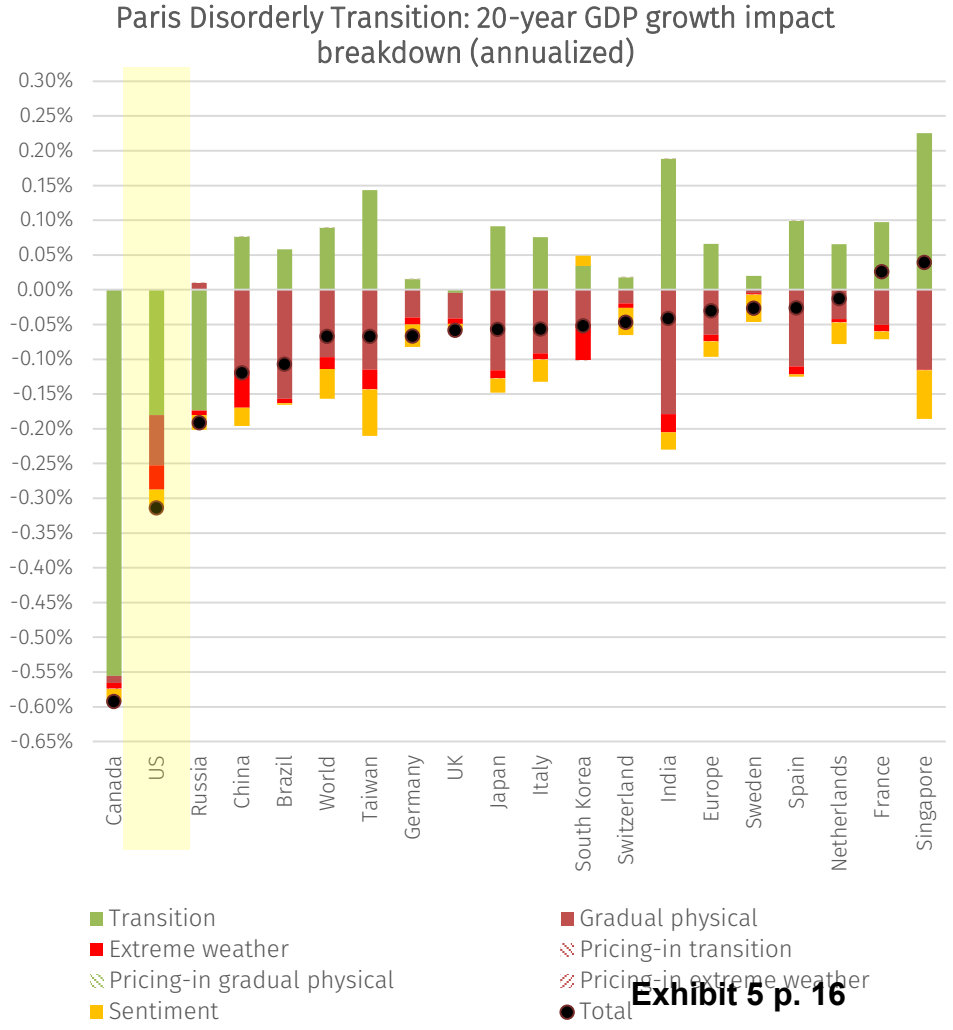


Exhibit 5 p. 16

How do other countries rank in terms of climate impacts?

GDP shocks: A Failed Transition has negative impacts on all countries, but to varying degrees.

- The US, together with India, Brazil and China are the most impacted by a Failed Transition.
- Canada and the Nordic countries are least impacted by the Failed Transition thanks to their demographic and geographic situation.

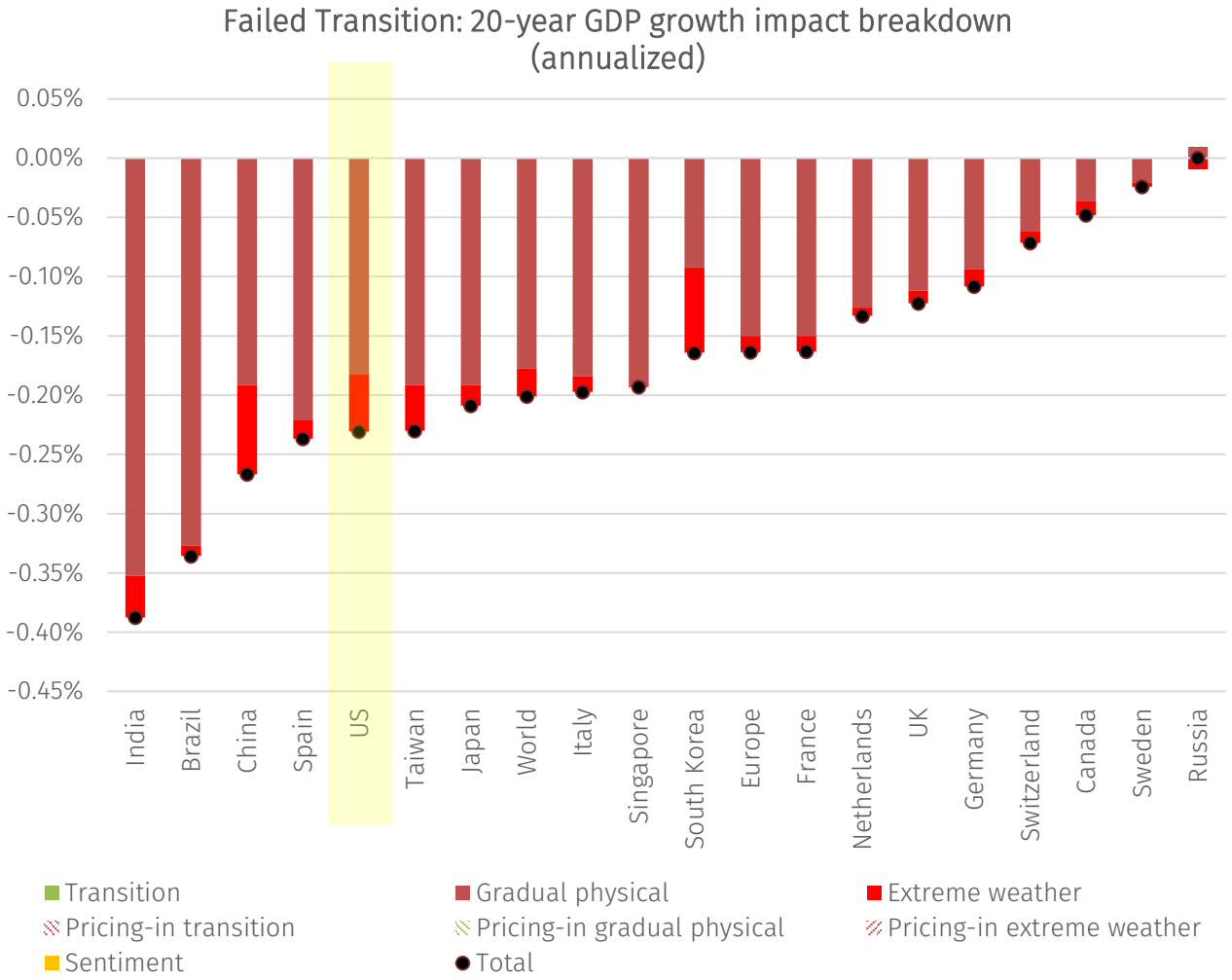


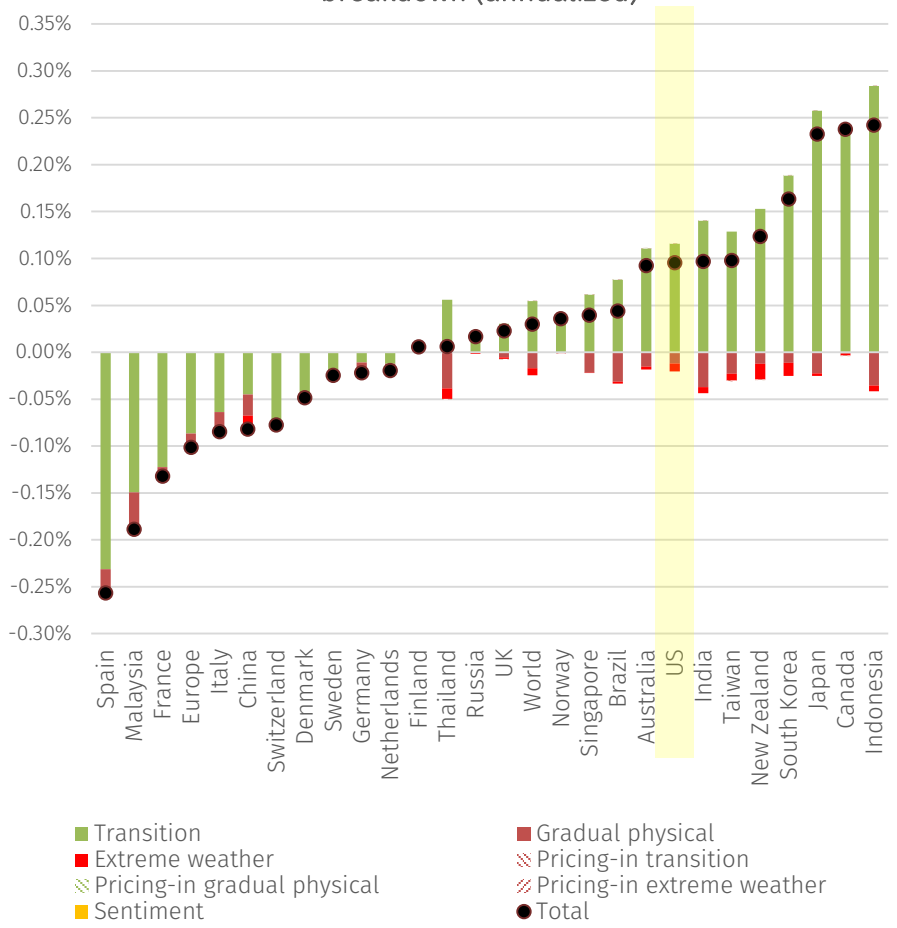
Exhibit 5 p. 17

How do other countries rank in terms of climate impacts?

Inflation shocks vary across countries and under each pathway.

- While for some countries, inflation is relatively unaffected by climate change, others experience either a net positive or a net negative inflation impact under the transition scenarios.
- The US experiences high net positive inflation impacts. This is largely driven by demand-pull inflation from higher fuel and carbon taxes.

Paris Orderly Transition: 20-year inflation impact breakdown (annualized)



Paris Disorderly Transition: 20-year inflation impact breakdown (annualized)

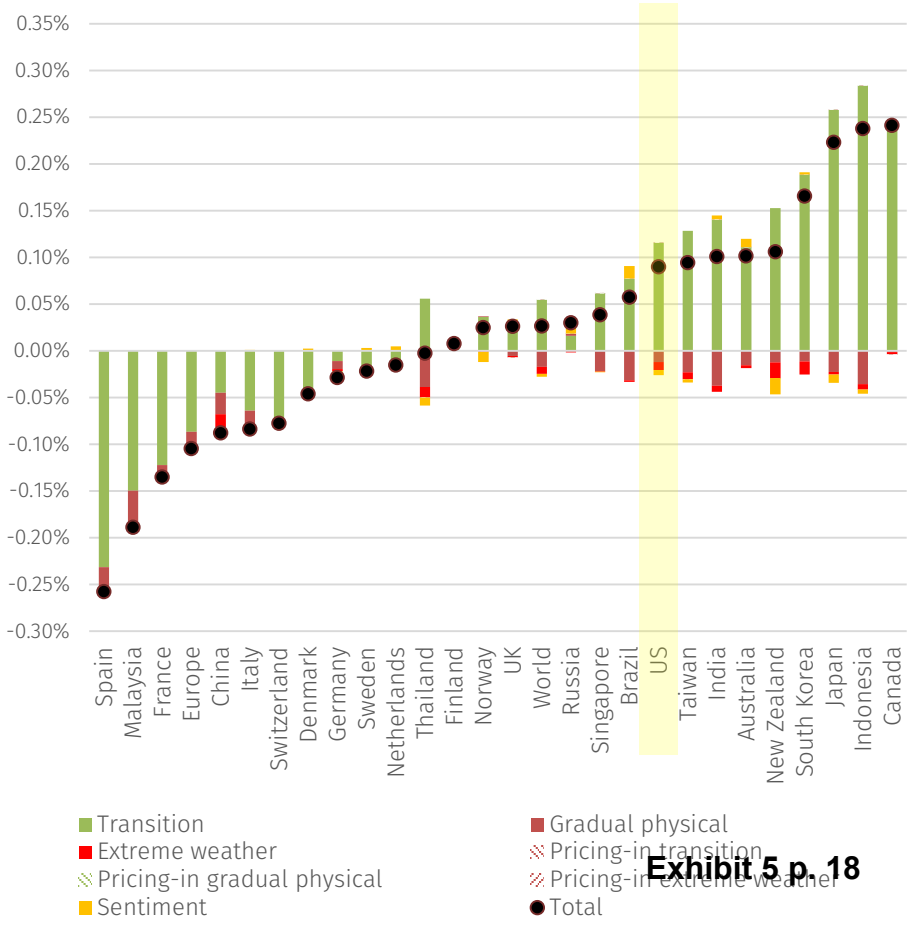


Exhibit 5 p. 18

How do other countries rank in terms of climate impacts?

Inflation shocks: almost all countries experience negative shock under a Failed Transition.

- Under a Failed Transition scenario pretty much all countries experience a negative inflation impact.
- The US is relatively heavily impacted compared to Europe or Canada.

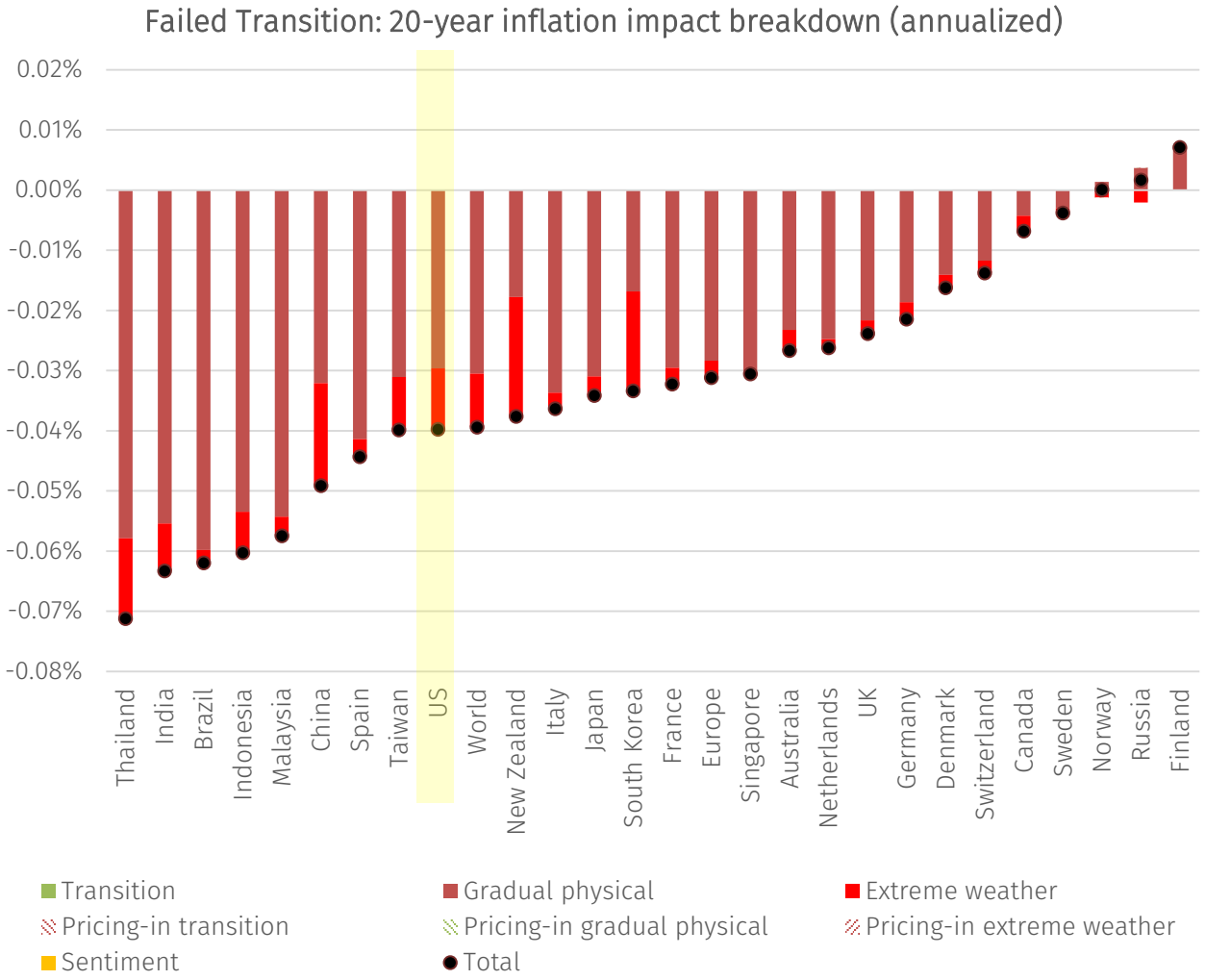


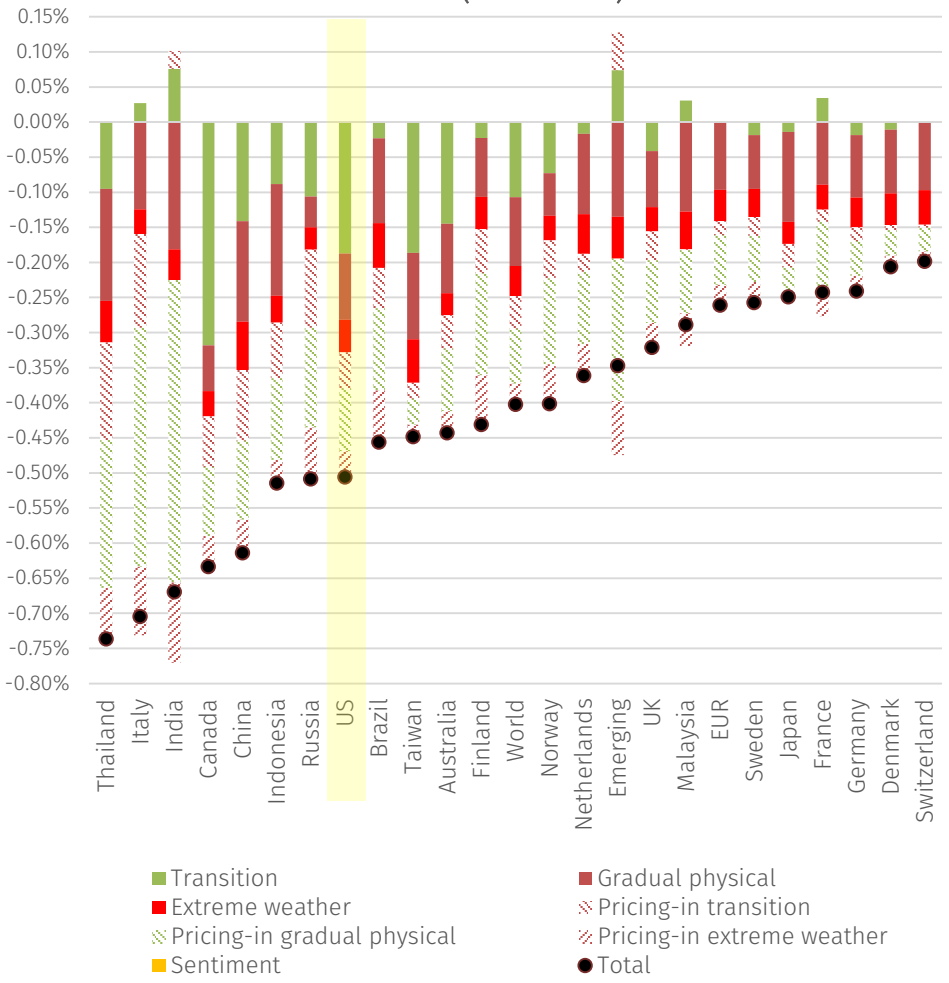
Exhibit 5 p. 19

How do other countries rank in terms of climate impacts?

Equity returns are one of the least resilient asset classes and suffer both from transition and physical risk drivers.

- Transition impacts on equity returns are significantly more severe if the transition happens in a disorderly manner.
- Under both transition scenarios, the US ranks among the most impacted regions although not as much as Canada.

Paris Orderly Transition: 20-year global equities impact breakdown (annualized)



Paris Disorderly Transition: 20-year global equities impact breakdown (annualized)

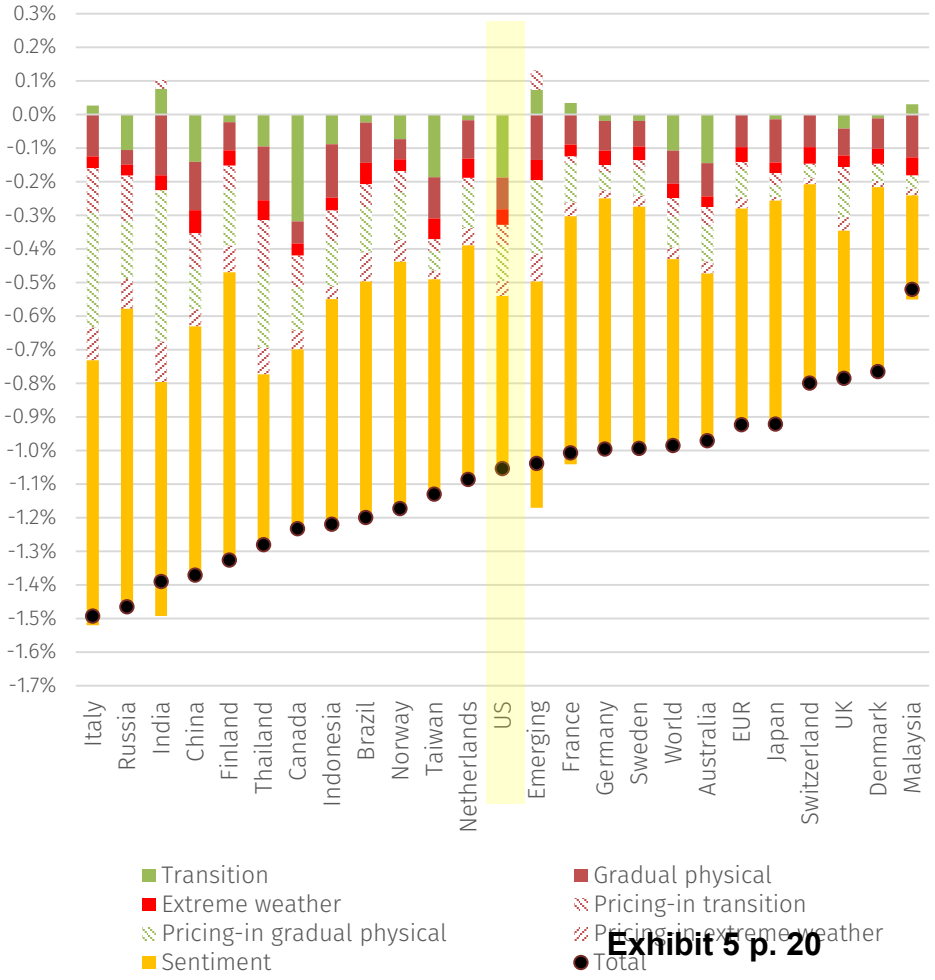


Exhibit 5 p. 20

How do other countries rank in terms of climate impacts?

Equity returns vary across countries and under each pathway.

- A Failed Transition impacts equity returns most severely via the markets pricing-in of gradual physical risks.
- While Taiwan, India, China, and other emerging markets are the most negatively impacted nations, the US still leads the way in terms of developed nation facing physical risks (-2.16% in annual losses)

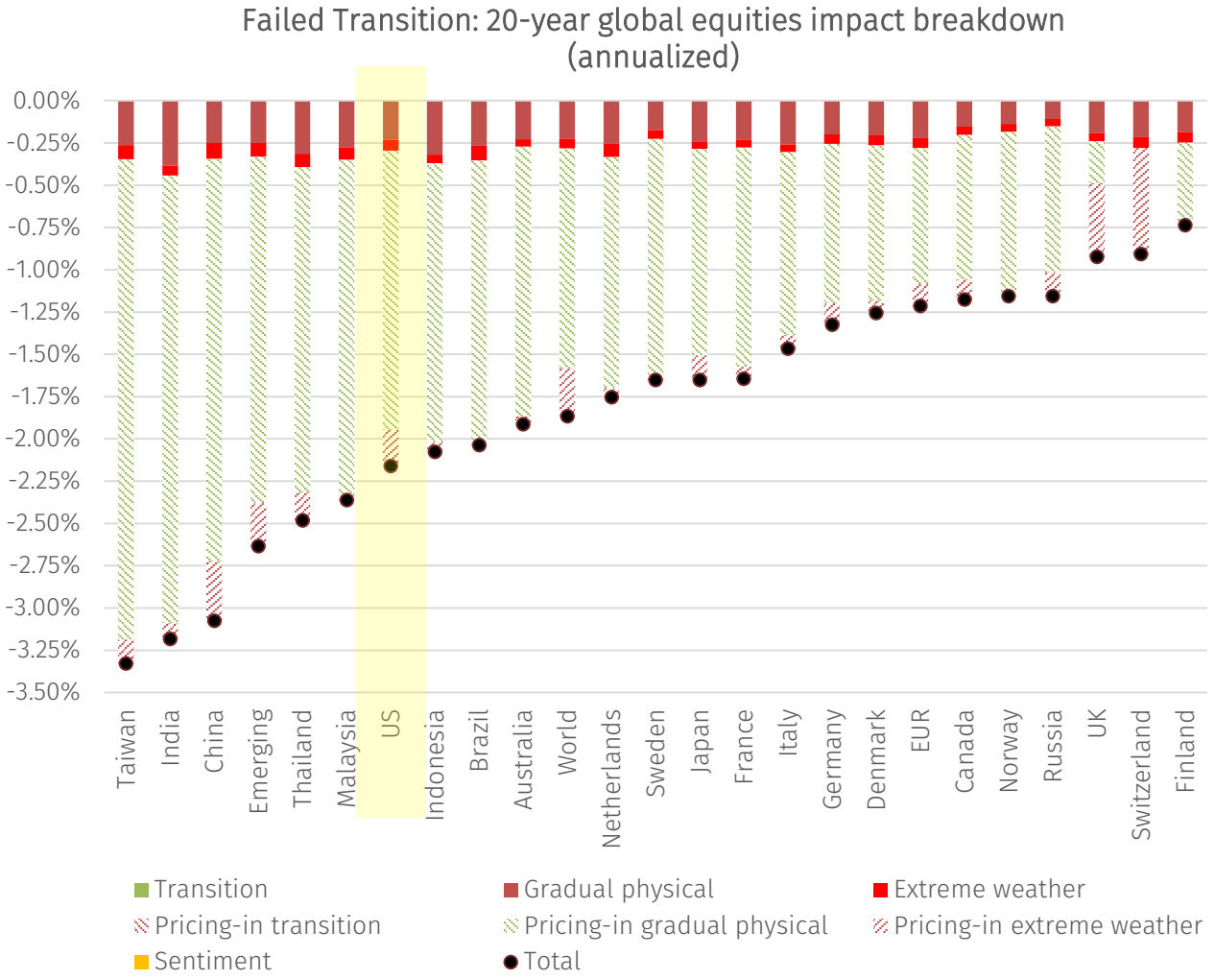
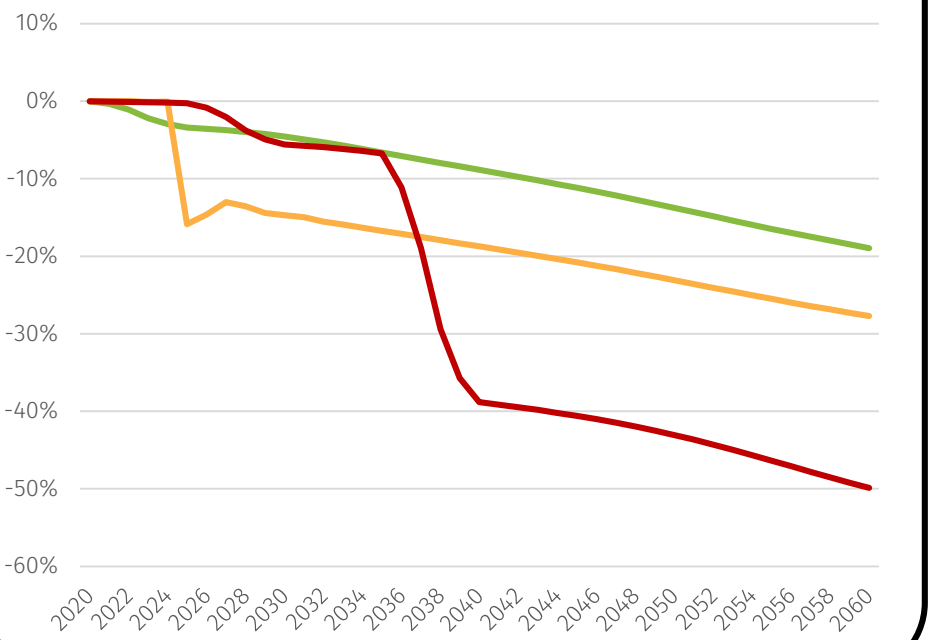


Exhibit 5 p. 21

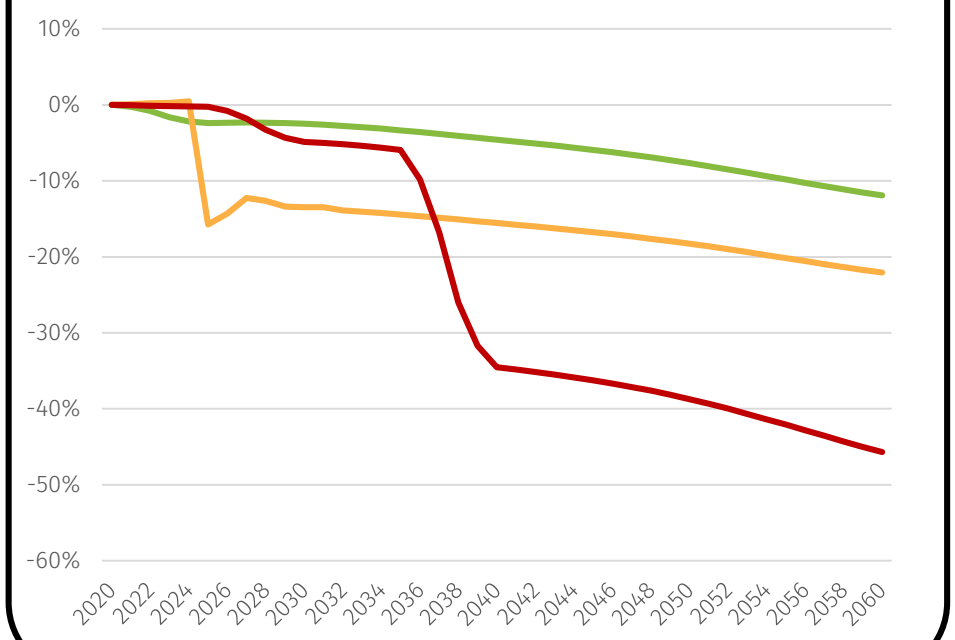
Climate impacts on US Equities vs. the World

US equities face higher transition risk, and seem less resilient to physical risk exposure

MSCI US



MSCI World



Comments

The Paris Orderly and Disorderly Transition Pathways have a large impact on the US economy, due in part by reduced income from oil and gas exports and high emitting sectors. This is reflected in the impacts on US equity. Compared to the rest of the world, transition impacts are expected to be 50% larger under an orderly transition and 20% larger under a disorderly transition by 2060. Unlike its northern neighbor, the US exposure to physical risks renders the country more vulnerable than most countries. Compared to World equities (of which US is c.60% - MSCI ACWI), US equities are expected to be 40% more exposed to physical risks.

Exhibit 5 p. 22

Failed Transition Paris Orderly Transition Pathway Paris Disorderly Transition Pathway

Contribution Analysis: What Types of Risk Affect Your Assets?

A closer look at climate impacts on equities in various markets – Paris Orderly Scenario

Exhibit 5 p. 23

Contribution Analysis: What Types of Risk Affect Your Assets?

A closer look at climate impacts on equities in various markets – Paris Disorderly Scenario

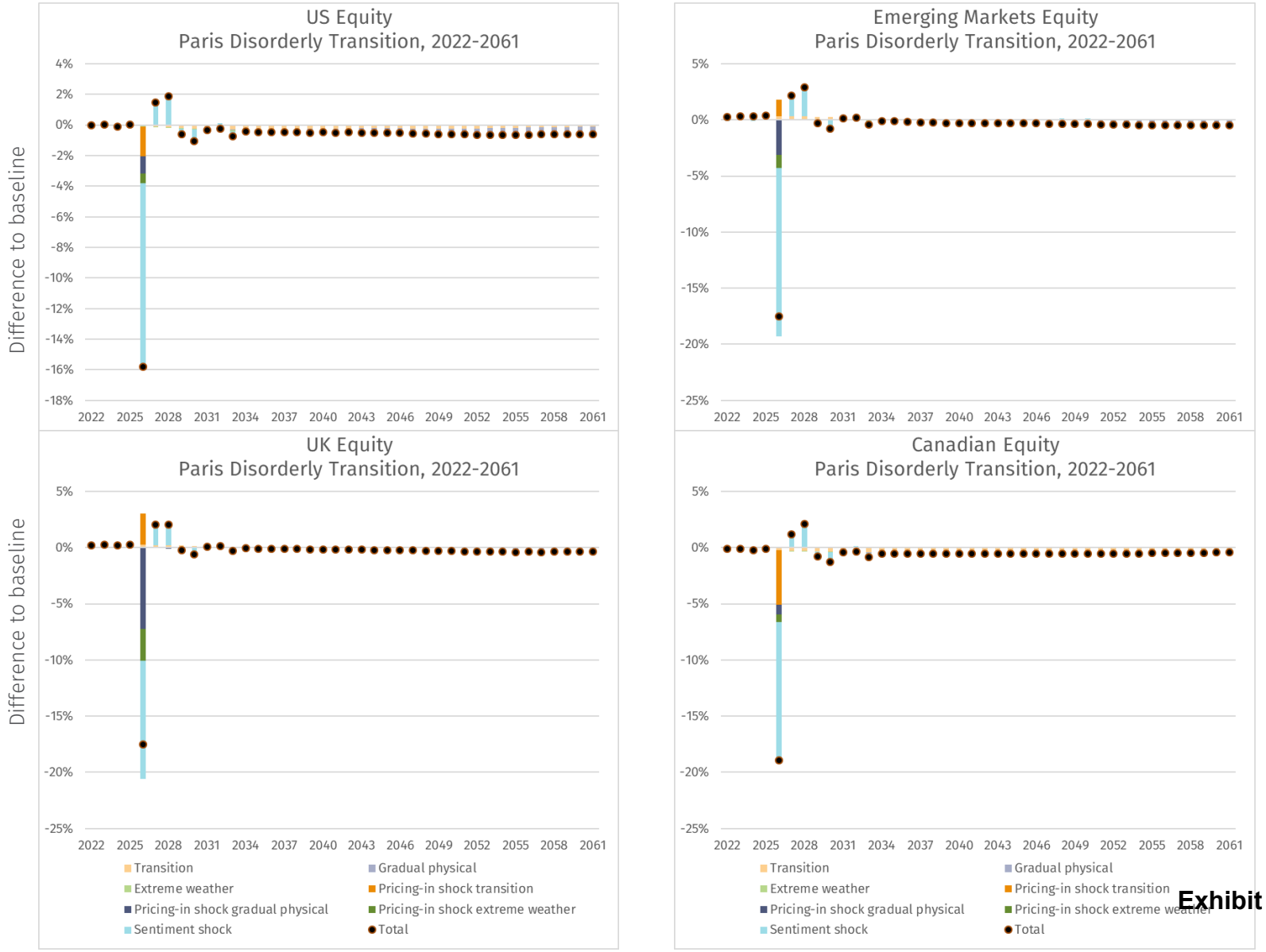


Exhibit 5 p. 24

Contribution Analysis: What Types of Risk Affect Your Assets?

A closer look at climate impacts on equities in various markets – Failed Transition

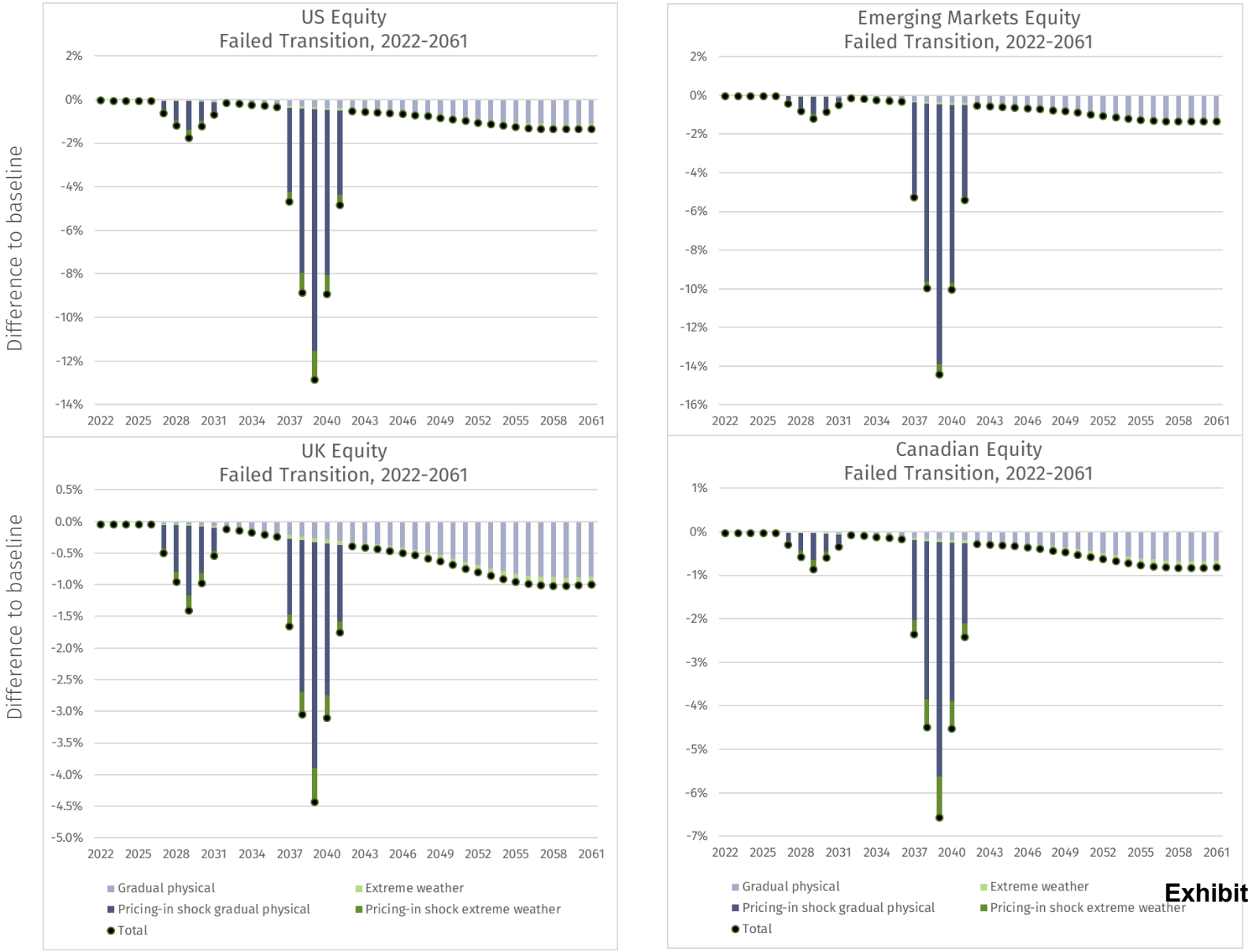


Exhibit 5 p. 25

Asset class insights

Having considered regional differences, this section focuses in on the asset classes currently forming the portfolio.

Results are presented in time buckets, showing the median return and the downside 5th percentile.

We show median return for each scenario as a delta to the baseline, so as to give a "climate shock" for that scenario.

For the risk measure, we show the difference in return between the scenario median and the scenario 5% CVaR. This is intended to give you a sense of the downside dispersion of the distribution in that scenario.

By color-coding the tables we can see the hot and cool spots in the portfolio, where it could be most efficient to make deeper investigations into risks and opportunities.

Further granularity is provided in the annex.

Exhibit 5 p. 26

Key Findings – Asset Classes

FOCUS ON PARIS DISORDERLY TRANSITION RISKS

Fixed Income:

- Less sensitive to climate risks than other asset classes.
- Corporate and non-investment grade bonds are more sensitive and sector-specific in exposure

Equities and PE:

- Global equities very sensitive
- US especially hard hit
- PE mirrors equity sensitivities

Alternatives, Real Estate, Infrastructure:

- Alternatives can offer climate transition protection due to a lower beta
- Real estate and infrastructure follow similar dynamics as public equity especially if strong links to energy and utilities
- Real assets - holdings slightly more exposed due to exposure to transition-exposed sectors
- Physical risk exposure becomes more critical through time

All of the above should be weighed against the need to meet pension liabilities.

More detailed tables (also for the other climate scenarios), with upside and downside 5% VaR are included in the annex.

Scenario 2: Paris *disorderly* transition pathway	2021-2025		2026-2030		2031-2040	
	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR
Fund	-2.6%	-7.4%	0.6%	-8.0%	-0.3%	-5.0%
Fixed income						
US Investment Grade						
US Government Bonds						
US Index-Linked						
US High Yield						
EM Debt						
Equity						
MSCI World AC						
Small Cap						
Minimum Volatility						
Private Equity						
Venture Capital/Growth						
Buyout						
Emerging Market						
Distressed Debt						
Real Estate						
Direct Real Estate						
REITs						
Real Assets						
Real Asset Portfolio						
Opportunity Portfolio						
Diversifying Strategies						
HF Fund of Funds						
Risk Parity						
Global Sovereign Rates						
Inflation-Linked Bonds						
Corporate Credits						
Listed Equities						
Commodities						

Data Redacted

Exhibit 5 p. 27

Risk/Return Analysis of portfolio constituents* (annualized results)

Scenario 1: Paris *orderly* transition pathway

	2021-2025		2026-2030		2031-2040		2041-2050		2051-2060		2021-2060	
	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR
Fund	-0.5%	-7.2%	-0.1%	-7.9%	-0.3%	-5.0%	-0.5%	-5.2%	-0.5%	-5.2%	-0.4%	-2.7%
Fixed income												
US Investment Grade												
US Government Bonds												
US Index-Linked												
US High Yield												
EM Debt												
Equity												
MSCI World AC												
Small Cap												
Minimum Volatility												
Private Equity												
Venture Capital/Growth												
Buyout												
Emerging Market												
Distressed Debt												
Real Estate												
Direct Real Estate												
REITs												
Real Assets												
Real Asset Portfolio												
Opportunity Portfolio												
Diversifying Strategies												
HF Fund of Funds												
Risk Parity												
Global Sovereign Rates												
Inflation-Linked Bonds												
Corporate Credits												
Listed Equities												
Commodities												

Data Redacted

Exhibit 5 p. 28

*Additional granularity can be provided upon request

Risk/Return Analysis of portfolio constituents* (annualized results)

Scenario 2: Paris *disorderly* transition pathway

	2021-2025		2026-2030		2031-2040		2041-2050		2051-2060		2021-2060	
	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR
Fund	-2.6%	-7.4%	0.6%	-8.0%	-0.3%	-5.0%	-0.5%	-5.1%	-0.5%	-5.1%	-0.5%	-2.7%
Fixed income												
US Investment Grade												
US Government Bonds												
US Index-Linked												
US High Yield												
EM Debt												
Equity												
MSCI World AC												
Small Cap												
Minimum Volatility												
Private Equity												
Venture Capital/Growth												
Buyout												
Emerging Market												
Distressed Debt												
Real Estate												
Direct Real Estate												
REITs												
Real Assets												
Real Asset Portfolio												
Opportunity Portfolio												
Diversifying Strategies												
HF Fund of Funds												
Risk Parity												
Global Sovereign Rates												
Inflation-Linked Bonds												
Corporate Credits												
Listed Equities												
Commodities												

Data Redacted

Exhibit 5 p. 29

*Additional granularity can be provided upon request

Risk/Return Analysis of portfolio constituents* (annualized results)

Scenario 3: Failed transition pathway

	2021-2025		2026-2030		2031-2040		2041-2050		2051-2060		2021-2060	
	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR
Fund	0.0%	-7.2%	-0.7%	-7.9%	-2.8%	-4.9%	-0.9%	-5.1%	-0.9%	-5.1%	-1.1%	-2.7%
Fixed income												
US Investment Grade												
US Government Bonds												
US Index-Linked												
US High Yield												
EM Debt												
Equity												
MSCI World AC												
Small Cap												
Minimum Volatility												
Private Equity												
Venture Capital/Growth												
Buyout												
Emerging Market												
Distressed Debt												
Real Estate												
Direct Real Estate												
REITs												
Real Assets												
Real Asset Portfolio												
Opportunity Portfolio												
Diversifying Strategies												
HF Fund of Funds												
Risk Parity												
Global Sovereign Rates												
Inflation-Linked Bonds												
Corporate Credits												
Listed Equities												
Commodities												

Data Redacted

Exhibit 5 p. 30

*Additional granularity can be provided upon request

Focus on real assets (1/3)

What drives the climate exposure of your real asset portfolio? Zoom in on the main contributing sectors

The real asset portfolio was analyzed on a bespoke basis in Climate MAPS. We analyzed the sector exposure within the portfolio to create the bespoke climate shock. As the portfolio breakdown slides above illustrate, the asset class is quite exposed to climate risks.

To better understand, we created a bespoke calibration for the real assets portfolios. Working with your teams, we agreed on the following mapping to capture the systemic region/sector exposures. Sector allocations were made on the basis of data provided which was assumed to reflect the dominant economic activity of the individual holding.

As with the rest of our analysis, the outputs should be viewed as an overlay to your knowledge of the underlying holdings.

Also note that what are described here as “sectors” are more accurately “economic activities”, and so a more diversified company could (if more granular data were available) be considered a blend of different region/sector pairs.

Cells circled pink denote the sectors highlighted in the charts on the next slide. Some cells show a 0% due to rounding for clarity of presentation, however they were included in the model.

Real asset portfolio allocation %	Fossil fuel utilities	Industrials	Low carbon utility	Energy	IT	Oil & gas	Materials	Forestry	Cons staples
North America	7%	5%	6%	8%	6%	30%	4%	5%	4%
Europe	3%	2%	2%	1%	5%	2%	1%		0%
Asia	1%	1%	1%	0%	1%	1%	3%		

Exhibit 5 p. 31

Focus on real assets (2/3)

What drives the climate exposure of your real asset portfolio? Zoom in on the main contributing sectors

Below, we show the performance of the top 5 equity sector/region combinations in the real asset portfolio. These 5 sectors represent c.55% of the real asset portfolio. The most notable exposure stems from US Oil & Gas that represents c.30% of the portfolio. This sector is expected to suffer significantly during the transition.

In the Failed Transition scenario, all sectors are impacted equally by physical risks - there are no safe haven when viewed at this level of granularity. At individual holding/project level there will be considerable difference in resilience to physical client risks.

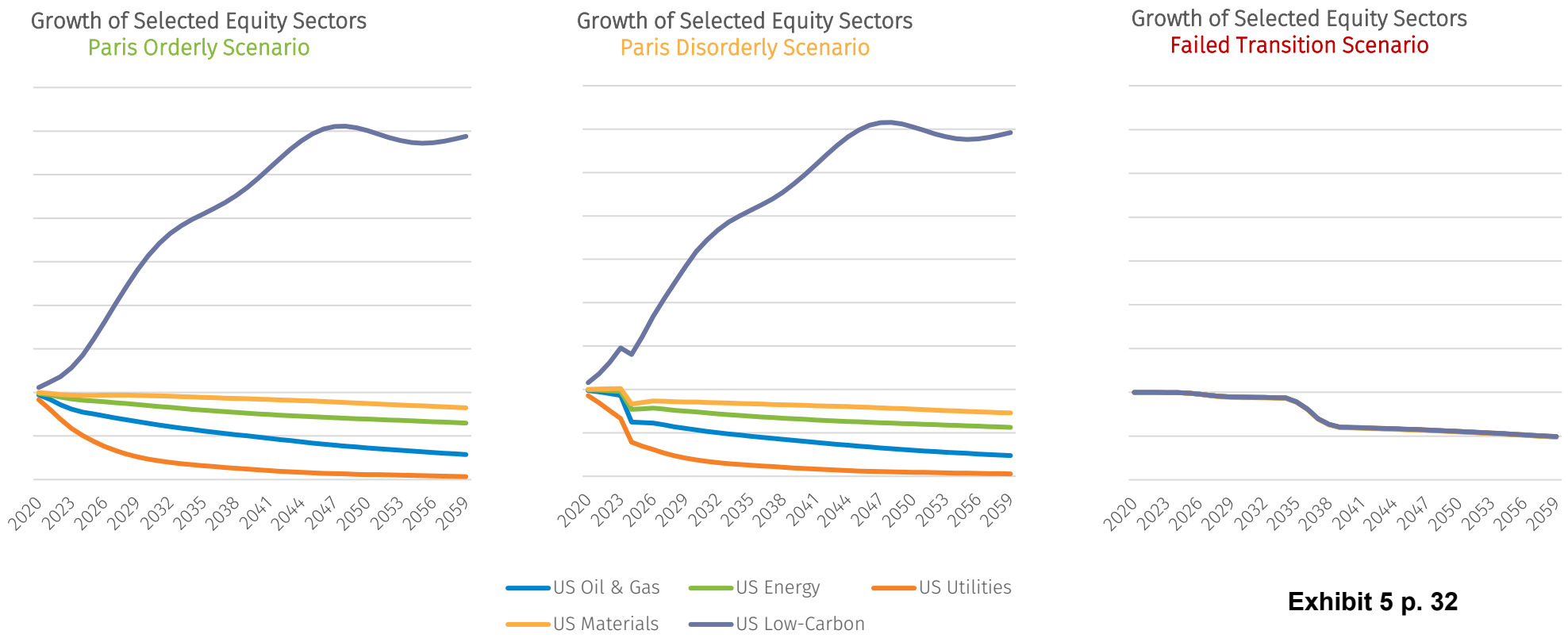


Exhibit 5 p. 32

Focus on real assets (3/3)

What drives the climate exposure of your real asset portfolio? Zoom in on the main contributing sectors

The overall impact on your real asset portfolio is a blended average of the performance of the sectors previously shown as well as the smaller exposures not presented on the previous slide. The picture below details further the underperformance of your real asset portfolio illustrated in the previous tables.

Potential "quick wins" for this portfolio could be to consider carefully exposures to the utility and oil & gas sectors (transition risk) as well as considering diversifying with foreign investments in countries less exposed to climate risk such as in Europe (both physical and transition risks).

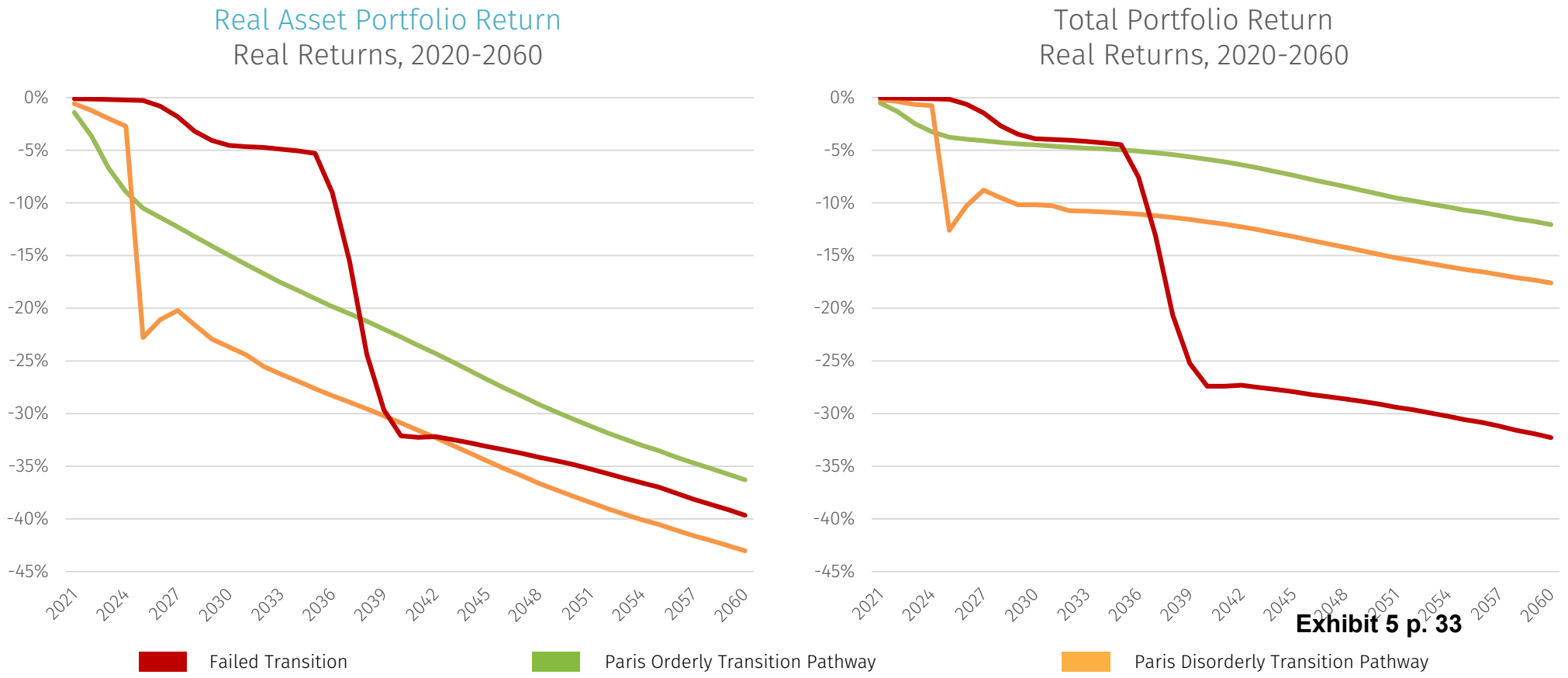


Exhibit 5 p. 33

Sector insights

The sector-level impact of climate risk is highly differentiated.

By considering the differences between sectors within countries and between countries, we can start to make sense of the landscape of risks and opportunities.

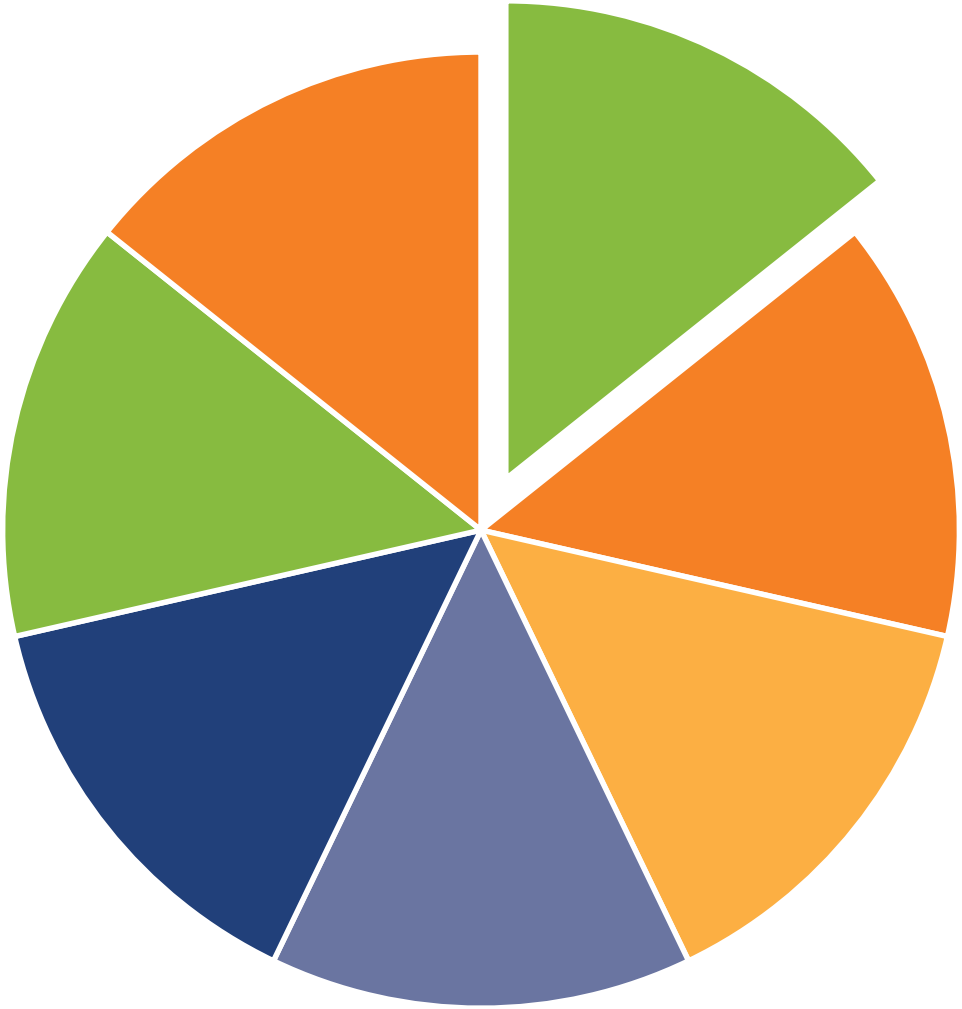


Exhibit 5 p. 34

Sector insights – key findings

The sector-level impact of climate risk is highly differentiated. Remembering that the sector heatmaps reflect economic activities, it is likely that any one company has exposure to multiple cells in the heatmap – regardless of the sector that company may been allocated to in a system like GICS.

Paris Orderly

Short term, the orderly pricing-in of the transition sees significant "losers" in fossil-exposed sectors such as fossil-based utilities (which need to be substituted, so utility companies shift activities to low-carbon utilities), Other Energy (coal and oil sands) and O&G. Low-carbon energy sees significant upside from both sector growth and revenues transferring from fossil-based energy generation. Within 20 years fossil-based utilities have essentially disappear.

Paris Disorderly

This disorderly shock, which is modelled in the first 5 years, has an epicenter in the high-emission and fossil-exposed sectors. The subsequent recovery is faster in climate-aligned activity sectors such as low-carbon utilities and to a lesser extent in more neutral activity sectors like consumer.

Failed transition

The physical risk impacts central to this scenario do not start to be priced in until after 2025. But after 10y the impacts are marked and in our current modelling most differentiated by region. However, other factors to consider in assessing physical risk at holding level are the length/complexity of supply chains and the resilience of major facilities to extreme weather.

How to use this in your decisions

One potential way to use these tables is in testing portfolio construction resilience, understanding sector-level "what ifs" and their impact on strategy implementation.

Another application could be for fund managers to overlay these "sector views" over their views on individual holding and how they could respond to this systemic impacts.

Exhibit 5 p. 35

Sectorial Impacts under the Paris Orderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 5 years

	5Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
Cumulative climate impact - Paris Orderly	World	-1.8%	-11.7%	-8.5%	10.0%	-54.4%	-1.7%	-1.7%	-1.2%	-3.0%	-0.6%	-2.0%	-1.6%	-1.8%	-1.3%	-1.0%	-1.4%	-1.5%
	DM																	
	Europe																	
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM																	
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Data Redacted

Exhibit 5 p. 36

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Sectorial Impacts under the Paris Disorderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 5 years

Cumulative climate impact - Paris Disorderly	5Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-15.9%	-26.8%	-23.3%	-2.7%	-67.8%	-15.8%	-15.8%	-15.4%	-17.2%	-14.7%	-16.1%	-15.6%	-15.9%	-15.4%	-15.2%	-15.5%	-15.6%
	DM																	
	Europe																	
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM																	
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Data Redacted

Exhibit 5 p. 40

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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Sectoral Impacts under the Failed Transition Pathway

Cumulative returns (difference to baseline) heat map – Public equities – 20 years

Cumulative climate impact - Failed Transition	20Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-36.3%	-36.2%	-36.3%	-36.3%	-36.1%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%
	DM																	
	Europe																	
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM																	
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Data Redacted

Exhibit 5 p. 46

*Note that from Dec21 our modelling will better differentiate the imipact to different sectors from physical risk

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What-if Analysis: Switch all listed equities to “Paris-aligned” companies

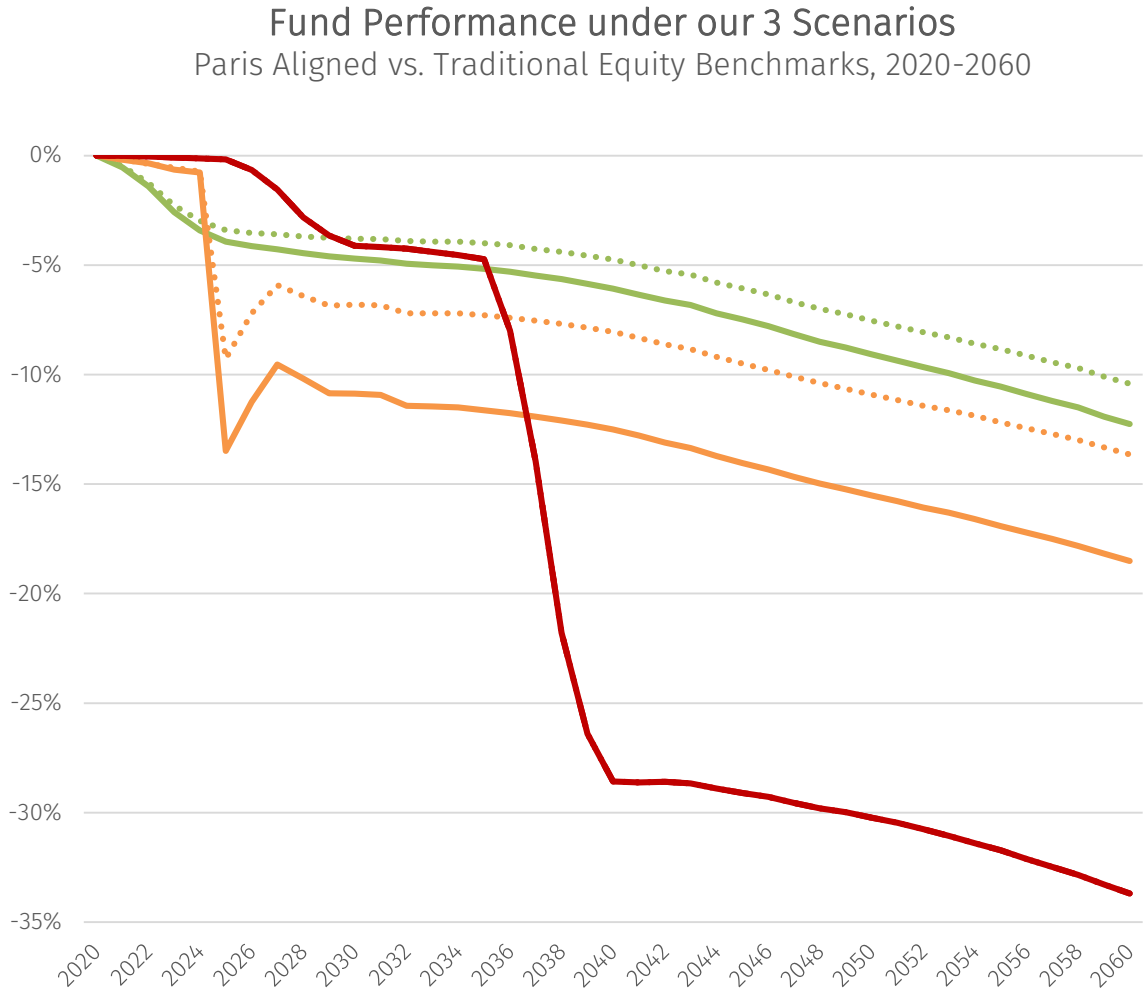
This section analyzes the impact of switching all investments in listed equities to a low-carbon (Paris-aligned) benchmark. (100% of companies aligned to a world consistent with the goals of the Paris agreement).

The current equity portfolio was simplified and represented by MSCI World.

Performance of the fund is compared between the base benchmark and a completely aligned benchmark.

Exhibit 5 p. 49

Switching to Paris-aligned benchmarks potentially mitigates downside performance if a disorderly transition scenario unfolds



"What happens to OPERF's real returns when equities are allocated to Paris-aligned benchmarks?"

- Started the analysis from the current portfolio and swapped all equities for MSCI World (30% of fund).
- Analyzed two alternatives: standard MSCI World benchmark versus a fully Paris-aligned version of the benchmark
- Switching to an (idealized) 100% Paris aligned benchmark would provide the best hedge from transition risks. However, implementation limitations mean that the real degree of alignment will probably be lower (too few aligned companies to maintain diversification)
- As more companies commit to net-zero, higher degrees of alignment could be achieved.
- It is important to note, however, that Paris alignment does not help for mitigating physical risks.

Failed Transition
Paris Orderly Transition Pathway
Paris Disorderly Transition Pathway
Standard MSCI World
MSCI World Paris Aligned (100%)

Exhibit 5 p. 50

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Next steps

We have drawn on our experience with many pension funds globally to provide a brief set of recommendations for OST to consider as “next steps” following this analysis.

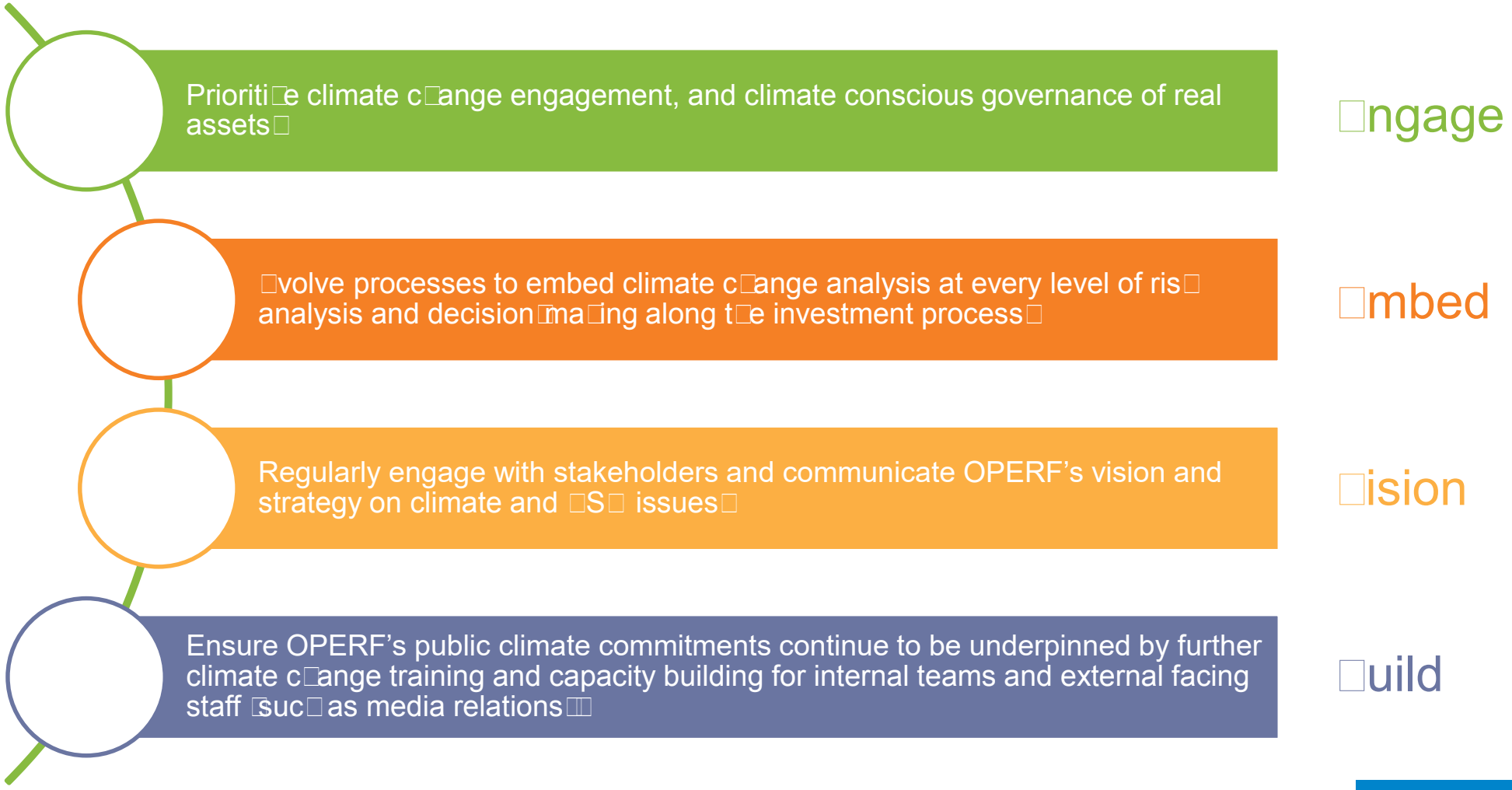
The recommendations are, however, just suggestions not advice and we would naturally expect the Treasury to arrive at its own decisions.

Whilst our analysis has been focused on the asset-allocation aspects, our suggestions cover the full gamut of the investment process since that is typically what is required to fully address this huge topic.

Exhibit 5 p. 52

Recommendations – observations on best practice

Climate Strategy



Recommendations – observations on best practice

Total Portfolio

Exhibit 5 p. 54

Recommendations – observations on best practice

Asset Classes

Equities: □ilt e□uity portfolios to be less exposed to transition ris□ by using climate□aware benc□mar□s or sustainable funds aligned to transition scenarios□
Consider aligning fund manager □PIs to your appetite for transition ris□ in mandate design□

□□uity

Prioriti□e researc□ing climate ris□s in utilities/energy stoc□s, bonds and real□assets□

□ocus

□o support potential future reporting re□uirements, include capturing climate transition indicators □regulatory, regional, business and tec□nology ris□ etc□□and analy□ing sector specific climate ris□s□

□etrics

Alternatives: given OPERF's allocation to alternatives, consider new allocations to climate solutions oriented private assets □suc□ as green infrastructure□□

Alternatives

Fixed Income: □S corporate credits are less sensitive to climate transition ris□s t□an e□uities and could be a good way to maintain □S exposure□□owever, t□is s□ould be balanced wit□ t□e need to meet liabilities□

Credit

Exhibit 5 p. 55

Next steps – Phase 2: Proposals for insightful "what-if" analysis

1) Investigate the potential benefit of geographic diversification by halving US equity and real asset exposure and rebalancing to less climate-exposed regions

Chart
Redacted

Exhibit 5 p. 56

Exhibit 5 p. 57

US Policies

cambridge econometrics
camecon.com

- Carbon tax
- Investment subsidies for CCS
- □eed□in tariffs for renewables
- Coal□fired electricity fully p□ased out by 2050
- □iofuel blending re□uirements
- Policies supporting ta□e up of □□s
- Investments in energy efficiency

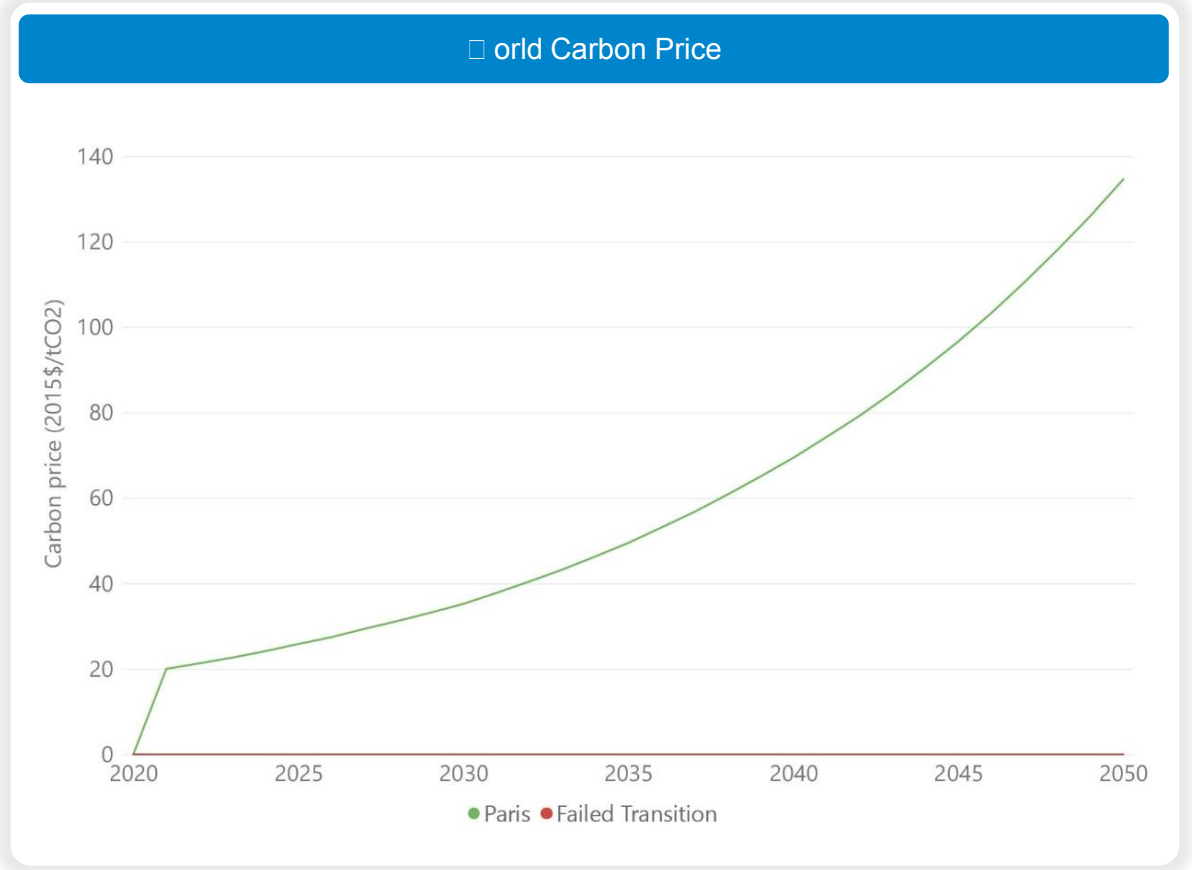
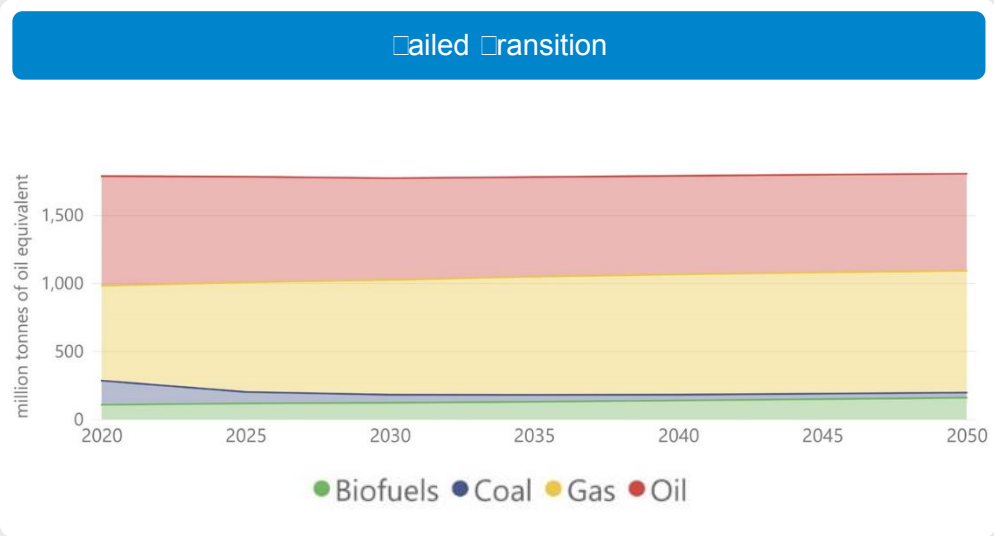


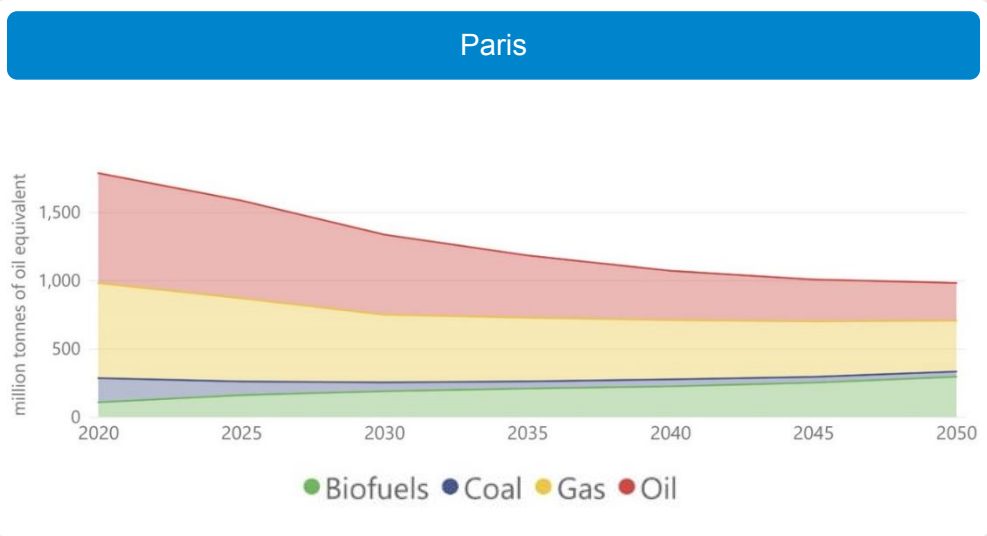
Exhibit 5 p. 58

□ind out more on our Narratives □as□board□www□climatemaps□app

US Fuel Demand

cambridge econometrics
camecon.com





In Paris □ransition Pat□ways□

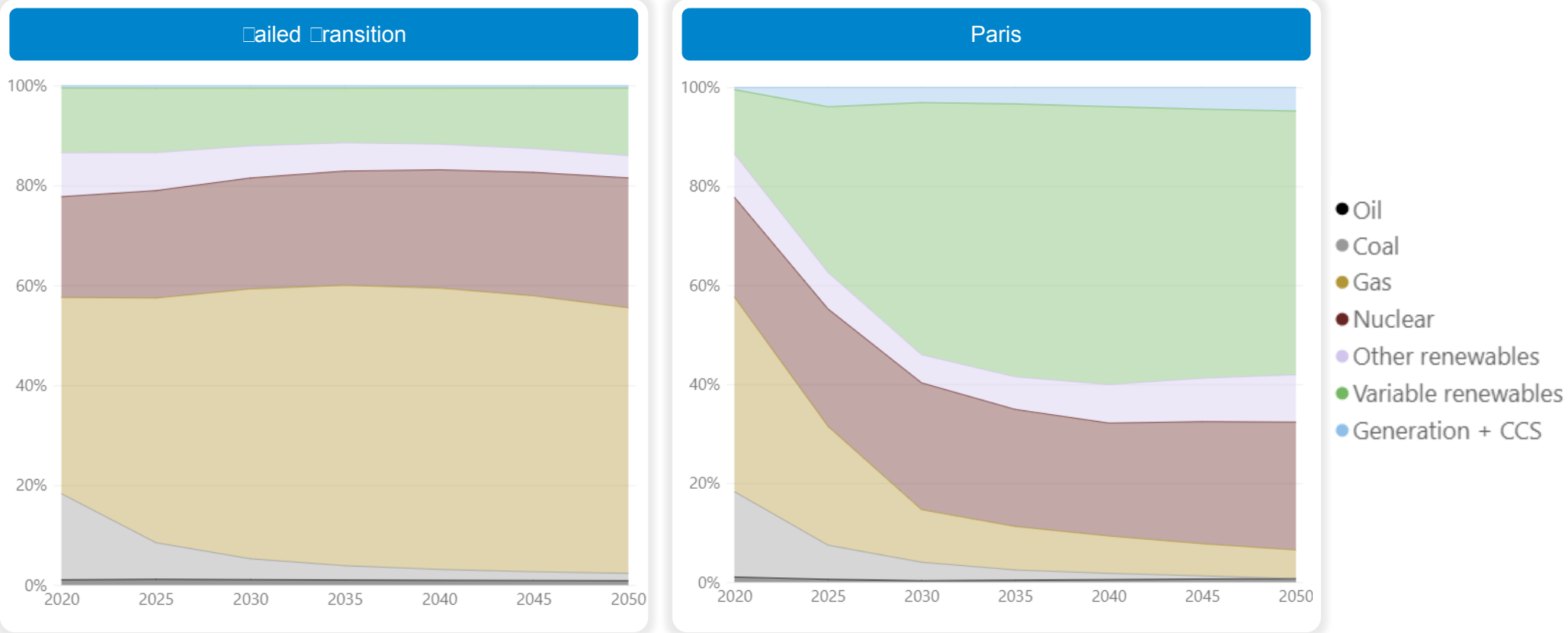
- Primary fuel demand decreases 45□ by 2050 relative to 2020
- □iofuel use grows more t□an tenfold
- Proportion of gas stays relatively stable
- S□are of oil and coal reduces substantially

Exhibit 5 p. 59

□ind out more on our Narratives □as□board□www□climatemaps□app

US Electricity Generation

cambridge econometrics
camecon.com



In Paris □ransition Pat□ways□

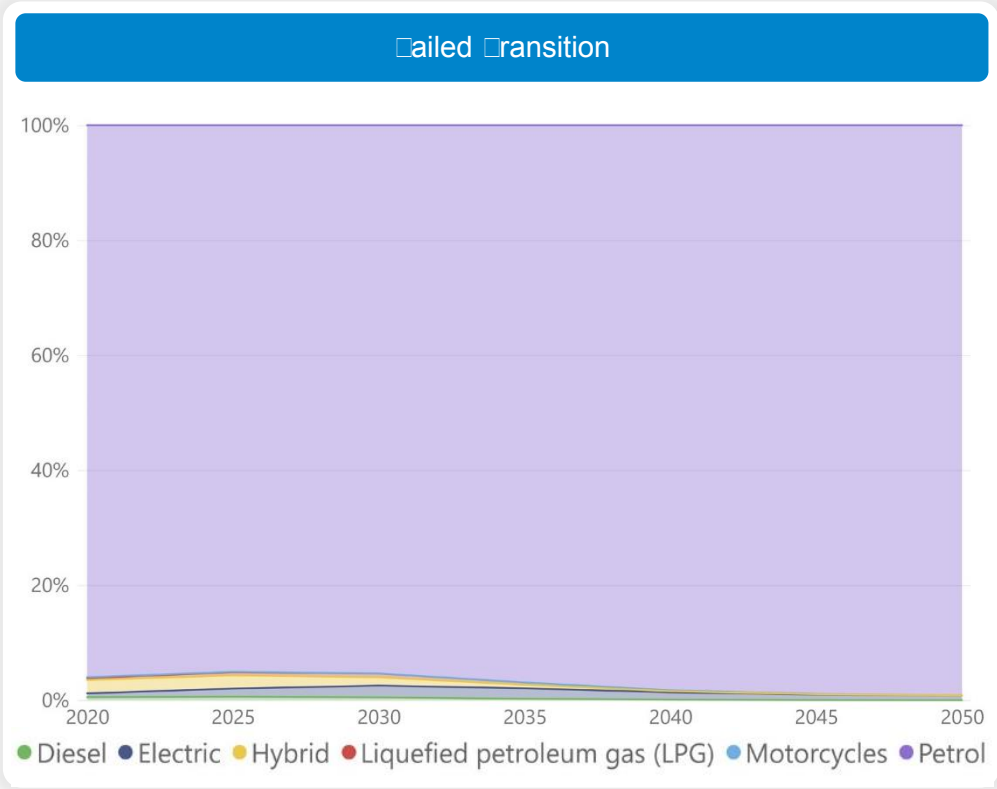
- Renewables and CCS tec□nologies ma□e up over □0□ of t□e □S electricity generation mix in 2050
- □ossil fuel p□ase out rapidly in t□e s□ort term and gradually in t□e long term
- □a□e up of new tec□nology due to investment in low□carbon tec□nology

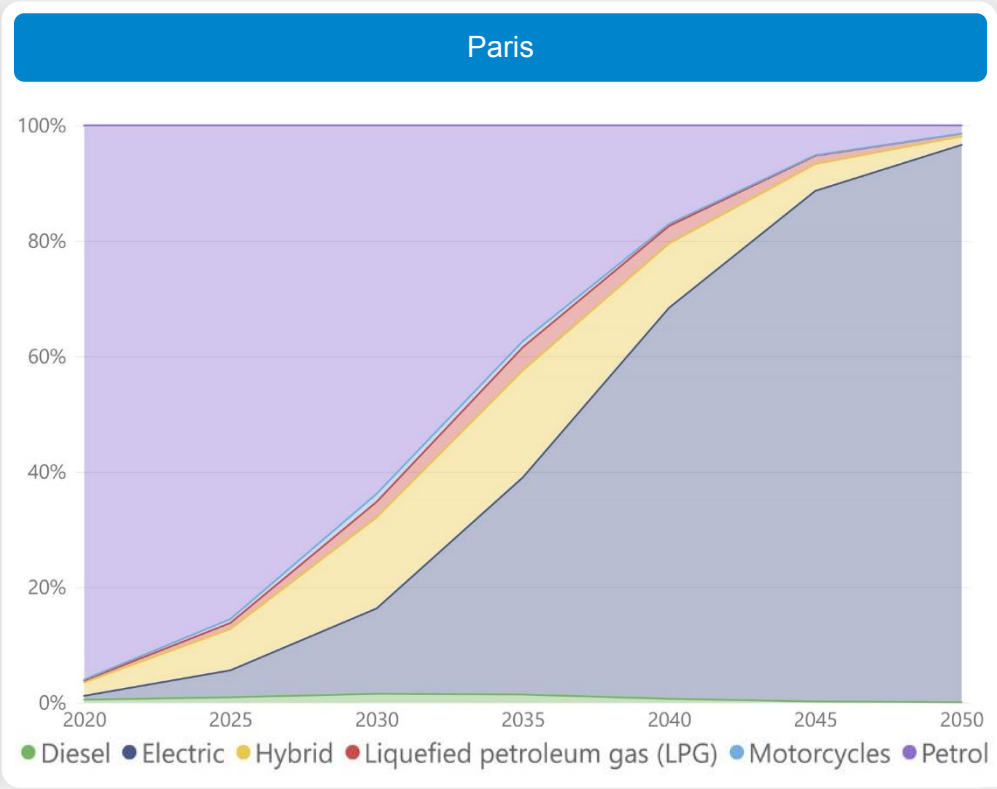
Exhibit 5 p. 60

□ind out more on our Narratives □as□board□www□climatemaps□app

US Passenger Transport

cambridge econometrics
camecon.com





In Paris □ransition Pat□ways□

- □y 2050 electric ve□icles ma□e up 9□□ of t□e □S passenger transport mix

Exhibit 5 p. 61

□ind out more on our Narratives □as□board□www□climatemaps□app

A closer look at the three climate pathways

The impact of orderly climate action

Scenario 1: Paris Orderly Transition Pathway

1. Paris Agreement goals **met**
2. Rapid and effective climate action, wit smoot mar et reaction
3. Ambitious low carbon policies – ig investment in low carbon tec nologies
4. a or c ange in global fuel / electricity mix
5. Average global temperature stabili es at 1 5°C above pre industrial levels
6. ransition as limited positive effect on global P and is more t an offset by negative p ysical impacts
7. oderate p ysical impacts, wit a muc lower increase in extreme weat er ris s between 2020 and 2100 t an under a ailed ransition scenario
8. e S, compared to ot er regions, is more negatively impacted by this pathway due to the its economy's dependency on fossil fuel exports, its slow progress on energy efficiency and carbon pricing, as well as its ig sensitivity to mar et sentiment

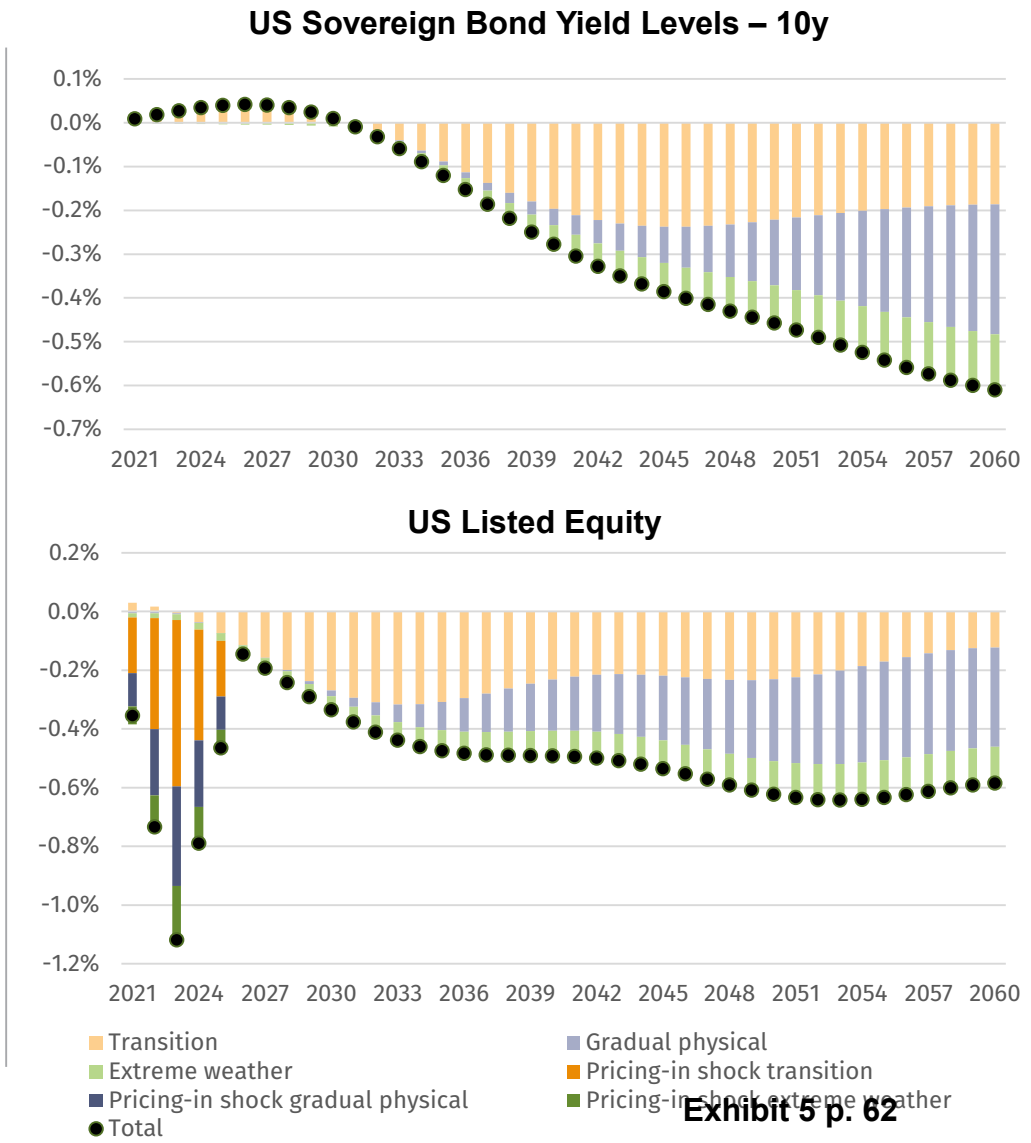


Exhibit 5 p. 62

Note: the data presented in the graphs is shown as difference to baseline and are annualized results

A closer look at the three climate pathways

The impact of a delayed market reaction

Scenario 2: Paris Disorderly Transition Pathway

1 Paris Agreement goals **met**

2 Rapid effective climate action, but markets slow to react

3 Ambitious low carbon policies – big investment in low carbon technologies

4 Major change in global fuel / electricity mix

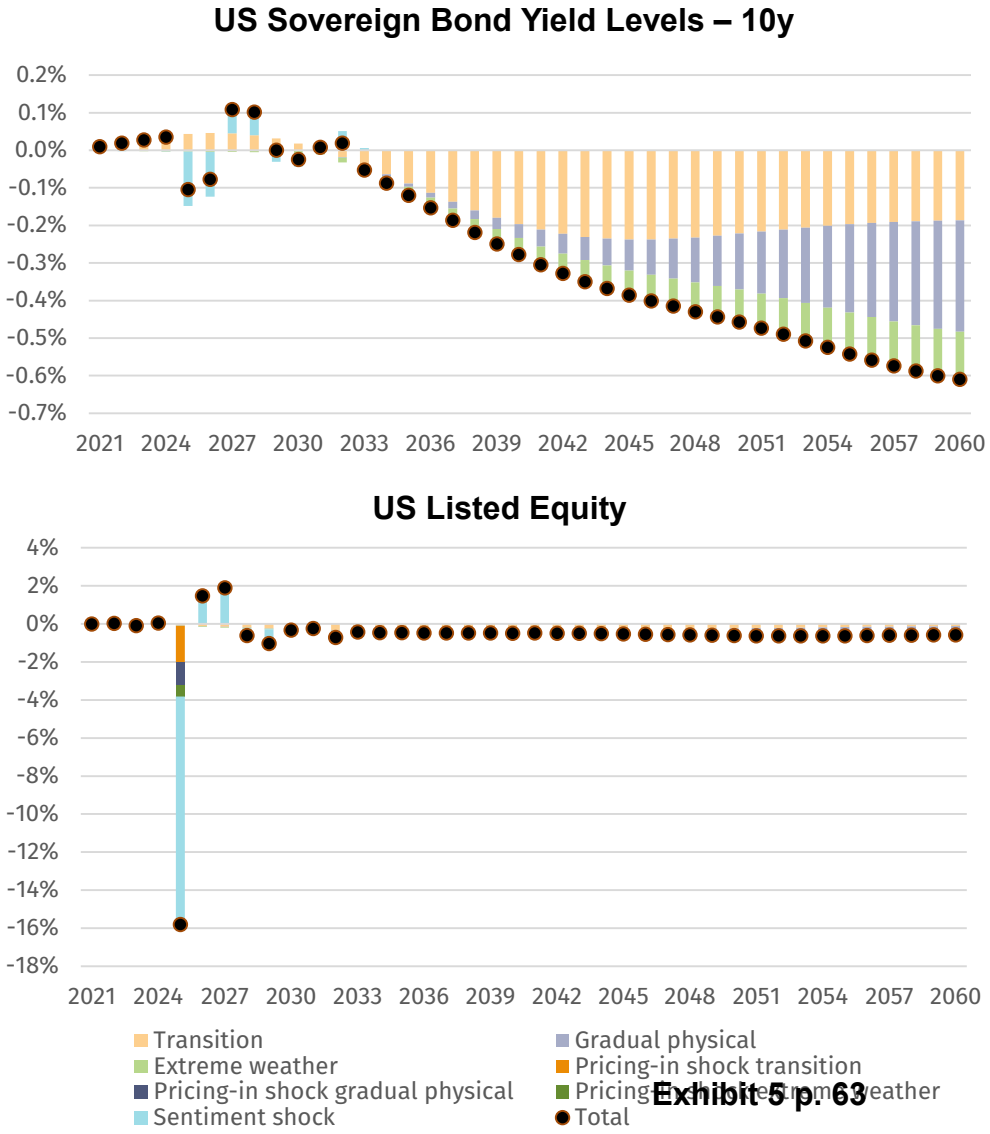
5 Average global warming stabilises at 1.5°C above pre-industrial levels

6 Transition has limited positive effect on global GDP and is outweighed by negative physical impacts

7 Abrupt market reaction in 2025 impacts the real economy, for example causing a fall in all major countries' GDP in 2025. In the long term, GDP is slightly lower than in the Paris Orderly scenario as a result of the disorderly transition

8 Moderate physical impacts, with a much lower increase in extreme weather risks between 2020 and 2100 than under a failed transition scenario

9 The US, compared to other regions, is more impacted due to its sensitivity to transition risks – how these are priced in



Note: the data presented in the graphs is shown as difference to baseline and are annualized results

A closer look at the three climate pathways

What might happen if Paris goals are not met?

Scenario 3: Failed Transition Pathway

1. Paris agreement goals **not met.**
2. Only existing climate policies are implemented
3. Limited change in global fuel / electricity mix despite significant falls in renewable energy prices
4. Average global warming is about 2°C by 2050 and 4°C by 2100, compared to pre-industrial levels
5. Physical impacts have a significant negative impact on global GDP
6. Extreme weather risks increase significantly between 2020 and 2100 via a combination of increasing event frequency and severity of losses

The physical risks are comparable to the two Paris scenarios for the first 10 years, then increase substantially and irreversibly. Warming makes agriculture impossible in certain areas around the world. Extreme weather events more than double on a global level.

8. Unfortunately, the US demography and geography plays against its favour and exacerbates the adverse effects of global warming especially at risk from extreme weather events.

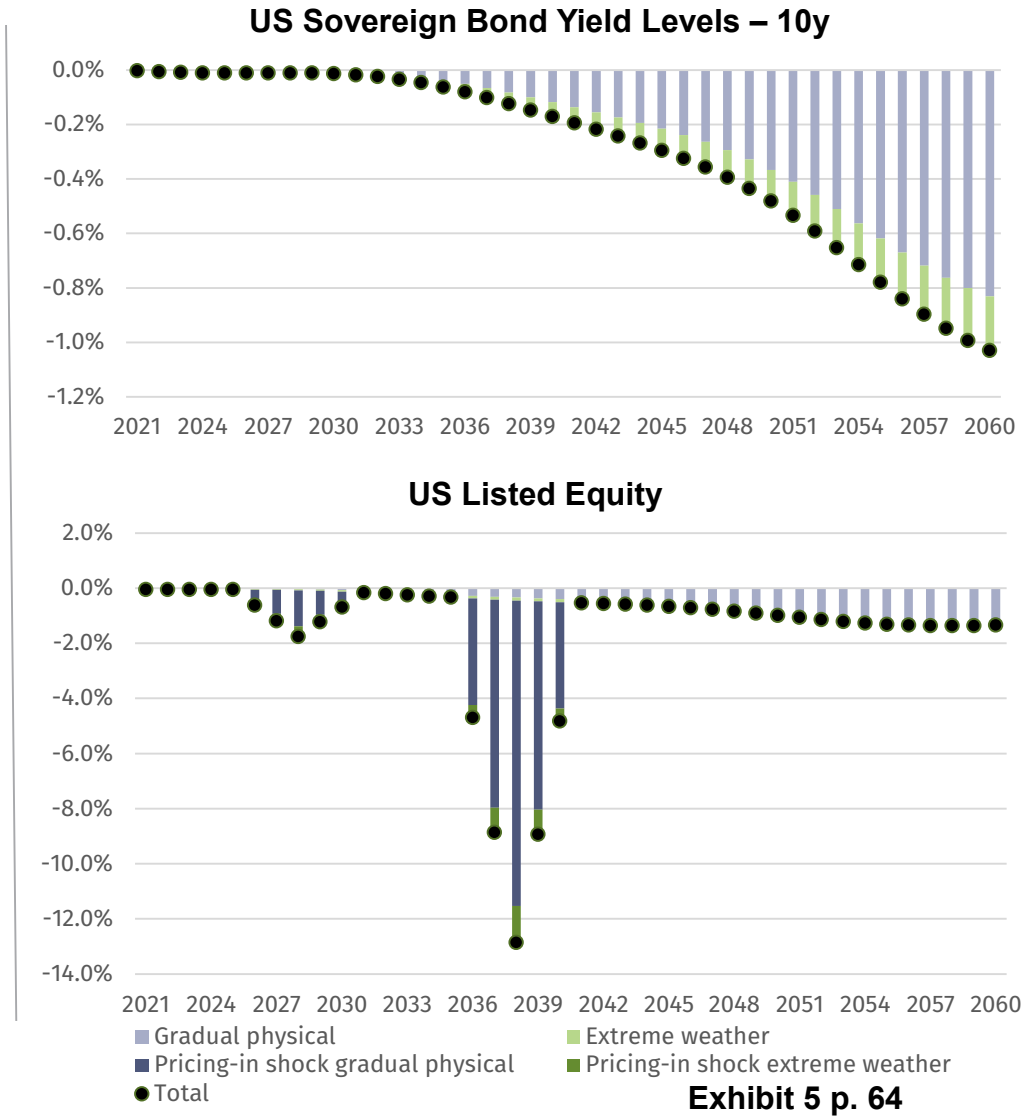
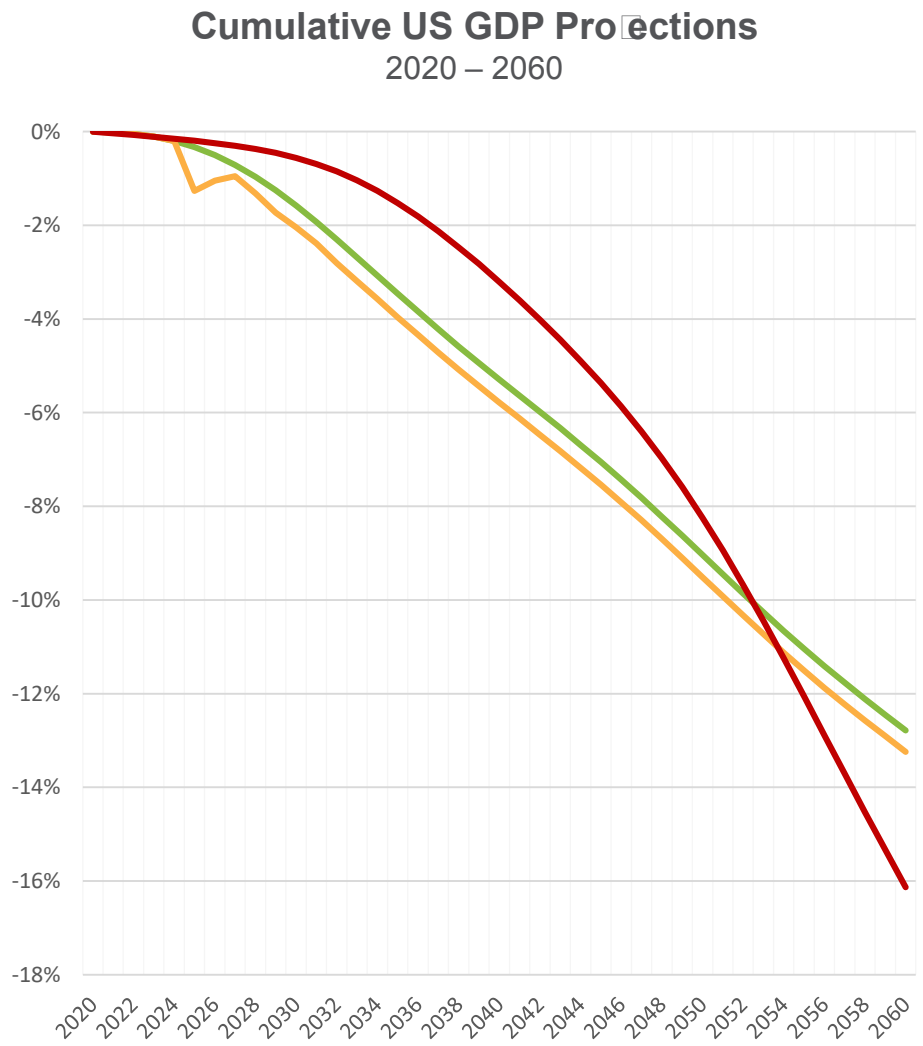


Exhibit 5 p. 64

Note: the data presented in the graphs is shown as difference to baseline and are annualized results

Climate impacts on selected macroeconomic variables – United States*

How is the economy impacted by climate change?



Paris Transition:

- Over the next 20 years, the US is heavily impacted by the transition pathways due to the economy's dependence on fossil fuel exports. Rapidly declining demand will impact also other related sectors, as well as government royalties, spending, and so on.
- Other regions, such as Europe and China, can even benefit from the low-carbon transition, such as renewable energy technology producers.
- In the second half of this century, transition risks will fade out and lower GDP expectations compared to baseline are due to the locked-in physical impacts of half a degree of further warming compared to today.

Failed Transition:

- Physical risks become more significant over time, which gradually affect GDP growth. These physical risks are particularly impactful for the US unlike other countries such as its neighbor, Canada.
- Due to its demographic and geographic situation, the US is more severely affected in the failed transition with GDP projections 16% lower by 2060 under a failed transition compared to baseline.

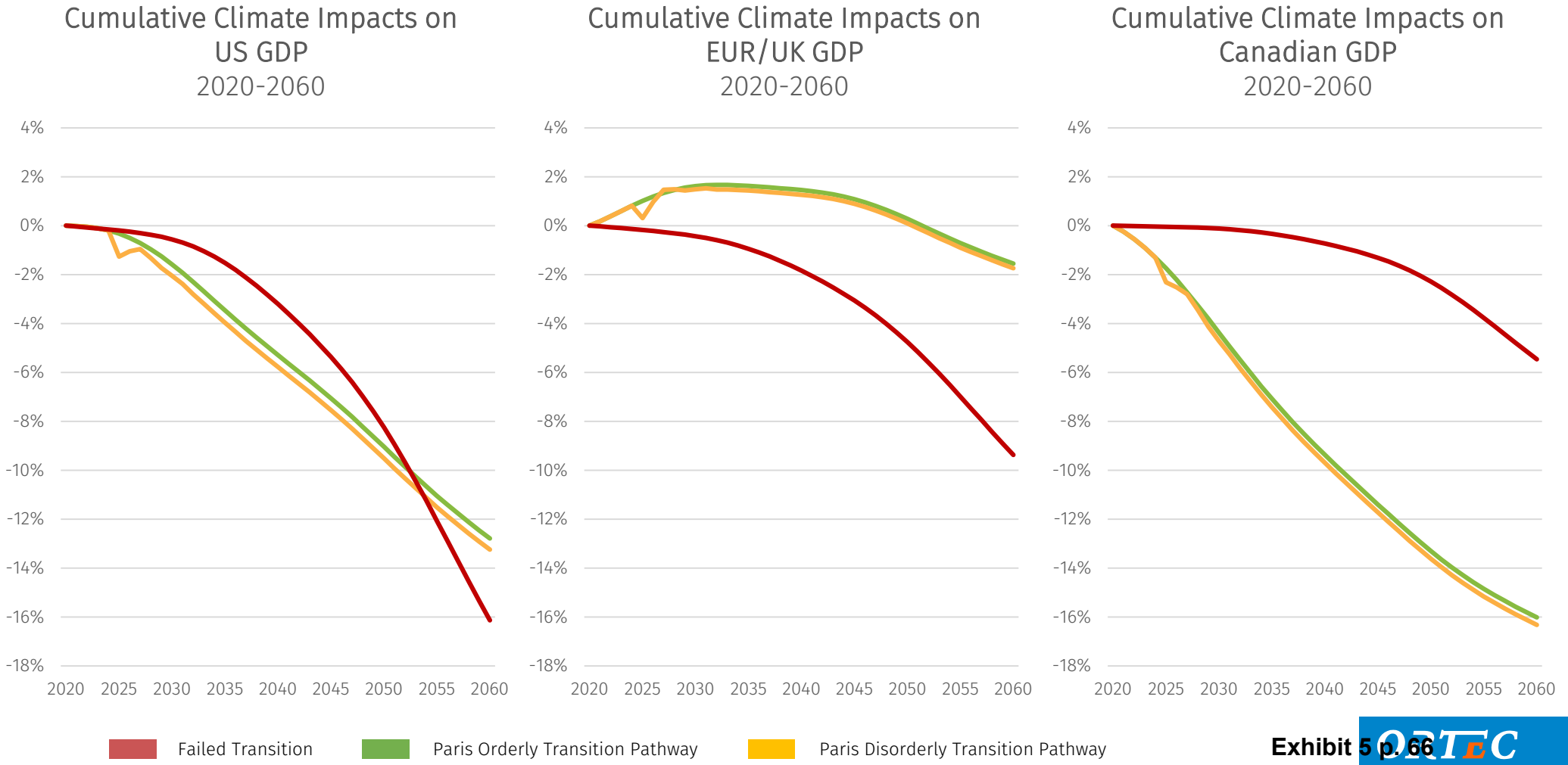
Failed Transition | Paris Orderly Transition Pathway | Paris Disorderly Transition Pathway

*Analyze many more variables using the ClimateMAPS Scenarios Narratives Dashboard.

Exhibit 5 p. 65

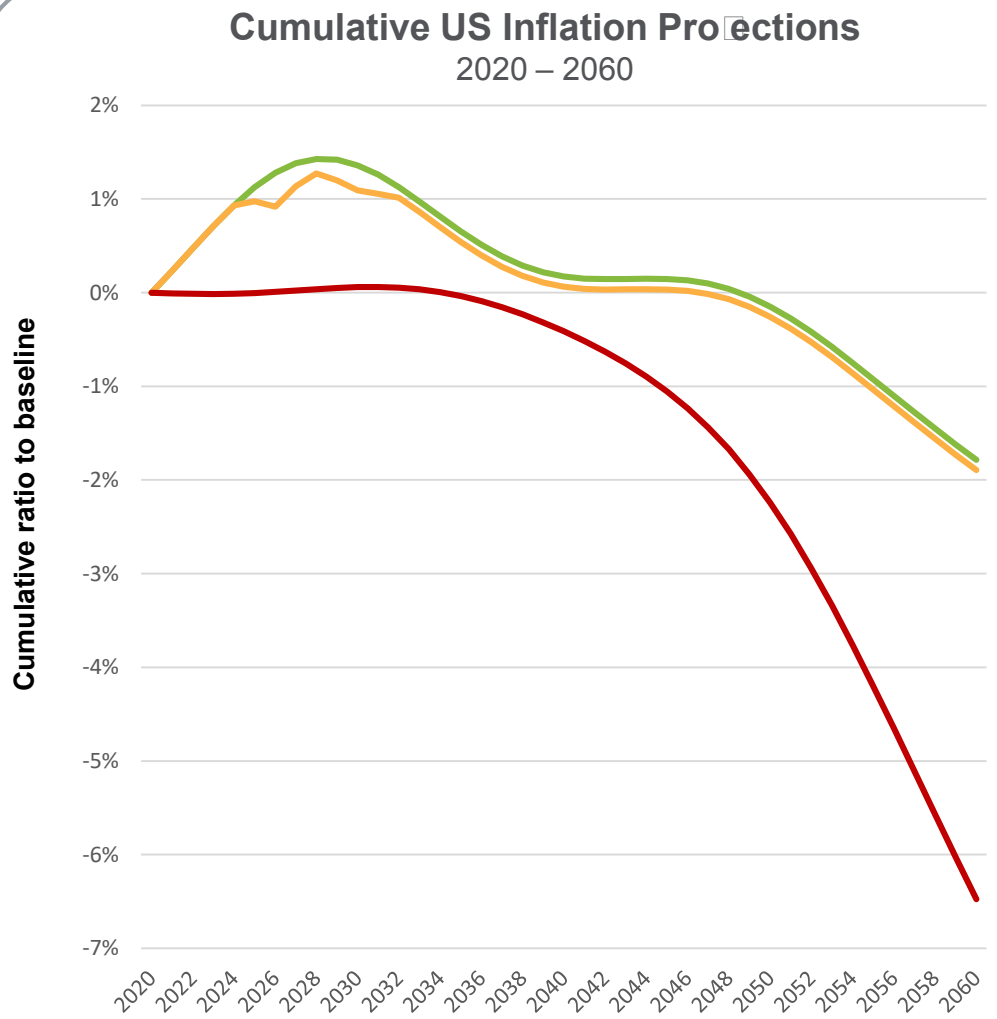
Climate impacts on key economies: GDP considerations

Countries are impacted differently depending on their specific geographic and economic considerations. While the US is severely impacted under our 3 scenarios, Canada for instance suffers particularly from a transition.



Climate impacts on selected macroeconomic variables – United States*

A transition to net zero will increase US inflation



Comments

In the US, under the Paris Orderly and Disorderly Transition Pathways, there is an increase in prices in the upcoming years driven by demand-pull inflation effects: the stimulus effects of low-carbon energy and infrastructure investment drive an initial increase in prices.

In the longer term, with the low-carbon regulation put in place (e.g. phase out of fossil fuels) as well as the effect of learning-by-doing, energy product cost is expected to fall. This then drive down the energy/fuel prices. With subsidies and regulation, the cost of renewable technologies decrease overtime which partly affect the electricity price.

Under a Failed Transition, prices are not influenced by new policy changes in the short-term. However, mounting physical impacts will impact the economy in the medium and long term which will impose deflationary pressure towards the end of the time horizon. These effects are particularly large for the US.

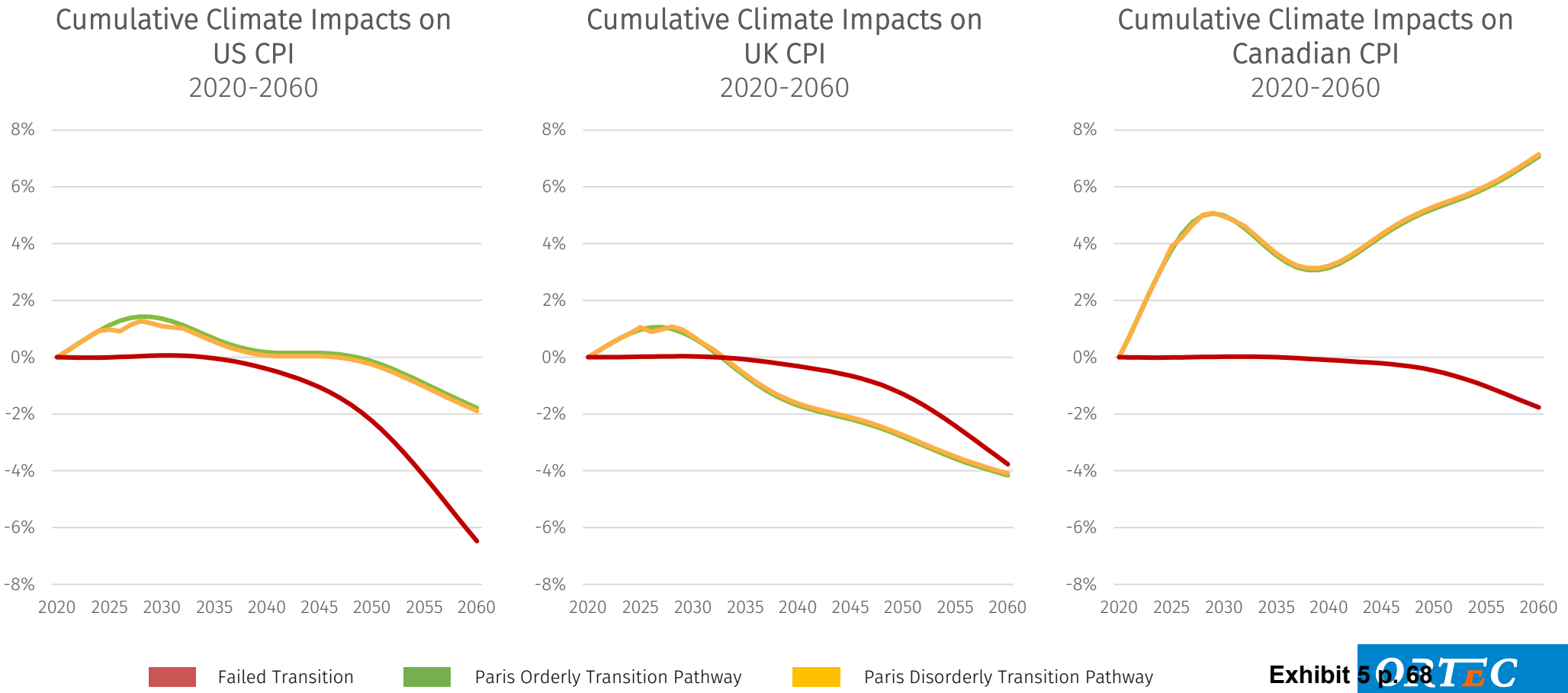
Failed Transition Paris Orderly Transition Pathway Paris Disorderly Transition Pathway

Exhibit 5 p. 67

*Analyze many more variables using the ClimateMAPS Scenarios Narratives Dashboard.

Climate impacts on key economies: inflation considerations

In the Paris Orderly and Disorderly Transition Pathways, the transition puts upward pressure on inflation in the US.
The positive transition impact is larger than the (negative) impact of increasing physical risks up to 2030.
In the long run, increasing gradual physical risks lead to a reduction in inflation.
In the Failed Transition Pathway, increasing physical risks decrease inflation from the early 2030s.



Financial Results

Paris Orderly Transition

The following subsection focuses on the impacts induced by the Paris Orderly Transition pathway on your portfolio.

The key effects to keep in mind in this pathway are the initial transition shock occurring in the short-term as well as the locked-in physical risks that materialize later on. Annualized results are located in the annex.

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Paris Orderly Transition Pathway

Climate impacts summary – Public equities

Public equities:

- The asset class is impacted by pricing-in shocks spread over 2021-2026.

Summary of climate impacts on equities:

- Equities suffer from transition risks in the first years. After 2026, physical risks gradually increase over time. The cumulative relative performance of the equity arm of the portfolio compares to baseline over 40 years is -11% under the Paris Orderly Transition pathway.
- Emerging markets tend to be less sensitive to both climate-related risks.
- Canada & the US suffers the most due to their dependency on fossil fuel exports, lack of energy efficiency and carbon pricing progress and high sensitivity to market sentiment.
- Overall, Japan and Singapore are the winners among the developed markets.
- Low carbon electricity
  - Winners: emerging markets, Australia and Singapore
  - Losers: Europe, the UK
- Other utilities and energy are the most negatively impacted sectors where all regions suffer important losses.

Exhibit 5 p. 75

Paris Orderly Transition Pathway

Climate impacts summary – Others

Fixed Income:

- Interest rates in Canada, and most other countries, are not materially impacted in the short-run due to limited climate-related impacts on growth in this pathway.
- In the medium-run most countries experience some negative impacts from the transition, and in the longer term, they suffer more from physical risks.
- The gradual (but generally modest) decline in yields leads to a slight upward pressure on fixed income returns.
- Canadian corporate credits are more significantly impacted with cumulative return of -7% over the next 40 years compared to baseline. Still, these impacts remain much lower than those on equities.

Property:

- Listed and unlisted real estate behave similarly as listed equities. However, differences arise from divergence in regional exposure. It also has some differences in volatility between listed and unlisted benchmarks within a country.

Infrastructure:

- Listed infrastructure assets are expected to perform in a similar fashion as broad equities, albeit with a slightly more negative cumulative performance. OPERF's specific infrastructure exposure is slightly more at risk than our broad benchmark, but remain in line with what's expected on the asset class.

Financial Results

Paris Disorderly Transition

The following subsection focuses on the impacts induced by the Paris Disorderly Transition pathway your portfolio.

The key effects to keep in mind in this pathway are the delayed transition shock that strikes in 2024 as well as the sentiment shock and increased volatility in the following few years. After this initial chaotic transition, this pathway behaves the same way as its orderly counterpart. Annualized results are located in the annex.

Exhibit 5 p. 77

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Paris Disorderly Transition Pathway

Climate impacts summary – Public equities

Public equity:

- The asset class is impacted by the pricing-in shock in 2025H2 – 2026H1. This shock is deployed rapidly due to the delay in the implementation of required policies under the Paris transition.
- Both the pricing-in shock and the sentiment shock have a large impact across all regions from 2025H2 – 2026H1 onwards as delayed market pricing-in strikes.
- Under the Paris Disorderly pathway, there is a loss of about 17% on your equity portfolio in the first 5 years compared to the baseline. In 2025H2 – 2026H1, the abrupt sentiment shock also takes place and adds on top of the pricing-in shock.
- After the recovery, equity returns move roughly to baseline levels in both Paris pathways, while towards the end of the time horizon, equity returns are lowered by physical risks.

Summary of climate impacts on equities:

- Because of the delayed pricing-in shock, all the impacts are more significant in this pathway than under the Paris Orderly transition. Furthermore, the sentiment shock materially affects cumulative climate impacts by 2026.
- Emerging markets benefit from the transition to low-carbon technologies but are also more sensitive to negative impacts on high carbon technologies.
- Japan and Singapore are the “winners” among developed markets.
- Low carbon electricity – all regions benefit, however relatively we see the following:
    - Winners are Australia, emerging markets, Japan, the US
    - Losers: Europe and the UK
- Other utilities and Energy are the most negatively impacted sectors where all regions suffer important losses.

Exhibit 5 p. 83

Paris Disorderly Transition Pathway

Climate impacts summary – Others

Fixed Income:

- Apart from the sentiment shock as well as different size and timing of the pricing-in shock, the yields are impacted in the same way as under the Paris Orderly Transition pathway. Therefore, in the medium term, interest rates generally go down slightly, with a somewhat larger impact for Canada than the UK for instance.
- This gradual (but generally modest) decline in yields leads to slight upward pressure on fixed income returns.
- The sentiment shock causes some upward short-term movements of sovereign yields, especially for the Canada, which in turns improve fixed income returns.
- For corporate credits, spread tightening movements benefit the portfolio after climate shocks.

Property:

- Similar impacts as under the Paris Orderly Transition pathway.

Infrastructure:

- Similar impacts as under the Paris Orderly Transition pathway.

Financial Results

Failed Transition

The following subsection focuses on the impacts induced by the Failed Transition pathway on your portfolio. The key effects to keep in mind in this pathway are the important physical risks that build up as time goes on. The expected losses associated with the physical risks compound with time and lead to important losses. As noted earlier, by 2038, the Failed Transition pathway is already expected to be the worst pathway of the three. From our experience, your portfolio is moderately impacted due to its exposure to relatively exposed assets classes such as public equities, real estate and infrastructure. The strong emphasis on Canadian assets reduces the exposure of the portfolio due to the smaller physical risks, compared to other, less resilient countries such as the US. All alternative asset mixes increase this exposure due to the reduction in Canadian exposure. Annualized results are located in the annex.

Exhibit 5 p. 85

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Failed Transition Pathway

Climate impacts summary – Public equities

Public equities:

- The entire asset class is affected by the delayed pricing in shocks from 2026-2031 and 2036-2041.

Summary of climate impacts on equities:

- In the first 5 year time bucket, impacts on equities are muted when compared to those of the Paris Transition pathways. This is because under the Failed Transition pathway, pricing-in shocks only start in 2026 and no transition shock occurs. A second pricing shock strikes in 2036-2041, intensifying the impact of physical risks on the asset class.
- Unlike under the Paris Transition pathways, the low-carbon electricity sector does not grow under the Failed Transition pathway. Since no additional efforts are made to transition towards renewable energy and no additional “green” technologies are developed, sectors only suffer from physical and extreme weather impacts, without experiencing any transition opportunities.
- There are no winners. The least impacted countries are Switzerland and Canada – due to their geographic location.

Failed Transition Pathway

Climate impacts summary – Others

Fixed income:

- Pricing in physical shocks in 2026-2031 and 2036-2041 hit the asset class during these periods. However, the credit spreads tightening in the subsequent years after both shocks benefit the asset class. From 2040, we see a rebound in credit returns.
- The asset class is not strongly affected by slow onset physical risks over the short and medium term. The influence on interest rates becomes significant in the long term (roughly from 2040 onwards). Significant lower economic growth in the long term drives nominal yields down.
- In the short to medium term, fixed income returns are not significantly impacted. In the long term, expected returns are lower due to the structurally low yields.
- Credits have a positive climate shock over the whole horizon. In comparison to equities, this is partially explained by the shorter term horizon compared to equities while climate impacts, especially under the Failed Transition, are more long-term oriented.

Property:

- Real estate is significantly affected by the pricing in shocks as the asset class is sensitive to physical damages and requires a strong correction in its valuation.
- The asset class is further impacted more significantly towards the end of the period when physical damages start to affect real estate prices.

Infrastructure:

- Infrastructure assets are expected to be affected more than other asset classes, particularly so in the US. The asset class suffers more or less like listed equities.

Exhibit 5 p. 92

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CLIMATE MAPS

Oregon Treasury

Climate Scan Report

October 2021

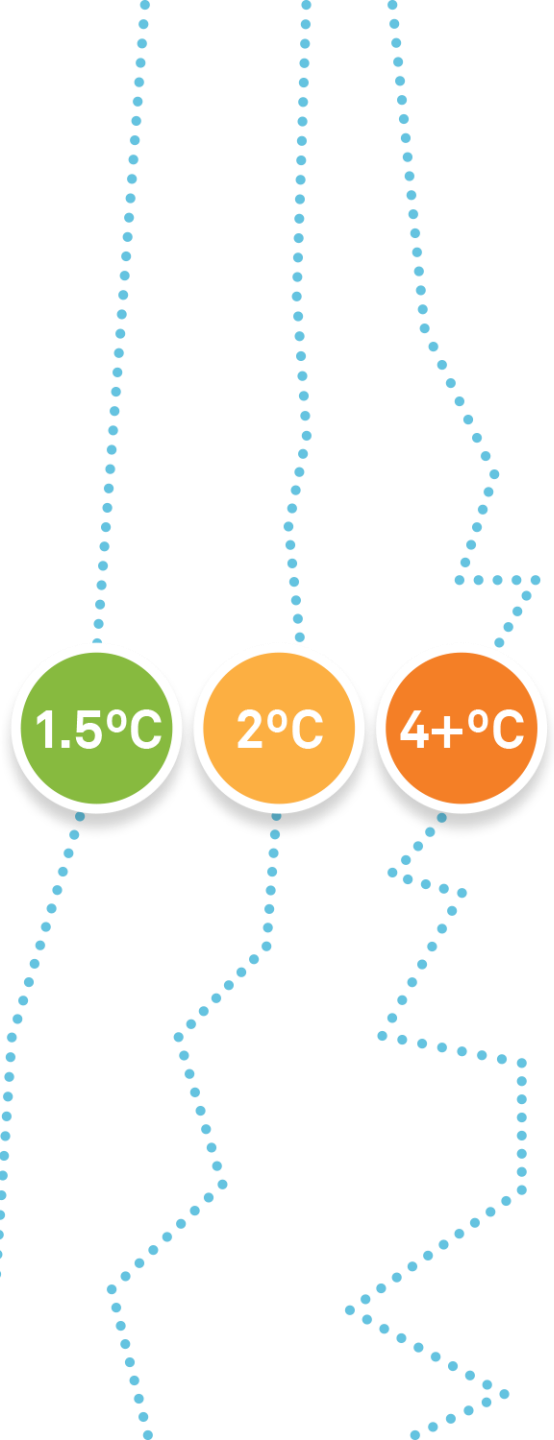

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Table of Contents

Climate risk exposure | OPERF investment portfolio

The view from 10,000 feet

1. Lower return expectations across all assets due to negative climate impact over time.

Over the next 20 years, **all three climate scenarios see lower growth expectations** compared to a baseline. This poses a material risk to both scheme balance sheets and future contribution/funding needs.

2. Worst outcomes come in a Failed Transition due to physical risks.

Globally, the **physical risks** experienced when **transition to a greener economy fails, have the most significant impacts** (63% lower US GDP by 2100). **Notably, by 2037 OPERF's portfolio value in the Failed Transition scenario is significantly down compared to an orderly low-carbon transition.** In a Failed Transition, by 2060 your asset portfolio value is expected to c.20% lower than baseline.

3. Transition risk impacts may occur sooner than most expect.

On the other hand, a **transition scenario** – even a disorderly one – **enables global economies to stabilize** once the transition has been completed. There is hope, and this demonstrates the need for investors to engage with companies and sovereigns on the transition whilst also positioning their portfolios well in the interim.

In the near future, transition impacts are generally positive in Europe. In contrast, the US is more negatively impacted than many other countries due to fossil fuels exports and other high-emitting activity currently being a significant contributor to GDP. Relative to the baseline, in a disorderly transition scenario, high exposure to the US economy contributes to OPERF's portfolio reducing in value by roughly 8% over the next 5 years.

4. Climate risk changes the Strategic Asset Allocation (SAA) landscape as climate impacts affect long-term expectations.

Risk-adjusted returns vary across assets, pathways and time horizons. In general, **cash & corporate bonds are more resilient whereas the least resilient asset classes are listed/private equities and properties** due to their sensitivity to pricing-in shocks and market over-reaction.

Compared to a typical globally-exposed pension scheme, **your portfolio's current climate risk exposure is relatively more vulnerable** due to a exposure to sensitive regions, sectors, and asset classes.

Climate change is likely to see strongly differentiated risk/return at a sector level. As such, future SAA/ALM decisions may benefit from sector-level differences being captured in the analysis.

Key Takeaways | Both short-term and long-term risk is material

Outlook

In the near future, the portfolio could suffer in particular from losses if a disorderly climate transition transpires.

The longer it takes for coordinated policy action on climate, the more radical and disruptive it is likely to be for markets.

The pricing-in of physical risk is likely to come many years or decades ahead of direct impacts. The Failed Transition scenario shows **your current portfolio experiences significant impacts from a failed transition by the middle of the 2030's** as inevitable future physical damage is priced-in.

US

The US represents c.70% of OPERF's allocation exposure (using data received and proxies agreed with you and noting that allocation exposure is not the same as economic exposure). **The US economy is negatively exposed to both physical and transition-related climate risks under all pathways**. The country's position as a net fossil fuel exporter, with low energy efficiency, low carbon pricing and high sensitivity to market sentiment shocks make it highly exposed to transition risks. At the same time it is already experiencing severe extreme weather challenges (both "wet" and "dry") which will only worsen with increasing temperatures, even under the transition scenarios.

So what?

Across all pathways, there is significant differentiation between the likely experiences of different countries, sectors and asset classes. We recommend that using this analysis, you could work with your fund managers and advisors further integrating climate into your investment process. For example:

- Identify the "**hotspots**" of risk, for closer inspection by risk- and asset-managers
- **Consider SAA/ALM actions** to balance de-risking, scheme investment objectives and budgetary considerations
  - For example a "climate-informed" SAA exercise
    - Consider rotation away from transition-sensitive sectors/geographies whilst resilience testing asset de-risking in mitigating climate risk
    - Careful, climate-risk informed choice of longer term, illiquid assets
- Consider if fund benchmarks are **incentivizing fund managers to align their funds with your objectives**/risk appetites in the light of this study?
- Where segregated mandates are a used, then **careful mandate design** will be crucial to appropriately managing climate risk and **taking risk-conscious advantage of the coming economic shifts**. For example maturity caps on debt issued by climate-exposed sectors and climate-aware KPIs for total return funds.
- Potential next steps are expanded upon later in this report with suggestions for different elements of the investment process.

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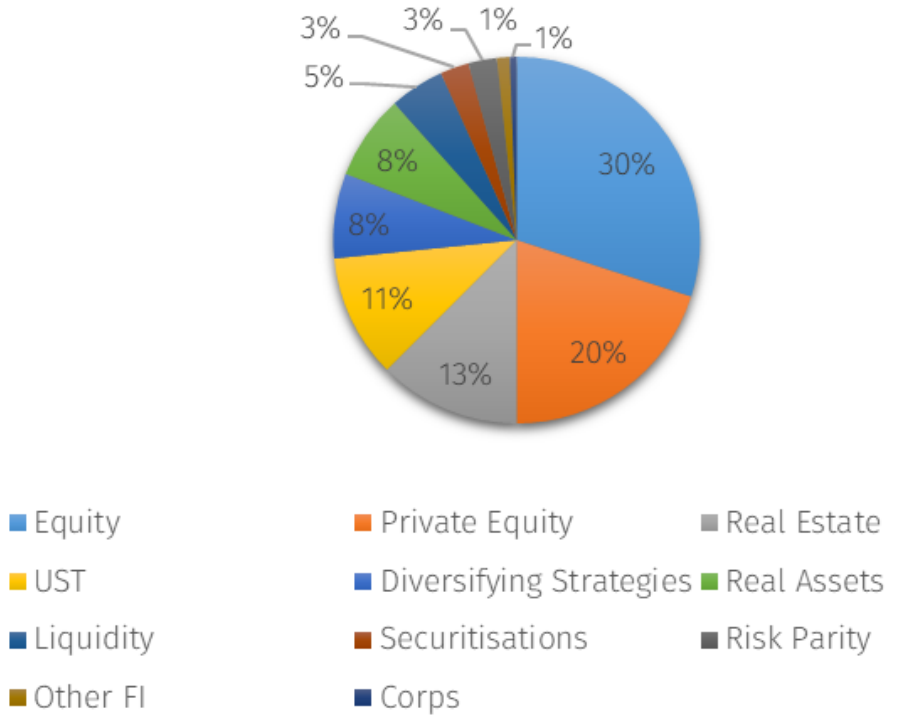
The fund's asset allocation

- Below are asset class and geographic summaries of the allocations we modelled. These were based on data provided by OST and then mapped to our model. Where proxies were required these were agreed with the team.
- In many ways the allocations are typical of other large pension funds open to members and accruing benefits. The significant domestic bias is also typical of pension funds around the world.



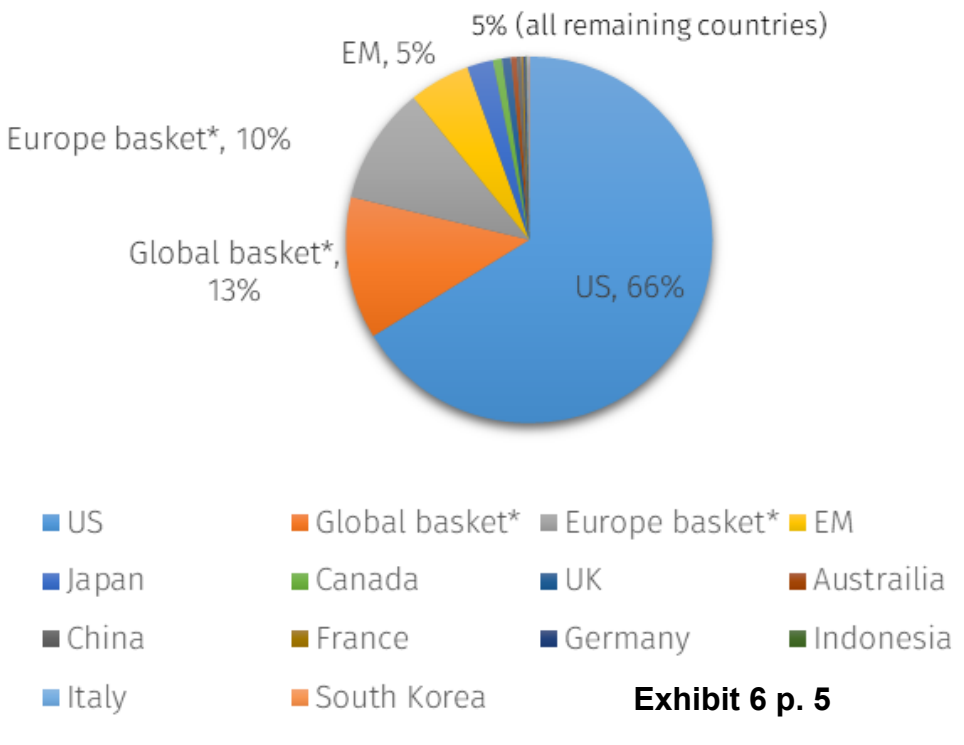


Exhibit 6 p. 5

Climate scenarios at a glance

We consider **three plausible climate pathways** that explore potential future climate policies, interventions, and consequences of the world failing to mitigate climate change.

Scenarios cannot cover all possible outcomes, and are not mutually exclusive. There is no meaningful or practically useful way to give a probability of a scenario coming to fruition. These scenarios were selected to identify portfolio weak spots that aid decision making to respond to climate risk.

These "what if" climate change scenarios focus on two interdependent climate risk drivers:

- **Transition risk** focuses on the impacts (risks/opportunities) of *policy / technology uptake* towards a low-carbon economy
- **Physical risk** focuses on changes in the natural system attributable to global warming, i.e. sea level rise, frequency and severity of extreme weather events.

Paris Orderly Pathway

- **Large transition impact** due to policy measures & technology drivers
- Transition is assumed to occur as smoothly as possible
- **Market pricing-in** dynamics occur smoothed out over the 2020-2025 period
- **Physical impacts** occur up to 1.5/2°C which are greater than today but still much less than under a Failed Transition

In line with: Emissions ≈ IPCC **RCP 2.6**

Average temp increase of 1.6°C by 2100.

97% probability of limiting warming to 2°C and c.29% probability of limiting to 1.5°C.

Tests exposure to the risks/opportunities from the systemic drivers of an orderly transition and locked-in physical risk

Paris Disorderly Pathway

- **Large transition impact** due to policy measures & technology drivers
- Transition has disruptive effects on financial markets with **repricing** followed by a sudden **sentiment shock** and stranded assets in 2024 / 2025
- **Physical impacts** occur up to 1.5/2°C which are greater than today but still much less than under a failed transition

In line with: Emissions ≈ IPCC **RCP 2.6**

Average temp increase of 1.6°C by 2100.

97% probability of limiting warming to 2°C and c.29% probability of limiting to 1.5°C.

Shows resilience of the portfolio to sudden transition triggering a market dislocation centred on high emitting stocks

Failed Transition Pathway

- **Limited transition impact -** economies follow the business-as-usual track without **additional** new policy measures
- **Severe physical impacts** occur and continues to increase over time – both **gradual physical** changes, as well as more frequent and severe **extreme weather events**
- **Markets price-in physical risks** up to 2050 by end of this decade, and price-in post-2050 physical risks from the mid-2030s onwards

In line with: Emissions ≈ IPCC **RCP 6.0**

Expected global warming by 2100 **3.8°C**

The main focus of this scenario is physical risk, results show the exposure to plausible, severe climate change impacts

Exhibit 6 p. 6

Some guiding principles for using these results

The modeling was performed using benchmarks, tailored to reflect the asset allocation of the OPERF portfolio.

Unless stated otherwise, results are shown relative to a baseline that does not make an explicit allowance for the paradigm-shifting changes that our scenarios consider. Instead the baseline is conditioned on historic relationships and long-term views based on current market conditions.

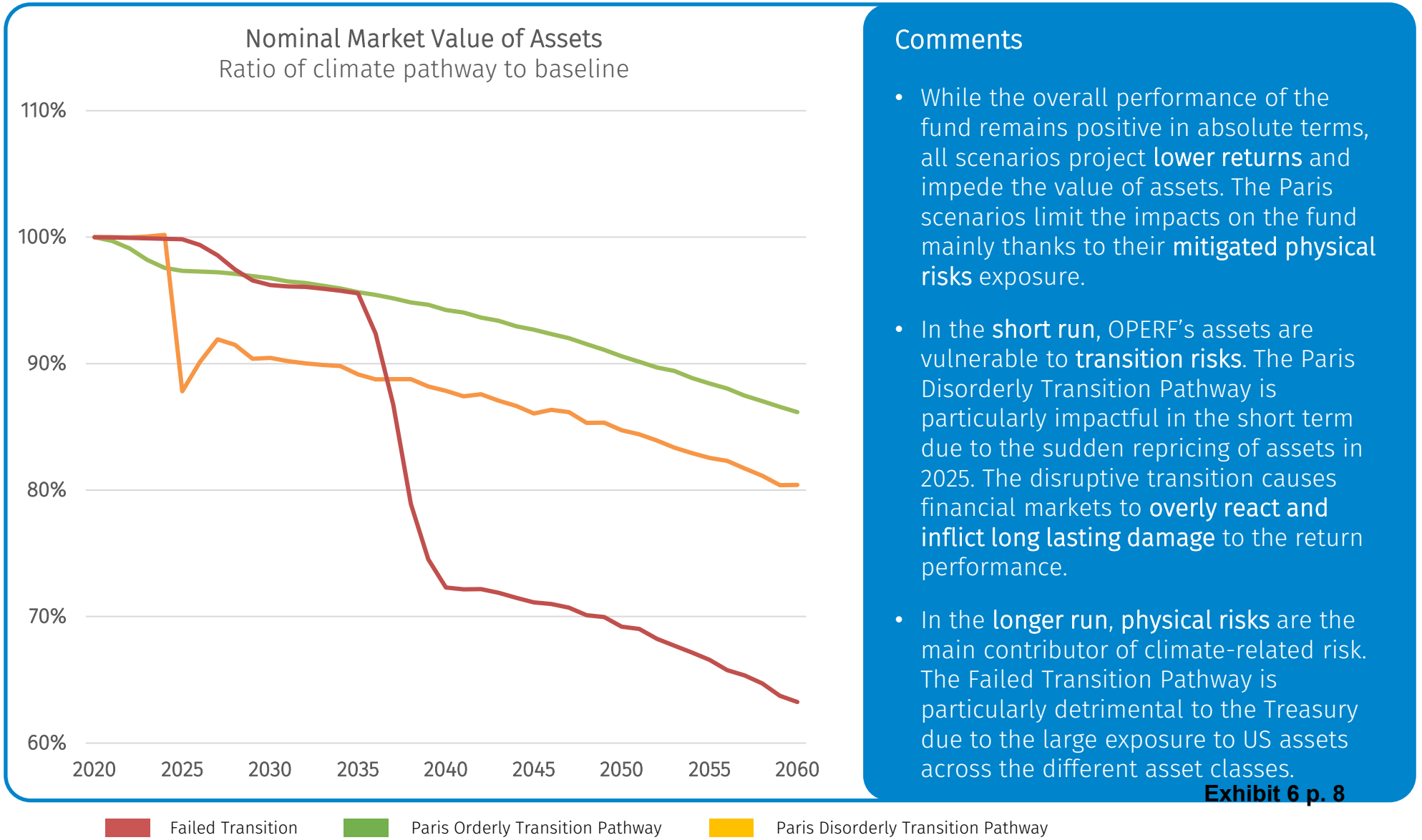
The scenarios have been constructed as diligently as possible. However, climate science is intrinsically subject to significant uncertainties. So scenarios are best viewed as a pressure test for the portfolio, probing for climate-risk weak spots.

Interpretation notes

- Focus on direction and magnitude vs exact numbers
  - Overlay these results on your views/knowledge of individual holdings
  - Results are shown relative to the baseline
- Many climate-financial relationships are non-linear
- Physical risk impacts are likely underestimated
- Climate change scenarios focus on two interdependent climate risk drivers:
  - Transition risk focuses on the impacts (opportunities/risks) of policy/technology uptake towards a low-carbon economy
  - Physical risk focuses on changes in the natural system and impacts on natural catastrophe severity/frequency and resource availability
  - It is entirely plausible that the future holds a mixture of the effects that we model

OPERF investment portfolio performance

The figure below shows the **ratio of cumulative impacts** relative to baseline over the next 40 years.



Comments

- While the overall performance of the fund remains positive in absolute terms, all scenarios project **lower returns** and impede the value of assets. The Paris scenarios limit the impacts on the fund mainly thanks to their **mitigated physical risks** exposure.
- In the **short run**, OPERF's assets are vulnerable to **transition risks**. The Paris Disorderly Transition Pathway is particularly impactful in the short term due to the sudden repricing of assets in 2025. The disruptive transition causes financial markets to **overly react and inflict long lasting damage** to the return performance.
- In the **longer run, physical risks** are the main contributor of climate-related risk. The Failed Transition Pathway is particularly detrimental to the Treasury due to the large exposure to US assets across the different asset classes.

Exhibit 6 p. 8

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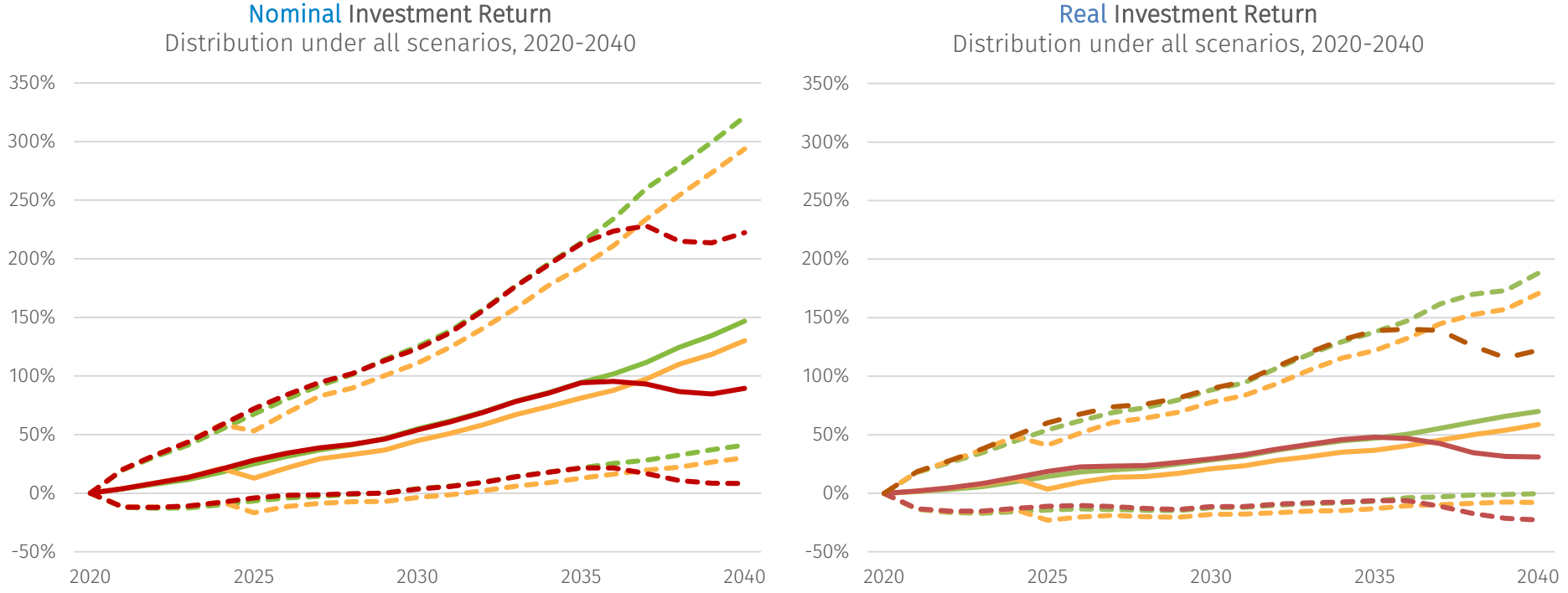
Full slide re-inserted

The impact of climate risk on OPERF's portfolio

The two figures below show the **ratio of cumulative climate impacts compared to baseline** in the next 20 years



Comments

- While the overall performance of the fund remains positive in absolute terms, all scenarios project **lower returns** and impede the value of assets. The Paris scenarios limit the impacts on the fund mainly thanks to their **mitigated physical risks** exposure.
- Comparing results in nominal and real terms, we can infer that inflation has a slight dampening effect on the more extreme moves at some points in our scenarios.

Exhibit 6 p. 9

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Geographic exposure – country rankings

To help us make sense of the drivers for country exposure this section considers the main levers of regional differences before examining our "rankings" of countries by

- Scenario
- Key economic variables
- Equity performance

Exhibit 6 p. 10

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Portfolio exposure – geographic lens

Whilst a strong domestic bias is typical of many pension funds, at a systemic level the US is more exposed to climate risk than many other countries.

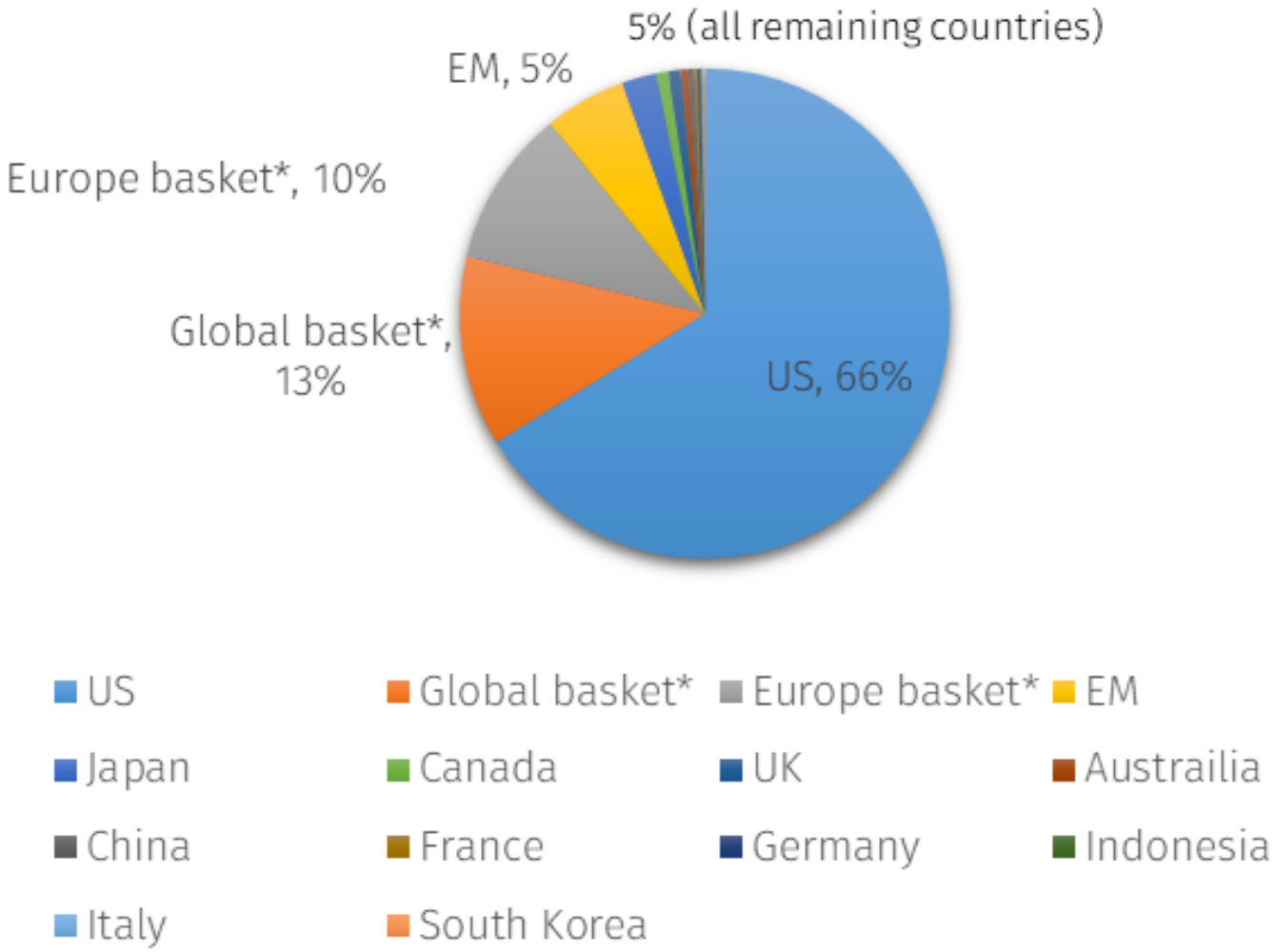

Exhibit 6 p. 11

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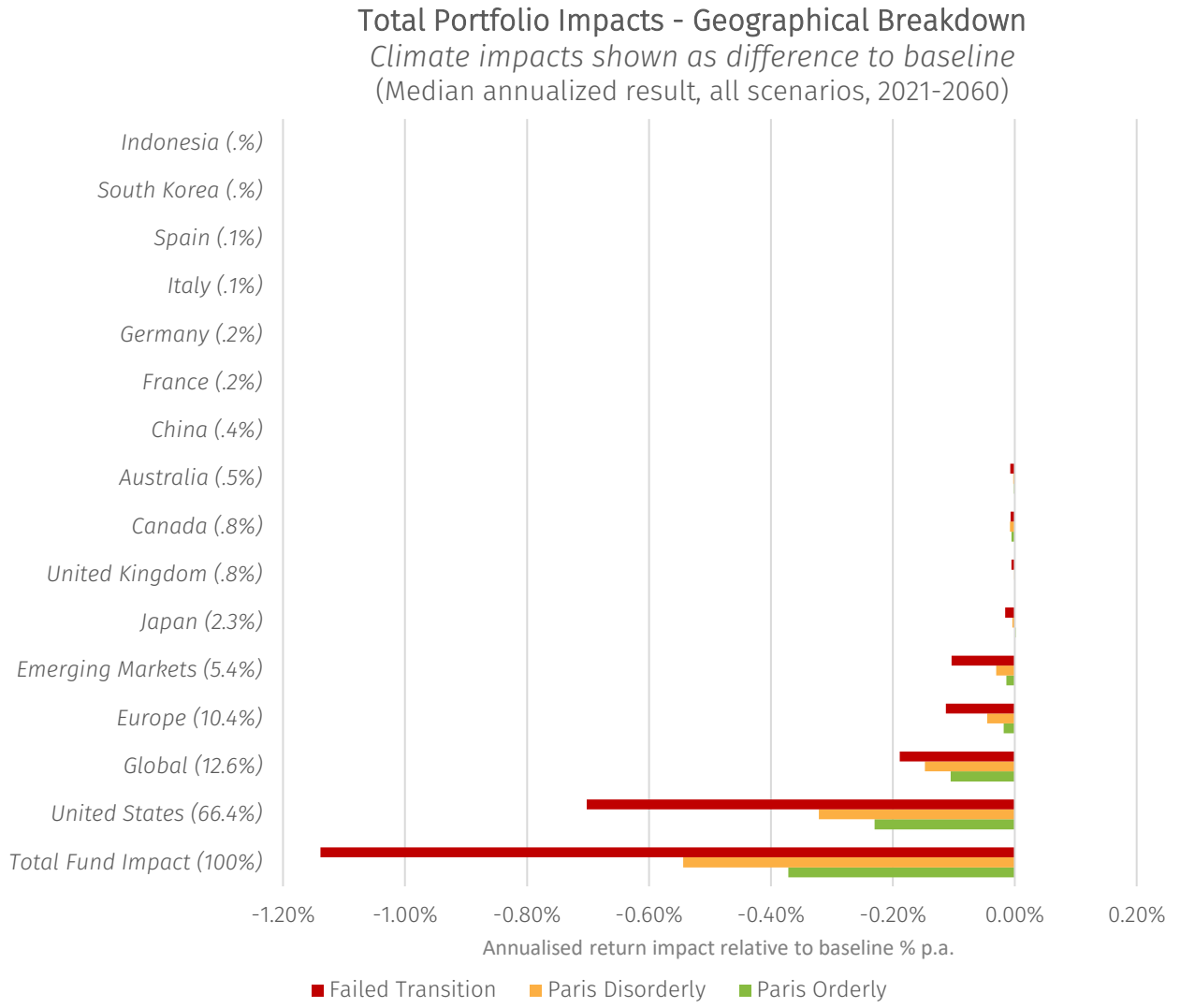
Country attribution of total climate risk impacts – all assets

Across all asset classes, US and EM exposures drive total impacts slightly larger than justified by allocations



Comments

- Main source of risk comes from the large exposure to US assets.
- The top 3 regions (US, EU, EM) account for most of the risks in the fund across all scenarios.
- Given its unique geographical situation, and allowing for the relative benefits of USTs the US contributes it's fair share of climate risk in the Failed Transition and Disorderly scenario. However, without USTs the picture is very different.
- Despite its much lower allocation, EM is a large contributor of physical risks under a Failed Transition in particular.

Exhibit 6 p. 12

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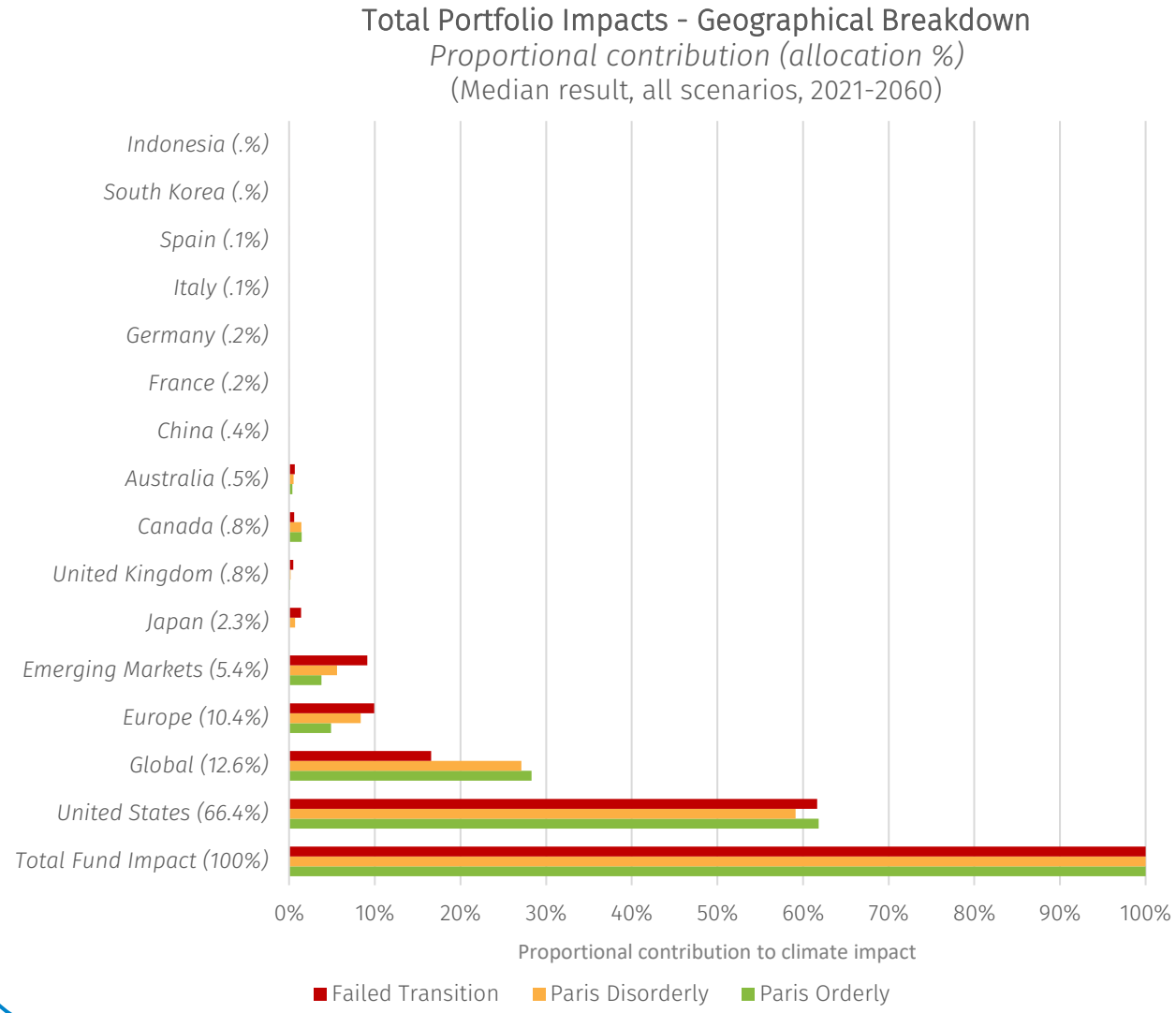
Proportional country attribution – all assets

Across all asset classes, US and EM exposures drive total impacts disproportionate to their allocations



Comments

- By re-framing the contributions as a % of total and comparing to allocated capital, we can see which regions produce more climate risk than their fair share.
- The most striking here are US (all scenarios), Global basket (transition) and EM (physical risk – failed transition).
- Note that if we removed the dampening effect of USTs from the US bucket, it would be contributing c.70%-80% of the risk – somewhat in excess of the proportional capital allocated.

Exhibit 6 p. 13

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Key transition risk drivers explaining regional performance differences

Key Transition Risk Drivers	Impact Narrative	Example Countries
Level of carbon price	The higher it is, the more the region benefits from investments in low-carbon technologies.	Europe
Net importer/exporter of (high marginal production cost) fossil fuels	Exporters tend to be worse off, importers tend to be better off.	Brazil/Malaysia vs. Canada/US/Saudi Arabia/Norway
Weight of energy sector in local stock market	The higher the weight, the more negatively impacted.	Canada, Norway
Relative energy efficiency of the economy	If energy efficient, then investments in energy efficiency (driven by carbon price) boost economic performance.	Europe
Carbon revenue recycling	The higher the carbon price, the more scope for a lowering of VAT / income tax which boosts household incomes. Households are buffered from increasing energy prices.	Europe
Sensitivity to sentiment shock	Some countries are historically more sensitive than others to market shocks.	USA
Investment stimulus	Positive GDP impact in those countries where transition investments are taking place.	China, Netherlands, Finland, Sweden, Turkey
Consumer spending stimulus	Positive GDP impact in those countries where consumer spending in transition activities is taking place.	UK, Europe, New Zealand
Stimulus combined with debt repayment	Initial positive GDP impacts; then decrease in GDP in later years.	Italy, Switzerland

Exhibit 6 p. 14

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Key physical risk drivers explaining regional performance differences

Physical Risk Drivers

Latitude effect	Countries closer to the poles are currently still less exposed, but warming at faster rates. Countries closer to the equator are already more exposed, with temperature having non-linear impact on productivity.
Current temperature	Countries with current average temperatures below ~5°C (such as Finland and Russia) experience initial positive GDP growth impacts from warming, while countries with high average temperatures experience large negative impacts on GDP growth (e.g. India and Saudi Arabia).
Sensitivity to physical impacts	Decreasing land, labor and industrial productivity in regions that are relatively more exposed to physical impacts.
Sensitivity to economic amplification	Countries with a lower economic coping capacity to buffer extreme weather losses (if they start to occur more frequently)

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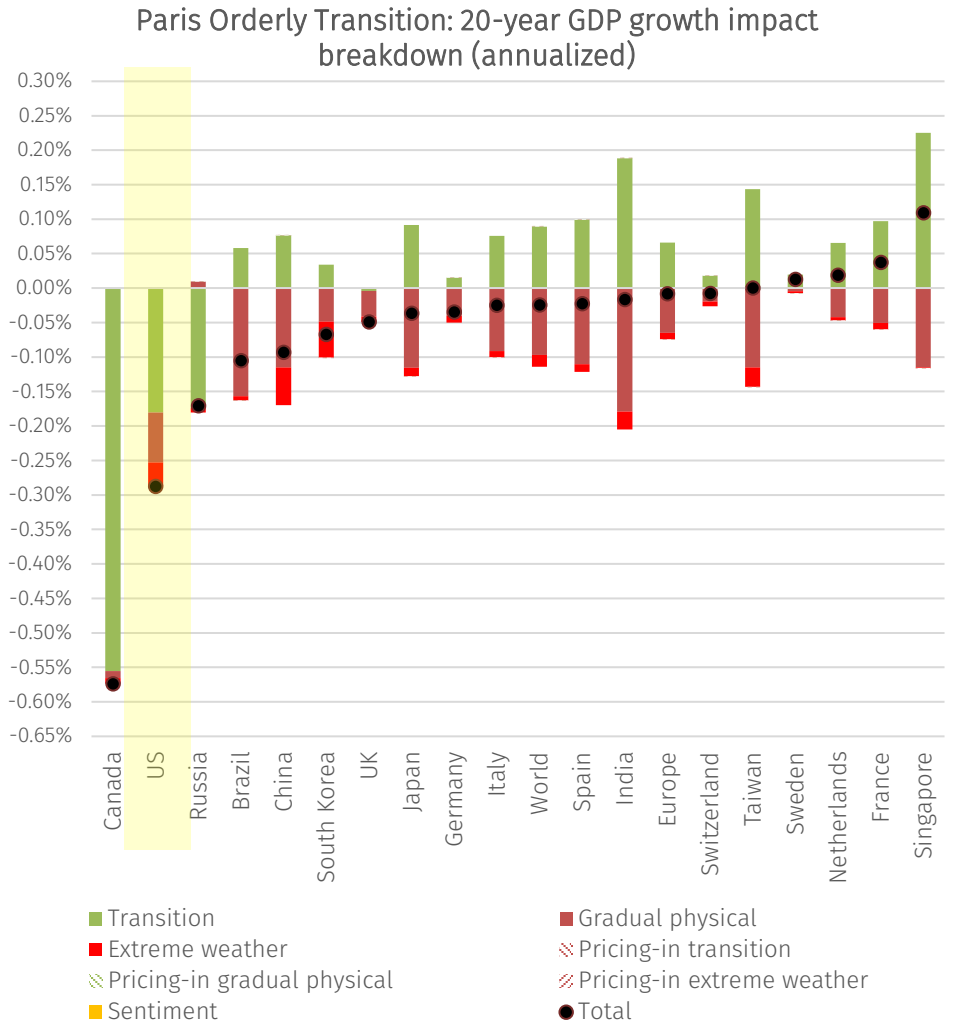
How do other countries rank in terms of climate impacts?

GDP shocks: Transition scenarios expose countries to risks and opportunities.

- After Canada, the US is the most **negatively** impacted country under both transition pathways.
- Singapore, France, the Netherlands, Sweden and Spain are most **positively** impacted under a transition scenario.



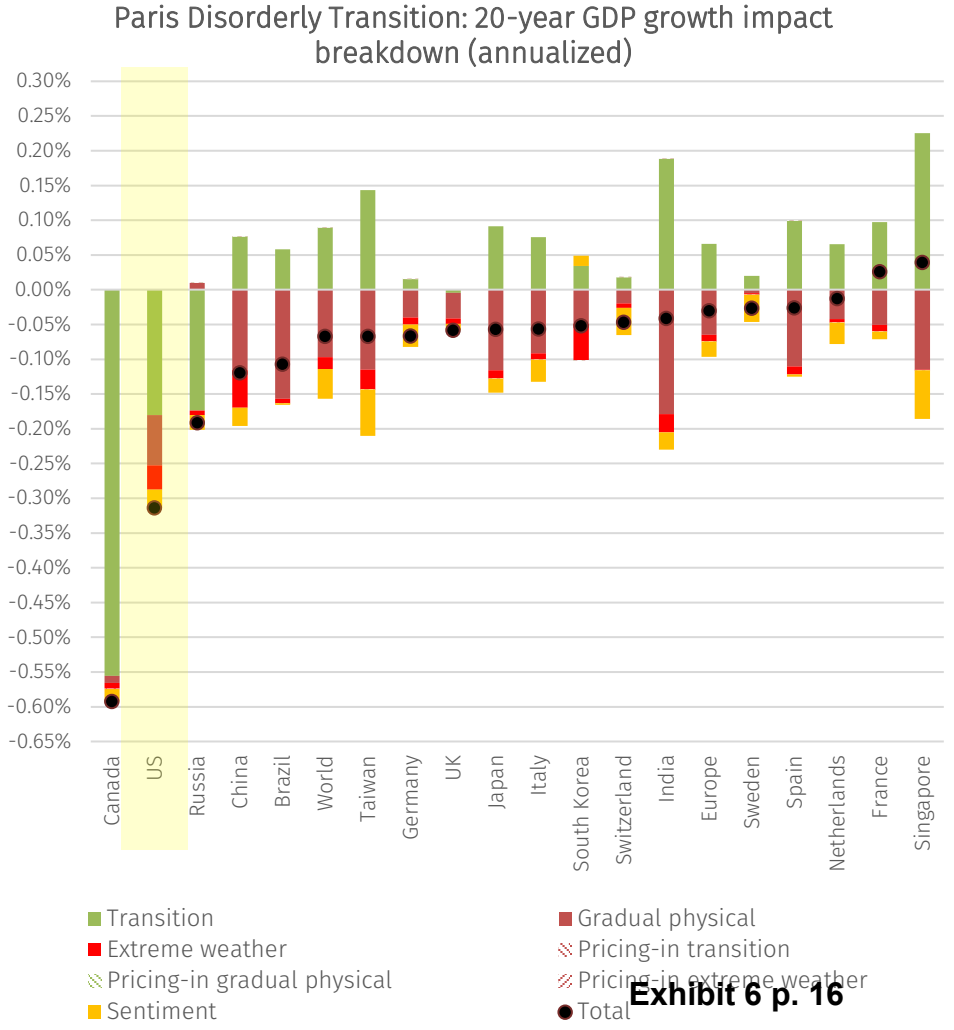


Exhibit 6 p. 16

How do other countries rank in terms of climate impacts?

GDP shocks: A Failed Transition has negative impacts on all countries, but to varying degrees.

- The US, together with India, Brazil and China are the most impacted by a Failed Transition.
- Canada and the Nordic countries are least impacted by the Failed Transition thanks to their demographic and geographic situation.

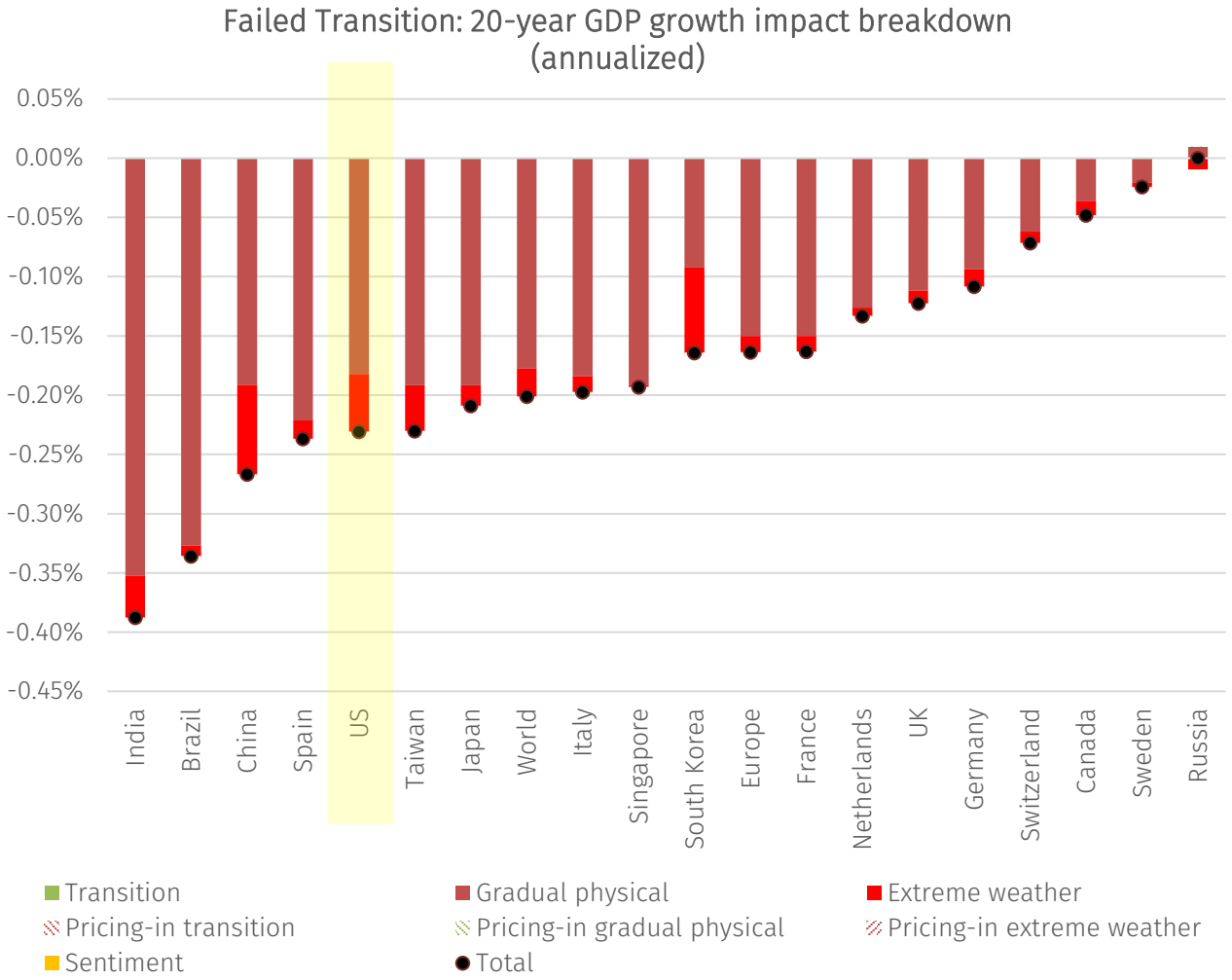


Exhibit 6 p. 17

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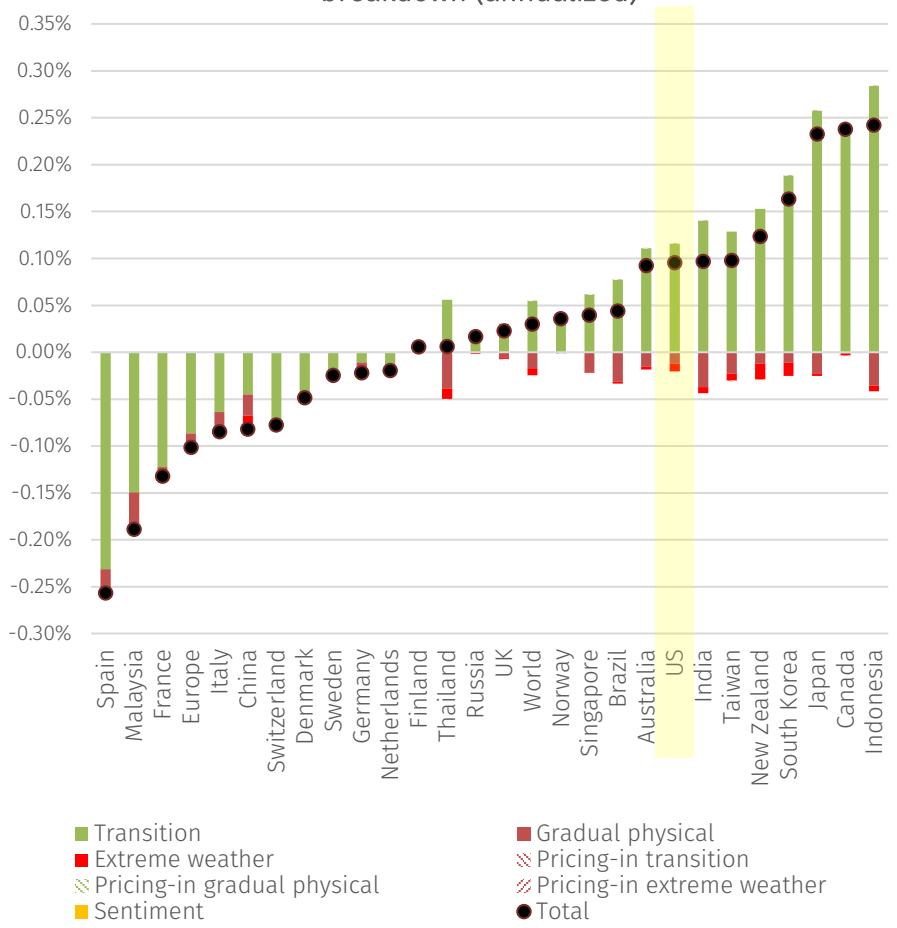
How do other countries rank in terms of climate impacts?

Inflation shocks vary across countries and under each pathway.

- While for some countries, inflation is relatively unaffected by climate change, others experience either a net positive or a net negative inflation impact under the transition scenarios.
- The US experiences high net positive inflation impacts. This is largely driven by demand-pull inflation from higher fuel and carbon taxes.

Paris Orderly Transition: 20-year inflation impact breakdown (annualized)



Paris Disorderly Transition: 20-year inflation impact breakdown (annualized)

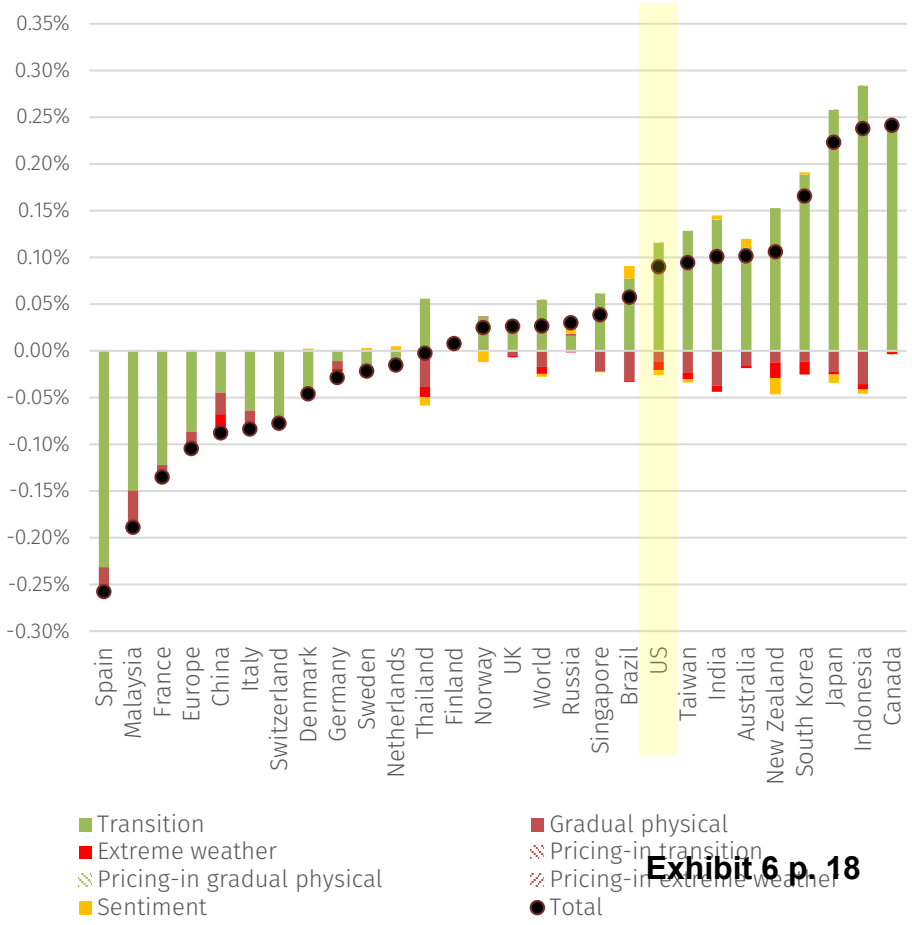


Exhibit 6 p. 18

How do other countries rank in terms of climate impacts?

Inflation shocks: almost all countries experience negative shock under a Failed Transition.

- Under a Failed Transition scenario pretty much all countries experience a negative inflation impact.
- The US is relatively heavily impacted compared to Europe or Canada.

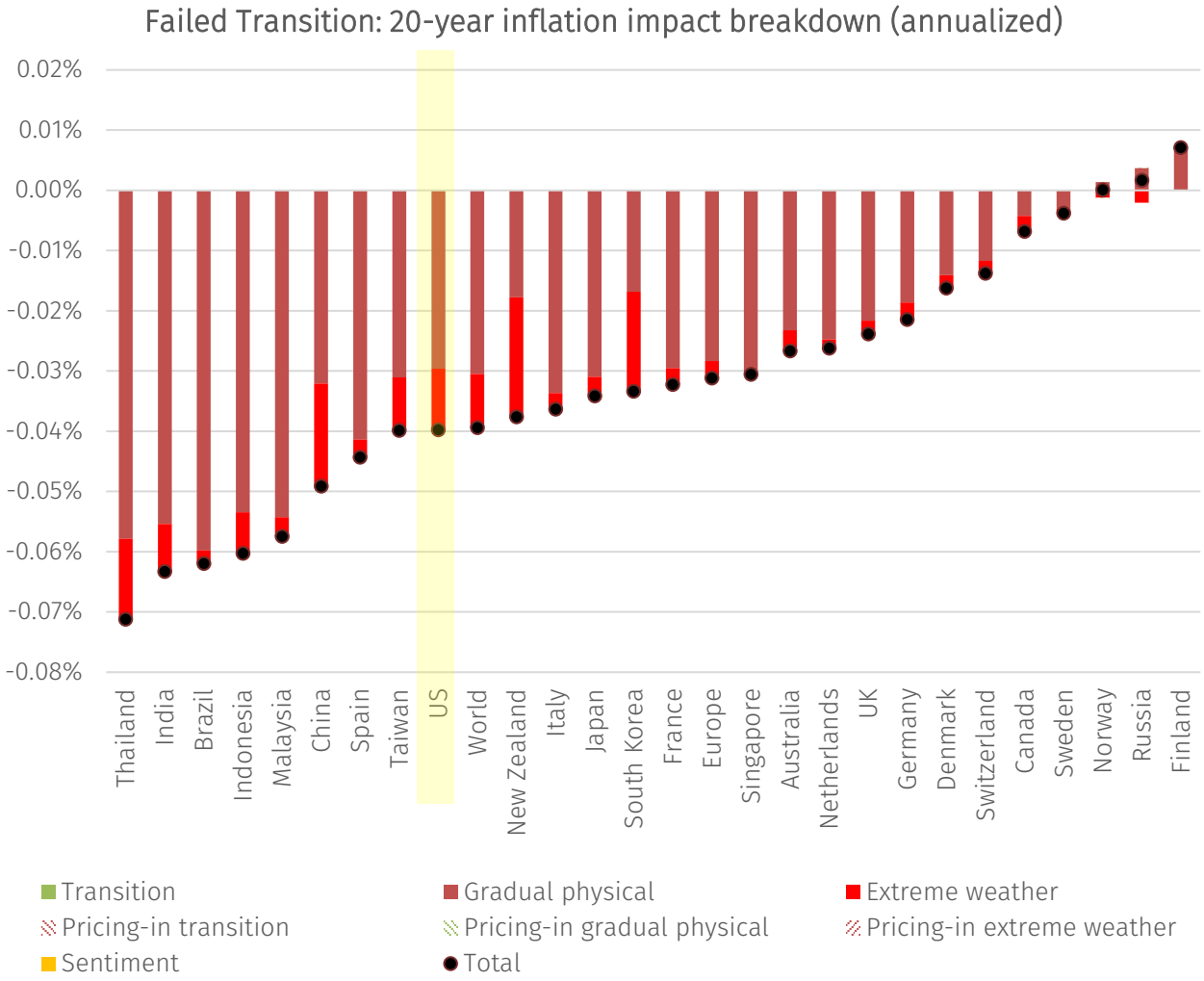


Exhibit 6 p. 19

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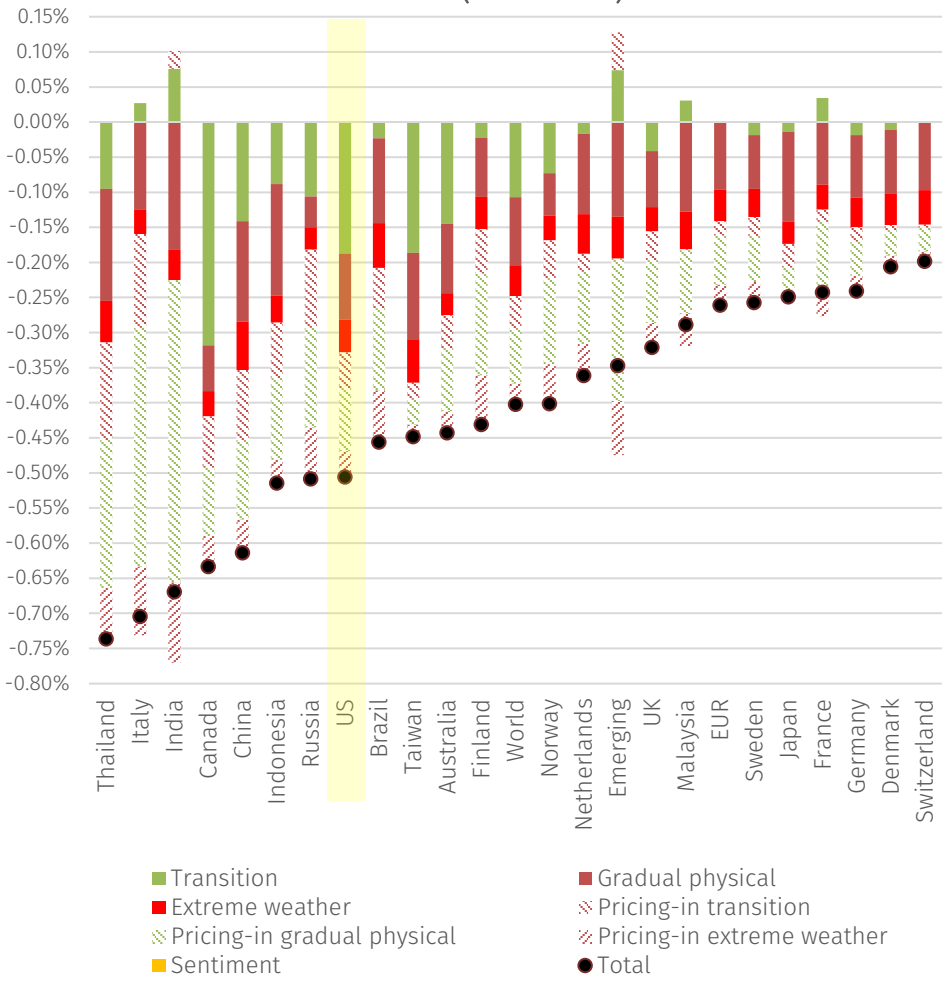
How do other countries rank in terms of climate impacts?

Equity returns are one of the least resilient asset classes and suffer both from transition and physical risk drivers.

- Transition impacts on equity returns are significantly more severe if the transition happens in a disorderly manner.
- Under both transition scenarios, the US ranks among the most impacted regions although not as much as Canada.

Paris Orderly Transition: 20-year global equities impact breakdown (annualized)



Paris Disorderly Transition: 20-year global equities impact breakdown (annualized)

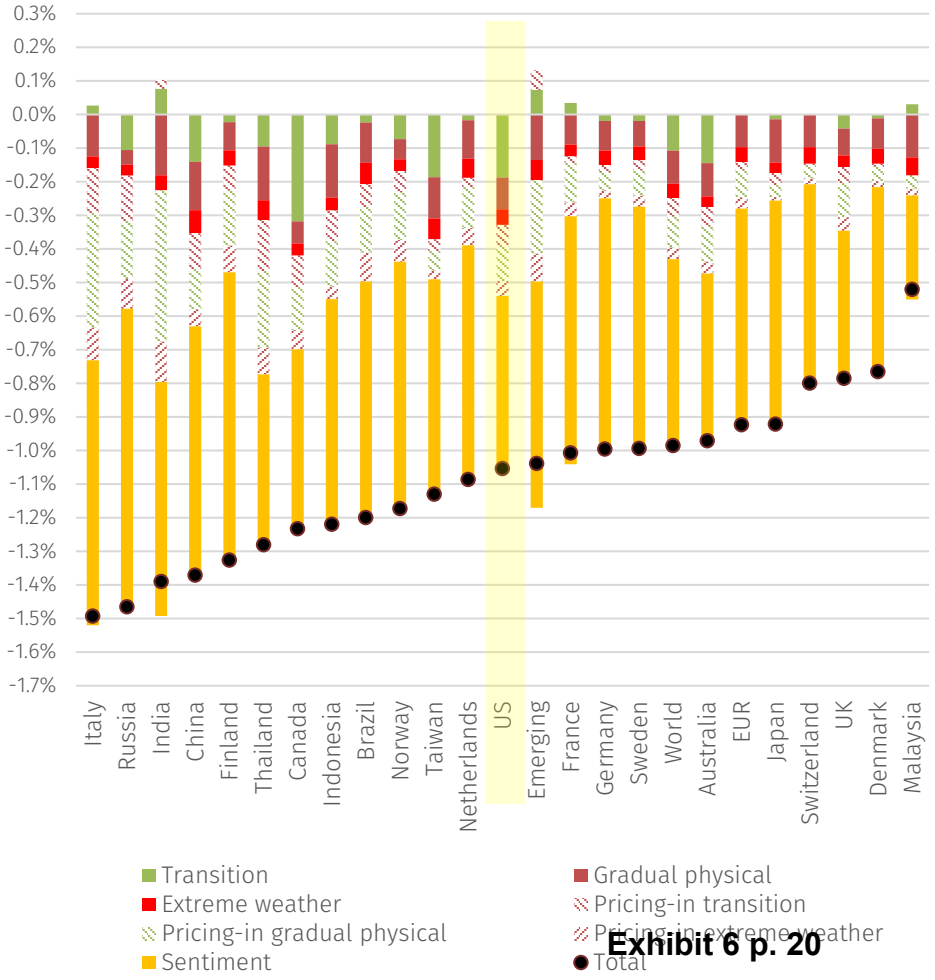


Exhibit 6 p. 20

How do other countries rank in terms of climate impacts?

Equity returns vary across countries and under each pathway.

- A Failed Transition impacts equity returns most severely via the markets pricing-in of gradual physical risks.
- While Taiwan, India, China, and other emerging markets are the most negatively impacted nations, the US still leads the way in terms of developed nation facing physical risks (-2.16% in annual losses)

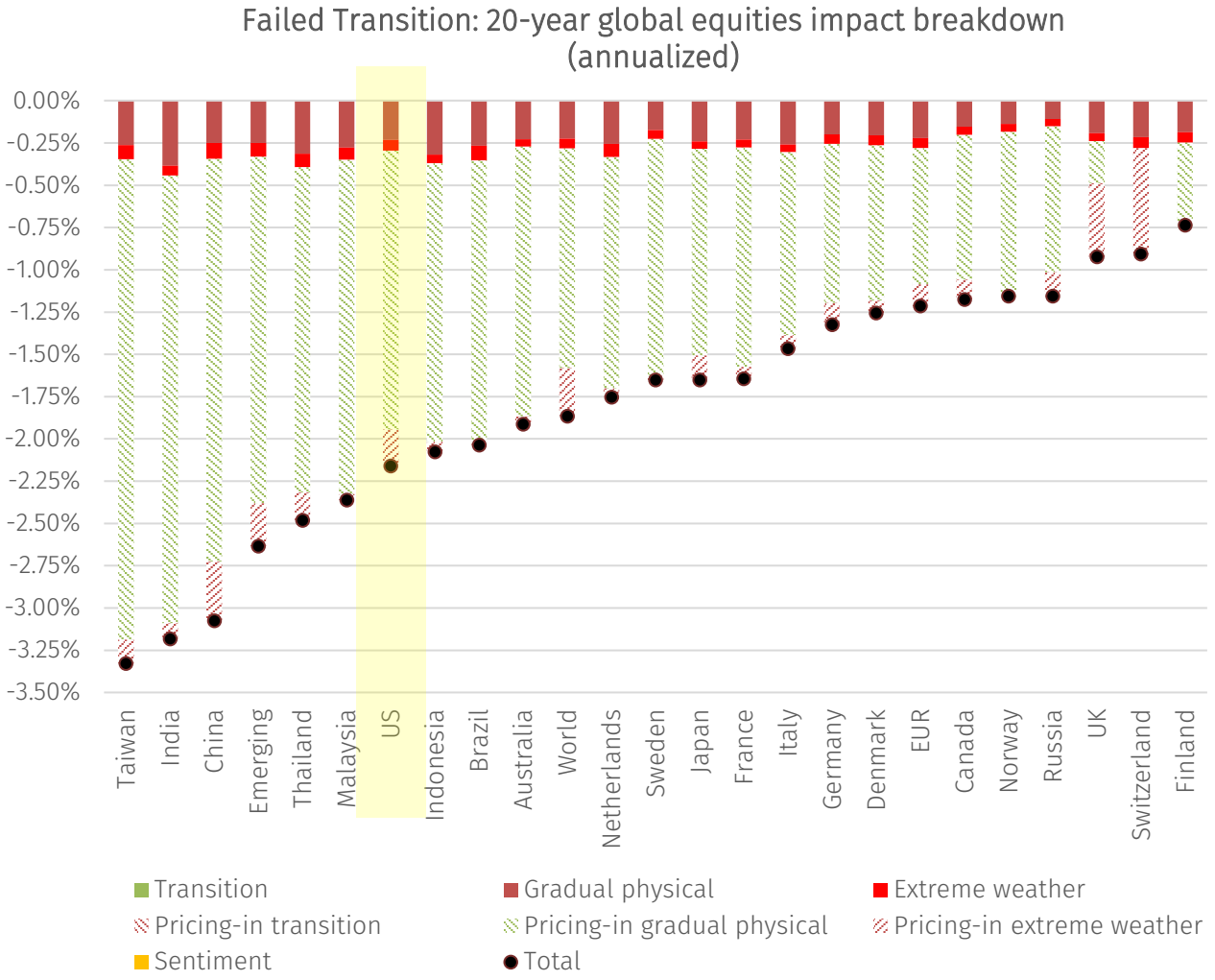


Exhibit 6 p. 21

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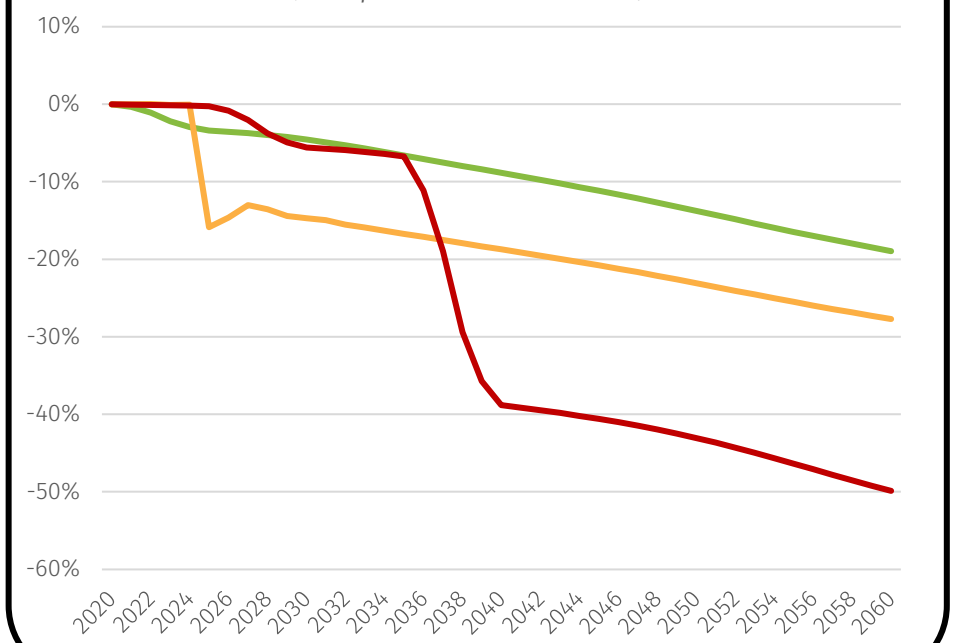
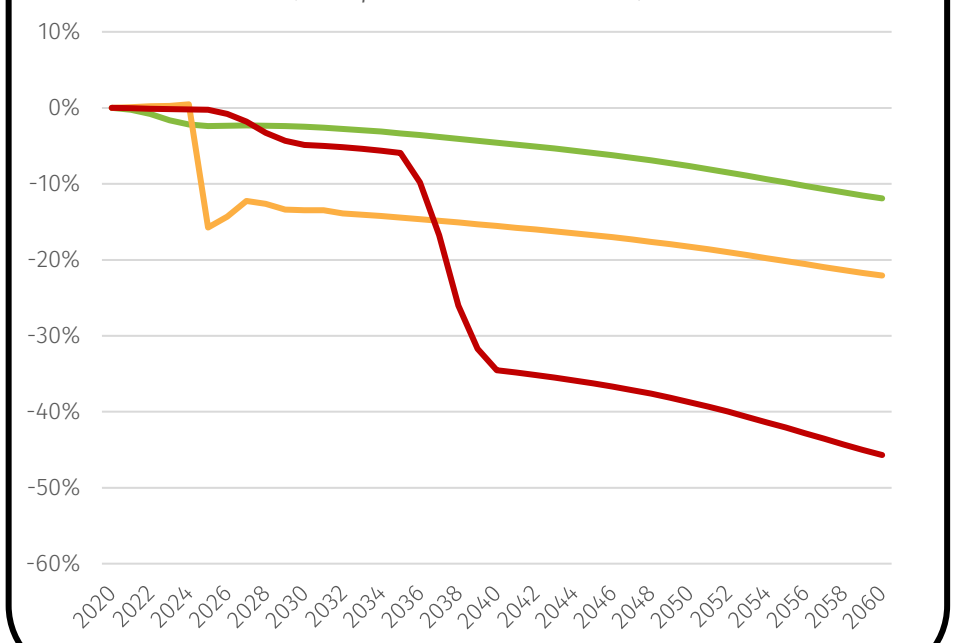
Climate impacts on US Equities vs. the World

US equities face higher transition risk, and seem less resilient to physical risk exposure

MSCI US



MSCI World



Comments

The Paris Orderly and Disorderly Transition Pathways have a large impact on the US economy, due in part by reduced income from oil and gas exports and high emitting sectors. This is reflected in the impacts on US equity. Compared to the rest of the world, transition impacts are expected to be 50% larger under an orderly transition and 20% larger under a disorderly transition by 2060. Unlike its northern neighbor, the US exposure to physical risks renders the country more vulnerable than most countries. Compared to World equities (of which US is c.60% - MSCI ACWI), US equities are expected to be 40% more exposed to physical risks.

Exhibit 6 p. 22

Failed Transition Paris Orderly Transition Pathway Paris Disorderly Transition Pathway

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Contribution Analysis: What Types of Risk Affect Your Assets?

A closer look at climate impacts on equities in various markets – Paris Orderly Scenario

Exhibit 6 p. 23

Contribution Analysis: What Types of Risk Affect Your Assets?

A closer look at climate impacts on equities in various markets – Paris Disorderly Scenario

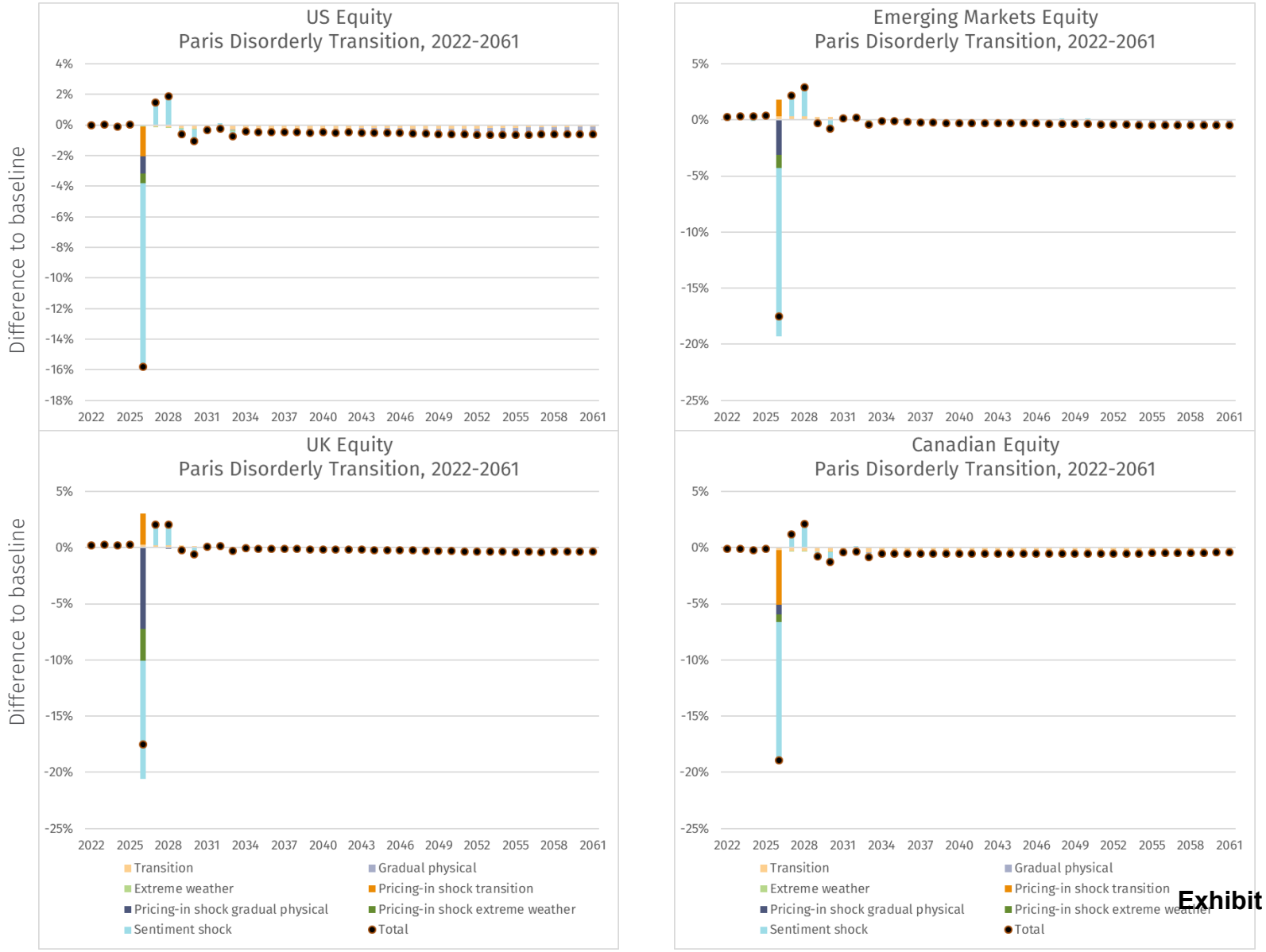

Exhibit 6 p. 24

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Contribution Analysis: What Types of Risk Affect Your Assets?

A closer look at climate impacts on equities in various markets – Failed Transition

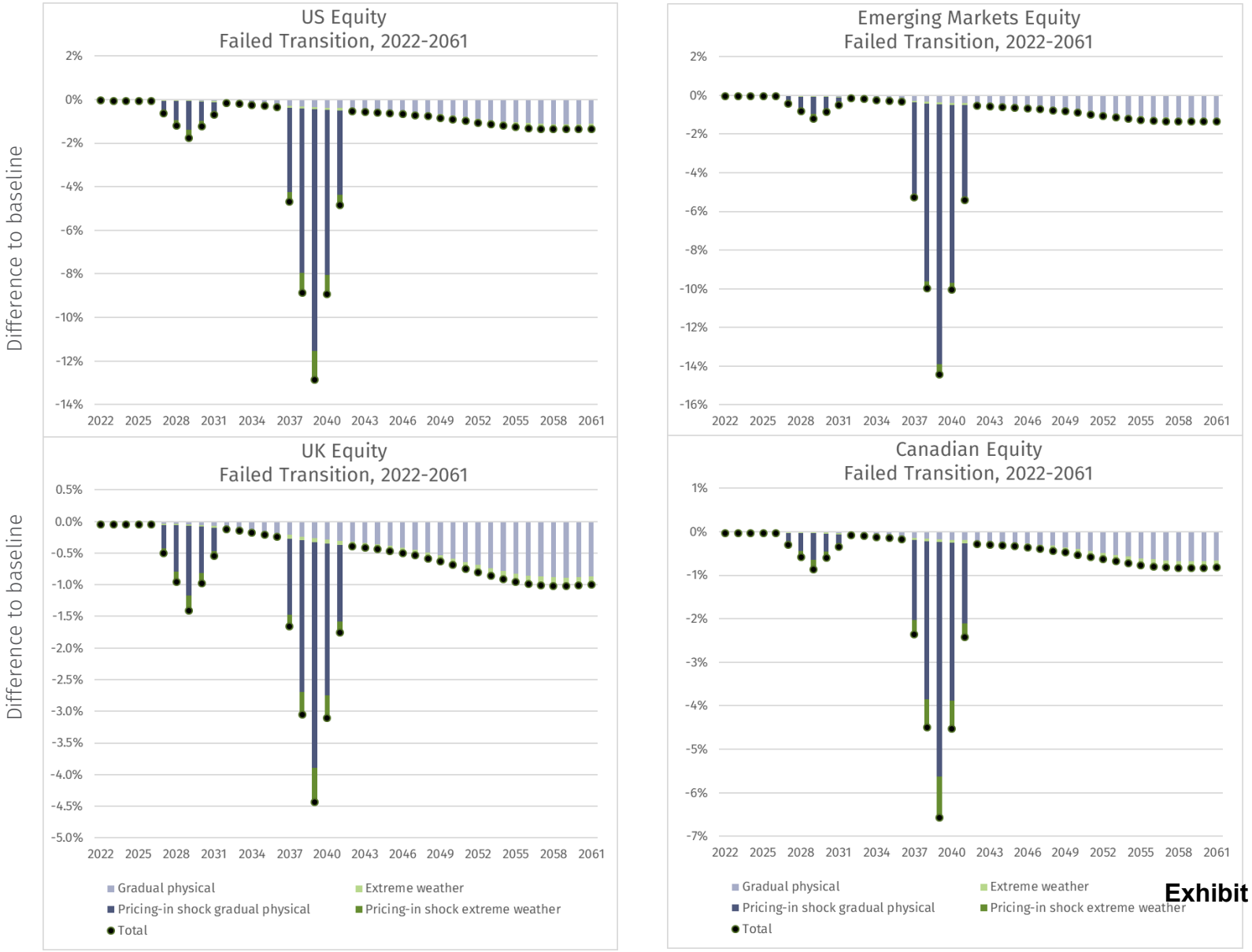

Exhibit 6 p. 25

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Asset class insights

Having considered regional differences, this section focuses in on the asset classes currently forming the portfolio.

Results are presented in time buckets, showing the median return and the downside 5th percentile.

We show median return for each scenario as a delta to the baseline, so as to give a "climate shock" for that scenario.

For the risk measure, we show the difference in return between the scenario median and the scenario 5% CVaR. This is intended to give you a sense of the downside dispersion of the distribution in that scenario.

By color-coding the tables we can see the hot and cool spots in the portfolio, where it could be most efficient to make deeper investigations into risks and opportunities.

Further granularity is provided in the annex.

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only redacting the quantified results for sub-asset classes and sectors depicted in tables in the report

Key Findings – Asset Classes

FOCUS ON PARIS DISORDERLY TRANSITION RISKS

Fixed Income:

- Less sensitive to climate risks than other asset classes.
- Corporate and non-investment grade bonds are more sensitive and sector-specific in exposure

Equities and PE:

- Global equities very sensitive
- US especially hard hit
- PE mirrors equity sensitivities

Alternatives, Real Estate, Infrastructure:

- Alternatives can offer climate transition protection due to a lower beta
- Real estate and infrastructure follow similar dynamics as public equity especially if strong links to energy and utilities
- Real assets - holdings slightly more exposed due to exposure to transition-exposed sectors
- Physical risk exposure becomes more critical through time

All of the above should be weighed against the need to meet pension liabilities.

More detailed tables (also for the other climate scenarios), with upside and downside 5% VaR are included in the annex.

Scenario 2: Paris *disorderly* transition pathway	2021-2025		2026-2030		2031-2040	
	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR
Fund	-2.6%	-7.4%	0.6%	-8.0%	-0.3%	-5.0%
Fixed income	-0.5%	-2.7%	0.8%	-3.5%	0.1%	-2.9%
US Investment Grade						
US Government Bonds						
US Index-Linked						
US High Yield						
EM Debt						
Equity	-3.3%	-12.2%	0.4%	-12.4%	-0.3%	-8.6%
MSCI World AC						
Small Cap						
Minimum Volatility						
Private Equity	-3.5%	-14.4%	1.0%	-14.8%	-0.3%	-8.8%
Venture Capital/Growth						
Buyout						
Emerging Market						
Distressed Debt						
Real Estate	-2.0%	-6.7%	0.3%	-6.8%	-0.3%	-4.6%
Direct Real Estate						
REITs						
Real Assets	-4.9%	-10.3%	-0.1%	-11.0%	-1.1%	-6.0%
Real Asset Portfolio						
Opportunity Portfolio						
Diversifying Strategies	-1.3%	-5.1%	0.7%	-5.0%	-0.1%	-3.9%
HF Fund of Funds						
Risk Parity	-2.3%	-10.6%	1.0%	-10.8%	0.1%	-6.3%
Global Sovereign Rates						
Inflation-Linked Bonds						
Corporate Credits						
Listed Equities						
Commodities						

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Risk/Return Analysis of portfolio constituents* (annualized results)

Scenario 1: Paris *orderly* transition pathway	2021-2025		2026-2030		2031-2040		2041-2050		2051-2060		2021-2060	
	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR
Fund	-0.5%	-7.2%	-0.1%	-7.9%	-0.3%	-5.0%	-0.5%	-5.2%	-0.5%	-5.2%	-0.4%	-2.7%
Fixed income	0.0%	-2.5%	0.1%	-3.3%	0.1%	-2.9%	-0.3%	-3.4%	-0.3%	-3.4%	-0.1%	-1.4%
US Investment Grade												
US Government Bonds												
US Index-Linked												
US High Yield												
EM Debt												
Equity	-0.5%	-11.5%	-0.1%	-12.2%	-0.3%	-8.6%	-0.5%	-8.8%	-0.5%	-8.8%	-0.4%	-4.6%
MSCI World AC												
Small Cap												
Minimum Volatility												
Private Equity	-0.7%	-14.4%	-0.1%	-14.7%	-0.3%	-8.8%	-0.5%	-9.4%	-0.5%	-9.4%	-0.4%	-4.6%
Venture Capital/Growth												
Buyout												
Emerging Market												
Distressed Debt												
Real Estate	-0.6%	-6.7%	-0.1%	-6.7%	-0.3%	-4.6%	-0.6%	-4.7%	-0.6%	-4.7%	-0.4%	-2.5%
Direct Real Estate												
REITs												
Real Assets	-2.0%	-10.3%	-1.0%	-11.0%	-1.1%	-6.0%	-1.0%	-6.3%	-1.0%	-6.3%	-1.2%	-3.1%
Real Asset Portfolio												
Opportunity Portfolio												
Diversifying Strategies	-0.1%	-5.1%	0.0%	-4.9%	-0.1%	-3.9%	-0.1%	-3.8%	-0.1%	-3.8%	-0.1%	-2.0%
HF Fund of Funds												
Risk Parity	-0.2%	-10.1%	0.0%	-10.7%	0.2%	-6.3%	-0.2%	-6.7%	-0.2%	-6.7%	0.0%	-3.4%
Global Sovereign Rates												
Inflation-Linked Bonds												
Corporate Credits												
Listed Equities												
Commodities												

only redacting the quantified results for sub-asset classes and sectors depicted in tables in the report

Exhibit 6 p. 28

*Additional granularity can be provided upon request

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Risk/Return Analysis of portfolio constituents* (annualized results)

Scenario 2: Paris *disorderly* transition pathway	2021-2025		2026-2030		2031-2040		2041-2050		2051-2060		2021-2060	
	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR
Fund	-2.6%	-7.4%	0.6%	-8.0%	-0.3%	-5.0%	-0.5%	-5.1%	-0.5%	-5.1%	-0.5%	-2.7%
Fixed income	-0.5%	-2.7%	0.8%	-3.5%	0.1%	-2.9%	-0.3%	-3.4%	-0.3%	-3.4%	-0.1%	-1.4%
US Investment Grade												
US Government Bonds												
US Index-Linked												
US High Yield												
EM Debt												
Equity	-3.3%	-12.2%	0.4%	-12.4%	-0.3%	-8.6%	-0.5%	-8.8%	-0.5%	-8.8%	-0.7%	-4.6%
MSCI World AC												
Small Cap												
Minimum Volatility												
Private Equity	-3.5%	-14.4%	1.0%	-14.8%	-0.3%	-8.8%	-0.5%	-9.4%	-0.5%	-9.4%	-0.6%	-4.6%
Venture Capital/Growth												
Buyout												
Emerging Market												
Distressed Debt												
Real Estate	-2.0%	-6.7%	0.3%	-6.8%	-0.3%	-4.6%	-0.6%	-4.7%	-0.6%	-4.7%	-0.6%	-2.5%
Direct Real Estate												
REITs												
Real Assets	-4.9%	-10.3%	-0.1%	-11.0%	-1.1%	-6.0%	-1.0%	-6.3%	-1.0%	-6.3%	-1.5%	-3.1%
Real Asset Portfolio												
Opportunity Portfolio												
Diversifying Strategies	-1.3%	-5.1%	0.7%	-5.0%	-0.1%	-3.9%	-0.1%	-3.8%	-0.1%	-3.8%	-0.2%	-1.9%
HF Fund of Funds												
Risk Parity	-2.3%	-10.6%	1.0%	-10.8%	0.1%	-6.3%	-0.2%	-6.8%	-0.2%	-6.8%	-0.1%	-3.4%
Global Sovereign Rates												
Inflation-Linked Bonds												
Corporate Credits												
Listed Equities												
Commodities												

only redacting the quantified results for sub-asset classes and sectors depicted in tables in the report

Exhibit 6 p. 29

*Additional granularity can be provided upon request

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Risk/Return Analysis of portfolio constituents* (annualized results)

Scenario 3: Failed transition pathway	2021-2025		2026-2030		2031-2040		2041-2050		2051-2060		2021-2060	
	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR	Median	Bottom 5% VaR
Fund	0.0%	-7.2%	-0.7%	-7.9%	-2.8%	-4.9%	-0.9%	-5.1%	-0.9%	-5.1%	-1.1%	-2.7%
Fixed income	0.0%	-2.5%	0.0%	-3.4%	0.0%	-2.9%	-0.3%	-3.4%	-0.3%	-3.4%	0.0%	-1.4%
US Investment Grade												
US Government Bonds												
US Index-Linked												
US High Yield												
EM Debt												
Equity	0.0%	-11.5%	-0.9%	-12.2%	-3.5%	-8.6%	-1.2%	-8.8%	-1.2%	-8.8%	-1.5%	-4.6%
MSCI World AC												
Small Cap												
Minimum Volatility												
Private Equity	0.0%	-14.4%	-1.3%	-14.7%	-5.0%	-8.8%	-1.1%	-9.4%	-1.1%	-9.4%	-1.9%	-4.6%
Venture Capital/Growth												
Buyout												
Emerging Market												
Distressed Debt												
Real Estate	-0.1%	-6.7%	-0.8%	-6.8%	-3.2%	-4.7%	-1.1%	-4.7%	-1.1%	-4.7%	-1.4%	-2.5%
Direct Real Estate												
REITs												
Real Assets	0.0%	-10.3%	-0.8%	-11.1%	-3.4%	-6.0%	-1.2%	-6.3%	-1.2%	-6.3%	-1.4%	-3.1%
Real Asset Portfolio												
Opportunity Portfolio												
Diversifying Strategies	0.0%	-5.1%	-0.3%	-4.9%	-1.1%	-3.9%	-0.3%	-3.8%	-0.3%	-3.8%	-0.4%	-2.0%
HF Fund of Funds												
Risk Parity	0.0%	-10.1%	-0.4%	-10.7%	-1.4%	-6.4%	-0.3%	-6.7%	-0.3%	-6.7%	-0.5%	-3.3%
Global Sovereign Rates												
Inflation-Linked Bonds												
Corporate Credits												
Listed Equities												
Commodities												

only redacting the quantified results for sub-asset classes and sectors depicted in tables in the report

Exhibit 6 p. 30

*Additional granularity can be provided upon request

Focus on real assets (1/3)

What drives the climate exposure of your real asset portfolio? Zoom in on the main contributing sectors

The real asset portfolio was analyzed on a bespoke basis in Climate MAPS. We analyzed the sector exposure within the portfolio to create the bespoke climate shock. As the portfolio breakdown slides above illustrate, the asset class is quite exposed to climate risks.

To better understand, we created a bespoke calibration for the real assets portfolios. Working with your teams, we agreed on the following mapping to capture the systemic region/sector exposures. Sector allocations were made on the basis of data provided which was assumed to reflect the dominant economic activity of the individual holding.

As with the rest of our analysis, the outputs should be viewed as an overlay to your knowledge of the underlying holdings.

Also note that what are described here as “sectors” are more accurately “economic activities”, and so a more diversified company could (if more granular data were available) be considered a blend of different region/sector pairs.

Cells circled pink denote the sectors highlighted in the charts on the next slide. Some cells show a 0% due to rounding for clarity of presentation, however they were included in the model.

Real asset portfolio allocation %	Fossil fuel utilities	Industrials	Low carbon utility	Energy	IT	Oil & gas	Materials	Forestry	Cons staples
North America	7%	5%	6%	8%	6%	30%	4%	5%	4%
Europe	3%	2%	2%	1%	5%	2%	1%		0%
Asia	1%	1%	1%	0%	1%	1%	3%		

Exhibit 6 p. 31

Focus on real assets (2/3)

What drives the climate exposure of your real asset portfolio? Zoom in on the main contributing sectors

Below, we show the performance of the top 5 equity sector/region combinations in the real asset portfolio. These 5 sectors represent c.55% of the real asset portfolio. The most notable exposure stems from US Oil & Gas that represents c.30% of the portfolio. This sector is expected to suffer significantly during the transition.

In the Failed Transition scenario, all sectors are impacted equally by physical risks - there are no safe haven when viewed at this level of granularity. At individual holding/project level there will be considerable difference in resilience to physical client risks.

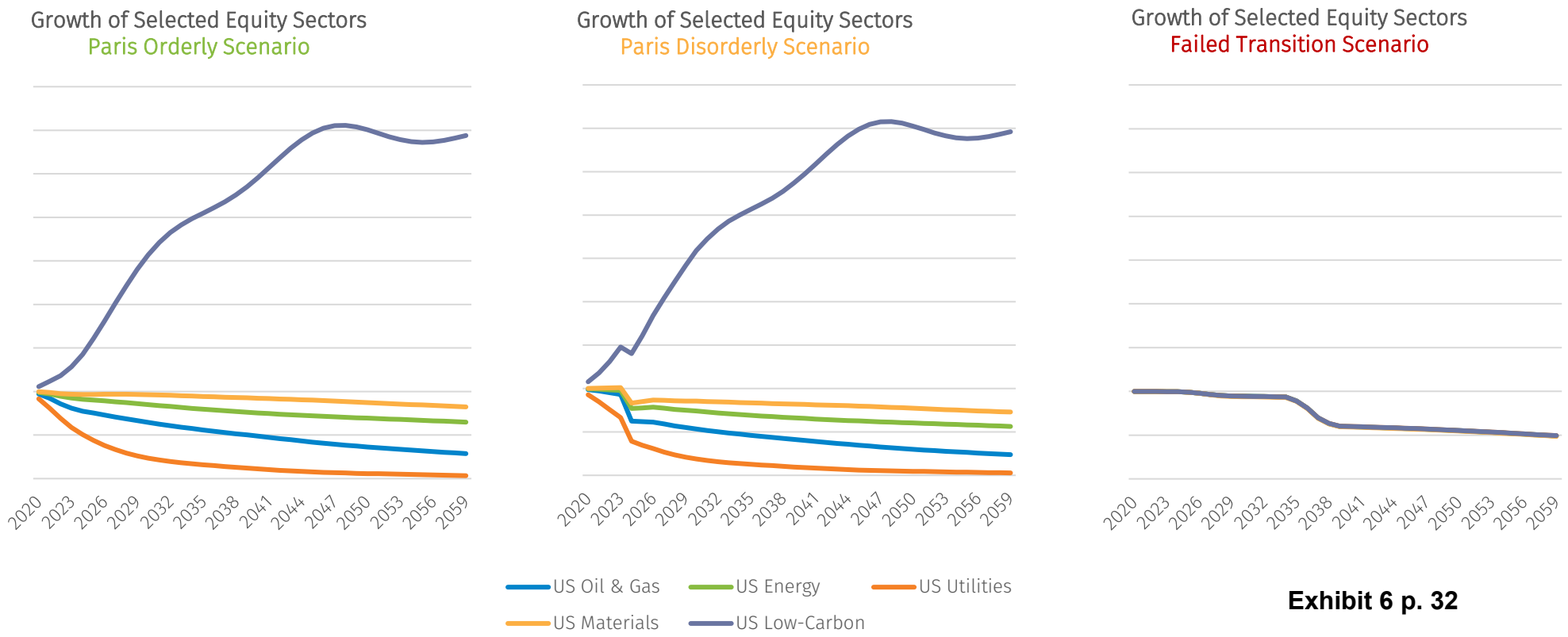

Exhibit 6 p. 32

Focus on real assets (3/3)

What drives the climate exposure of your real asset portfolio? Zoom in on the main contributing sectors

The overall impact on your real asset portfolio is a blended average of the performance of the sectors previously shown as well as the smaller exposures not presented on the previous slide. The picture below details further the underperformance of your real asset portfolio illustrated in the previous tables.

Potential "quick wins" for this portfolio could be to consider carefully exposures to the utility and oil & gas sectors (transition risk) as well as considering diversifying with foreign investments in countries less exposed to climate risk such as in Europe (both physical and transition risks).

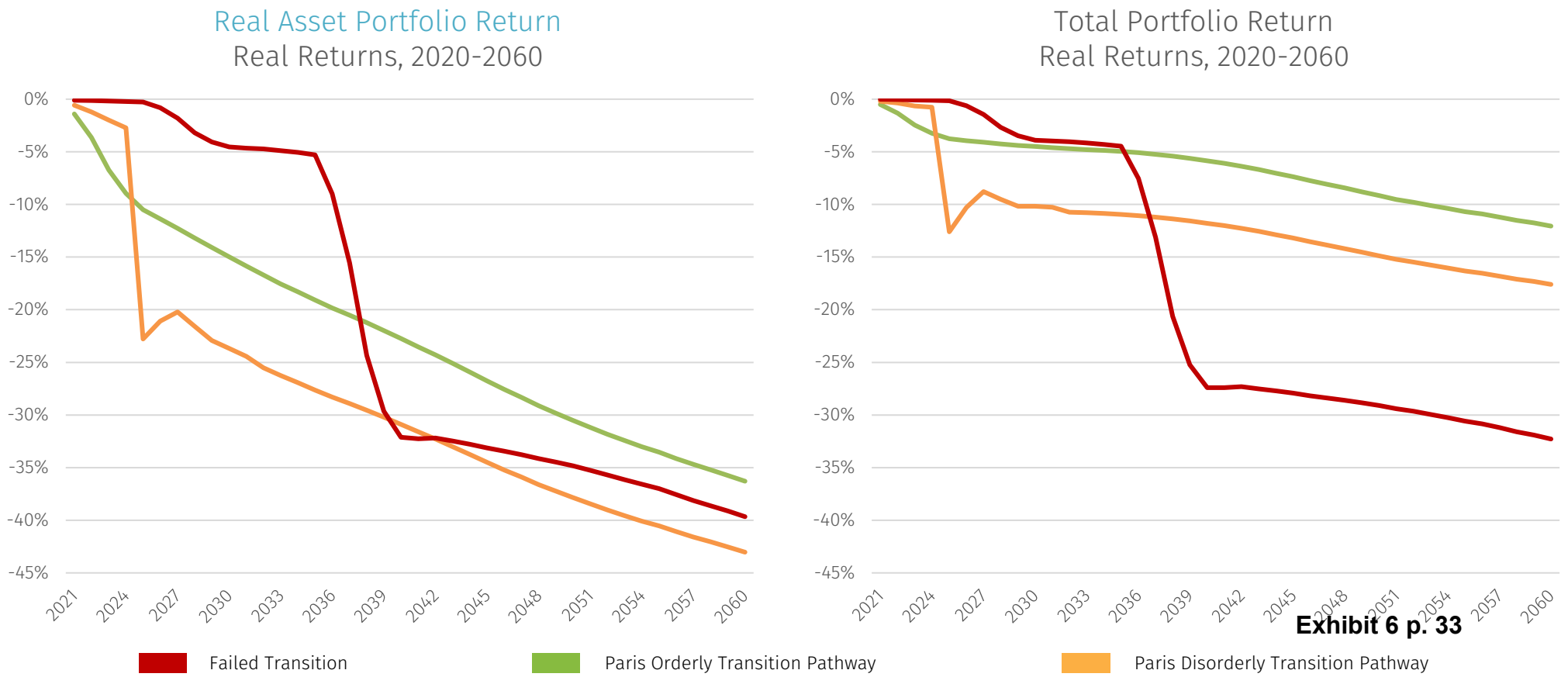

Exhibit 6 p. 33

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Sector insights

The sector-level impact of climate risk is highly differentiated.

By considering the differences between sectors within countries and between countries, we can start to make sense of the landscape of risks and opportunities.

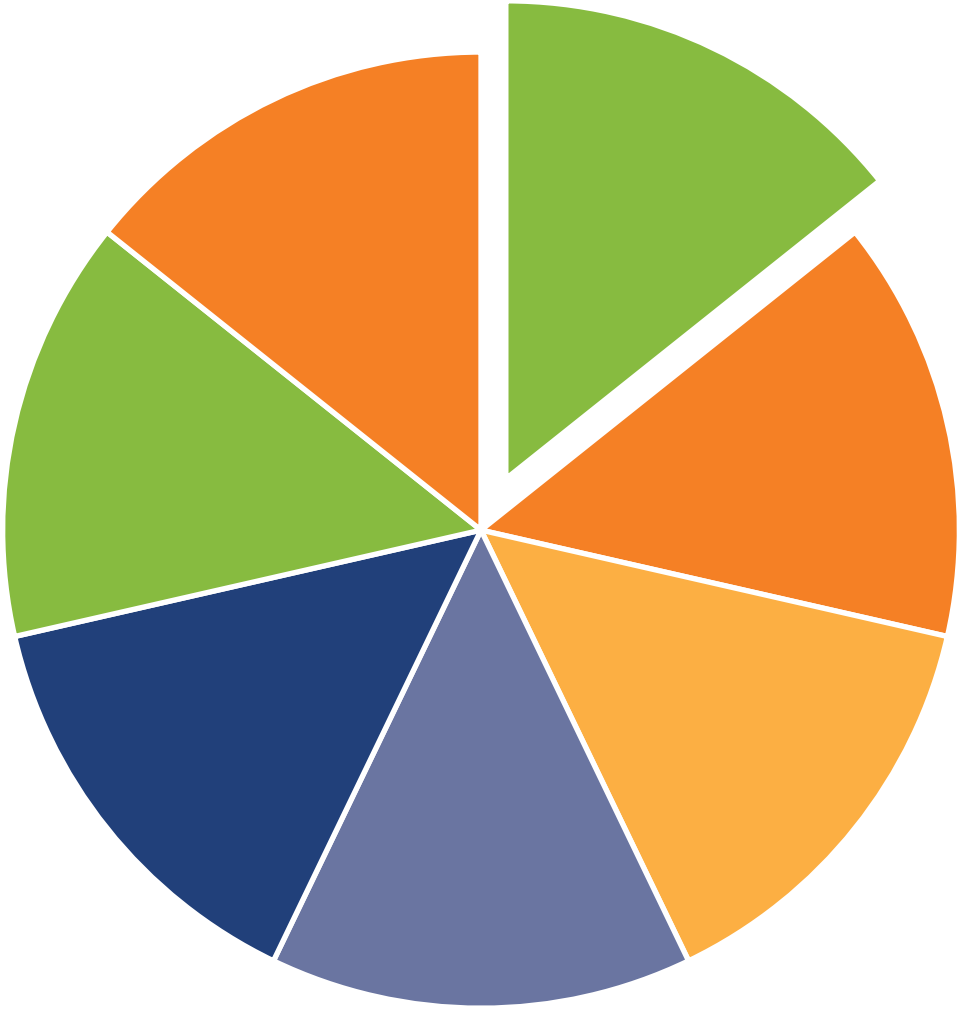

Exhibit 6 p. 34

Sector insights – key findings

The sector-level impact of climate risk is highly differentiated. Remembering that the sector heatmaps reflect economic activities, it is likely that any one company has exposure to multiple cells in the heatmap – regardless of the sector that company may been allocated to in a system like GICS.

Paris Orderly

Short term, the orderly pricing-in of the transition sees significant "losers" in fossil-exposed sectors such as fossil-based utilities (which need to be substituted, so utility companies shift activities to low-carbon utilities), Other Energy (coal and oil sands) and O&G. Low-carbon energy sees significant upside from both sector growth and revenues transferring from fossil-based energy generation. Within 20 years fossil-based utilities have essentially disappear.

Paris Disorderly

This disorderly shock, which is modelled in the first 5 years, has an epicenter in the high-emission and fossil-exposed sectors. The subsequent recovery is faster in climate-aligned activity sectors such as low-carbon utilities and to a lesser extent in more neutral activity sectors like consumer.

Failed transition

The physical risk impacts central to this scenario do not start to be priced in until after 2025. But after 10y the impacts are marked and in our current modelling most differentiated by region. However, other factors to consider in assessing physical risk at holding level are the length/complexity of supply chains and the resilience of major facilities to extreme weather.

How to use this in your decisions

One potential way to use these tables is in testing portfolio construction resilience, understanding sector-level "what ifs" and their impact on strategy implementation.

Another application could be for fund managers to overlay these "sector views" over their views on individual holding and how they could respond to this systemic impacts.

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Sectorial Impacts under the Paris Orderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 5 years

Cumulative climate impact - Paris Orderly	5Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-1.8%	-11.7%	-8.5%	10.0%	-54.4%	-1.7%	-1.7%	-1.2%	-3.0%	-0.6%	-2.0%	-1.6%	-1.8%	-1.3%	-1.0%	-1.4%	-1.5%
	DM	-2.9%	-19.3%	-9.2%	29.0%	-47.9%	-2.5%	-2.9%	-2.7%	-5.2%	-2.0%	-2.9%	-1.0%	-2.8%	-2.5%	-2.2%	-2.7%	-2.9%
	Europe	-1.5%	-16.6%	-12.3%	5.7%	-44.8%	-0.1%	-0.5%	-0.9%	-1.2%	-0.4%	-1.5%	0.2%	-0.8%	-0.8%	-0.1%	-0.1%	-0.8%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-1.4%	-17.4%	-6.4%	10.8%	-54.2%	-0.9%	-0.9%	-0.4%	-1.0%	-0.2%	-2.1%	-1.0%	-0.9%	0.5%	-0.5%	0.0%	-0.9%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

only redacting the quantified results for sub-asset classes and sectors depicted in tables in the report

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Sectorial Impacts under the Paris Orderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 10 years

	10Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
Cumulative climate impact - Paris Orderly	World	-0.5%	-21.2%	-14.5%	55.3%	-72.8%	-0.2%	-0.9%	1.1%	-3.5%	2.4%	-1.9%	-1.1%	-1.4%	-0.4%	1.7%	-0.2%	-0.4%
	DM	-2.4%	-30.1%	-14.6%	105.5%	-72.4%	-2.0%	-2.6%	-1.8%	-7.0%	-0.4%	-2.7%	-0.6%	-3.2%	-2.5%	-0.8%	-2.4%	-3.0%
	Europe	-0.7%	-33.2%	-21.2%	22.3%	-72.7%	3.0%	0.3%	1.5%	-1.2%	2.6%	-0.8%	1.1%	-0.8%	-0.1%	3.6%	1.9%	0.2%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	0.0%	-26.9%	-10.4%	58.2%	-69.1%	0.2%	0.5%	3.0%	0.1%	3.2%	-2.6%	0.0%	-0.1%	2.8%	1.8%	2.3%	0.7%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 37

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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ORTEC FINANCE

Sectoral Impacts under the Paris Orderly Transition Pathway

Cumulative returns (difference to baseline) heat map – Public equities – 20 years

Cumulative climate impact - Paris Orderly	20Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-2.2%	-33.6%	-24.2%	81.2%	-94.5%	-1.2%	-2.6%	-1.0%	-6.4%	0.7%	-3.8%	-2.0%	-2.7%	-1.4%	-0.5%	-1.3%	-1.7%
	DM	-4.5%	-45.0%	-24.6%	179.0%	-86.6%	-3.9%	-4.6%	-4.9%	-11.4%	-3.2%	-4.9%	-0.2%	-5.2%	-4.0%	-3.5%	-4.6%	-5.4%
	Europe	-1.5%	-50.2%	-34.5%	25.3%	-88.6%	5.3%	0.1%	0.0%	-1.4%	1.5%	-1.8%	3.4%	-0.4%	-0.4%	1.6%	2.9%	-0.1%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
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	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-1.1%	-39.9%	-15.6%	181.7%	-79.9%	-0.1%	-0.3%	1.8%	-0.7%	1.9%	-4.1%	-0.6%	-0.8%	5.1%	0.4%	3.1%	-0.7%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 38

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Sectorial Impacts under the Paris Orderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 40 years

Cumulative climate impact - Paris Orderly	40Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-11.3%	-48.0%	-36.3%	83.3%	-100.0%	-12.3%	-11.4%	-10.2%	-17.2%	-7.8%	-12.3%	-10.8%	-12.0%	-9.9%	-9.8%	-10.7%	-10.8%
	DM	-12.8%	-62.1%	-35.1%	206.7%	-95.3%	-12.6%	-13.8%	-14.0%	-22.2%	-11.9%	-13.3%	-5.9%	-13.2%	-11.4%	-12.1%	-13.6%	-14.6%
	Europe	-7.5%	-56.6%	-42.3%	7.5%	-99.0%	-4.8%	-3.6%	-7.0%	-6.6%	-5.4%	-7.4%	-0.8%	-5.2%	-4.7%	-5.5%	-3.9%	-5.6%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
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	Sweden																	
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	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-6.3%	-54.9%	-27.6%	588.6%	-97.9%	-6.9%	-5.8%	-4.5%	-7.3%	-4.1%	-11.1%	-7.0%	-6.4%	-1.0%	-4.8%	-5.1%	-6.9%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 39

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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Sectorial Impacts under the Paris Disorderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 5 years

Cumulative climate impact - Paris Disorderly	5Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-15.9%	-26.8%	-23.3%	-2.7%	-67.8%	-15.8%	-15.8%	-15.4%	-17.2%	-14.7%	-16.1%	-15.6%	-15.9%	-15.4%	-15.2%	-15.5%	-15.6%
	DM	-16.6%	-34.3%	-23.5%	23.4%	-59.1%	-16.0%	-16.3%	-16.2%	-19.0%	-15.6%	-16.3%	-14.1%	-16.2%	-15.8%	-15.7%	-16.2%	-16.4%
	Europe	-16.7%	-33.1%	-28.6%	-9.5%	-57.1%	-15.2%	-15.5%	-16.2%	-16.3%	-15.7%	-16.7%	-14.6%	-15.9%	-15.8%	-15.5%	-15.2%	-15.9%
DEVELOPED MARKETS	US																	
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	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-18.0%	-34.4%	-23.1%	-2.7%	-82.9%	-17.0%	-17.0%	-16.8%	-16.3%	-15.6%	-17.7%	-17.3%	-16.1%	-16.3%	-13.8%	-16.9%	-14.8%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 40

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Sectorial Impacts under the Paris Disorderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 10 years

Cumulative climate impact - Paris Disorderly	10Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-12.2%	-32.6%	-26.2%	41.1%	-80.2%	-12.0%	-12.6%	-10.9%	-15.2%	-9.6%	-13.5%	-12.7%	-13.0%	-12.0%	-10.3%	-11.9%	-12.1%
	DM	-13.7%	-41.4%	-25.9%	102.6%	-77.4%	-13.2%	-13.8%	-13.1%	-18.3%	-11.8%	-13.9%	-11.4%	-14.2%	-13.5%	-12.2%	-13.6%	-14.1%
	Europe	-13.2%	-44.6%	-33.7%	8.0%	-78.0%	-9.8%	-12.1%	-11.4%	-13.6%	-10.4%	-13.4%	-11.0%	-13.1%	-12.5%	-9.5%	-10.7%	-12.3%
DEVELOPED MARKETS	US																	
	Japan																	
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	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-13.5%	-39.8%	-23.6%	54.7%	-89.2%	-12.3%	-12.2%	-10.5%	-12.2%	-9.5%	-14.9%	-13.0%	-12.2%	-11.4%	-9.2%	-11.7%	-10.7%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 41

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Sectoral Impacts under the Paris Disorderly Transition Pathway

Cumulative returns (difference to baseline) heat map – Public equities – 20 years

Cumulative climate impact - Paris Disorderly	20Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-14.0%	-43.4%	-34.8%	64.2%	-96.0%	-13.1%	-14.3%	-12.9%	-18.0%	-11.3%	-15.5%	-13.8%	-14.5%	-13.2%	-12.5%	-13.1%	-13.5%
	DM	-15.7%	-53.9%	-34.7%	175.3%	-88.8%	-15.1%	-15.7%	-16.1%	-22.3%	-14.5%	-16.0%	-11.2%	-16.2%	-15.1%	-14.7%	-15.7%	-16.5%
	Europe	-14.1%	-58.8%	-45.1%	10.2%	-90.8%	-8.0%	-12.5%	-13.0%	-14.0%	-11.5%	-14.5%	-9.3%	-13.0%	-13.0%	-11.5%	-10.0%	-12.8%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-14.6%	-50.3%	-29.5%	215.5%	-95.4%	-12.6%	-13.2%	-11.7%	-13.1%	-10.8%	-16.4%	-13.6%	-13.1%	-11.7%	-10.6%	-12.2%	-12.2%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 42

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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Sectorial Impacts under the Paris Disorderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 40 years

Cumulative climate impact - Paris Disorderly	40Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-22.1%	-55.7%	-45.3%	65.9%	-100.0%	-23.0%	-22.2%	-21.1%	-27.5%	-18.9%	-23.0%	-21.6%	-22.7%	-20.7%	-20.8%	-21.5%	-21.6%
	DM	-23.0%	-68.0%	-43.8%	204.1%	-95.8%	-22.8%	-23.8%	-24.0%	-31.8%	-22.2%	-23.4%	-16.3%	-23.2%	-21.6%	-22.3%	-23.7%	-24.6%
	Europe	-19.3%	-64.1%	-51.6%	-5.4%	-99.2%	-16.8%	-15.7%	-19.0%	-18.5%	-17.6%	-19.4%	-13.0%	-17.2%	-16.8%	-17.7%	-16.0%	-17.6%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
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	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-18.6%	-60.7%	-37.6%	545.3%	-97.9%	-19.0%	-18.1%	-17.1%	-18.7%	-16.1%	-22.4%	-19.2%	-17.8%	-13.7%	-14.9%	-17.7%	-17.3%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 43

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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Sectorial Impacts under the Failed Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 5 years

Cumulative climate impact - Failed Transition	5Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
	DM	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
	Europe	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

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Sectorial Impacts under the Failed Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 10 years

Cumulative climate impact - Failed Transition	10Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-5.2%	-5.0%	-5.1%	-5.2%	-4.9%	-5.2%	-5.2%	-5.2%	-5.1%	-5.2%	-5.2%	-5.2%	-5.1%	-5.1%	-5.2%	-5.2%	-5.1%
	DM	-5.3%	-4.7%	-4.9%	-4.7%	-4.4%	-5.2%	-5.2%	-5.3%	-4.6%	-5.4%	-5.5%	-5.1%	-4.8%	-5.1%	-5.3%	-4.9%	-4.7%
	Europe	-4.3%	-3.9%	-4.0%	-3.7%	-2.7%	-3.6%	-4.1%	-4.7%	-3.5%	-5.2%	-5.1%	-4.1%	-3.4%	-4.2%	-4.5%	-4.2%	-3.9%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
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	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-4.0%	-3.8%	-4.0%	-3.8%	-3.7%	-3.7%	-3.8%	-4.0%	-3.8%	-4.4%	-4.4%	-3.9%	-3.8%	-3.9%	-3.2%	-3.8%	-3.6%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

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Sectoral Impacts under the Failed Transition Pathway

Cumulative returns (difference to baseline) heat map – Public equities – 20 years

Cumulative climate impact - Failed Transition	20Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-36.3%	-36.2%	-36.3%	-36.3%	-36.1%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%
	DM	-34.9%	-34.0%	-34.1%	-32.1%	-31.9%	-32.4%	-34.5%	-35.2%	-31.9%	-36.4%	-36.3%	-34.2%	-31.9%	-33.7%	-34.0%	-33.1%	-32.7%
	Europe	-24.1%	-23.8%	-23.9%	-18.5%	-17.7%	-18.5%	-23.5%	-27.4%	-17.6%	-31.4%	-30.6%	-23.0%	-17.6%	-23.1%	-24.5%	-21.9%	-20.1%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-40.6%	-42.4%	-42.5%	-41.0%	-41.0%	-41.0%	-41.6%	-41.4%	-40.9%	-36.8%	-37.4%	-41.7%	-40.3%	-41.8%	-33.3%	-41.3%	-34.3%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

only redacting the quantified results for sub-asset classes and sectors depicted in tables in the report

Exhibit 6 p. 46

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only redacting the quantified results for sub-asset classes and sectors depicted in tables in the report

Sectorial Impacts under the Failed Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 40 years

Cumulative climate impact - Failed Transition	40Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-49.7%	-49.6%	-49.7%	-49.8%	-49.6%	-49.7%	-49.8%	-49.7%	-49.7%	-49.7%	-49.7%	-49.8%	-49.7%	-49.7%	-49.8%	-49.7%	-49.7%
	DM	-45.7%	-44.7%	-44.8%	-42.5%	-42.3%	-42.8%	-45.1%	-45.7%	-42.4%	-47.2%	-47.0%	-44.9%	-42.3%	-44.2%	-44.6%	-43.7%	-43.3%
	Europe	-34.2%	-33.9%	-34.0%	-28.2%	-27.5%	-28.2%	-33.5%	-37.6%	-27.3%	-41.7%	-40.9%	-33.0%	-27.2%	-33.1%	-34.6%	-31.8%	-29.9%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-51.4%	-52.9%	-52.9%	-51.0%	-51.0%	-51.0%	-51.6%	-51.7%	-50.7%	-48.3%	-49.0%	-52.0%	-50.1%	-52.0%	-40.9%	-51.5%	-43.3%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

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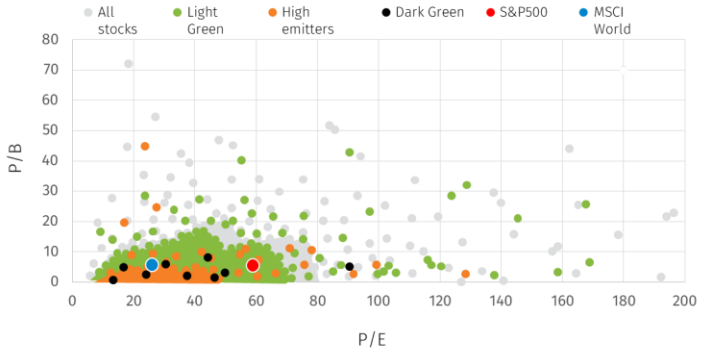
Sector insights | What is priced in?

- There is some evidence for pricing-in of transition risk in "pure play" stocks. It is plausible this is still not fully priced-in.
- Harder to assess for diversified stocks (lack of data) and physical risk.
- Measurements should improve with better reporting/disclosures

Inspiration: To what extent is climate risk currently "priced in"?

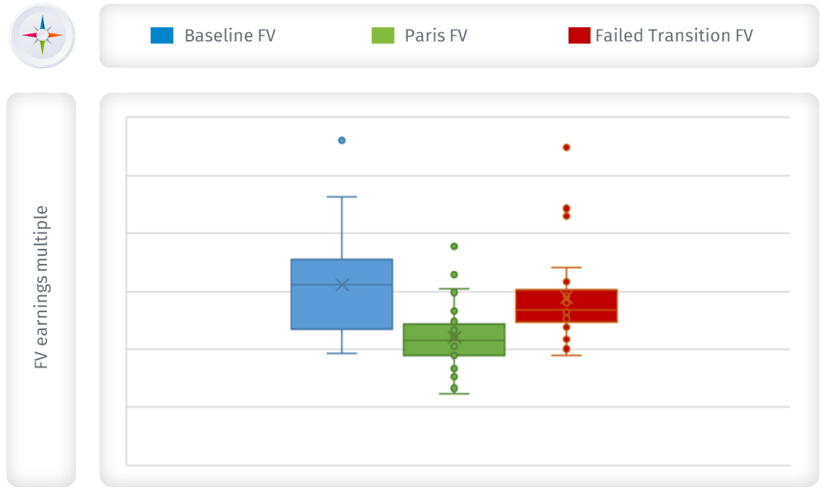
- The evidence is clearer for transition risk (high emitters and dark green)
- Significant issues with green definitions and reporting to enable clear answers



	Mean PE	Median PE
All holdings	32	18
"Light Green" (BBG Green tag = Yes)	26	18
"Others" (BBG Green tag = Yes)	34	18
Dark Green MAPS sectors	27	23
Transition exposed MAPS sectors	16	13

Fair Value estimates – P/E ratios

Where could coal/oil-sands valuations go from here?



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*Fair value estimates are based modelled estimates produced by Ortec Finance and do not represent advice or an actionable view

**Graph data is from a broad, global equity portfolio, PE ratio figures are historic with catagorization based on proprietary classifications (Bloomberg and Ortec Finance)

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What-if Analysis: Switch all listed equities to “Paris-aligned” companies

This section analyzes the impact of switching all investments in listed equities to a low-carbon (Paris-aligned) benchmark. (100% of companies aligned to a world consistent with the goals of the Paris agreement).

The current equity portfolio was simplified and represented by MSCI World.

Performance of the fund is compared between the base benchmark and a completely aligned benchmark.

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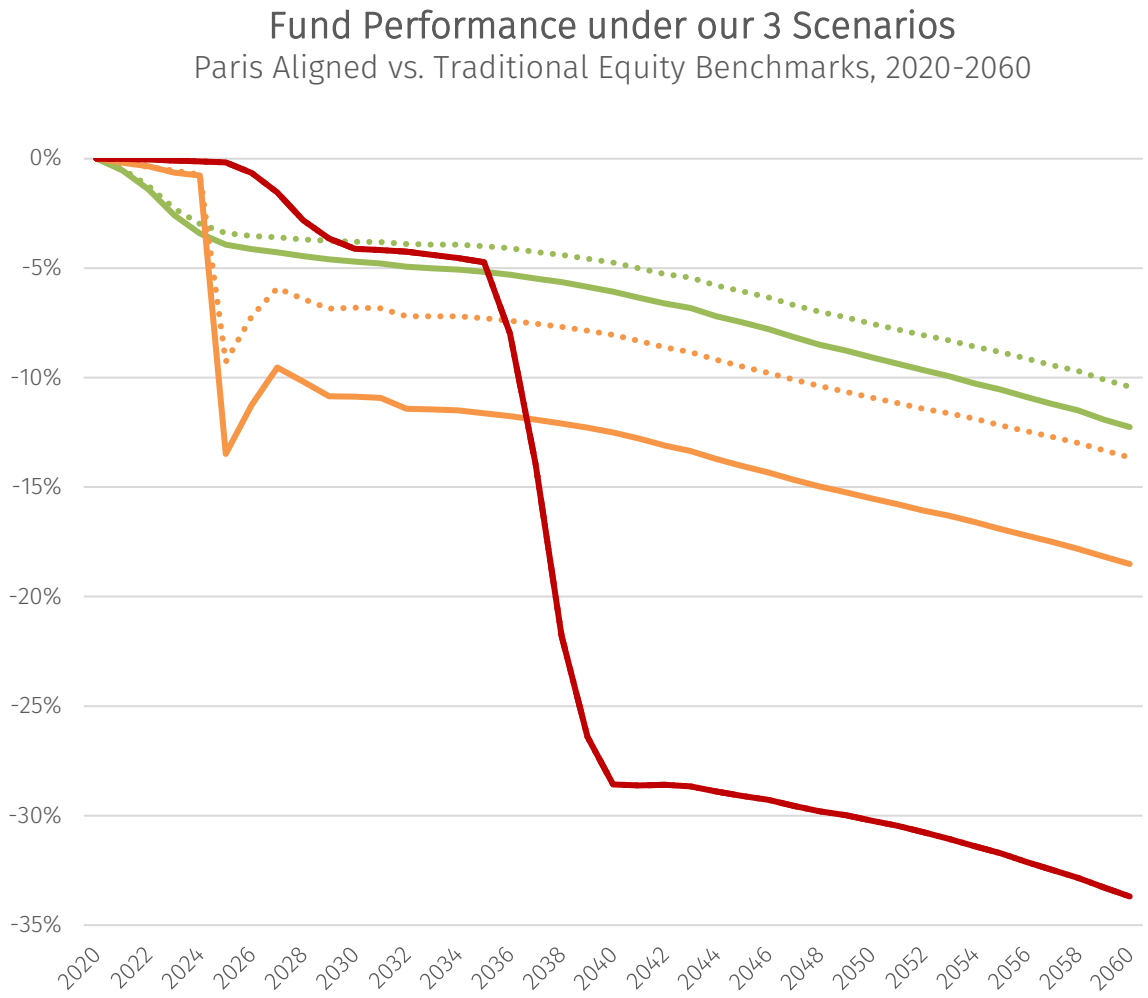
Switching to Paris-aligned benchmarks potentially mitigates downside performance if a disorderly transition scenario unfolds



"What happens to OPERF's real returns when equities are allocated to Paris-aligned benchmarks?"

- Started the analysis from the current portfolio and swapped all equities for MSCI World (30% of fund).
- Analyzed two alternatives: standard MSCI World benchmark versus a fully Paris-aligned version of the benchmark
- Switching to an (idealized) 100% Paris aligned benchmark would provide the best hedge from transition risks. However, implementation limitations mean that the real degree of alignment will probably be lower (too few aligned companies to maintain diversification)
- As more companies commit to net-zero, higher degrees of alignment could be achieved.
- It is important to note, however, that Paris alignment does not help for mitigating physical risks.

Exhibit 6 p. 50

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Focusing on companies with well-aligned business practices and science-based net-zero targets could reduce significantly the exposure to transition risks (cumulative results)

Scenario 1: Paris *orderly* transition pathway	2020-2025		2026-2030		2031-2040		2041-2050		2051-2060		2020-2060	
Fund	Median	5% CVaR	Median	5% CVaR	Median	5% CVaR	Median	5% CVaR	Median	5% CVaR	Median	5% CVaR
Fixed income	-0.2%	-0.2%	0.5%	0.5%	1.0%	1.0%	-1.7%	-2.1%	-3.3%	-3.7%	-4.3%	-3.7%
Equity												
MSCI World Paris Aligned (100%)	-0.9%	-1.1%	0.8%	1.2%	-1.7%	-1.6%	-2.5%	-3.0%	-3.8%	-4.7%	-7.1%	-8.3%
MSCI World Standard (No Paris Alignment)	-2.6%	-2.8%	-0.5%	-0.6%	-3.1%	-3.5%	-3.7%	-4.9%	-5.4%	-7.3%	-13.7%	-16.0%
MSCI World Paris Aligned (33%)	-1.7%	-1.9%	0.2%	0.3%	-2.4%	-2.6%	-3.1%	-3.9%	-4.6%	-6.0%	-10.5%	-12.2%
Private Equity	-3.7%	-3.6%	-0.3%	-0.3%	-2.9%	-2.9%	-4.1%	-4.0%	-5.1%	-5.1%	-15.2%	-15.1%
Real Assets	-9.4%	-9.4%	-4.8%	-4.6%	-10.2%	-10.3%	-10.4%	-10.6%	-9.8%	-10.0%	-37.3%	-37.6%
Diversifying Strategies	-0.7%	-0.7%	-0.2%	-0.2%	-1.3%	-1.3%	-1.2%	-1.2%	-1.4%	-1.4%	-4.8%	-4.8%
Risk Parity	-0.9%	-1.0%	0.2%	0.0%	1.7%	1.7%	1.8%	1.3%	-1.8%	-2.3%	1.9%	0.2%

Scenario 2: Paris *disorderly* transition pathway	2020-2025		2026-2030		2031-2040		2041-2050		2051-2060		2020-2060	
Fund	Median	5% CVaR	Median	5% CVaR	Median	5% CVaR	Median	5% CVaR	Median	5% CVaR	Median	5% CVaR
Fixed income	-2.7%	-3.6%	4.0%	3.4%	0.8%	0.8%	-1.7%	-2.1%	-3.3%	-3.7%	-3.4%	-3.0%
Equity												
MSCI World Paris Aligned (100%)	-1.4%	-1.9%	1.3%	1.1%	-1.4%	-1.6%	-2.6%	-2.9%	-4.0%	-4.7%	-7.2%	-8.4%
MSCI World Standard (No Paris Alignment)	-15.6%	-23.2%	1.8%	-0.7%	-3.1%	-3.8%	-3.7%	-4.8%	-5.6%	-7.2%	-24.7%	-28.7%
MSCI World Paris Aligned (33%)	-8.9%	-12.2%	1.8%	0.3%	-2.2%	-2.7%	-3.2%	-3.9%	-4.8%	-6.0%	-16.4%	-18.8%
Private Equity	-16.3%	-16.3%	4.9%	4.8%	-3.3%	-3.3%	-4.1%	-4.0%	-5.1%	-5.1%	-22.8%	-22.7%
Real Assets	-22.2%	-22.7%	-0.6%	-1.3%	-10.4%	-10.5%	-10.4%	-10.6%	-9.8%	-10.0%	-44.3%	-44.5%
Diversifying Strategies	-6.1%	-7.3%	3.5%	2.8%	-1.4%	-1.3%	-1.2%	-1.2%	-1.4%	-1.4%	-6.9%	-6.8%
Risk Parity	-10.9%	-13.8%	4.9%	4.4%	1.3%	1.3%	1.6%	1.4%	-1.5%	-1.6%	-7.3%	-7.3%

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Next steps

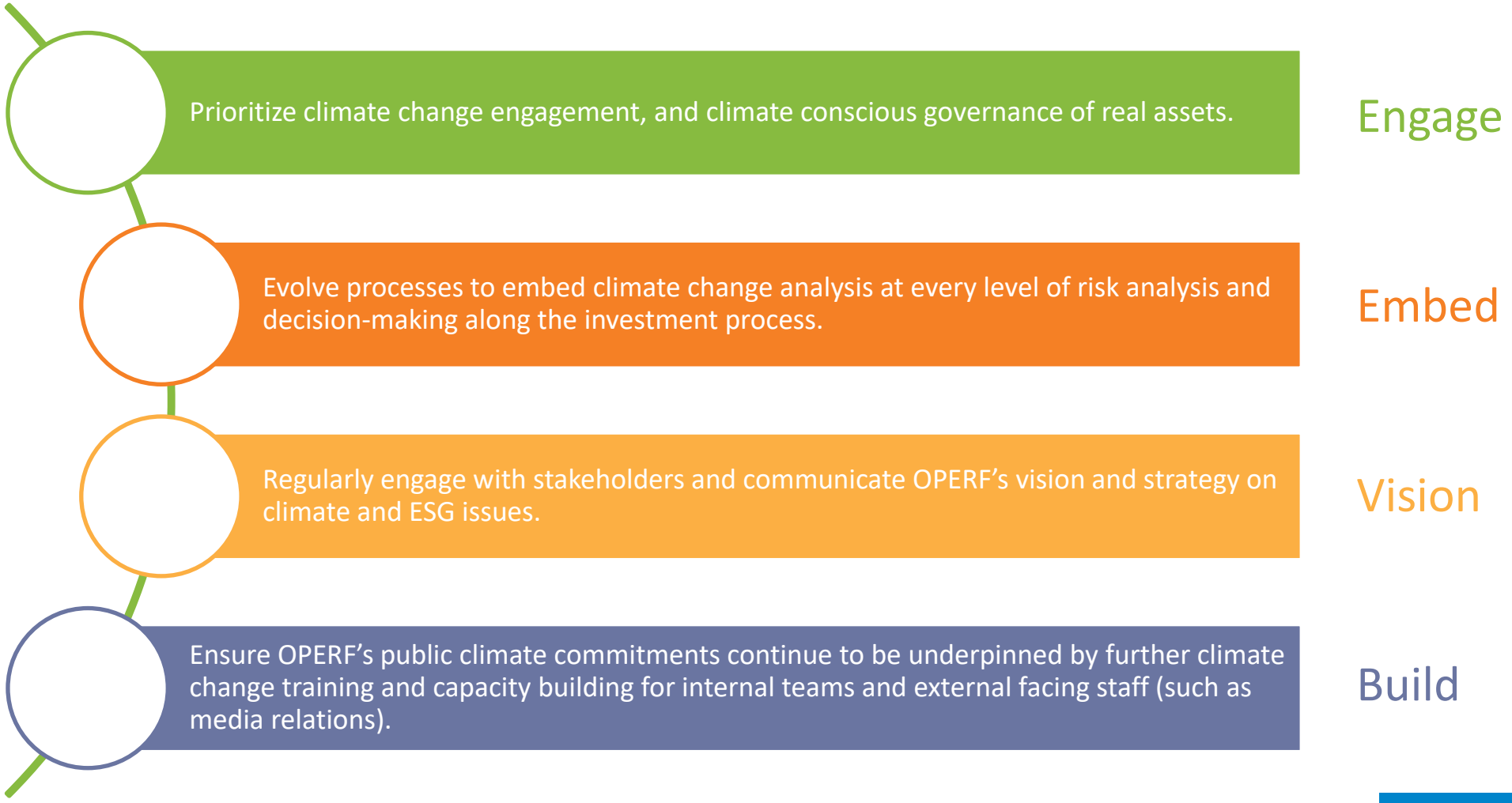
We have drawn on our experience with many pension funds globally to provide a brief set of recommendations for OST to consider as “next steps” following this analysis.

The recommendations are, however, just suggestions not advice and we would naturally expect the Treasury to arrive at its own decisions.

Whilst our analysis has been focused on the asset-allocation aspects, our suggestions cover the full gamut of the investment process since that is typically what is required to fully address this huge topic.

Recommendations – observations on best practice

Climate Strategy



Recommendations – observations on best practice

Total Portfolio

Consider positioning the portfolio toward a low-carbon (net zero) transition including conducting bottom up transition-analysis and creating a multi-year strategy with milestones and targets.	Align
Given the Paris Disorderly transition poses material short term risks to OPERF; implementation and sector and regional climate differences should be researched and considered.	Mitigate
Prioritize transition risk management focused on exposure to the energy and utilities sectors and within infrastructure, global credit, equity and private equity.	Manage
Develop an approach to manage physical risks which should include physical climate change risk resilience assessments especially for large infrastructure, PE, real estate. This could be allied with engagement on resilience building and adaptation.	Resilience

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Recommendations – observations on best practice

Asset Classes

Equities: Tilt equity portfolios to be less exposed to transition risk by using climate-aware benchmarks or sustainable funds aligned to transition scenarios.
Consider aligning fund manager KPIs to your appetite for transition risk in mandate design.

Equity

Prioritize researching climate risks in utilities/energy stocks, bonds and real-assets.

Focus

To support potential future reporting requirements, include capturing climate transition indicators (regulatory, regional, business and technology risk etc.) and analyzing sector specific climate risks.

Metrics

Alternatives: given OPERF's allocation to alternatives, consider new allocations to climate solutions oriented private assets (such as green infrastructure).

Alternatives

Fixed Income: US corporate credits are less sensitive to climate transition risks than equities and could be a good way to maintain US exposure. However, this should be balanced with the need to meet liabilities.

Credit

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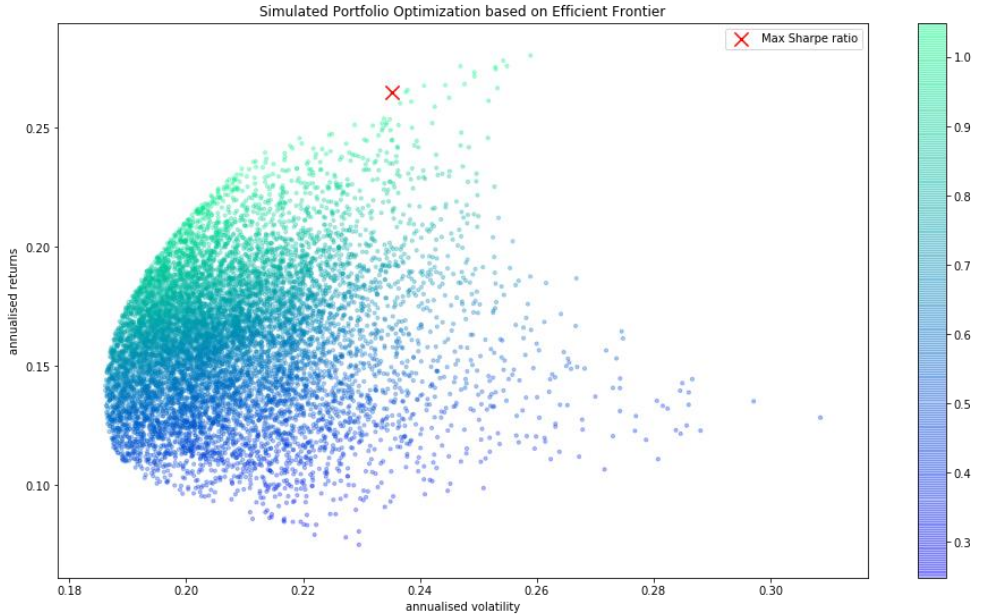
Next steps – Phase 2: Proposals for insightful “what-if” analysis

1) Investigate the potential benefit of geographic diversification by halving US equity and real asset exposure and rebalancing to less climate-exposed regions

2) Investigate the composition of the portfolio if optimized to climate scenarios



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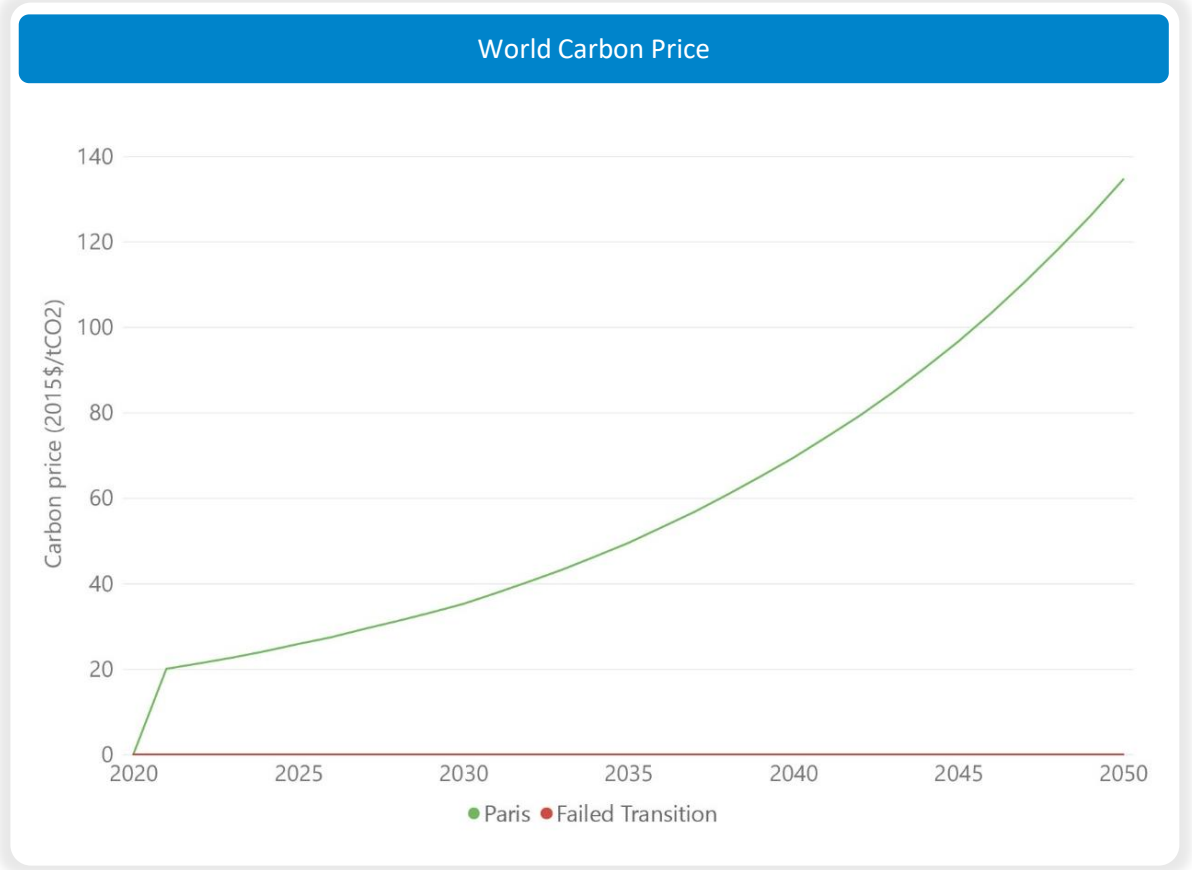
ANNEX

US Policies

- Carbon tax
- Investment subsidies for CCS
- Feed-in tariffs for renewables
- Coal-fired electricity fully phased out by 2050
- Biofuel blending requirements
- Policies supporting take up of EVs
- Investments in energy efficiency



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Find out more on our Narratives Dashboard: www.climatemaps.app

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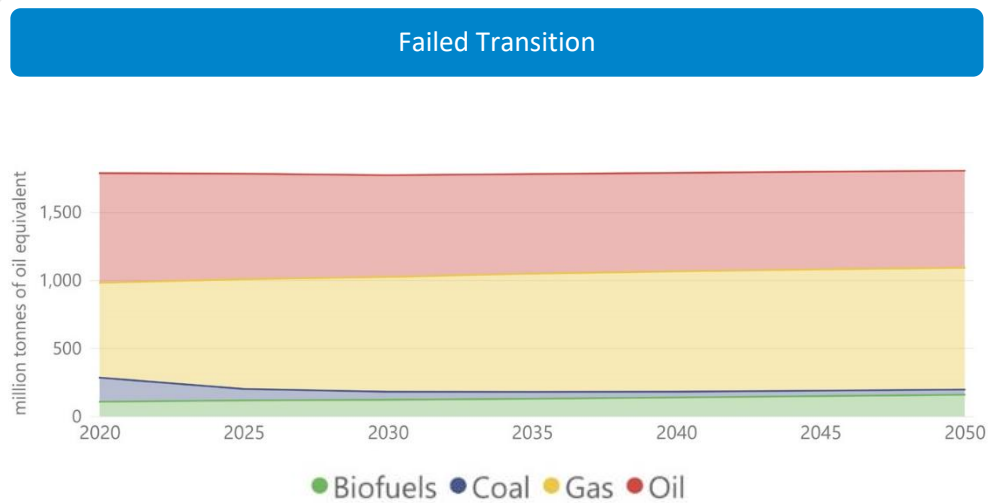
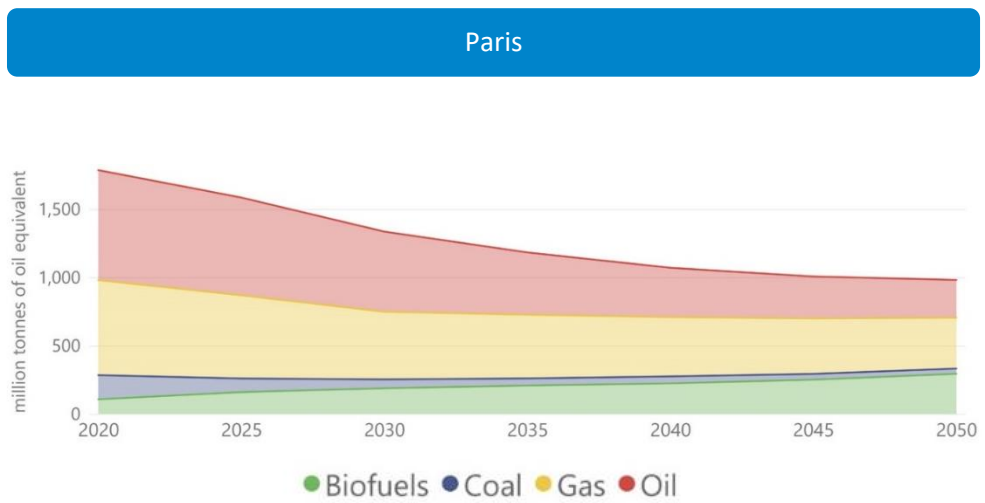
US Fuel Demand

cambridge econometrics
camecon.com





In Paris Transition Pathways:

- Primary fuel demand decreases 45% by 2050 relative to 2020
- Biofuel use grows more than tenfold
- Proportion of gas stays relatively stable
- Share of oil and coal reduces substantially

Exhibit 6 p. 59

Find out more on our Narratives Dashboard: www.climatemaps.app

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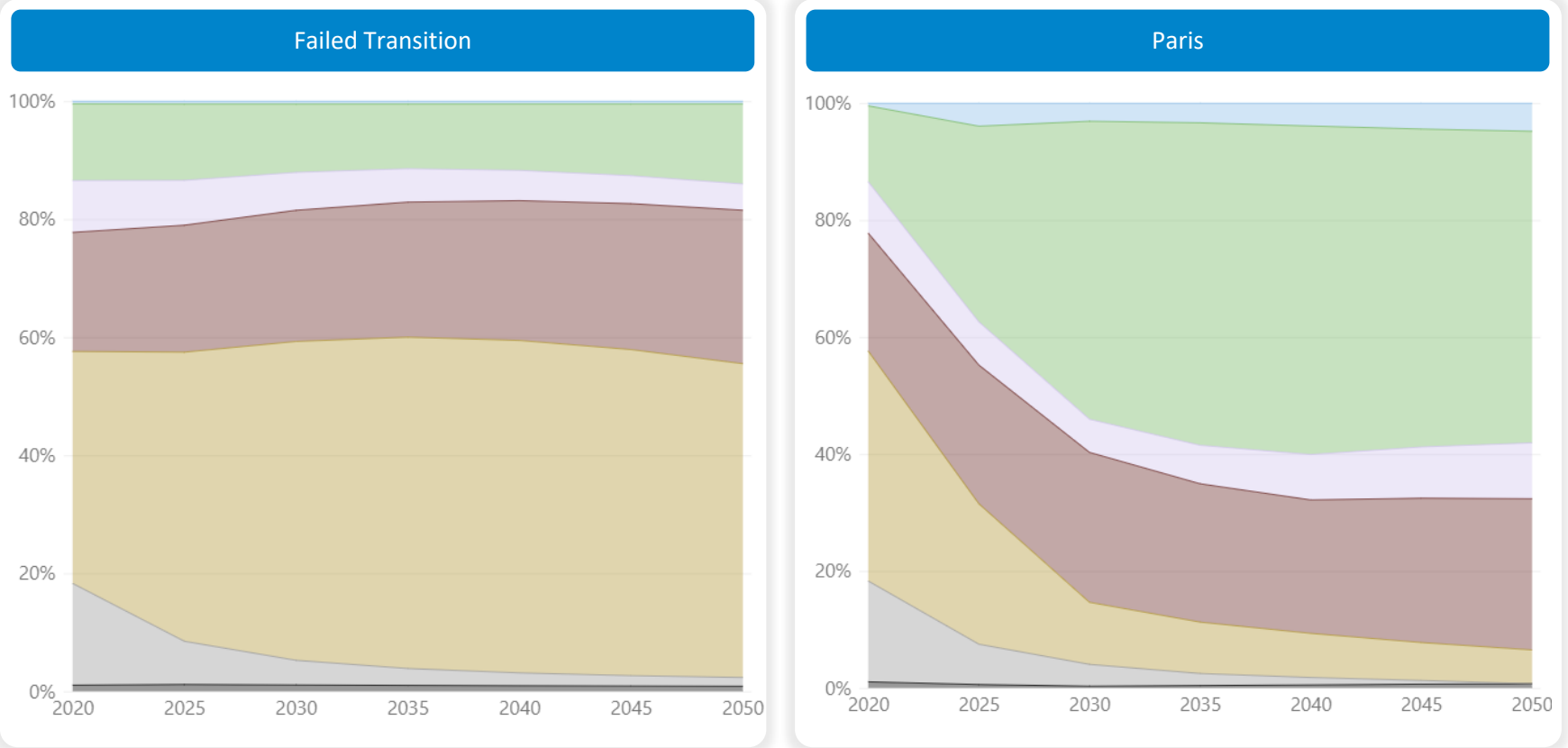
US Electricity Generation

cambridge econometrics
camecon.com



In Paris Transition Pathways:

- Renewables and CCS technologies make up over 70% of the US electricity generation mix in 2050
- Fossil fuel phase out rapidly in the short term and gradually in the long term
- Take up of new technology due to investment in low-carbon technology

Exhibit 6 p. 60

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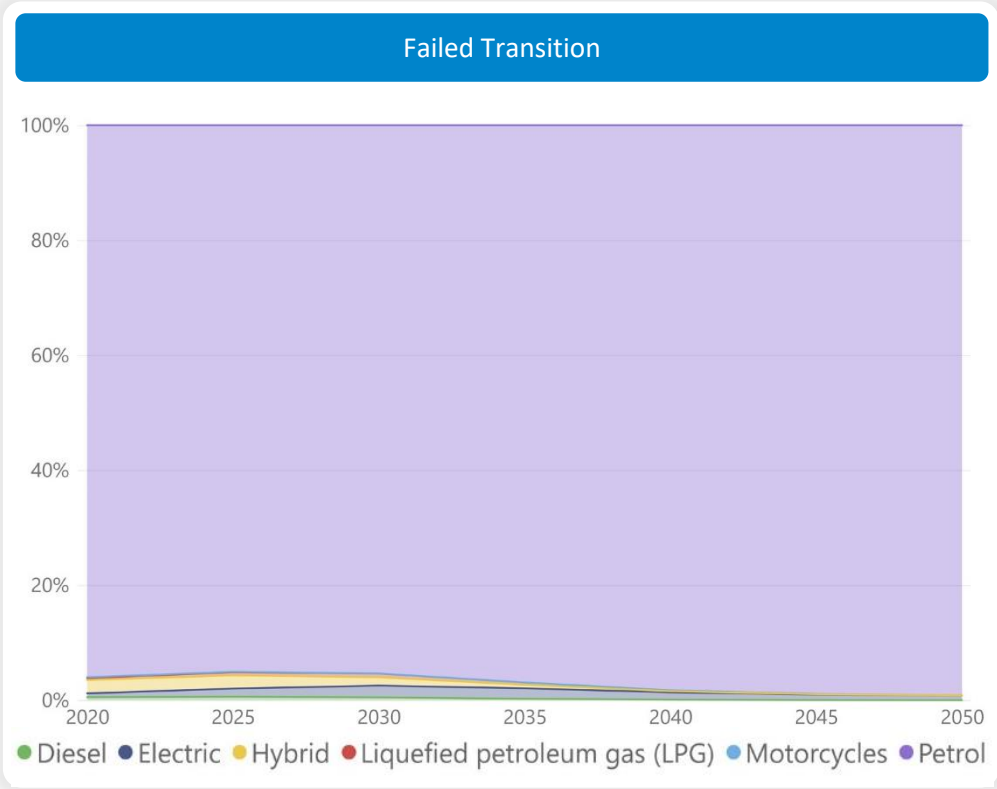
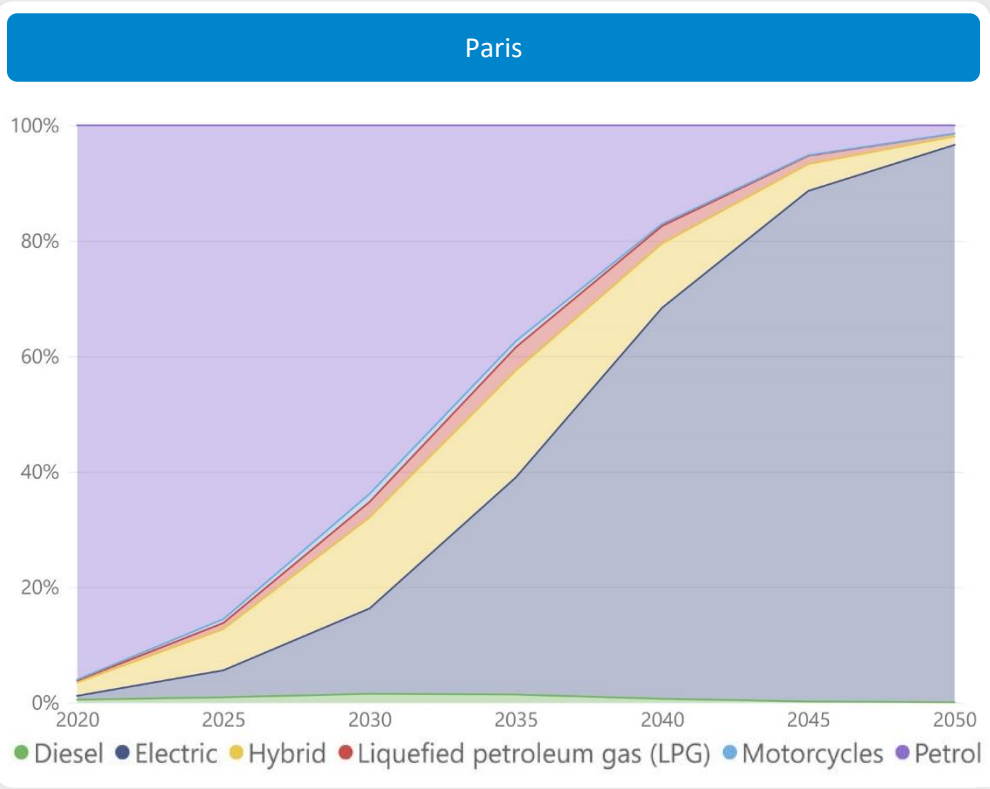
US Passenger Transport

cambridge econometrics
camecon.com





In Paris Transition Pathways:

- By 2050 electric vehicles make up 97% of the US passenger transport mix

Exhibit 6 p. 61

Find out more on our Narratives Dashboard: www.climatemaps.app

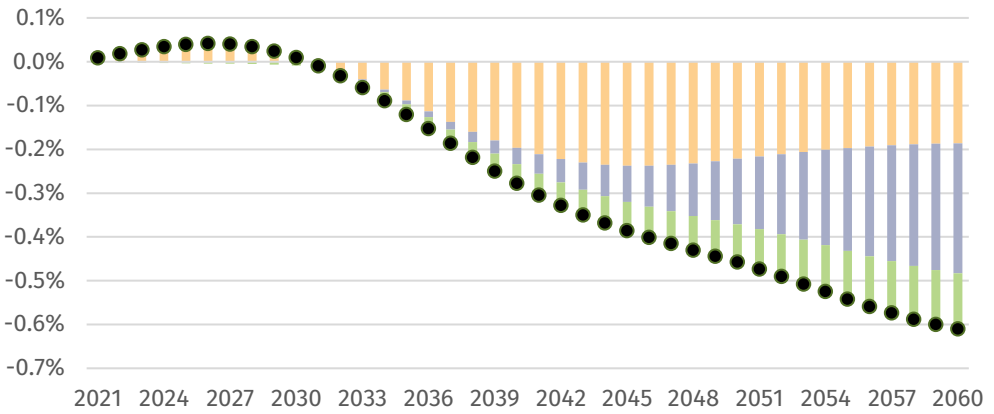
A closer look at the three climate pathways

The impact of orderly climate action

Scenario 1: Paris Orderly Transition Pathway

1. Paris Agreement goals **met**.
2. Rapid and effective climate action, with smooth market reaction.
3. Ambitious low carbon policies – high investment in low carbon technologies.
4. Major change in global fuel / electricity mix.
5. Average global temperature stabilizes at 1.5°C above pre-industrial levels.
6. Transition has limited positive effect on global GDP and is more than offset by negative physical impacts.
7. Moderate physical impacts, with a much lower increase in extreme weather risks between 2020 and 2100 than under a Failed Transition scenario.
8. The US, compared to other regions, is more negatively impacted by this pathway due to the its economy's dependency on fossil fuel exports, its slow progress on energy efficiency and carbon pricing, as well as its high sensitivity to market sentiment.

US Sovereign Bond Yield Levels – 10y



US Listed Equity

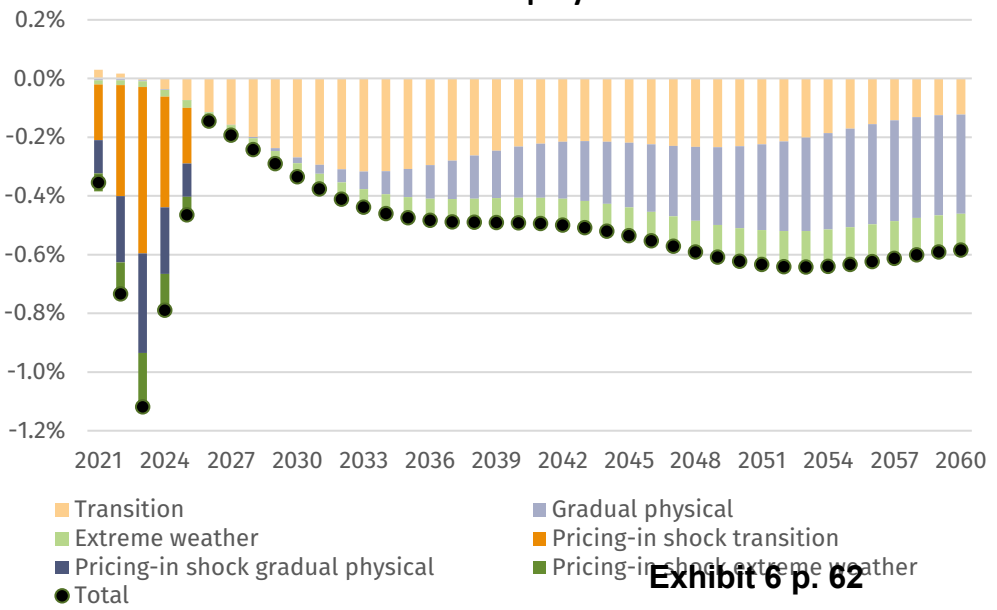


Exhibit 6 p. 62

Note: the data presented in the graphs is shown as difference to baseline and are annualized results

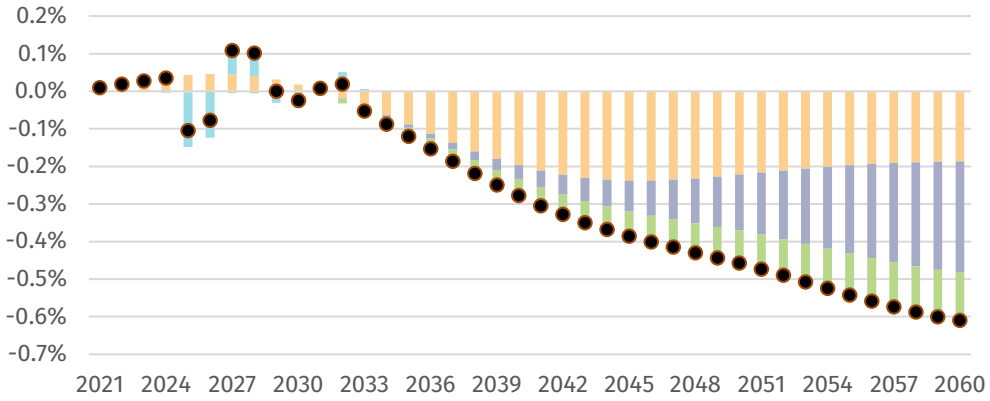
A closer look at the three climate pathways

The impact of a delayed market reaction

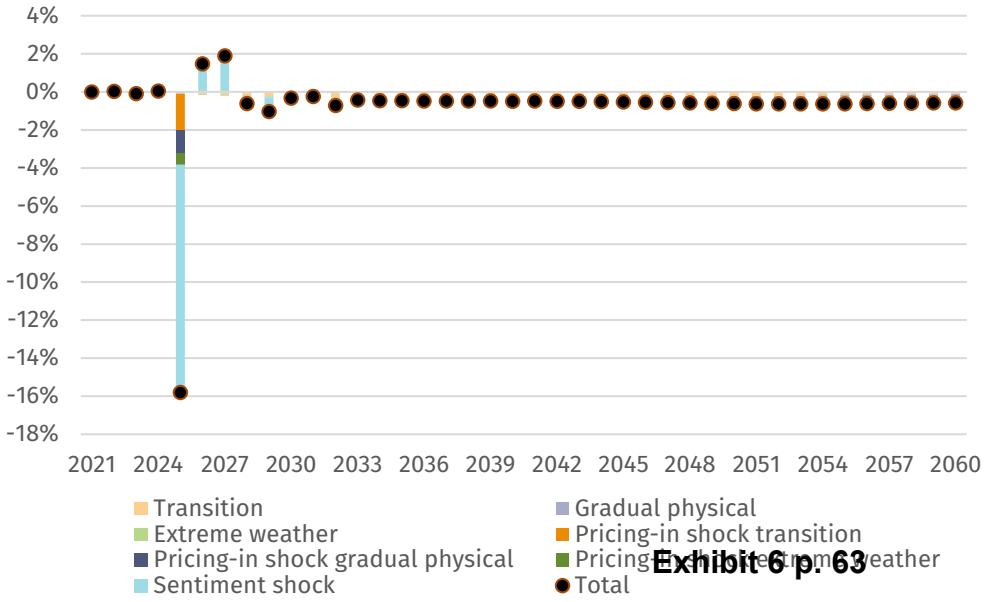
Scenario 2: Paris Disorderly Transition Pathway

1. Paris Agreement goals **met**.
2. Rapid & effective climate action, but markets slow to react.
3. Ambitious low carbon policies – high investment in low carbon technologies.
4. Major change in global fuel / electricity mix.
5. Average global warming stabilizes at 1.5°C above pre-industrial levels.
6. Transition has limited positive effect on global GDP and is outweighed by negative physical impacts.
7. Abrupt market reaction in 2025 impacts the real economy, for example causing a fall in all major countries' GDP in 2025. In the long term, GDP is slightly lower than in the Paris Orderly scenario as a result of the disorderly transition.
8. Moderate physical impacts, with a much lower increase in extreme weather risks between 2020 and 2100 than under a Failed Transition scenario.
9. The US, compared to other regions, is more impacted due to its sensitivity to transition risks & how these are priced in.

US Sovereign Bond Yield Levels – 10y



US Listed Equity



Note: the data presented in the graphs is shown as difference to baseline and are annualized results

A closer look at the three climate pathways

What might happen if Paris goals are not met?

Scenario 3: Failed Transition Pathway

1. Paris agreement goals **not met.**
2. Only existing climate policies are implemented.
3. Limited change in global fuel / electricity mix despite significant falls in renewable energy prices.
4. Average global warming is about 2°C by 2050 and 4°C by 2100, compared to pre-industrial levels.
5. Physical impacts have a significant negative impact on global GDP.
6. Extreme weather risks increase significantly between 2020 and 2100 via a combination of increasing event frequency and severity of losses.
7. The physical risks are comparable to the two Paris scenarios for the first 10 years, then increase substantially and irreversibly. Warming makes agriculture impossible in certain areas around the world. Extreme weather events more than double on a global level.
8. Unfortunately, the US demography and geography plays against its favour and exacerbates the adverse effects of global warming (especially at risk from extreme weather events)

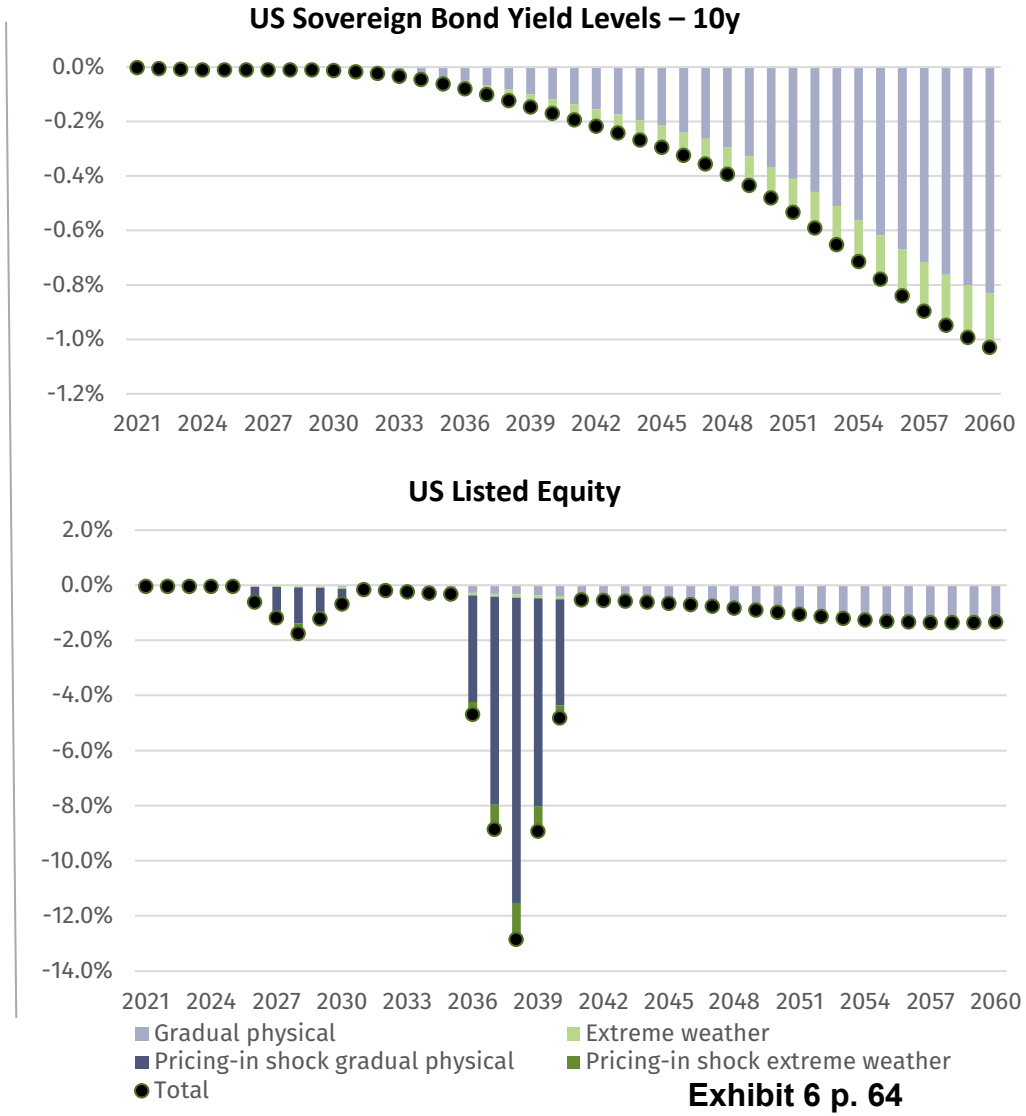


Exhibit 6 p. 64

Note: the data presented in the graphs is shown as difference to baseline and are annualized results

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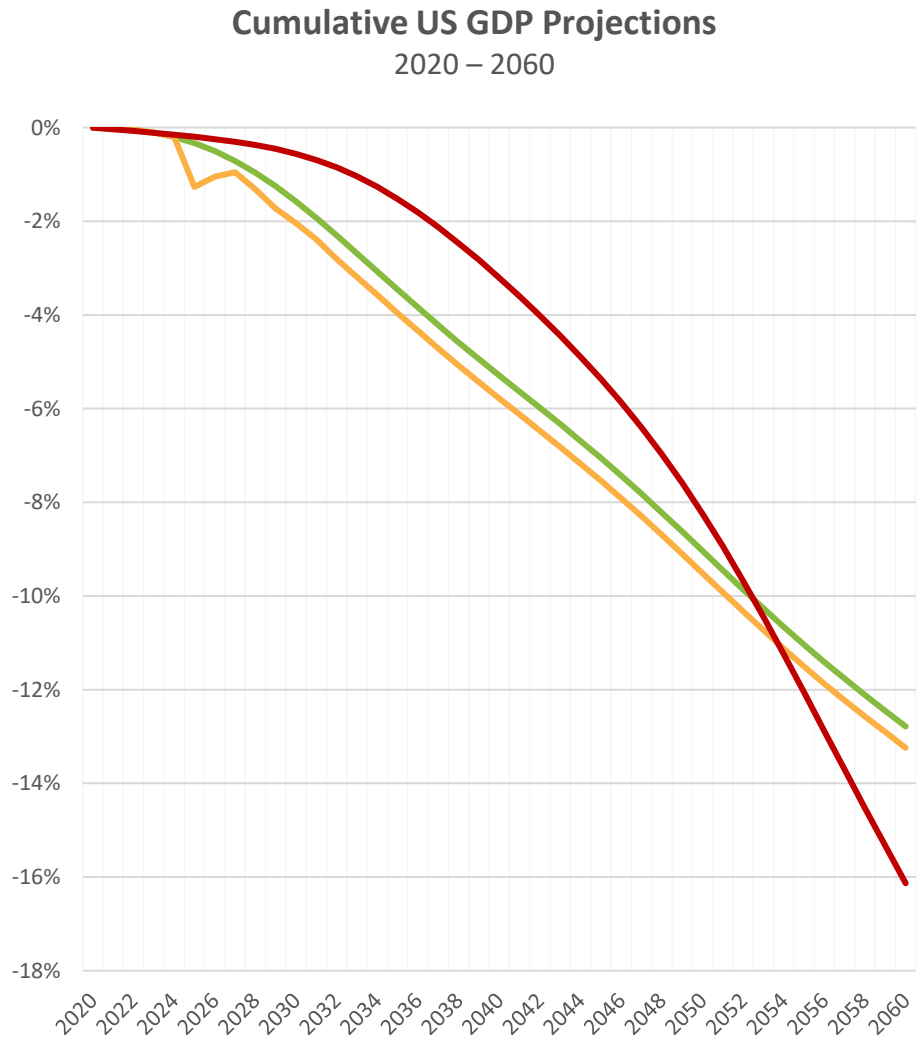
Climate impacts on selected macroeconomic variables – United States*

How is the economy impacted by climate change?



Paris Transition:

- Over the next 20 years, the US is heavily impacted by the transition pathways due to the economy's dependence on fossil fuel exports. Rapidly declining demand will impact also other related sectors, as well as government royalties, spending, and so on.
- Other regions, such as Europe and China, can even benefit from the low-carbon transition, such as renewable energy technology producers.
- In the second half of this century, transition risks will fade out and lower GDP expectations compared to baseline are due to the locked-in physical impacts of half a degree of further warming compared to today.

Failed Transition:

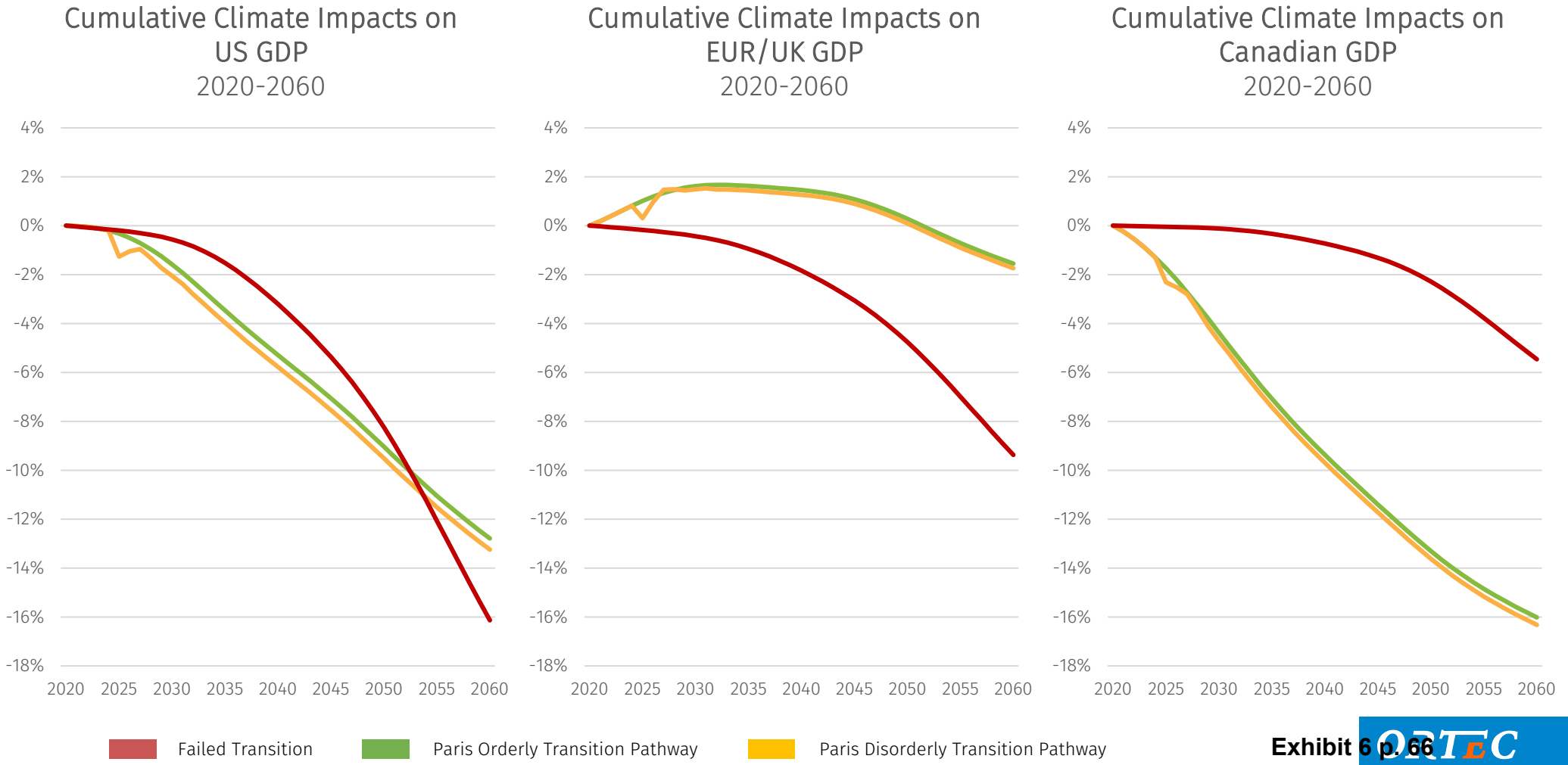
- Physical risks become more significant over time, which gradually affect GDP growth. These physical risks are particularly impactful for the US unlike other countries such as its neighbor, Canada.
- Due to its demographic and geographic situation, the US is more severely affected in the Failed Transition with GDP projections 16% lower by 2060 under a Failed Transition compared to baseline.

Failed Transition Paris Orderly Transition Pathway Paris Disorderly Transition Pathway

*Analyze many more variables using the ClimateMAPS Scenarios Narratives Dashboard.

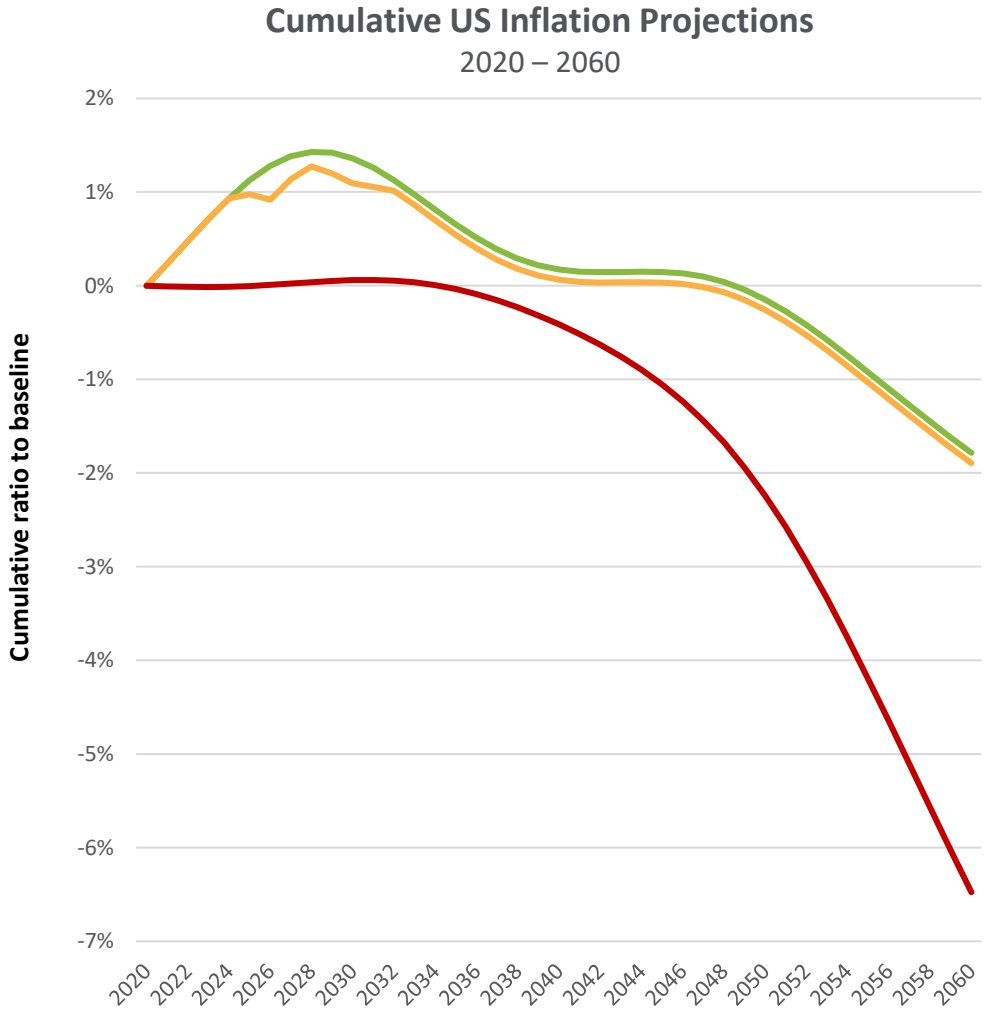
Climate impacts on key economies: GDP considerations

Countries are impacted differently depending on their specific geographic and economic considerations. While the US is severely impacted under our 3 scenarios, Canada for instance suffers particularly from a transition.



Climate impacts on selected macroeconomic variables – United States*

A transition to net zero will increase US inflation



Comments

In the US, under the Paris Orderly and Disorderly Transition Pathways, there is an increase in prices in the upcoming years driven by demand-pull inflation effects: the stimulus effects of low-carbon energy and infrastructure investment drive an initial increase in prices.

In the longer term, with the low-carbon regulation put in place (e.g. phase out of fossil fuels) as well as the effect of learning-by-doing, energy product cost is expected to fall. This then drive down the energy/fuel prices. With subsidies and regulation, the cost of renewable technologies decrease overtime which partly affect the electricity price.

Under a Failed Transition, prices are not influenced by new policy changes in the short-term. However, mounting physical impacts will impact the economy in the medium and long term which will impose deflationary pressure towards the end of the time horizon. These effects are particularly large for the US.

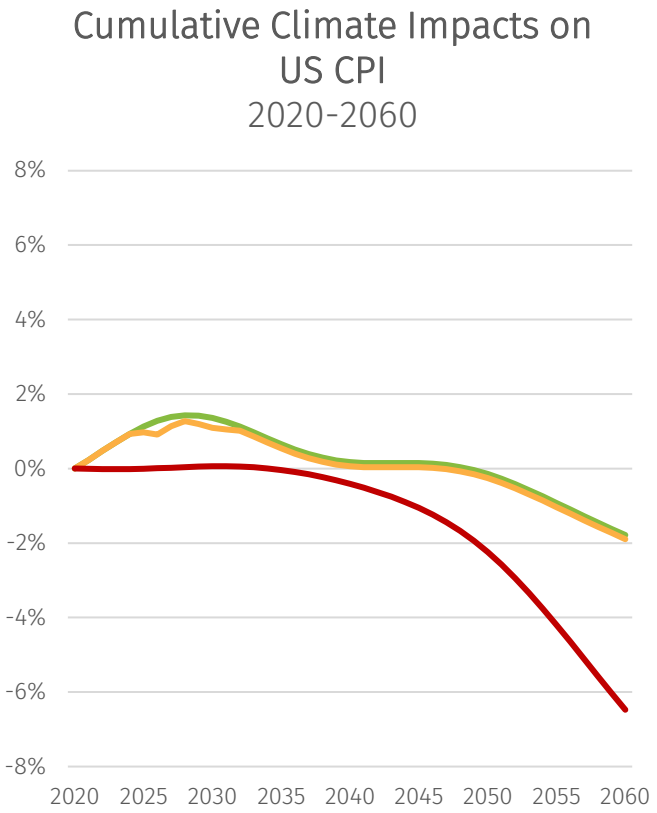
Failed Transition | Paris Orderly Transition Pathway | Paris Disorderly Transition Pathway

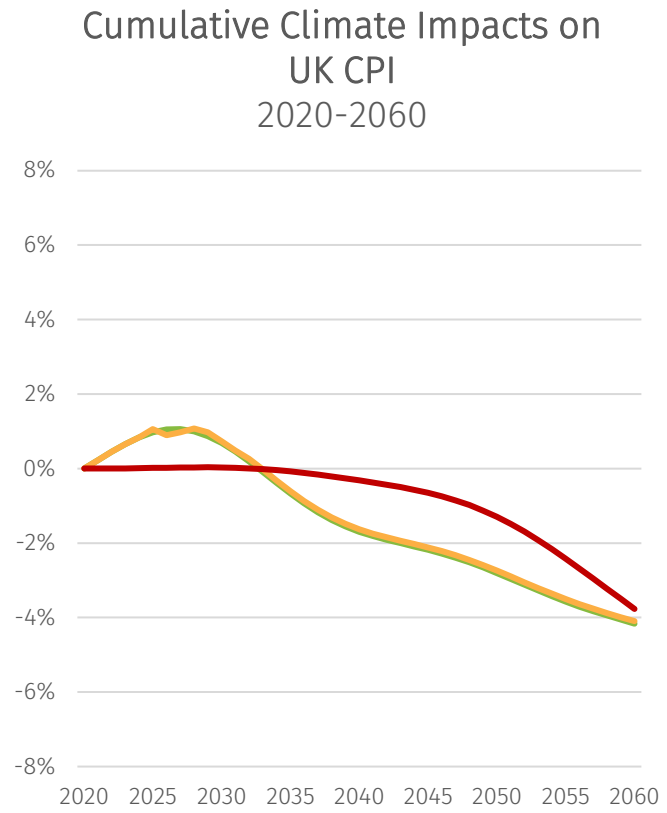
Exhibit 6 p. 67

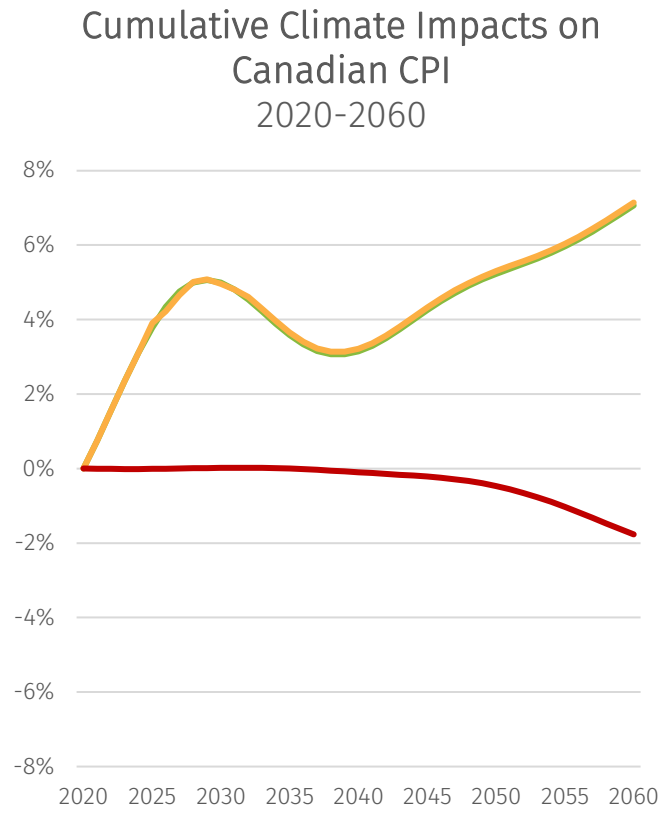
*Analyze many more variables using the ClimateMAPS Scenarios Narratives Dashboard.

Climate impacts on key economies: inflation considerations

In the Paris Orderly and Disorderly Transition Pathways, the transition puts upward pressure on inflation in the US.
The positive transition impact is larger than the (negative) impact of increasing physical risks up to 2030.
In the long run, increasing gradual physical risks lead to a reduction in inflation.
In the Failed Transition Pathway, increasing physical risks decrease inflation from the early 2030s.







Failed Transition
Paris Orderly Transition Pathway
Paris Disorderly Transition Pathway

Financial Results

Paris Orderly Transition

The following subsection focuses on the impacts induced by the Paris Orderly Transition pathway on your portfolio.

The key effects to keep in mind in this pathway are the initial transition shock occurring in the short-term as well as the locked-in physical risks that materialize later on. Annualized results are located in the annex.

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Risk/Return Analysis of portfolio constituents* (annualized absolute results)

Scenario 1: Paris *orderly* transition pathway	2021-2025			2026-2030			2031-2040			2041-2050			2051-2060			2021-2060		
	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR
Fund	-0.5%	-7.2%	8.1%	-0.1%	-7.9%	8.0%	-0.3%	-5.0%	5.2%	-0.5%	-5.2%	5.5%	-0.5%	-5.2%	5.5%	-0.4%	-2.7%	2.9%
Fixed income	0.0%	-2.5%	2.9%	0.1%	-3.3%	3.6%	0.1%	-2.9%	2.9%	-0.3%	-3.4%	4.9%	-0.3%	-3.4%	4.9%	-0.1%	-1.4%	1.8%
US Investment Grade																		
US Government Bonds																		
US Index-Linked																		
US High Yield																		
EM Debt																		
Equity	-0.5%	-11.5%	12.1%	-0.1%	-12.2%	11.7%	-0.3%	-8.6%	8.7%	-0.5%	-8.8%	9.1%	-0.5%	-8.8%	9.1%	-0.4%	-4.6%	4.6%
MSCI World AC																		
Small Cap																		
Minimum Volatility																		
Private Equity	-0.7%	-14.4%	17.2%	-0.1%	-14.7%	16.6%	-0.3%	-8.8%	9.3%	-0.5%	-9.4%	9.7%	-0.5%	-9.4%	9.7%	-0.4%	-4.6%	4.7%
Venture Capital/Growth																		
Buyout																		
Emerging Market																		
Distressed Debt																		
Real Estate	-0.6%	-6.7%	7.0%	-0.1%	-6.7%	6.7%	-0.3%	-4.6%	4.8%	-0.6%	-4.7%	5.0%	-0.6%	-4.7%	5.0%	-0.4%	-2.5%	2.8%
Direct Real Estate																		
REITs																		
Real Assets	-2.0%	-10.3%	10.5%	-1.0%	-11.0%	12.0%	-1.1%	-6.0%	5.8%	-1.0%	-6.3%	6.5%	-1.0%	-6.3%	6.5%	-1.2%	-3.1%	3.4%
Real Asset Portfolio																		
Opportunity Portfolio																		
Diversifying Strategies	-0.1%	-5.1%	5.3%	0.0%	-4.9%	5.5%	-0.1%	-3.9%	3.8%	-0.1%	-3.8%	4.1%	-0.1%	-3.8%	4.1%	-0.1%	-2.0%	1.8%
HF Fund of Funds																		
Risk Parity	-0.2%	-10.1%	10.7%	0.0%	-10.7%	10.7%	0.2%	-6.3%	7.0%	-0.2%	-6.7%	8.0%	-0.2%	-6.7%	8.0%	0.0%	-3.4%	3.8%
Global Sovereign Rates																		
Inflation-Linked Bonds																		
Corporate Credits																		
Listed Equities																		
Commodities																		

Additional granularity can be provided upon request

Exhibit 6 p. 70

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Sectorial Impacts under the Paris Orderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 5 years

Cumulative climate impact - Paris Orderly	5Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-1.8%	-11.7%	-8.5%	10.0%	-54.4%	-1.7%	-1.7%	-1.2%	-3.0%	-0.6%	-2.0%	-1.6%	-1.8%	-1.3%	-1.0%	-1.4%	-1.5%
	DM	-2.9%	-19.3%	-9.2%	29.0%	-47.9%	-2.5%	-2.9%	-2.7%	-5.2%	-2.0%	-2.9%	-1.0%	-2.8%	-2.5%	-2.2%	-2.7%	-2.9%
	Europe	-1.5%	-16.6%	-12.3%	5.7%	-44.8%	-0.1%	-0.5%	-0.9%	-1.2%	-0.4%	-1.5%	0.2%	-0.8%	-0.8%	-0.1%	-0.1%	-0.8%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-1.4%	-17.4%	-6.4%	10.8%	-54.2%	-0.9%	-0.9%	-0.4%	-1.0%	-0.2%	-2.1%	-1.0%	-0.9%	0.5%	-0.5%	0.0%	-0.9%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 71

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Sectorial Impacts under the Paris Orderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 10 years

	10Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
Cumulative climate impact - Paris Orderly	World	-0.5%	-21.2%	-14.5%	55.3%	-72.8%	-0.2%	-0.9%	1.1%	-3.5%	2.4%	-1.9%	-1.1%	-1.4%	-0.4%	1.7%	-0.2%	-0.4%
	DM	-2.4%	-30.1%	-14.6%	105.5%	-72.4%	-2.0%	-2.6%	-1.8%	-7.0%	-0.4%	-2.7%	-0.6%	-3.2%	-2.5%	-0.8%	-2.4%	-3.0%
	Europe	-0.7%	-33.2%	-21.2%	22.3%	-72.7%	3.0%	0.3%	1.5%	-1.2%	2.6%	-0.8%	1.1%	-0.8%	-0.1%	3.6%	1.9%	0.2%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	0.0%	-26.9%	-10.4%	58.2%	-69.1%	0.2%	0.5%	3.0%	0.1%	3.2%	-2.6%	0.0%	-0.1%	2.8%	1.8%	2.3%	0.7%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 72

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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Sectorial Impacts under the Paris Orderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 20 years

	20Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
Cumulative climate impact - Paris Orderly	World	-2.2%	-33.6%	-24.2%	81.2%	-94.5%	-1.2%	-2.6%	-1.0%	-6.4%	0.7%	-3.8%	-2.0%	-2.7%	-1.4%	-0.5%	-1.3%	-1.7%
	DM	-4.5%	-45.0%	-24.6%	179.0%	-86.6%	-3.9%	-4.6%	-4.9%	-11.4%	-3.2%	-4.9%	-0.2%	-5.2%	-4.0%	-3.5%	-4.6%	-5.4%
	Europe	-1.5%	-50.2%	-34.5%	25.3%	-88.6%	5.3%	0.1%	0.0%	-1.4%	1.5%	-1.8%	3.4%	-0.4%	-0.4%	1.6%	2.9%	-0.1%
DEVELOPED MARKETS	US																	
	Japan																	
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	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-1.1%	-39.9%	-15.6%	181.7%	-79.9%	-0.1%	-0.3%	1.8%	-0.7%	1.9%	-4.1%	-0.6%	-0.8%	5.1%	0.4%	3.1%	-0.7%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 73

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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Sectorial Impacts under the Paris Orderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 40 years

Cumulative climate impact - Paris Orderly	40Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-11.3%	-48.0%	-36.3%	83.3%	-100.0%	-12.3%	-11.4%	-10.2%	-17.2%	-7.8%	-12.3%	-10.8%	-12.0%	-9.9%	-9.8%	-10.7%	-10.8%
	DM	-12.8%	-62.1%	-35.1%	206.7%	-95.3%	-12.6%	-13.8%	-14.0%	-22.2%	-11.9%	-13.3%	-5.9%	-13.2%	-11.4%	-12.1%	-13.6%	-14.6%
	Europe	-7.5%	-56.6%	-42.3%	7.5%	-99.0%	-4.8%	-3.6%	-7.0%	-6.6%	-5.4%	-7.4%	-0.8%	-5.2%	-4.7%	-5.5%	-3.9%	-5.6%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-6.3%	-54.9%	-27.6%	588.6%	-97.9%	-6.9%	-5.8%	-4.5%	-7.3%	-4.1%	-11.1%	-7.0%	-6.4%	-1.0%	-4.8%	-5.1%	-6.9%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 74

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

Paris Orderly Transition Pathway

Climate impacts summary – Public equities

Public equities:

- The asset class is impacted by pricing-in shocks spread over 2021-2026.

Summary of climate impacts on equities:

- Equities suffer from transition risks in the first years. After 2026, physical risks gradually increase over time. The cumulative relative performance of the equity arm of the portfolio compares to baseline over 40 years is -11% under the Paris Orderly Transition pathway.
- Emerging markets tend to be less sensitive to both climate-related risks.
- Canada & the US suffers the most due to their dependency on fossil fuel exports, lack of energy efficiency and carbon pricing progress and high sensitivity to market sentiment.
- Overall, Japan and Singapore are the winners among the developed markets.
- Low carbon electricity
    - Winners: emerging markets, Australia and Singapore
    - Losers: Europe, the UK
- Other utilities and energy are the most negatively impacted sectors where all regions suffer important losses.

Paris Orderly Transition Pathway

Climate impacts summary – Others

Fixed Income:

- Interest rates in Canada, and most other countries, are not materially impacted in the short-run due to limited climate-related impacts on growth in this pathway.
- In the medium-run most countries experience some negative impacts from the transition, and in the longer term, they suffer more from physical risks.
- The gradual (but generally modest) decline in yields leads to a slight upward pressure on fixed income returns.
- Canadian corporate credits are more significantly impacted with cumulative return of -7% over the next 40 years compared to baseline. Still, these impacts remain much lower than those on equities.

Property:

- Listed and unlisted real estate behave similarly as listed equities. However, differences arise from divergence in regional exposure. It also has some differences in volatility between listed and unlisted benchmarks within a country.

Infrastructure:

- Listed infrastructure assets are expected to perform in a similar fashion as broad equities, albeit with a slightly more negative cumulative performance. OPERF's specific infrastructure exposure is slightly more at risk than our broad benchmark, but remain in line with what's expected on the asset class.

Financial Results

Paris Disorderly Transition

The following subsection focuses on the impacts induced by the Paris Disorderly Transition pathway your portfolio.

The key effects to keep in mind in this pathway are the delayed transition shock that strikes in 2024 as well as the sentiment shock and increased volatility in the following few years. After this initial chaotic transition, this pathway behaves the same way as its orderly counterpart. Annualized results are located in the annex.

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Risk/Return Analysis of portfolio constituents* (annualized absolute results)

Scenario 2: Paris *disorderly* transition pathway	2021-2025			2026-2030			2031-2040			2041-2050			2051-2060			2021-2060		
	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR
Fund	-2.6%	-7.4%	8.4%	0.6%	-8.0%	8.0%	-0.3%	-5.0%	5.2%	-0.5%	-5.1%	5.5%	-0.5%	-5.1%	5.5%	-0.5%	-2.7%	2.9%
Fixed income	-0.5%	-2.7%	2.9%	0.8%	-3.5%	3.8%	0.1%	-2.9%	2.9%	-0.3%	-3.4%	4.9%	-0.3%	-3.4%	4.9%	-0.1%	-1.4%	1.8%
US Investment Grade																		
US Government Bonds																		
US Index-Linked																		
US High Yield																		
EM Debt																		
Equity	-3.3%	-12.2%	13.1%	0.4%	-12.4%	12.2%	-0.3%	-8.6%	8.7%	-0.5%	-8.8%	9.1%	-0.5%	-8.8%	9.1%	-0.7%	-4.6%	4.7%
MSCI World AC																		
Small Cap																		
Minimum Volatility																		
Private Equity	-3.5%	-14.4%	17.1%	1.0%	-14.8%	16.6%	-0.3%	-8.8%	9.3%	-0.5%	-9.4%	9.7%	-0.5%	-9.4%	9.7%	-0.6%	-4.6%	4.7%
Venture Capital/Growth																		
Buyout																		
Emerging Market																		
Distressed Debt																		
Real Estate	-2.0%	-6.7%	7.1%	0.3%	-6.8%	6.7%	-0.3%	-4.6%	4.8%	-0.6%	-4.7%	5.0%	-0.6%	-4.7%	5.0%	-0.6%	-2.5%	2.8%
Direct Real Estate																		
REITs																		
Real Assets	-4.9%	-10.3%	10.5%	-0.1%	-11.0%	12.0%	-1.1%	-6.0%	5.8%	-1.0%	-6.3%	6.5%	-1.0%	-6.3%	6.5%	-1.5%	-3.1%	3.4%
Real Asset Portfolio																		
Opportunity Portfolio																		
Diversifying Strategies	-1.3%	-5.1%	5.5%	0.7%	-5.0%	5.5%	-0.1%	-3.9%	3.9%	-0.1%	-3.8%	4.1%	-0.1%	-3.8%	4.1%	-0.2%	-1.9%	1.9%
HF Fund of Funds																		
Risk Parity	-2.3%	-10.6%	11.3%	1.0%	-10.8%	10.9%	0.1%	-6.3%	7.1%	-0.2%	-6.8%	8.0%	-0.2%	-6.8%	8.0%	-0.1%	-3.4%	3.8%
Global Sovereign Rates																		
Inflation-Linked Bonds																		
Corporate Credits																		
Listed Equities																		
Commodities																		

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**Additional granularity can be provided upon request*

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Sectorial Impacts under the Paris Disorderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 5 years

Cumulative climate impact - Paris Disorderly	5Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-15.9%	-26.8%	-23.3%	-2.7%	-67.8%	-15.8%	-15.8%	-15.4%	-17.2%	-14.7%	-16.1%	-15.6%	-15.9%	-15.4%	-15.2%	-15.5%	-15.6%
	DM	-16.6%	-34.3%	-23.5%	23.4%	-59.1%	-16.0%	-16.3%	-16.2%	-19.0%	-15.6%	-16.3%	-14.1%	-16.2%	-15.8%	-15.7%	-16.2%	-16.4%
	Europe	-16.7%	-33.1%	-28.6%	-9.5%	-57.1%	-15.2%	-15.5%	-16.2%	-16.3%	-15.7%	-16.7%	-14.6%	-15.9%	-15.8%	-15.5%	-15.2%	-15.9%
DEVELOPED MARKETS	US																	
	Japan																	
	UK																	
	France																	
	Germany																	
	Canada																	
	Sweden																	
	Switzerland																	
	Australia																	
	Netherlands																	
	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-18.0%	-34.4%	-23.1%	-2.7%	-82.9%	-17.0%	-17.0%	-16.8%	-16.3%	-15.6%	-17.7%	-17.3%	-16.1%	-16.3%	-13.8%	-16.9%	-14.8%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 79

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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Sectorial Impacts under the Paris Disorderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 10 years

Cumulative climate impact - Paris Disorderly	10Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-12.2%	-32.6%	-26.2%	41.1%	-80.2%	-12.0%	-12.6%	-10.9%	-15.2%	-9.6%	-13.5%	-12.7%	-13.0%	-12.0%	-10.3%	-11.9%	-12.1%
	DM	-13.7%	-41.4%	-25.9%	102.6%	-77.4%	-13.2%	-13.8%	-13.1%	-18.3%	-11.8%	-13.9%	-11.4%	-14.2%	-13.5%	-12.2%	-13.6%	-14.1%
	Europe	-13.2%	-44.6%	-33.7%	8.0%	-78.0%	-9.8%	-12.1%	-11.4%	-13.6%	-10.4%	-13.4%	-11.0%	-13.1%	-12.5%	-9.5%	-10.7%	-12.3%
DEVELOPED MARKETS	US																	
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	Spain																	
	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-13.5%	-39.8%	-23.6%	54.7%	-89.2%	-12.3%	-12.2%	-10.5%	-12.2%	-9.5%	-14.9%	-13.0%	-12.2%	-11.4%	-9.2%	-11.7%	-10.7%
EMERGING MARKETS	China																	
	India																	
	South Korea																	
	Brazil																	
	Russia																	
	Malaysia																	
	Thailand																	
	Indonesia																	
	Philippines																	
	Taiwan																	

Exhibit 6 p. 80

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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Sectorial Impacts under the Paris Disorderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 20 years

Cumulative climate impact - Paris Disorderly	20Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-14.0%	-43.4%	-34.8%	64.2%	-96.0%	-13.1%	-14.3%	-12.9%	-18.0%	-11.3%	-15.5%	-13.8%	-14.5%	-13.2%	-12.5%	-13.1%	-13.5%
	DM	-15.7%	-53.9%	-34.7%	175.3%	-88.8%	-15.1%	-15.7%	-16.1%	-22.3%	-14.5%	-16.0%	-11.2%	-16.2%	-15.1%	-14.7%	-15.7%	-16.5%
	Europe	-14.1%	-58.8%	-45.1%	10.2%	-90.8%	-8.0%	-12.5%	-13.0%	-14.0%	-11.5%	-14.5%	-9.3%	-13.0%	-13.0%	-11.5%	-10.0%	-12.8%
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	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-14.6%	-50.3%	-29.5%	215.5%	-95.4%	-12.6%	-13.2%	-11.7%	-13.1%	-10.8%	-16.4%	-13.6%	-13.1%	-11.7%	-10.6%	-12.2%	-12.2%
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Exhibit 6 p. 81

** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

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Sectorial Impacts under the Paris Disorderly Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 40 years

Cumulative climate impact - Paris Disorderly	40Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.*	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-22.1%	-55.7%	-45.3%	65.9%	-100.0%	-23.0%	-22.2%	-21.1%	-27.5%	-18.9%	-23.0%	-21.6%	-22.7%	-20.7%	-20.8%	-21.5%	-21.6%
	DM	-23.0%	-68.0%	-43.8%	204.1%	-95.8%	-22.8%	-23.8%	-24.0%	-31.8%	-22.2%	-23.4%	-16.3%	-23.2%	-21.6%	-22.3%	-23.7%	-24.6%
	Europe	-19.3%	-64.1%	-51.6%	-5.4%	-99.2%	-16.8%	-15.7%	-19.0%	-18.5%	-17.6%	-19.4%	-13.0%	-17.2%	-16.8%	-17.7%	-16.0%	-17.6%
DEVELOPED MARKETS	US																	
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	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-18.6%	-60.7%	-37.6%	545.3%	-97.9%	-19.0%	-18.1%	-17.1%	-18.7%	-16.1%	-22.4%	-19.2%	-17.8%	-13.7%	-14.9%	-17.7%	-17.3%
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** Note that some region/sector combinations were originally very small which cause the growth rate to appear particularly large*

Paris Disorderly Transition Pathway

Climate impacts summary – Public equities

Public equity:

- The asset class is impacted by the pricing-in shock in 2025H2 – 2026H1. This shock is deployed rapidly due to the delay in the implementation of required policies under the Paris transition.
- Both the pricing-in shock and the sentiment shock have a large impact across all regions from 2025H2 – 2026H1 onwards as delayed market pricing-in strikes.
- Under the Paris Disorderly pathway, there is a loss of about 17% on your equity portfolio in the first 5 years compared to the baseline. In 2025H2 – 2026H1, the abrupt sentiment shock also takes place and adds on top of the pricing-in shock.
- After the recovery, equity returns move roughly to baseline levels in both Paris pathways, while towards the end of the time horizon, equity returns are lowered by physical risks.

Summary of climate impacts on equities:

- Because of the delayed pricing-in shock, all the impacts are more significant in this pathway than under the Paris Orderly transition. Furthermore, the sentiment shock materially affects cumulative climate impacts by 2026.
- Emerging markets benefit from the transition to low-carbon technologies but are also more sensitive to negative impacts on high carbon technologies.
- Japan and Singapore are the “winners” among developed markets.
- Low carbon electricity – all regions benefit, however relatively we see the following:
    - Winners are Australia, emerging markets, Japan, the US
    - Losers: Europe and the UK
- Other utilities and Energy are the most negatively impacted sectors where all regions suffer important losses.

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Paris Disorderly Transition Pathway

Climate impacts summary – Others

Fixed Income:

- Apart from the sentiment shock as well as different size and timing of the pricing-in shock, the yields are impacted in the same way as under the Paris Orderly Transition pathway. Therefore, in the medium term, interest rates generally go down slightly, with a somewhat larger impact for Canada than the UK for instance.
- This gradual (but generally modest) decline in yields leads to slight upward pressure on fixed income returns.
- The sentiment shock causes some upward short-term movements of sovereign yields, especially for the Canada, which in turns improve fixed income returns.
- For corporate credits, spread tightening movements benefit the portfolio after climate shocks.

Property:

- Similar impacts as under the Paris Orderly Transition pathway.

Infrastructure:

- Similar impacts as under the Paris Orderly Transition pathway.

Financial Results

Failed Transition

The following subsection focuses on the impacts induced by the Failed Transition pathway on your portfolio. The key effects to keep in mind in this pathway are the important physical risks that build up as time goes on. The expected losses associated with the physical risks compound with time and lead to important losses. As noted earlier, by 2038, the Failed Transition pathway is already expected to be the worst pathway of the three. From our experience, your portfolio is moderately impacted due to its exposure to relatively exposed assets classes such as public equities, real estate and infrastructure. The strong emphasis on Canadian assets reduces the exposure of the portfolio due to the smaller physical risks, compared to other, less resilient countries such as the US. All alternative asset mixes increase this exposure due to the reduction in Canadian exposure. Annualized results are located in the annex.

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Risk/Return Analysis of portfolio constituents* (annualized absolute results)

Scenario 3: Failed transition pathway

	2021-2025			2026-2030			2031-2040			2041-2050			2051-2060			2021-2060		
	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR	Median	Bottom 5% VaR	Top 5% VaR
Fund	0.0%	-7.2%	8.1%	-0.7%	-7.9%	8.0%	-2.8%	-4.9%	5.1%	-0.9%	-5.1%	5.5%	-0.9%	-5.1%	5.5%	-1.1%	-2.7%	2.9%
Fixed income	0.0%	-2.5%	2.9%	0.0%	-3.4%	3.7%	0.0%	-2.9%	3.0%	-0.3%	-3.4%	4.9%	-0.3%	-3.4%	4.9%	0.0%	-1.4%	1.7%
US Investment Grade																		
US Government Bonds																		
US Index-Linked																		
US High Yield																		
EM Debt																		
Equity	0.0%	-11.5%	12.1%	-0.9%	-12.2%	11.7%	-3.5%	-8.6%	8.7%	-1.2%	-8.8%	9.1%	-1.2%	-8.8%	9.1%	-1.5%	-4.6%	4.6%
MSCI World AC																		
Small Cap																		
Minimum Volatility																		
Private Equity	0.0%	-14.4%	17.2%	-1.3%	-14.7%	16.6%	-5.0%	-8.8%	9.3%	-1.1%	-9.4%	9.7%	-1.1%	-9.4%	9.7%	-1.9%	-4.6%	4.7%
Venture Capital/Growth																		
Buyout																		
Emerging Market																		
Distressed Debt																		
Real Estate	-0.1%	-6.7%	7.0%	-0.8%	-6.8%	6.8%	-3.2%	-4.7%	4.9%	-1.1%	-4.7%	4.9%	-1.1%	-4.7%	4.9%	-1.4%	-2.5%	2.8%
Direct Real Estate																		
REITs																		
Real Assets	0.0%	-10.3%	10.5%	-0.8%	-11.1%	12.1%	-3.4%	-6.0%	5.9%	-1.2%	-6.3%	6.5%	-1.2%	-6.3%	6.5%	-1.4%	-3.1%	3.4%
Real Asset Portfolio																		
Opportunity Portfolio																		
Diversifying Strategies	0.0%	-5.1%	5.3%	-0.3%	-4.9%	5.5%	-1.1%	-3.9%	3.8%	-0.3%	-3.8%	4.1%	-0.3%	-3.8%	4.1%	-0.4%	-2.0%	1.8%
HF Fund of Funds																		
Risk Parity	0.0%	-10.1%	10.6%	-0.4%	-10.7%	10.7%	-1.4%	-6.4%	7.1%	-0.3%	-6.7%	8.0%	-0.3%	-6.7%	8.0%	-0.5%	-3.3%	3.8%
Global Sovereign Rates																		
Inflation-Linked Bonds																		
Corporate Credits																		
Listed Equities																		
Commodities																		

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*Additional granularity can be provided upon request

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Sectorial Impacts under the Failed Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 5 years

Cumulative climate impact - Failed Transition	5Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
	DM	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
	Europe	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
DEVELOPED MARKETS	US																	
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	Finland																	
	Denmark																	
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	EM	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
EMERGING MARKETS	China																	
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Sectorial Impacts under the Failed Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 10 years

Cumulative climate impact - Failed Transition	10Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-5.2%	-5.0%	-5.1%	-5.2%	-4.9%	-5.2%	-5.2%	-5.2%	-5.1%	-5.2%	-5.2%	-5.2%	-5.1%	-5.1%	-5.2%	-5.2%	-5.1%
	DM	-5.3%	-4.7%	-4.9%	-4.7%	-4.4%	-5.2%	-5.2%	-5.3%	-4.6%	-5.4%	-5.5%	-5.1%	-4.8%	-5.1%	-5.3%	-4.9%	-4.7%
	Europe	-4.3%	-3.9%	-4.0%	-3.7%	-2.7%	-3.6%	-4.1%	-4.7%	-3.5%	-5.2%	-5.1%	-4.1%	-3.4%	-4.2%	-4.5%	-4.2%	-3.9%
DEVELOPED MARKETS	US																	
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	Finland																	
	Denmark																	
	Norway																	
	EM	-4.0%	-3.8%	-4.0%	-3.8%	-3.7%	-3.7%	-3.8%	-4.0%	-3.8%	-4.4%	-4.4%	-3.9%	-3.8%	-3.9%	-3.2%	-3.8%	-3.6%
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	Brazil																	
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Sectorial Impacts under the Failed Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 20 years

Cumulative climate impact - Failed Transition	20Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-36.3%	-36.2%	-36.3%	-36.3%	-36.1%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%	-36.3%
	DM	-34.9%	-34.0%	-34.1%	-32.1%	-31.9%	-32.4%	-34.5%	-35.2%	-31.9%	-36.4%	-36.3%	-34.2%	-31.9%	-33.7%	-34.0%	-33.1%	-32.7%
	Europe	-24.1%	-23.8%	-23.9%	-18.5%	-17.7%	-18.5%	-23.5%	-27.4%	-17.6%	-31.4%	-30.6%	-23.0%	-17.6%	-23.1%	-24.5%	-21.9%	-20.1%
DEVELOPED MARKETS	US																	
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	Italy																	
	Singapore																	
	Finland																	
	Denmark																	
	Norway																	
	EM	-40.6%	-42.4%	-42.5%	-41.0%	-41.0%	-41.0%	-41.6%	-41.4%	-40.9%	-36.8%	-37.4%	-41.7%	-40.3%	-41.8%	-33.3%	-41.3%	-34.3%
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Sectorial Impacts under the Failed Transition Pathway

Cumulative return (difference to baseline) heat map – Public equities – 40 years

Cumulative climate impact - Failed Transition	40Y	Total	Oil & Gas	Other Energy	Low Carbon Electric.	Other Utilities	Water Supply	Forestry	Materials	Public Admin.	Industrials	Consumer Disc.	Consumer Staples	Health	Financials	IT	Telecom	Real Estate
	World	-49.7%	-49.6%	-49.7%	-49.8%	-49.6%	-49.7%	-49.8%	-49.7%	-49.7%	-49.7%	-49.7%	-49.8%	-49.7%	-49.7%	-49.8%	-49.7%	-49.7%
	DM	-45.7%	-44.7%	-44.8%	-42.5%	-42.3%	-42.8%	-45.1%	-45.7%	-42.4%	-47.2%	-47.0%	-44.9%	-42.3%	-44.2%	-44.6%	-43.7%	-43.3%
	Europe	-34.2%	-33.9%	-34.0%	-28.2%	-27.5%	-28.2%	-33.5%	-37.6%	-27.3%	-41.7%	-40.9%	-33.0%	-27.2%	-33.1%	-34.6%	-31.8%	-29.9%
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	Denmark																	
	Norway																	
	EM	-51.4%	-52.9%	-52.9%	-51.0%	-51.0%	-51.0%	-51.6%	-51.7%	-50.7%	-48.3%	-49.0%	-52.0%	-50.1%	-52.0%	-40.9%	-51.5%	-43.3%
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Failed Transition Pathway

Climate impacts summary – Public equities

Public equities:

- The entire asset class is affected by the delayed pricing in shocks from 2026-2031 and 2036-2041.

Summary of climate impacts on equities:

- In the first 5 year time bucket, impacts on equities are muted when compared to those of the Paris Transition pathways. This is because under the Failed Transition pathway, pricing-in shocks only start in 2026 and no transition shock occurs. A second pricing shock strikes in 2036-2041, intensifying the impact of physical risks on the asset class.
- Unlike under the Paris Transition pathways, the low-carbon electricity sector does not grow under the Failed Transition pathway. Since no additional efforts are made to transition towards renewable energy and no additional “green” technologies are developed, sectors only suffer from physical and extreme weather impacts, without experiencing any transition opportunities.
- There are no winners. The least impacted countries are Switzerland and Canada – due to their geographic location.

Failed Transition Pathway

Climate impacts summary – Others

Fixed income:

- Pricing in physical shocks in 2026-2031 and 2036-2041 hit the asset class during these periods. However, the credit spreads tightening in the subsequent years after both shocks benefit the asset class. From 2040, we see a rebound in credit returns.
- The asset class is not strongly affected by slow onset physical risks over the short and medium term. The influence on interest rates becomes significant in the long term (roughly from 2040 onwards). Significant lower economic growth in the long term drives nominal yields down.
- In the short to medium term, fixed income returns are not significantly impacted. In the long term, expected returns are lower due to the structurally low yields.
- Credits have a positive climate shock over the whole horizon. In comparison to equities, this is partially explained by the shorter term horizon compared to equities while climate impacts, especially under the Failed Transition, are more long-term oriented.

Property:

- Real estate is significantly affected by the pricing in shocks as the asset class is sensitive to physical damages and requires a strong correction in its valuation.
- The asset class is further impacted more significantly towards the end of the period when physical damages start to affect real estate prices.

Infrastructure:

- Infrastructure assets are expected to be affected more than other asset classes, particularly so in the US. The asset class suffers more or less like listed equities.

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OREGON
STATE
TREASURY

Tobias Read
Oregon State Treasurer

Michael Kaplan
Deputy State Treasurer

January 18, 2023

Members of the Oregon Legislature:

I've been asked in recent days about my position on HB 2601 and other investment-related legislation. I'll be direct: Statutorily limiting the investment opportunities of the Oregon Public Employee Retirement Fund (OPERF)—no matter how well-intentioned—will lead to lower returns, higher employer rates, and a less robust retirement for thousands of Oregonians.

Nearly 400,000 current and former public employees receive or will receive retirement benefits via OPERF. The average annual benefit is $33,550. Money in OPERF, currently valued at more than $91 billion, belongs to these individuals and no one else. This money comes from two sources. The first is contributions from employers and approximately 181,000 public employees, who currently pay into the fund and rightly expect that someday it will make their retirement possible. The second is earnings from the investment of these contributions, managed at Treasury under my leadership and the oversight of the Oregon Investment Council.

Just under 75 percent of all benefits paid out to retirees are made possible by Treasury-managed investment earnings. In 2022, OPERF returns outperformed policy benchmarks by nearly 7 percent and the standard market portfolio by over 15 percent, proving that our investment strategies are beating expectations and resilient in all market conditions. Under Treasury's management, OPERF investment strategies have returned billions of dollars in net revenues to beneficiaries.

Legislation that imposes blanket or even targeted restrictions on how or where Treasury can invest will affect these numbers and would mean that funding retirement incomes is no longer the sole purpose of OPERF. Claims that limiting Oregon's investment choices through statute will automatically or easily be revenue-neutral or yield higher returns are pure fiction.

Instead, these restrictions will almost certainly lead to a reduction in investment returns and the benefits OPERF payments afford communities across our state. Lower returns would mean an increase in OPERF's unfunded liability. This could potentially erase the progress in funding status we've achieved from 75.4 percent when I was elected Treasurer in 2016, to 86 percent in 2021. A larger unfunded liability will require larger contributions from employers and their employees. When public entities must direct more money to cover their retirement system obligations, they have less money for the classroom, the firehouse, child welfare offices, and other state and local government services. Further, disregarding existing state law about investing for the sole benefit of OPERF beneficiaries will invite lawsuits and threaten our tax-

exempt status while breaking beneficiaries' trust in our stewardship of their personal retirement dollars.

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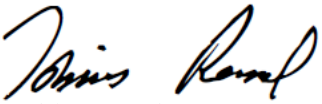
It's one thing to offer commentary and criticism of how this money is invested or which companies to pick; it's quite another to have a fiduciary and statutory responsibility to make participants' money as productive as possible, and to earn a rate of return each and every year, in good markets and bad, to ensure Oregon meets its promises to public servants. Our team of investment professionals has proven to be more than capable of meeting our fiduciary responsibilities while navigating changing market conditions and macro industry shifts, and I am confident in our ability to anticipate and respond to future market conditions.

Our obligation extends far into the future, and so does our planning. As legislation is introduced and debated this session, I urge you to reach out to me and my team, which includes 69 investment professionals who have taken great care to construct and manage diversified portfolios that deliver for Oregonians. I would be happy to provide details about work underway at Treasury to develop a responsible pathway to a net-zero portfolio that still allows us to respond to dynamic market conditions as the energy transition continues.

Sincerely,



Tobias Read

CC:

Governor Tina Kotek
Bob Livingston, Legislative Director and Labor Liaison, Office of the Governor
Kevin Olineck, Director, Oregon Public Employees Retirement System
Cara Samples, Chair, Oregon Investment Council
John Russell, Vice-Chair, Oregon Investment Council
Lorraine Arvin, Member, Oregon Investment Council
Pia Wilson-Body, Member, Oregon Investment Council
George Naughton, Chief Financial Officer, Department of Administrative Services
Amanda Beitel, Legislative Fiscal Officer, Oregon State Legislature
Chris Allanach, Legislative Revenue Officer, Oregon State Legislature
Misty Mason Freeman, Legislative Policy and Research Director, Oregon State Legislature

Returns for periods ending DEC-2021

Oregon Public Employees Retire

Regular Account

OPERF	Policy[1]	Target[1]	$ Thousands[2]	Actual
Public Equity	25.0-35.0%	30.0%	$ 25,734,656	26.7%

Figure 5: Asset Allocation and Climate Scenario Analysis[1]

Name of Asset Owner	AUM ($B)	Address Climate Change Risks/Opportunities in Strategic Asset Allocation?	Employ Climate Scenario Analysis?
MSBI	94	No	No
CalPERS	480	Not explicitly but assumptions are made based on climate risk	Yes
CalSTRS	320	No	No
NYSCRF	280	Yes	Yes
NYCRF	275	No	Ad hoc
UC Regents	168	Yes	Yes
NYSTRS	146	No, address Stewardship	No, reviewing vendors
OST	97	No	Engaged with external parties to provide portfolio impact analysis
LACERA	75	Yes	Yes, both top-down and bottom-up
MSRPS	68	Yes	Yes
PD	48	Yes, dedicated portfolios for sustainable/green investments	Temperature alignment tools used for public equity
CRTPF	46	Yes, generally, no climate related to date	No
SFERS	37	No	Yes, use PACTA scenario analysis
Illinois SURS	24	No	No
DCRB	11	No	No
ERSRI	11	No	No
LPFA	10	Intended	No
VPIC	6	Yes	No
SCERS	4	Yes	Yes
EBMUDERS	2	Not directly	No

→ Explicitly incorporating climate risks and opportunities into capital market assumptions, that are then used to set long-term strategic asset allocation, is a nascent practice.

→ The majority of plans do not currently address climate changes risks and opportunities in their strategic asset allocation. Among the nine funds who indicated that they do, there were widely ranging definitions including specific carve outs dedicated to sustainable/green investments.

→ Ten of the plans do not currently employ climate scenario analysis. Three funds indicate that they are either reviewing options or may use climate scenario analysis in the future.

[1] Source: Meketa survey and research.

MEKETA
INVESTMENT GROUP

Oregon Investment Council

November 2, 2022

2022
Final Asset-Liability Study Results

Table of Contents

Introduction and Goals for Today

Introduction

→ This presentation seeks to conclude the 2022 Asset-Liability Study.

→ A subset of major asset-liability metrics are analyzed across a series of portfolios:

- Current Policy
- Actual Allocation
- Option #1
- Option #2
- Option #3

} Staff/Consultant Recommendations

→ For the OIC, asset allocation design is the most important decision on the asset side.

→ The process for designing and selecting an asset allocation is part art and science.

→ There is no "right" asset allocation for all purposes.

Goals for Today

→ The ultimate goal for today is to select a new long-term policy allocation for OPERF.

→ We will review the major takeaways from the entire process as well as new asset-liability output for a series of proposed portfolio options.

→ After in-depth dialogue in September regarding preliminary results, the following were the major conclusions:

- Based on the asset-liability modeling process, OPERF appears well situated.
- With the currently utilized constraints, improvements in the asset-liability posture are difficult.
  - More "efficient" portfolios would generally rely on even higher allocations to private markets and/or higher allocations to Diversifying Strategies. Both options face headwinds (e.g., liquidity constraints, implementation challenges, etc.).
- Examining materially different portfolios (e.g., less private markets) could shift the asset-liability posture, but the shift would likely be to a less efficient portfolio.
- Any alterations, whether small or large, would represent more of a preference of the OIC rather than a conclusion from the asset-liability modeling process.

→ Staff, Meketa, and Aon incorporated these takeaways and propose three potential new long-term policy allocations for the OIC to consider.

Current, Actual, and Proposed Portfolios | Asset-only Metrics

	Current Policy	Actual Allocation*	Option #1	Option #2	Option #3
Public Equity	30.0%	23.0%	30.0%	25.0%	20.0%
Fixed Income	20.0%	20.0%	20.0%	25.0%	30.0%
Risk Parity	2.5%	2.0%	---	---	---
Private Equity	20.0%	28.0%	22.5%	22.5%	22.5%
Real Estate	12.5%	14.0%	12.5%	12.5%	12.5%
Real Assets	7.5%	8.0%	7.5%	7.5%	7.5%
Diversifying Strategies	7.5%	5.0%	7.5%	7.5%	7.5%
Expected Max Drawdown*	41.4%	44.7%	43.2%	40.0%	37.0%
Expected Volatility*	11.9%	12.7%	12.3%	11.6%	10.8%
Expected Return*	7.7%	8.0%	7.8%	7.6%	7.5%
Illiquids	40.0%	50.0%	42.5%	42.5%	42.5%

→ All proposed options:

- Eliminate allocation to Risk Parity
- Increase Private Equity target by 2.5%
- Maintain allocations to Real Estate, Real Assets, and Diversifying Strategies

→ *Sole difference: Tradeoff between Public Equity and Fixed Income*

*Actual Allocation as of 11/2/2022 will differ. Detailed allocation is as of August 2022 and is consistent with the September A/L presentation.
**See Appendix for methodology/calculation details

Portfolio Options - Rationale

	Decision	Rationale
Public Equity Fixed Income	Range of allocations: Public Equity (20-30%) Fixed Income (20-30%) Total = 50%	• The most liquid elements of OPERF. Total allocation of 50% is prudent for liquidity management. • Tradeoff among the two is the primary mechanism (based on other constraints/decisions) to influence total OPERF risk level.
Risk Parity	Eliminate	• Elimination of the segment is largely an effort to streamline the portfolio and corresponding oversight/management. • At the current target weight, the impact on the total portfolio is immaterial. • Recent experience has failed to meet expectations. • Current cost of leverage is an additional headwind.
Private Equity	Increase target by 2.5%	• Effectively the reallocation away from Risk Parity and to Private Equity. • Actual allocation is materially above current target allocation. • A slight increase in the policy target helps to narrow the difference between actual allocation and policy target. • New target provides a more achievable level.
Real Estate	Maintain at current policy target	• Actual allocation is within a reasonable range of current policy target. • Collective agreement among Staff/Meketa/Aon that policy target is appropriate from risk/return and liquidity perspectives.
Real Assets	Maintain at current policy target	• Actual allocation is within a reasonable range of current policy target. • Collective agreement among Staff/Meketa/Aon that policy target is appropriate from risk/return and liquidity perspectives.
Diversifying Strategies	Maintain at current policy target	• Relatively new class with a newly adopted structure. • Current policy target represents an achievable allocation with a corresponding measurable impact on the total portfolio.

Process Review

3 key high-level steps to the A/L process:

1.

Develop an understanding of **how the financial condition of OPERS/OPERF might vary** based on outcomes of the investment portfolio.

2.

Set a consensus definition and view of the risk(s) the OIC is willing to bear.

3.

Once a view/tolerance for risk has been established, **select an appropriate long-term investment strategy** (i.e., a policy portfolio / strategic allocation).

Simulation-Based Optimization

→ For OPERF, Meketa utilized a proprietary, customizable simulation model.

→ For each asset class, we developed non-normal distribution assumptions (i.e., forward-looking assumptions for expected return, volatility, skew, and kurtosis).

→ Portfolio statistics are based on 10,000 multi-decade simulations (e.g., 20 years).

→ Process requires significant time and computing power, but it allows for custom modeling and performance statistics.

→ Differs from traditional mean-variance optimization.

- Mean-Variance Optimization ("MVO"):
  - Workhorse for asset allocation analysis since the 1950s
  - Single-period model
  - Assumes normal distributions and linear relationships
  - Only examines risk under standard deviation lens
  - Doesn't incorporate crisis situations (i.e., correlations moving to 1)
  - Fails to accurately reflect potential outliers

Liability Structure

→ Output from Meketa's simulation model was provided to Milliman for integration with the liability structure.

→ Milliman utilized the same model as shown to the PERS Board at the December 2021 meeting[1].

→ The model was updated to incorporate the 2021 full-year OPERF returns and inflation.

→ Meketa provided Milliman with 10,000 simulations of 20-year horizons for each potential portfolio under examination.

- The first year of each simulation incorporated OPERF realized returns[2] and inflation for the first six months with simulated data for the remaining six months. All other years were fully simulated.

→ In addition to simulations for different total portfolios, Meketa provided Milliman with corresponding simulations for Public Equity and Inflation.

[1] Please refer to that presentation for information on the data, assumptions, methods, reliance, and disclaimers regarding the model.
[2] To better reflect economic reality, Meketa and OST Staff elected to markdown the Private Equity portfolio by the same amount as Public Equity for the first six months of 2022.

Review of Prior Discussions

→ Up to this point, the 2022 OPERF Asset-Liability Study has revolved around three primary items:

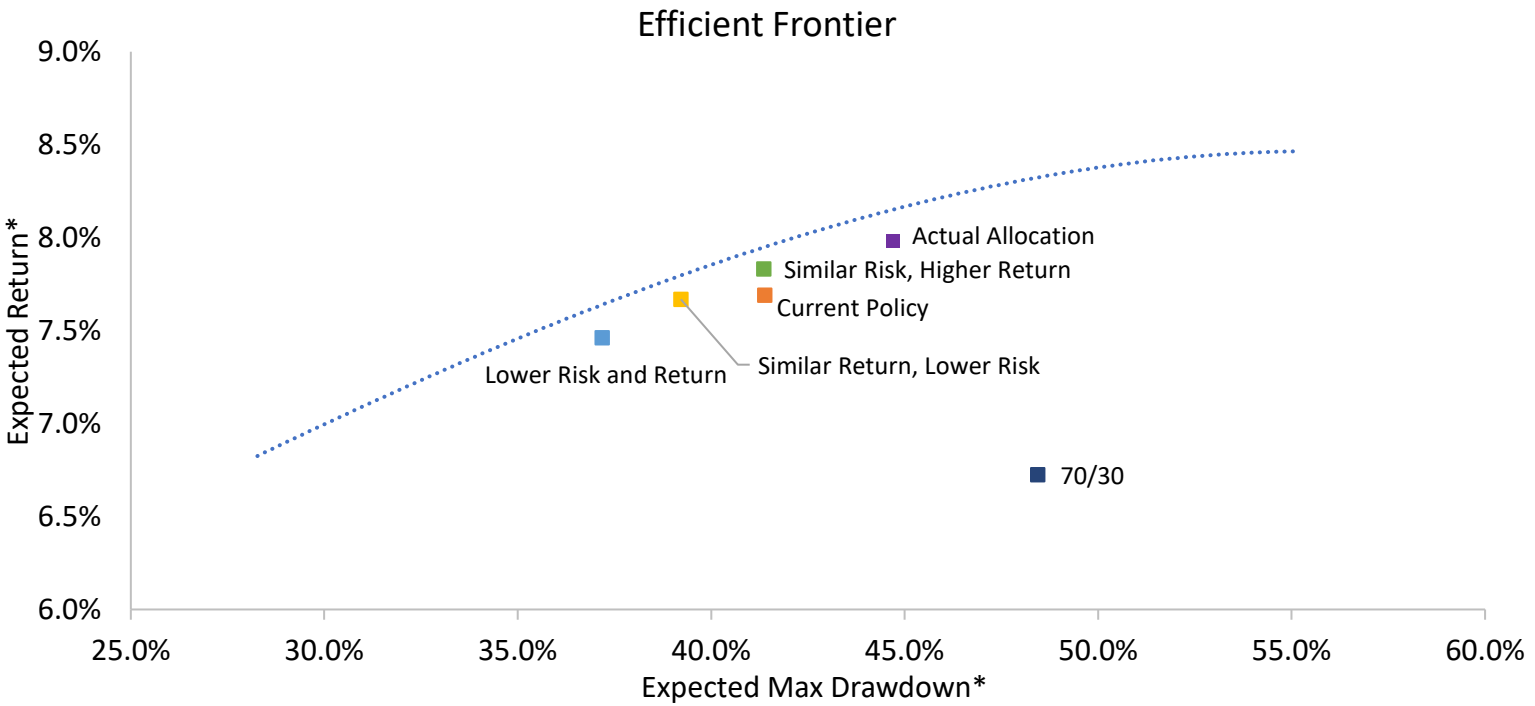
- April | Risk and Implementation Survey Results
- June | Capital Market Assumptions
- September | Exploration of Preliminary Asset-Liability Results

→ Each of these discussions built on top of one another, with today's discussion representing the culmination of the reviewed data and dialogue to date.

- The following two slides were presented in September and are provided again solely for review purposes.

From September OIC Meeting

Efficient Frontier and Examined Portfolios



→ The discussion in September focused on three illustrative portfolios. These represented general "directions" that OPERF could follow based on metrics from an asset-only perspective.

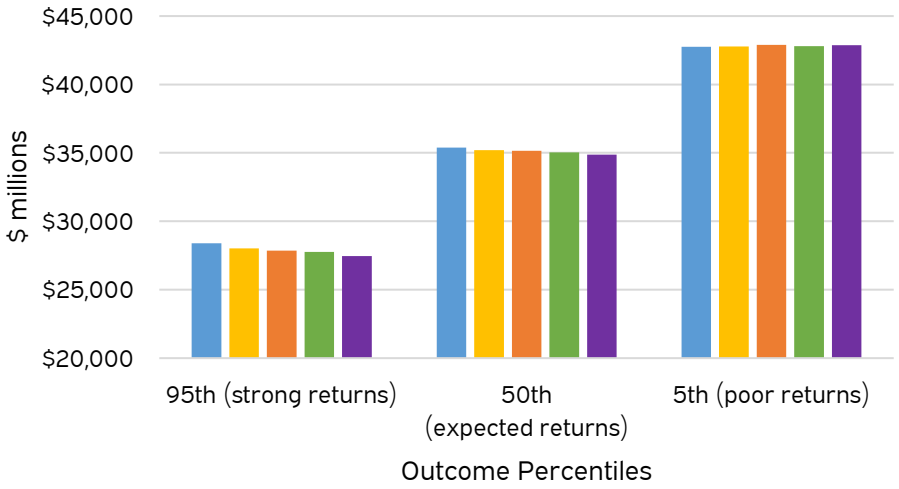
→ In addition to an asset-only view, the OIC examined these same illustrative portfolios under an asset-liability lens.

*See Appendix for methodology/calculation details

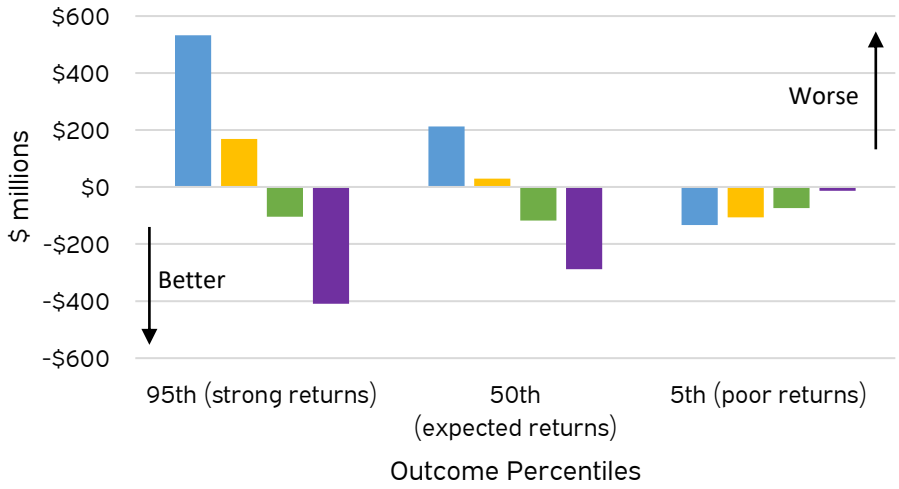
From September OIC Meeting

Total Contributions over 10 Years*

Total Contributions over 10 years (2022-2031)



Total Contributions (vs. Current Policy) over 10 years (2022-2031)



Lower Risk and Return | Similar Return, Lower Risk | Current Policy | Similar Risk, Higher Return | Actual Allocation

→ From an asset-liability perspective, the illustrative portfolios exhibited only marginal differences over an intermediate timeframe (i.e., 10 years).

→ Contribution differences were greatest under a strong return environment (top 5th percentile of outcomes).

→ Contribution differences were minimal under a poor return environment (bottom 5th percentile of outcomes).

*Excluding Side Account transfers

Market Update

Market Update

→ 2022 has been an extremely volatile year.

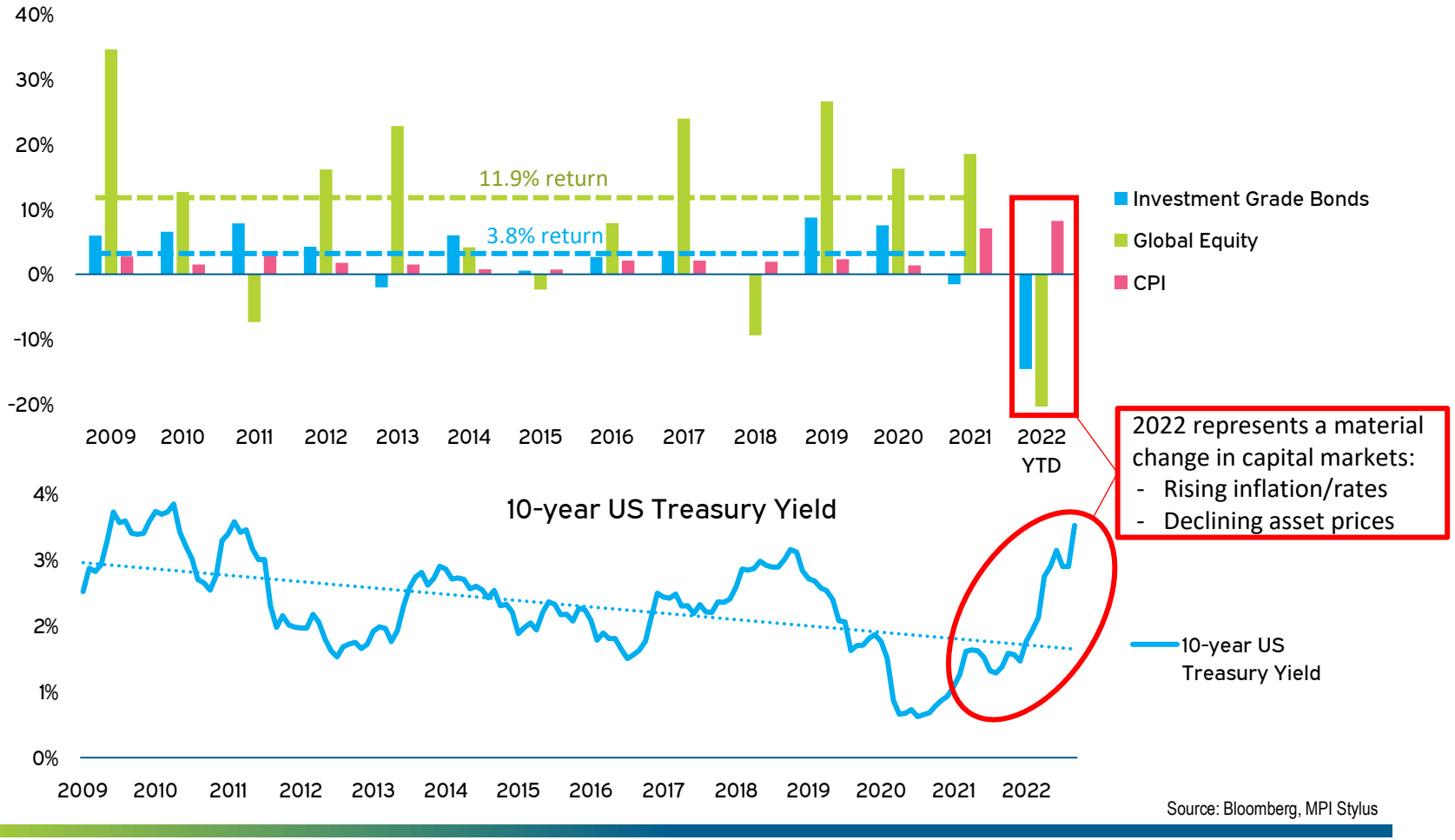
- Major events across the globe (e.g., inflation, rising interest rates, Russia/Ukraine, UK Gilts, etc.) continue to shape and/or be shaped by capital market dynamics.

→ Subsequent to the September meeting, Staff/Meketa/Aon have continued to examine the capital market environment and potential new policy portfolios.

- While forecasting market behavior (particularly over the short-term) is an extremely challenging endeavor, ensuring that the capital market assumptions remain reasonable is necessary.

Looking Back - A Decade+ of Tailwinds

Equities, Bonds, and Inflation | 2009-2022 YTD (as of 9/30/22)



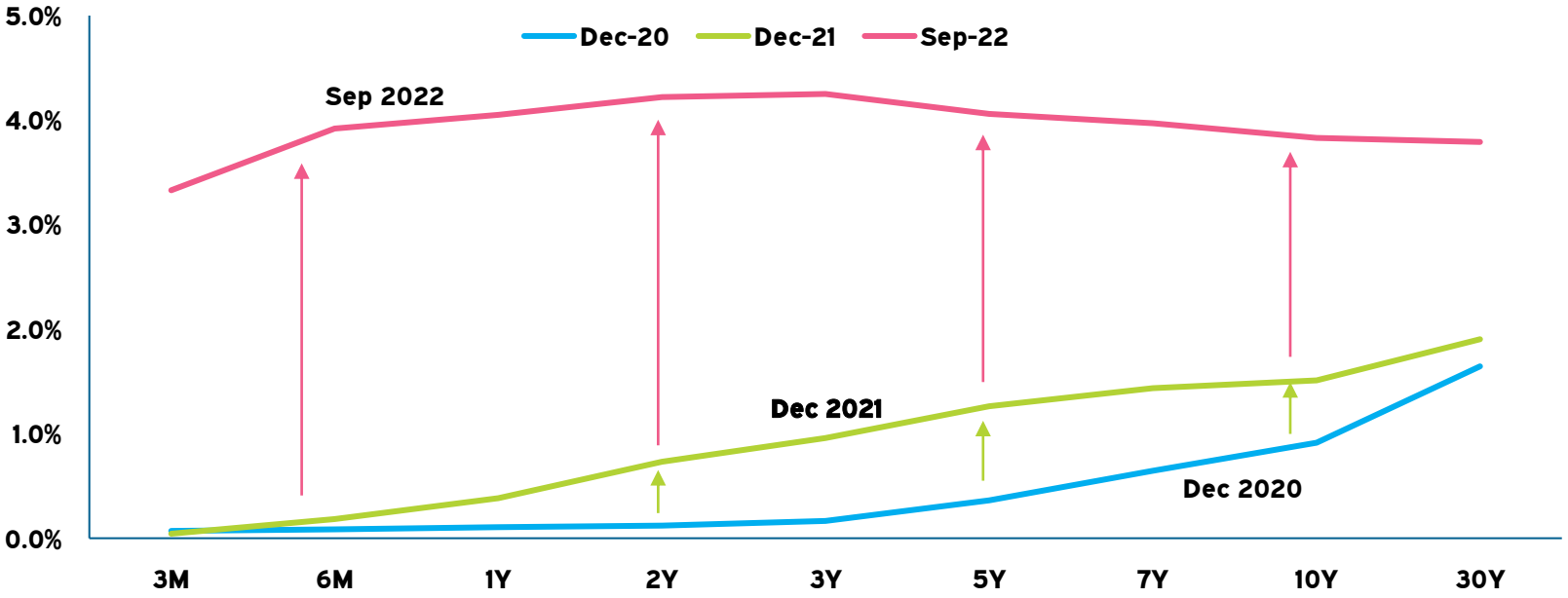
Source: Bloomberg, MPI Stylus

Rising Interest Rates

→ The US Treasury yield curve steepened during 2021, as concerns about inflation battled with the demand for safe-haven assets (e.g., Treasuries) and Federal Reserve polices designed to maintain low rates (e.g., the quantitative easing program).

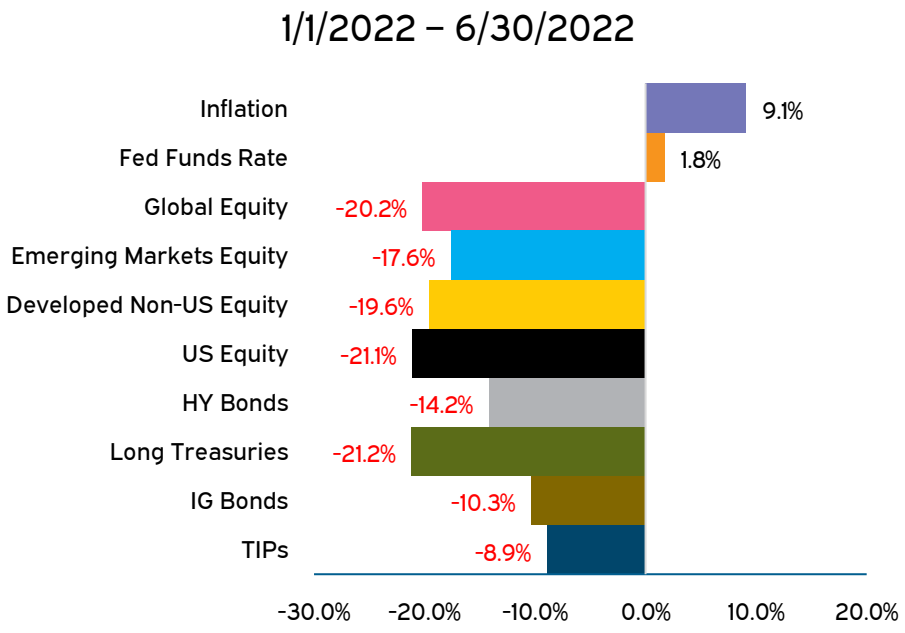
→ Coinciding with elevated and sustained inflation, rates have continued to increase in 2022 YTD.

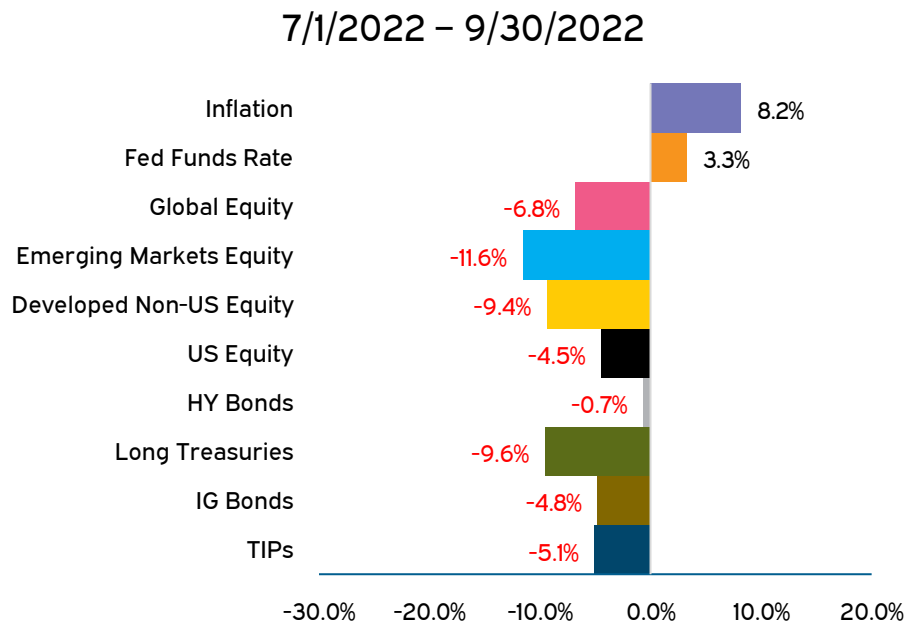
US Yield Curve



Source: Bloomberg. Data is as of September 30, 2022.

2022 = A Consistent Theme





→ Q3 2022 (right chart) details the additional market declines due to sustained inflation and rising interest rates.

→ Throughout 2022, there has been nowhere to hide in traditional markets.

Source: Bloomberg, MPI Stylus
Note: Inflation data represents trailing 12-month CPI.

Capital Market Assumptions

→ OST Staff, Meketa, and Aon believe that the previously presented capital market assumptions remain prudent.

→ Within risk-oriented markets (e.g., equity, credit, etc.), the tradeoff between more attractive valuations is likely buffered by a deterioration in fundamentals (e.g., earnings, defaults/recoveries, etc.).

→ The prevailing interest rate environment was generally incorporated into prior assumptions.

→ The utilized capital market assumptions remain reasonable for the long-term oriented time horizon of an asset-liability study.

Model Output

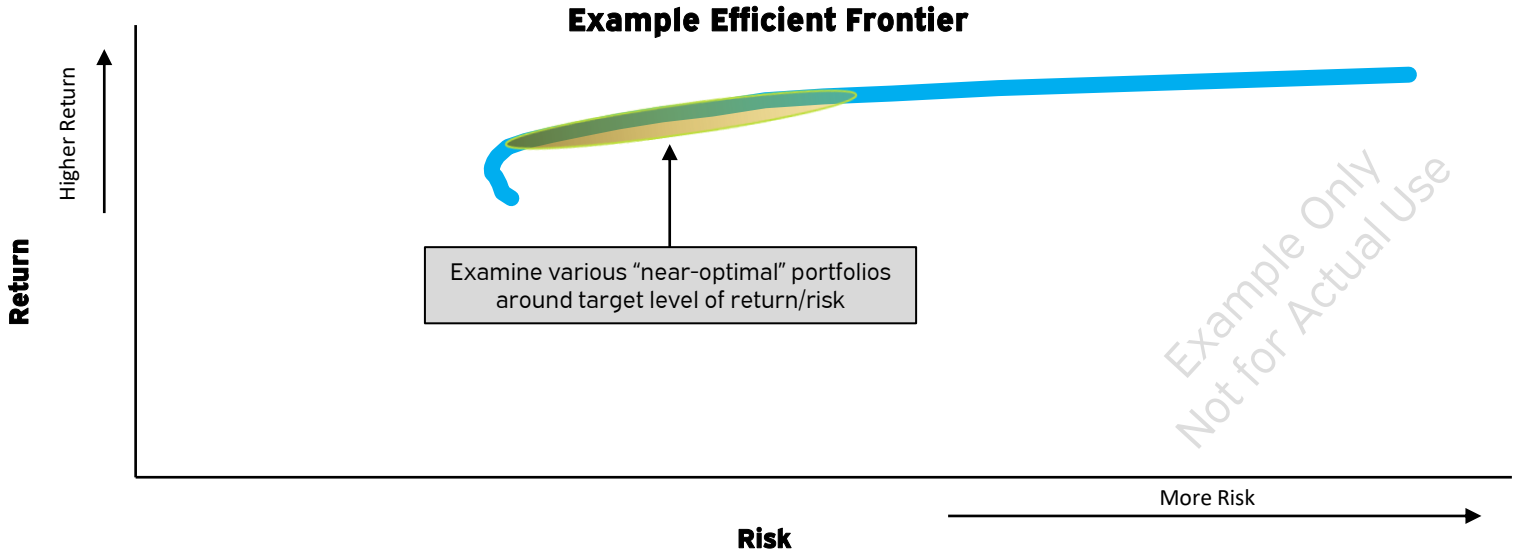
Examining the Efficient Frontier

→ Strategic allocation optimizations produce an "efficient frontier," which is a series of portfolios with the highest expected return for a given level of risk.

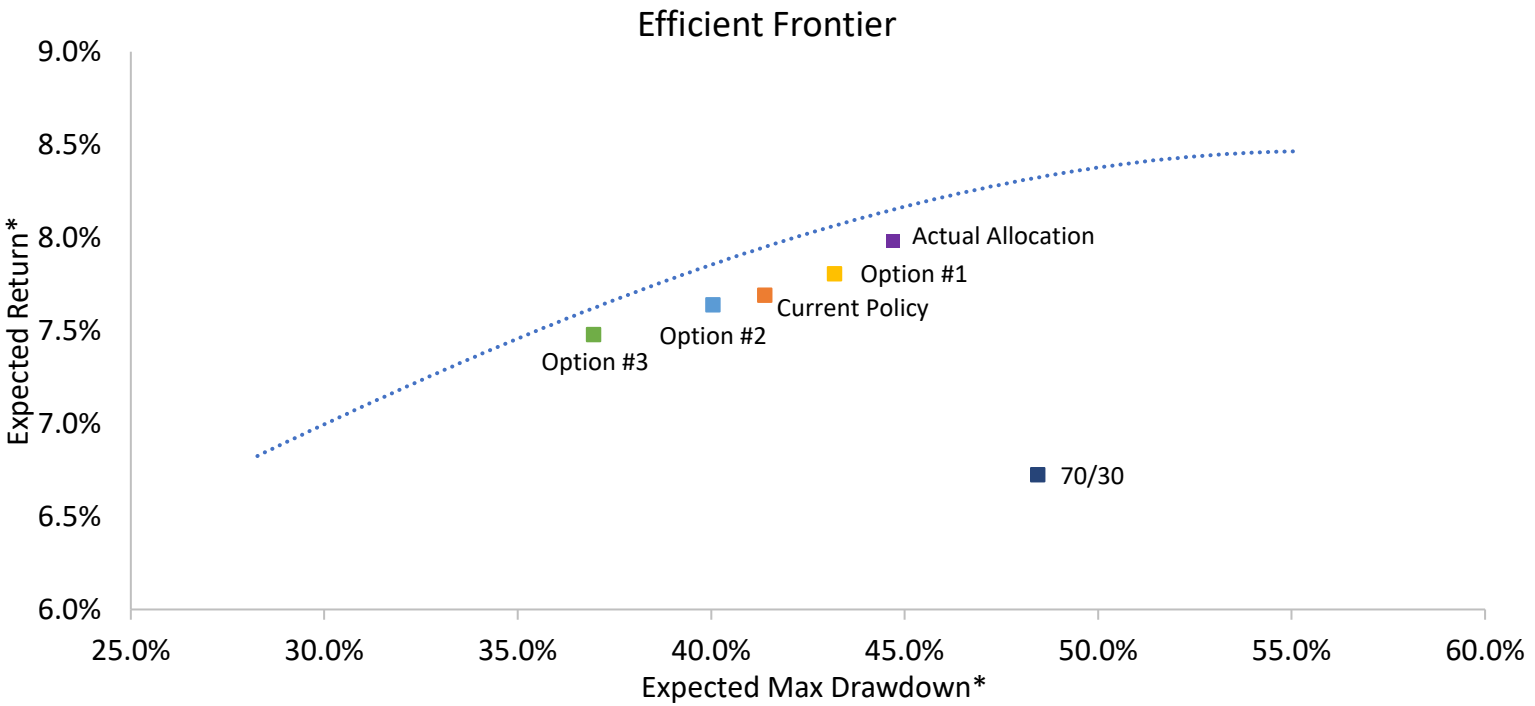
- Note: the measure of "return" and "risk" can be reframed to be a variety of metrics.

→ It is important to recognize that financial modeling is an imperfect exercise, and, thus, it is crucial to examine "near optimal" portfolios.

- Portfolios with similar expected returns/risks as those on the efficient frontier but with moderately different allocations.



Efficient Frontier and Proposed Portfolios

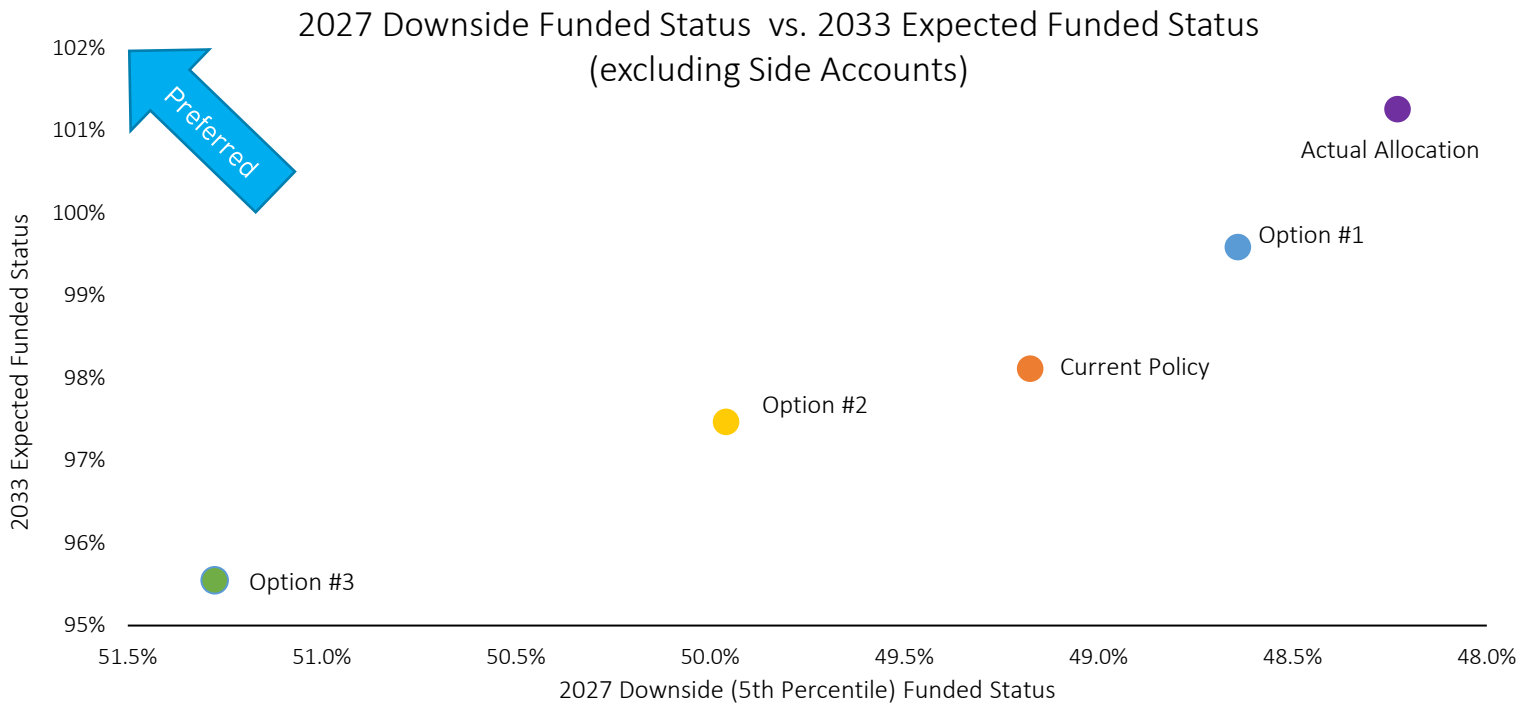


→ The three proposed options/portfolios all reside in the "near-optimal" space from an asset-only perspective.

→ The decrease in risk level from Option #1 to Options #2 and #3 is due to the transfer from Public Equity to Fixed Income. All other class allocations remain the same among the options.

*See Appendix for methodology/calculation details

Funded Status Efficient Frontier – Short and Medium-term Scenarios

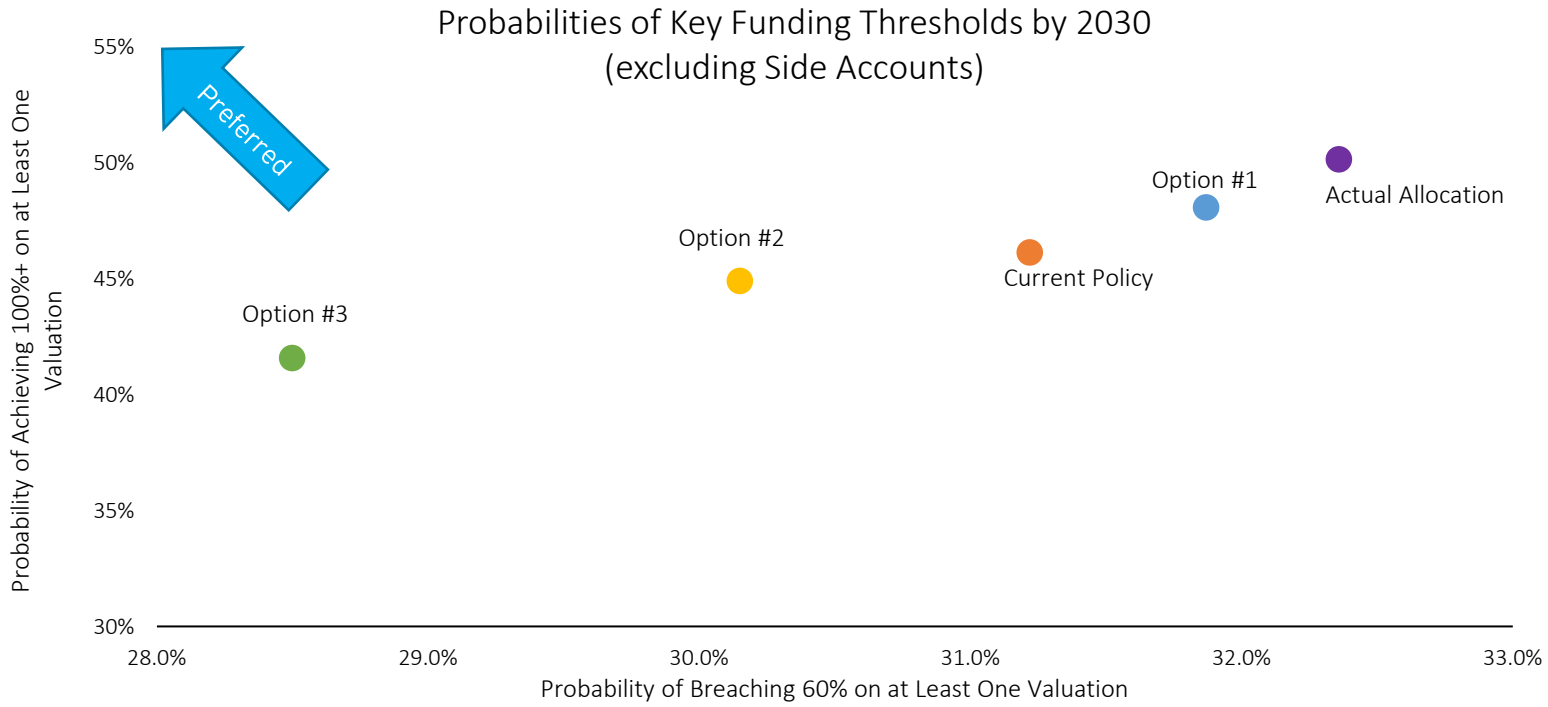


→ Reframing the efficient frontier:

Reward = medium-term funded status | Risk = short-term downside funded status

→ The efficient frontier is shaped how one would expect, but the differences among the portfolio options are generally insignificant.

Funded Status Efficient Frontier – Key Thresholds



→ Reframing the efficient frontier:

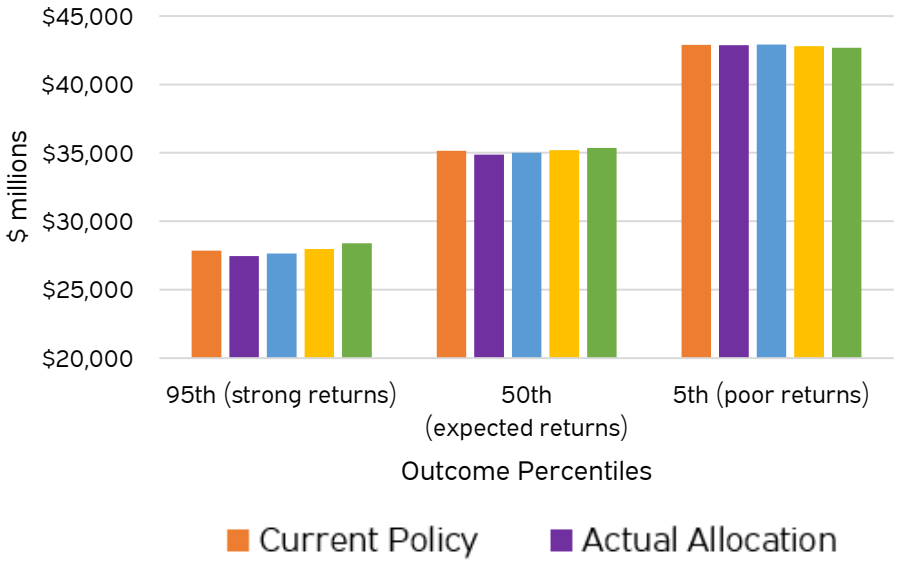
Reward = probability of achieving 100%+ on at least one valuation date on/before 12/2030

Risk = probability of breaching 60% on at least one valuation date on/before 12/2030

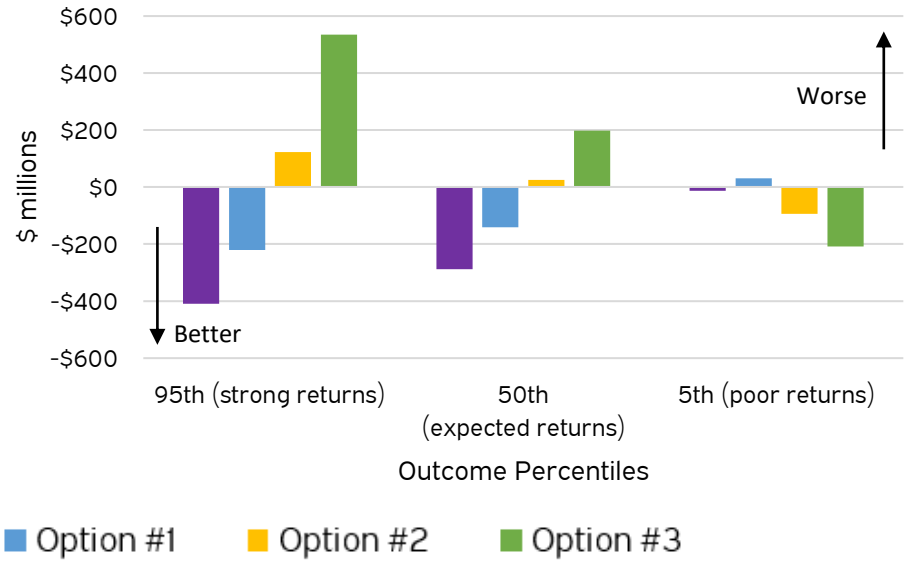
→ The efficient frontier is shaped how one would expect, but the differences among the portfolio options are generally insignificant.

Total Contributions over 10 Years*

Total Contributions over 10 years (2022-2031)



Total Contributions (vs. Current Policy) over 10 years (2022-2031)



Current Policy | Actual Allocation | Option #1 | Option #2 | Option #3

→ From an asset-liability perspective, the proposed options/portfolios exhibited only marginal differences over an intermediate timeframe (i.e., 10 years).

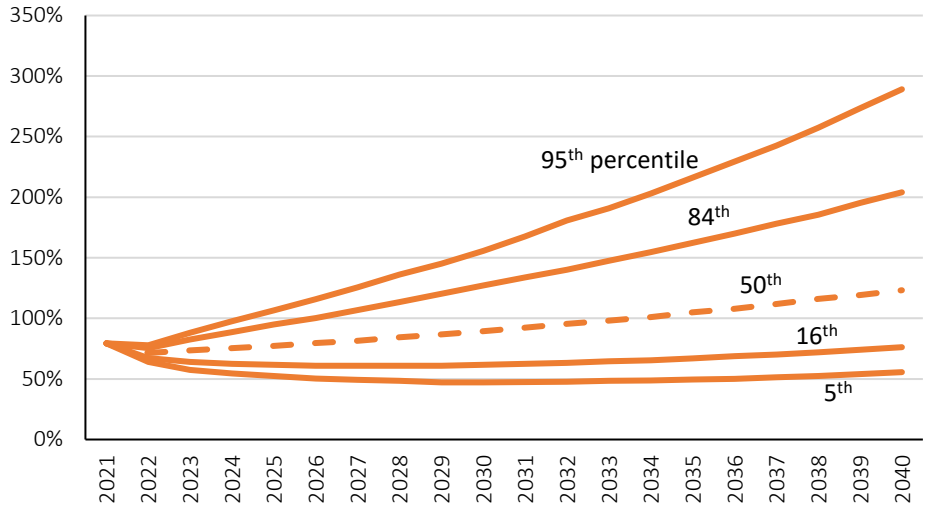
→ Contribution differences are greatest under a strong return environment (top 5th percentile of outcomes).

→ Contribution differences are minimal under a poor return environment (bottom 5th percentile of outcomes).

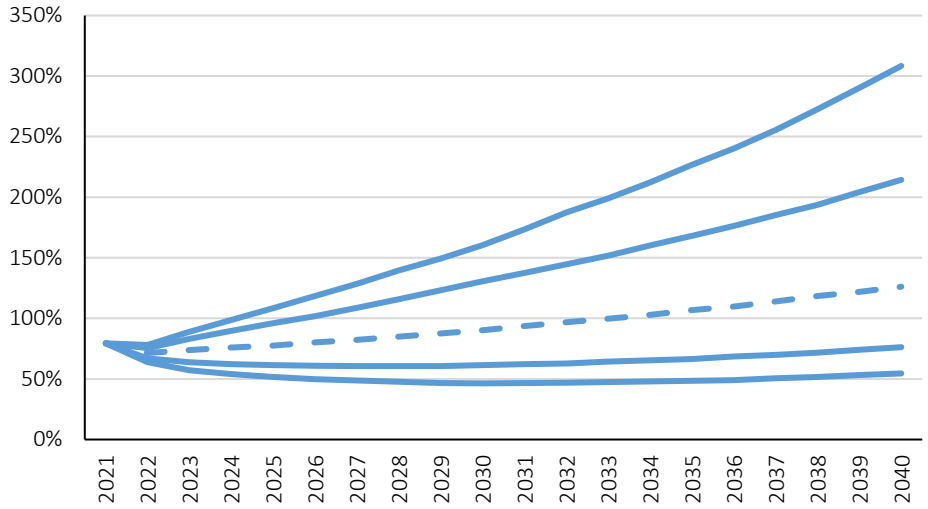
*Excluding Side Account transfers

Funded Status (excluding Side Accounts)

Current Policy



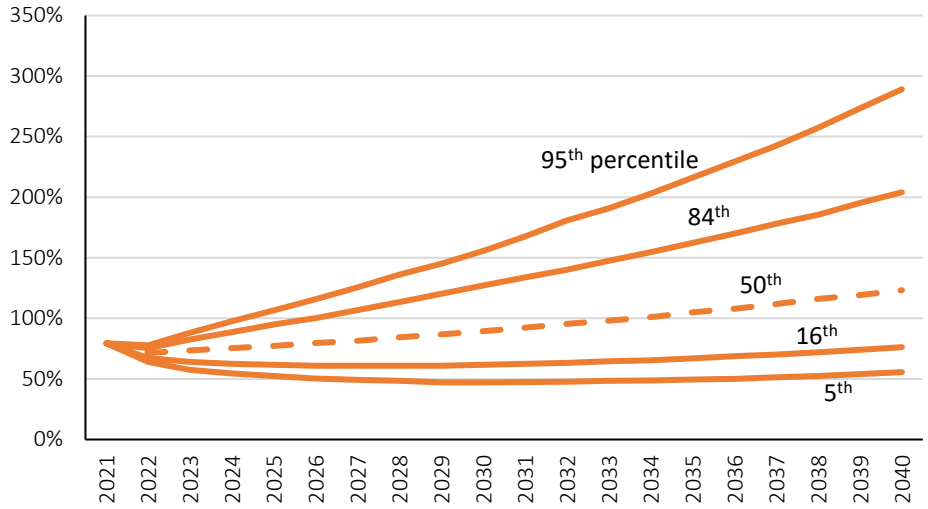
Option #1



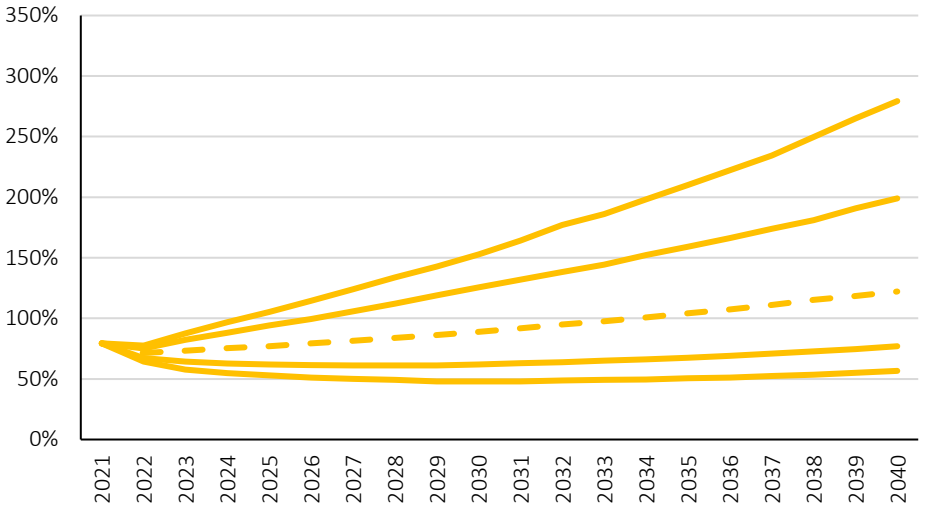
→ Compared to the *Current Policy*, the *Option #1* allocation exhibits similar funded status projections during downside percentiles but marginally higher funded status projections for most scenarios.

Funded Status (excluding Side Accounts)

Current Policy



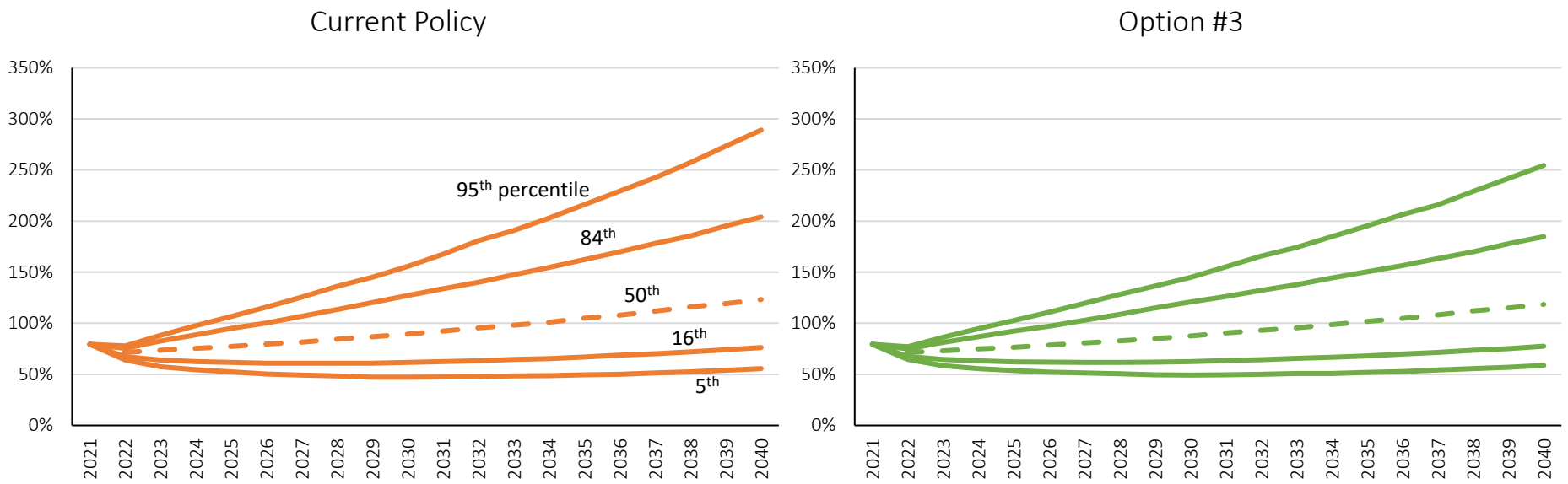
Option #2



→ Compared to the *Current Policy*, the *Option #2* allocation exhibits slightly lower funded status projections at the median and higher percentiles.

→ Downside percentile projections are marginally better with the *Option #2*.

Funded Status (excluding Side Accounts)



→ Compared to the *Current Policy*, the *Option #3* allocation exhibits lower funded status projections at the median and higher percentiles.

→ Downside percentile projections are better with the *Option #3*.

Conclusion

Conclusion

→ OST Staff, Meketa, Aon, and Milliman have completed a comprehensive asset-liability analysis of OPERF and potential portfolios to consider.

→ Based on the asset-liability modeling process, OPERF appears well situated and material alterations do not appear necessary.

- This conclusion is based on OIC viewpoints regarding risk and implementation, the prevailing capital market environment, and the projected interaction among assets and liabilities.

→ The proposed Options #1-3 represent potential options for the OIC to consider. Each of these portfolios are aligned with goals and preferences that the OIC has discussed, thus far.

→ All proposed options:

- Eliminate allocation to Risk Parity
- Increase Private Equity target by 2.5%
- Maintain allocations to Real Estate, Real Assets, and Diversifying Strategies

→ *Sole difference: Tradeoff between Public Equity and Fixed Income*

→ OST Staff, Meketa, and Aon recommend that Option #2 be selected.

Current, Actual, and Proposed Portfolios | Asset-only Metrics

	Current Policy	Actual Allocation*	Option #1	Option #2	Option #3
Public Equity	30.0%	23.0%	30.0%	25.0%	20.0%
Fixed Income	20.0%	20.0%	20.0%	25.0%	30.0%
Risk Parity	2.5%	2.0%	---	---	---
Private Equity	20.0%	28.0%	22.5%	22.5%	22.5%
Real Estate	12.5%	14.0%	12.5%	12.5%	12.5%
Real Assets	7.5%	8.0%	7.5%	7.5%	7.5%
Diversifying Strategies	7.5%	5.0%	7.5%	7.5%	7.5%
Expected Max Drawdown*	41.4%	44.7%	43.2%	40.0%	37.0%
Expected Volatility*	11.9%	12.7%	12.3%	11.6%	10.8%
Expected Return*	7.7%	8.0%	7.8%	7.6%	7.5%
Illiquids	40.0%	50.0%	42.5%	42.5%	42.5%

Recommended new long-term policy portfolio

*Actual Allocation as of 11/2/2022 will differ. Detailed allocation is as of August 2022 and is consistent with the September A/L presentation.
**See Appendix for methodology/calculation details

Appendix

Final CMAs

→ The table below highlights the preliminary CMAs that were presented to the OIC in June as well as the final CMAs that were utilized in the study.

- Reflecting the 2022 drawdown, most expected returns are marginally higher.

Expected Returns (%)

Strategic Class	As presented in June			Final CMA
	Meketa	Aon	Staff	
Public Equity	7.2	7.3	7.0	*7.5*
Fixed Income	2.4	2.8	3.0	*3.8*
Risk Parity	5.2	4.5	5.2	*5.4*
Private Equity	10.0	9.4	9.5	*10.1*
Real Estate	6.8	5.6	7.0	*6.2*
Real Assets	9.0	9.2	7.5	*9.2*
Diversifying Strategies	5.0	7.4	5.5	*5.7*

Annual Volatility (%)

Strategic Class	As Presented in June			Final CMA
	Meketa	Aon	Staff	
Public Equity	18.0	18.5	20.0	*18.8*
Fixed Income	4.0	4.5	4.3	*4.3*
Risk Parity	10.0	10.0	10.0	*10.0*
Private Equity	28.0	25.5	26.0	*26.5*
Real Estate	13.8	17.4	13.8	*15.0*
Real Assets	19.1	15.6	17.0	*17.2*
Diversifying Strategies	8.4	8.1	8.0	*8.2*

Notes:
CMAs are long-term in nature (20-30 years).

Final Expected Returns
Average of updated compound/geometric return assumptions from Meketa and Aon.

Final Volatilities
Average of assumptions from Meketa, Aon, and Staff.
These figures did not change from June.

Historical Scenario Analysis (Negative)

→ Examining historical (negative) scenarios shows very little difference among the potential portfolios.

Scenario	Current Policy (%)	Actual Allocation (%)	Option #1 (%)	Option #2 (%)	Option #3 (%)
COVID-19 Market Shock (Feb 2020-Mar 2020)	-13.4	-11.5	-13.0	-11.4	-9.8
Taper Tantrum (May - Aug 2013)	0.5	1.2	0.9	0.7	0.6
Global Financial Crisis (Oct 2007 - Mar 2009)	-20.9	-20.2	-21.2	-18.3	-15.4
Popping of the TMT Bubble (Apr 2000 - Sep 2002)	-8.0	-6.9	-8.8	-5.0	-1.3
LTCM (Jul - Aug 1998)	-5.5	-4.6	-5.3	-4.5	-3.7
Asian Financial Crisis (Aug 97 - Jan 98)	4.6	6.3	4.9	5.3	5.7
Rate spike (1994 Calendar Year)	4.3	5.3	4.7	4.3	3.9
Early 1990s Recession (Jun - Oct 1990)	-1.6	-0.7	-1.6	-0.8	-0.1
Crash of 1987 (Sep - Nov 1987)	-6.3	-4.7	-6.2	-5.0	-3.9
Strong dollar (Jan 1981 - Sep 1982)	7.1	7.4	5.9	7.9	10.0
Volcker Recession (Jan - Mar 1980)	-3.3	-3.2	-3.0	-3.2	-3.3
Stagflation (Jan 1973 - Sep 1974)	-12.9	-12.2	-13.3	-11.0	-8.6

Historical Scenario Analysis (Positive)

→ Examining historical (positive) scenarios shows very little difference among the potential portfolios.

Scenario	Current Policy (%)	Actual Allocation (%)	Option #1 (%)	Option #2 (%)	Option #3 (%)
Global Financial Crisis Recovery (Mar 2009 - Nov 2009)	24.3	21.1	24.4	21.8	19.3
Best of Great Moderation (Apr 2003 - Feb 2004)	24.6	22.7	24.6	22.5	20.4
Peak of the TMT Bubble (Oct 1998 - Mar 2000)	40.4	43.9	42.2	39.6	36.9
Plummeting Dollar (Jan 1986 - Aug 1987)	49.2	42.2	48.3	43.6	38.9
Volcker Recovery (Aug 1982 - Apr 1983)	26.3	23.7	25.0	24.2	23.4
Bretton Wood Recovery (Oct 1974 - Jun 1975)	22.0	20.2	21.8	20.0	18.2

Stress Testing: Expected Returns under Hypothetical Scenarios*

→ Examining hypothetical scenarios shows very little difference among the potential portfolios.

Scenario	Current Policy (%)	Actual Allocation (%)	Option #1 (%)	Option #2 (%)	Option #3 (%)
10-year Treasury Bond rates rise 100 bps	3.7	3.7	3.9	3.3	2.7
10-year Treasury Bond rates rise 200 bps	-0.8	-0.9	-0.7	-1.2	-1.7
10-year Treasury Bond rates rise 300 bps	-3.5	-3.7	-3.4	-3.9	-4.5
Baa Spreads widen by 50 bps, High Yield by 200 bps	1.1	1.1	1.0	1.3	1.5
Baa Spreads widen by 300 bps, High Yield by 1000 bps	-17.1	-16.8	-17.3	-15.6	-14.0
Trade Weighted Dollar gains 10%	-3.2	-3.0	-3.3	-2.8	-2.3
Trade Weighted Dollar gains 20%	-1.5	-1.7	-1.5	-1.0	-0.5
U.S. Equities decline 10%	-4.9	-5.2	-5.2	-4.5	-3.9
U.S. Equities decline 25%	-14.7	-14.9	-15.0	-13.7	-12.4
U.S. Equities decline 40%	-21.8	-21.3	-21.9	-19.9	-17.9

*Based on historical relationships examined via OLS regressions. Assets not directly exposed to the factor are affected nonetheless.

Stress Testing: Expected Returns under Hypothetical Scenarios (cont'd)*

→ Examining hypothetical scenarios shows very little difference among the potential portfolios.

Scenario	Current Policy (%)	Actual Allocation (%)	Option #1 (%)	Option #2 (%)	Option #3 (%)
Inflation slightly higher than expected	-0.4	-0.3	-0.4	-0.4	-0.4
Inflation meaningfully higher than expected	-4.0	-3.3	-3.8	-3.5	-3.2
Low Growth and Low Inflation	-4.7	-3.9	-4.6	-4.0	-3.5
Low Growth and High Inflation	-7.3	-5.8	-7.1	-6.3	-5.4
Brief, moderate inflation spike	-1.9	-1.8	-2.0	-1.8	-1.6
Extended, moderate inflation spike	-3.8	-3.8	-4.0	-3.5	-3.1
Brief, extreme inflation spike	-5.0	-5.0	-5.1	-4.6	-4.0
Extended, extreme inflation spike	-6.8	-6.9	-7.0	-6.2	-5.4

*Based on historical relationships examined via OLS regressions. Assets not directly exposed to the factor are affected nonetheless.

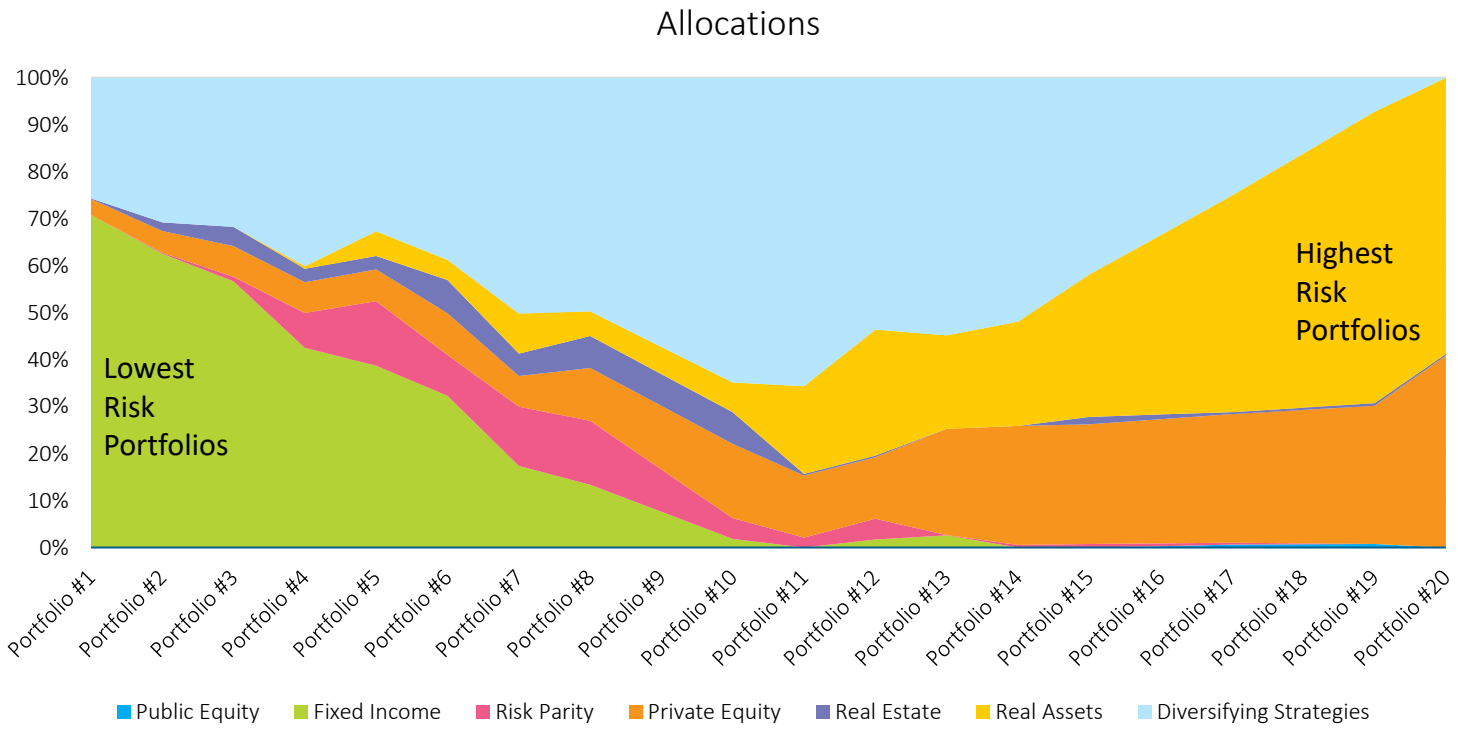
Stress Testing: Expected Returns under Hypothetical Scenarios (cont'd)*

→ Examining hypothetical scenarios shows very little difference among the potential portfolios.

Scenario	Current Policy (%)	Actual Allocation (%)	Option #1 (%)	Option #2 (%)	Option #3 (%)
10-year Treasury Bond rates drop 100 bps	2.0	2.1	2.0	2.2	2.3
10-year Treasury Bond rates drop 200 bps	8.5	7.7	8.3	8.0	7.7
Baa Spreads narrow by 30bps, High Yield by 100 bps	6.6	6.8	6.8	6.3	5.9
Baa Spreads narrow by 100bps, High Yield by 300 bps	9.5	8.7	9.4	8.6	7.9
Trade Weighted Dollar drops 10%	6.9	6.5	6.8	6.4	5.9
Trade Weighted Dollar drops 20%	19.8	18.3	19.8	18.4	17.1
U.S. Equities rise 10%	6.4	6.7	6.6	6.2	5.9
U.S. Equities rise 30%	13.3	12.5	13.3	12.2	11.1
High Growth and Low Inflation	8.1	7.4	7.9	7.0	6.2
High Growth and Moderate Inflation	6.6	6.3	6.4	5.8	5.1
High Growth and High Inflation	4.7	4.8	4.5	4.1	3.7

*Based on historical relationships examined via OLS regressions. Assets not directly exposed to the factor are affected nonetheless.

Initial "Unconstrained" Model



→ On the lower end of the risk spectrum, model favors Fixed Income and Diversifying Strategies.

→ Middle portion of the risk spectrum utilizes several asset classes roughly equally but materially allocates to Diversifying Strategies.

→ High risk allocations are biased towards Real Assets and Private Equity.

Final "Constrained" Model

→ After multiple iterations of optimizations and exploring different minimum/maximum constraints, Meketa, Aon, and Staff agreed on the following constraints.

Asset Class/Strategy	Minimum Weight	Maximum Weight
Public Equity	20.0	40.0
Fixed Income	10.0	40.0
Risk Parity	0.0	10.0
Private Equity	15.0	30.0
Real Estate	10.0	20.0
Real Assets	5.0	10.0
Diversifying Strategies	0.0	10.0

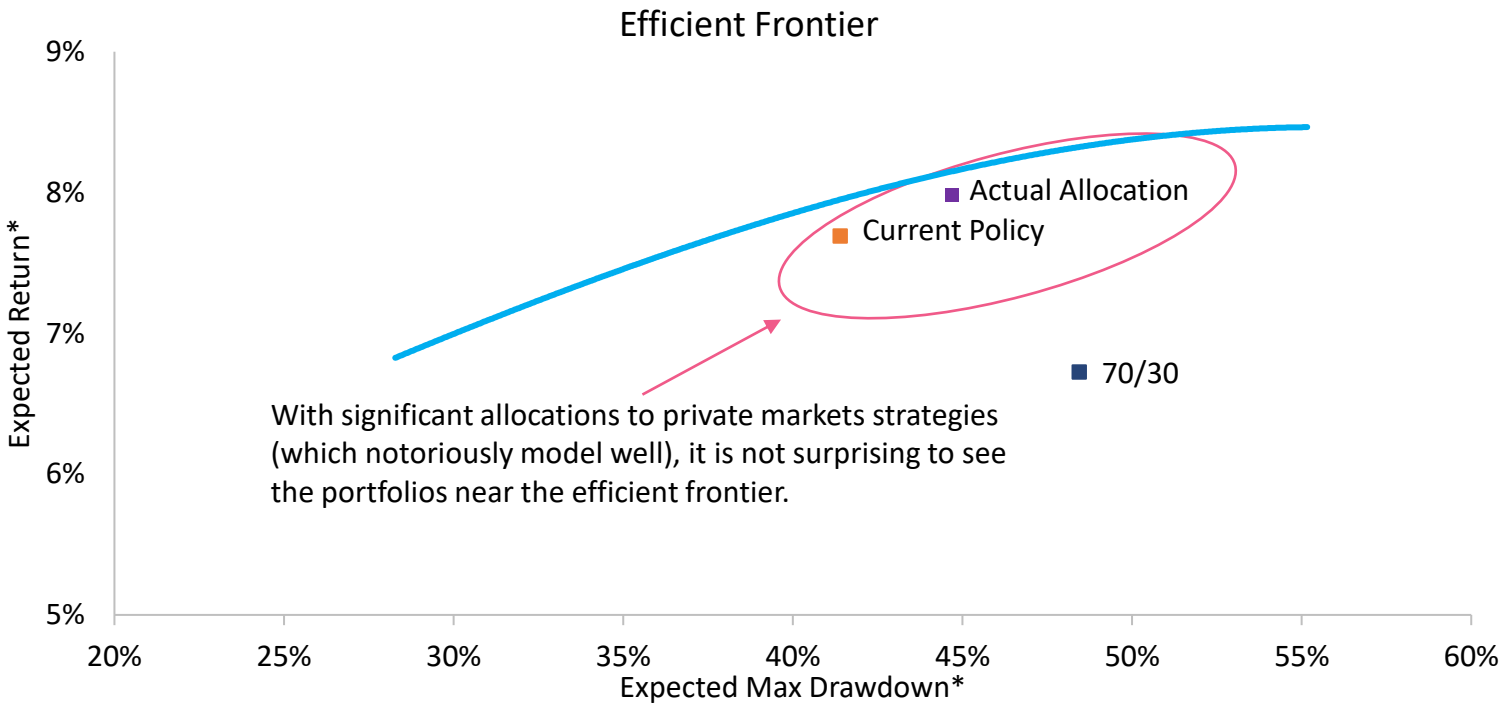
→ The minimums are primarily focused on addressing allocations that cannot be easily shifted away from in the near-term (i.e., within 3-5 years).

→ The maximums were put in place to: 1) protect against biases/concentrations that often show up with optimizations, 2) encourage implementable allocations, and 3) limit meaningful increases in illiquidity.

→ OIC may discuss implementing more meaningful changes via other mechanisms (e.g., secondary sales).

→ The utilized constraints will inherently limit material asset-liability differences (e.g., contribution levels, funding ranges, etc.) among examined portfolios.

Final "Constrained" Model



→ With final constraints, both the *Current Policy* and *Actual Allocation* portfolios are near the efficient frontier, but potential modest improvements can be made.

→ The 70/30 portfolio is materially away from the efficient frontier.

*See Appendix for methodology/calculation details

From September OIC Meeting

Asset-Liability Integration

→ In order to examine OPERF under a full asset-liability lens, simulations for the Current Policy, Actual Allocation, and three illustrative portfolios were integrated with Milliman's model.

→ The illustrative portfolios represent likely high-level tradeoffs that the OIC may want to pursue.

- While a final selection by the OIC may look similar to one of these portfolios, they are not intended to be recommendations.

→ Examined Portfolios (*from September OIC Meeting*)

1. Current Policy
2. Actual Allocation
3. Similar Return, Lower Risk (compared to policy)
4. Lower Risk and Return (compared to policy)
5. Similar Risk, Higher Return (compared to policy)

} Illustrative Portfolios

From September OIC Meeting

Examined Portfolios | Asset-only Metrics

	Current Policy	Actual Allocation	Similar Return, Lower Risk	Lower Risk and Return	Similar Risk, Higher Return
Public Equity	30.0%	23.0%	25.0%	25.0%	25.0%
Fixed Income	20.0%	20.0%	15.0%	20.0%	12.5%
Risk Parity	2.5%	2.0%	10.0%	10.0%	10.0%
Private Equity	20.0%	28.0%	20.0%	17.5%	22.5%
Real Estate	12.5%	14.0%	12.5%	12.5%	12.5%
Real Assets	7.5%	8.0%	7.5%	7.5%	7.5%
Diversifying Strategies	7.5%	5.0%	10.0%	7.5%	10.0%
Expected Max Drawdown*	41.4%	44.7%	39.2%	37.2%	41.4%
Expected Volatility*	11.9%	12.7%	11.5%	10.9%	12.0%
Expected Return*	7.7%	8.0%	7.7%	7.5%	7.8%
Illiquids	40.0%	50.0%	40.0%	37.5%	42.5%

→ Despite what may appear to be different allocations, there is a high degree of commonality among the examined portfolios.

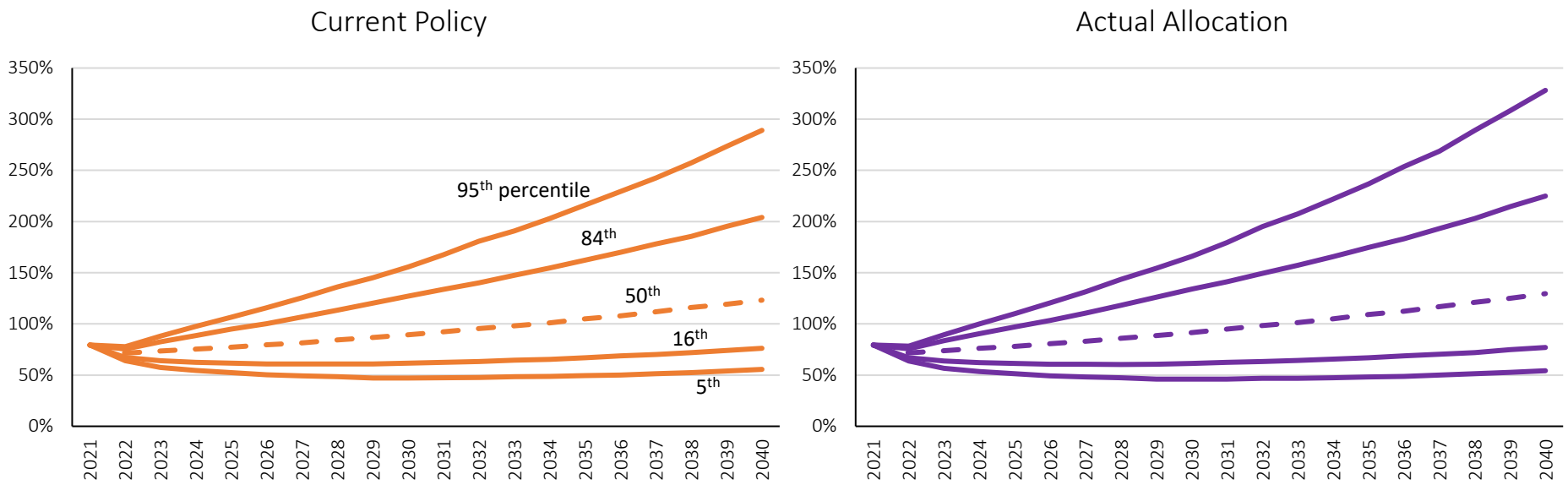
→ Major risk/return metrics are similar across the examined portfolios.

→ Due to the high level of commonality, asset-liability metrics are unlikely to show meaningful differences across portfolios.

*See Appendix for methodology/calculation details

From September OIC Meeting

Funded Status (excluding Side Accounts)

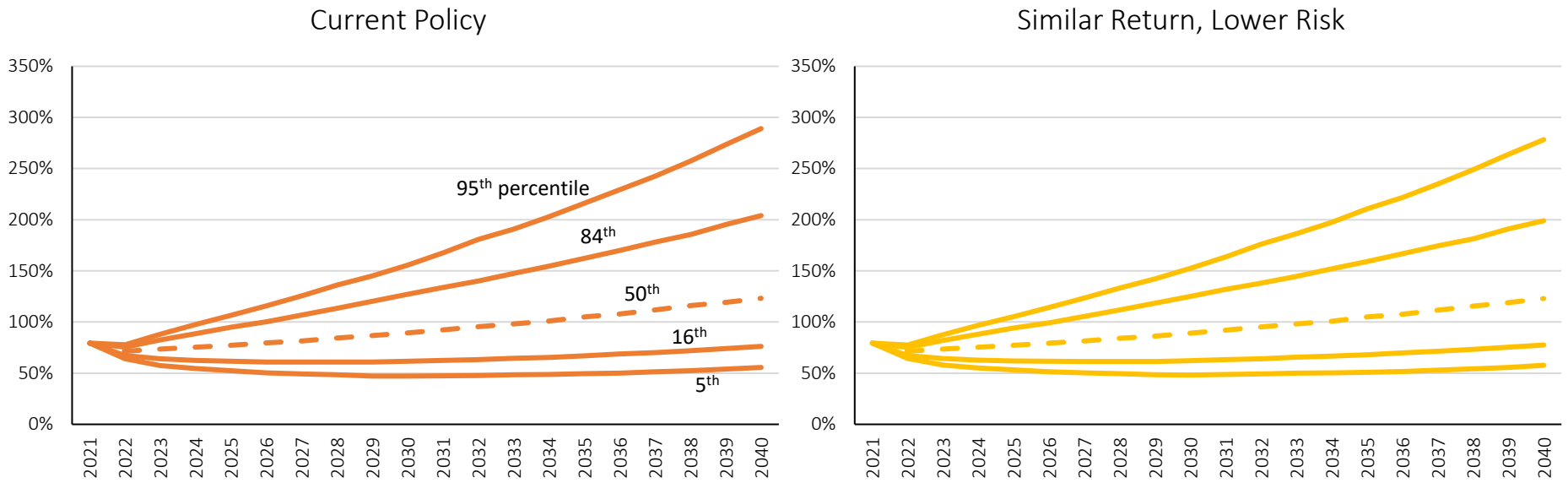


→ Compared to the *Current Policy*, the *Actual Allocation* exhibits slightly higher funded status projections at the median and higher percentiles.

→ Downside percentile projections are similar between the two.

From September OIC Meeting

Funded Status (excluding Side Accounts)

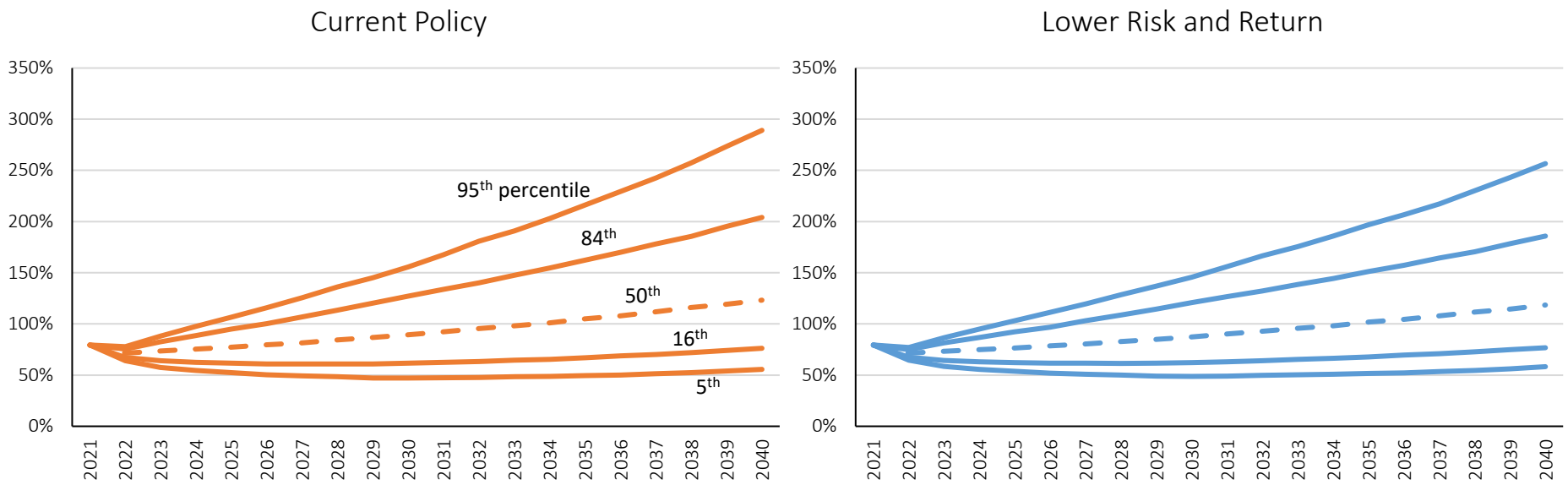


→ Compared to the *Current Policy*, the *Similar Return, Lower Risk* allocation exhibits slightly lower funded status projections at the median and higher percentiles.

→ Downside percentile projections are marginally better with the *Similar Return, Lower Risk* allocation.

From September OIC Meeting

Funded Status (excluding Side Accounts)

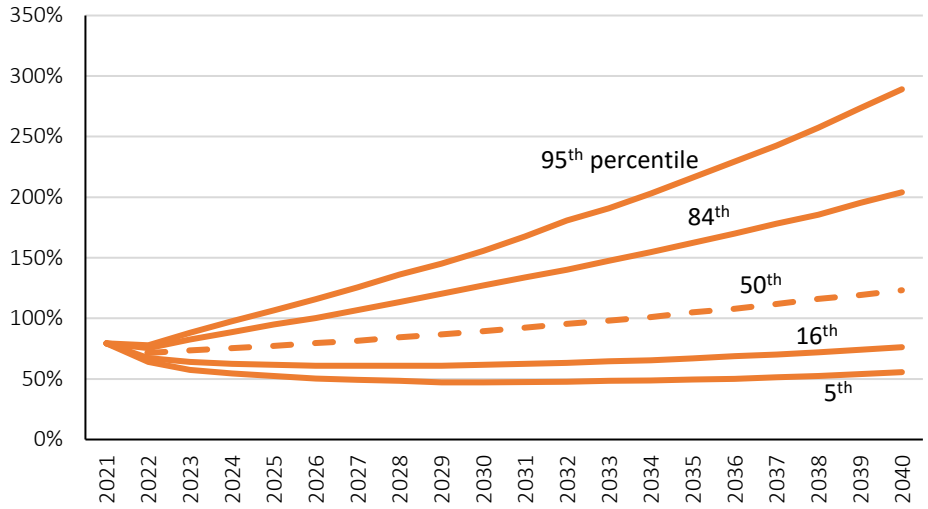


→ Compared to the *Current Policy*, the *Lower Risk and Return* allocation exhibits slightly higher funded status projections during downside percentiles but lower funded status projections for most scenarios.

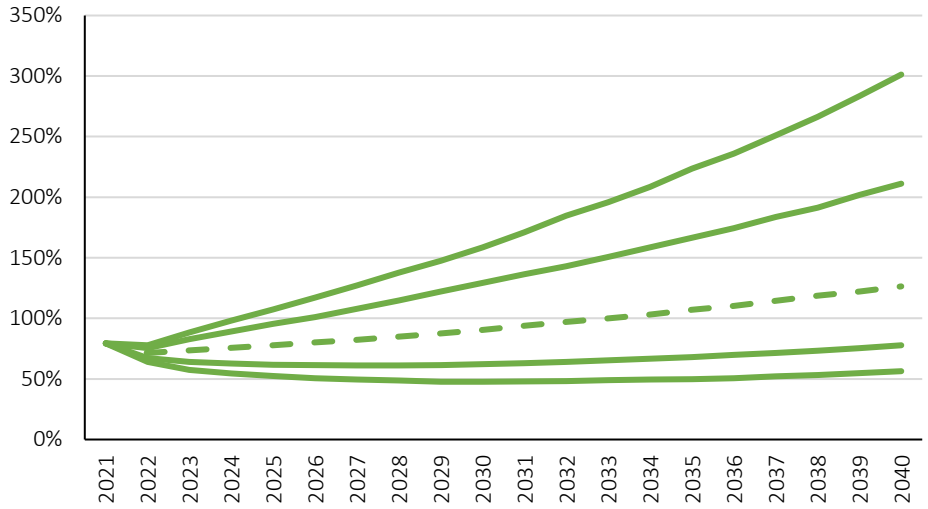
From September OIC Meeting

Funded Status (excluding Side Accounts)

Current Policy

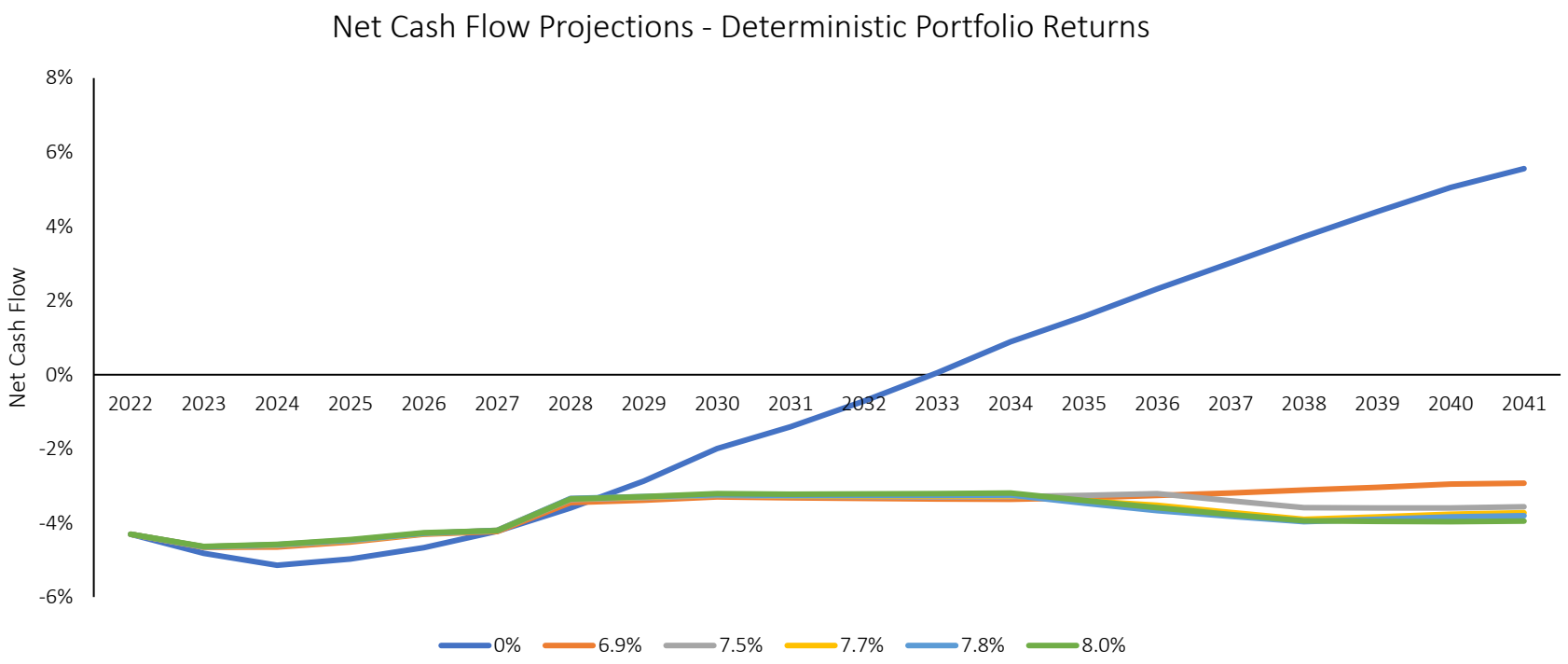


Similar Risk, Higher Return



→ Compared to the *Current Policy*, the *Similar Risk, Higher Return* allocation exhibits slightly higher funded status projections at all percentiles.

Net Cash Flow Projections



→ Net cash flow position is expected to marginally worsen in the near-term before improving and settling in the -3.0% to -4.0% range.

Note: For the period 1/1/2022-6/30/22, model seeks to capture realized 2022 YTD experience. After 6/30/22, model utilizes annualized effective rates of deterministic returns.

Definitions

→ Note: Each portfolio is run through 10,000 simulations that are 20-years in length. The statistics are derived from these simulation results.

Simulation Statistic	Definition/Description
Expected Compound Return	This is a portfolio's expected geometric/compound return. This metric is analogous to an actuarial assumed rate of return. This is calculated as the median geometric/compound return from all 10,000 simulations.
Expected Volatility	This is a portfolio's expected volatility (i.e., a common measure of risk). This is calculated as the average volatility from all 10,000 simulations.
Expected Maximum Drawdown	This is a measure of a "worst case" scenario. This is a peak-to-trough result that can occur over a series of years before recovering. This is calculated as the average of the 1,000 worst drawdowns from all 10,000 simulations (i.e., the average of the tail of the distribution).

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AON

Liquidity Analysis

Oregon Investment Council

November 2022

Table of Contents

Overview
Background

The liquidity analysis for Oregon Public Employees Retirement Fund (OPERF) is performed under five portfolio scenarios. These include OPERF's Current Policy, OPERF's Actual Allocation[1], and three alternative portfolios.

Intended as a stress-testing model, incorporating the profile of the liabilities as well as expected future contributions

Uses different scenarios for economic environments and other relevant events

Shows how the portfolio's liquidity profile could evolve with a given investment strategy

We categorized investments by liquidity into five buckets

Liquid (Risk-Reducing Assets): less than 3 months needed for return of capital (e.g. publicly traded securities)

Liquid (Return-Seeking Assets): less than 3 months needed for return of capital (e.g. publicly traded securities)

Quasi-Liquid: Typical lock-up of 3–12 months. Conservatively, we assumed a 1-year lock-up in most economic environments, 2 years in a Recession scenario, and 3 years in a Dark Skies scenario (e.g. many hedge funds, open-end real assets)

Illiquid: Potential lock-up of 5–10 years, depending on economic environment (e.g. closed-end real assets)

Illiquid: Potential lock-up of 10+ years (e.g. typical private equity)

This is intended to be a conservative approximation of the actual liquidity properties of the assets

[1]Actual Allocation is as of August 2022

Overview

Asset allocation and liquidity category

	Current Policy	Actual	Option 1	Option 2	Option 3
Liquid (Risk-Reducing Assets)					
Core Fixed Income	20.0%	20.0%	20.0%	25.0%	30.0%
Subtotal	*20.0%*	*20.0%*	*20.0%*	*25.0%*	*30.0%*
Liquid (Return-Seeking Assets)					
Public Equity	30.0%	23.0%	30.0%	25.0%	20.0%
Risk Parity	2.5%	2.0%	--	--	--
Subtotal	*32.5%*	*25.0%*	*30.0%*	*25.0%*	*20.0%*
Quasi-Liquid Assets					
Alternatives (Diversifying Strategies)	7.5%	5.0%	7.5%	7.5%	7.5%
Real Estate	10.0%	11.2%	10.0%	10.0%	10.0%
Subtotal	*17.5%*	*16.2%*	*17.5%*	*17.5%*	*17.5%*
Illiquid 5-10 Years					
Real Estate	2.5%	2.8%	2.5%	2.5%	2.5%
Alternatives (Infrastructure)	4.5%	4.8%	4.5%	4.5%	4.5%
Alternatives (Natural Resources)	3.0%	3.2%	3.0%	3.0%	3.0%
Subtotal	*10.0%*	*10.8%*	*10.0%*	*10.0%*	*10.0%*
Illiquid 10+ Years					
Private Equity	20.0%	28.0%	22.5%	22.5%	22.5%
Subtotal	*20.0%*	*28.0%*	*22.5%*	*22.5%*	*22.5%*
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Total Quasi + Illiquid Assets	**47.5%**	**55.0%**	**50.0%**	**50.0%**	**50.0%**

Overview
Economic scenarios

Base Case Scenario

Markets perform consistent with Aon's Capital Market Assumptions

Recession Scenario

Somewhat pessimistic outlook for the markets

Return-seeking assets decline in the first two years with a modest rebound in later years

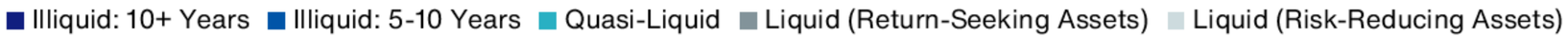
Dark Skies Scenario

Very pessimistic outlook for markets

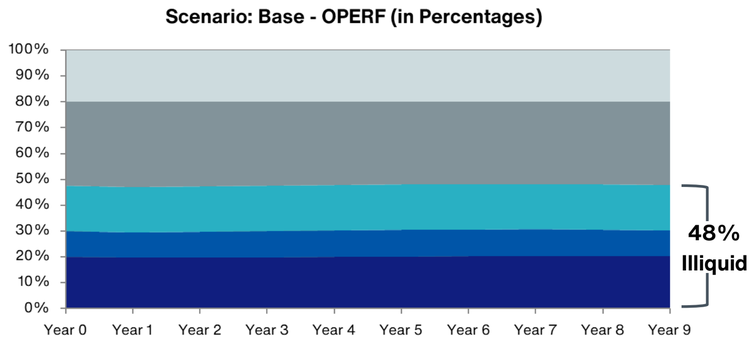
Return-seeking assets decline significantly

The value of public equities declines approximately 50% over three years, without an immediate rebound

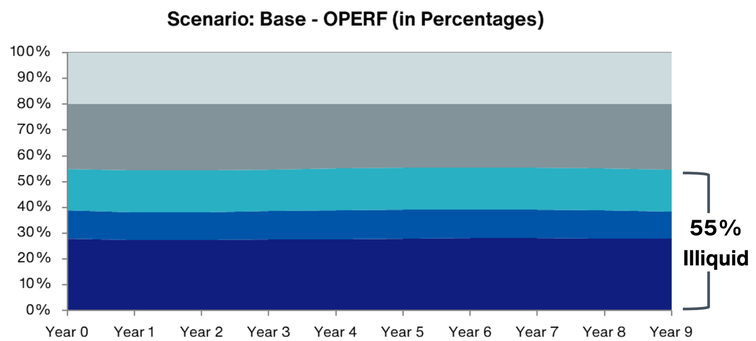
Liquidity Analysis
Base Case



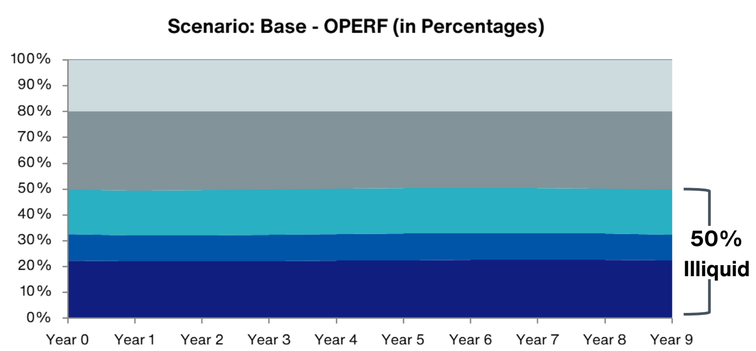
Current Policy



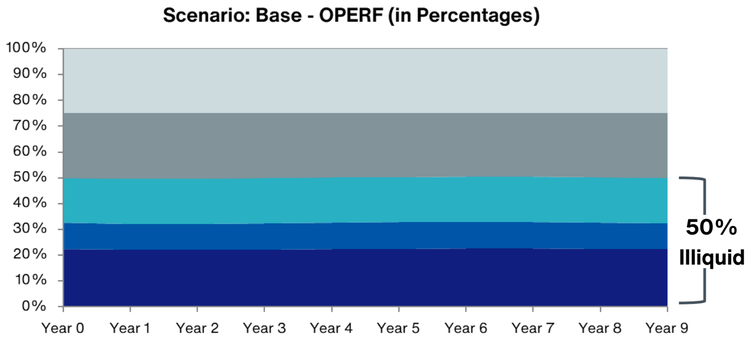
Actual



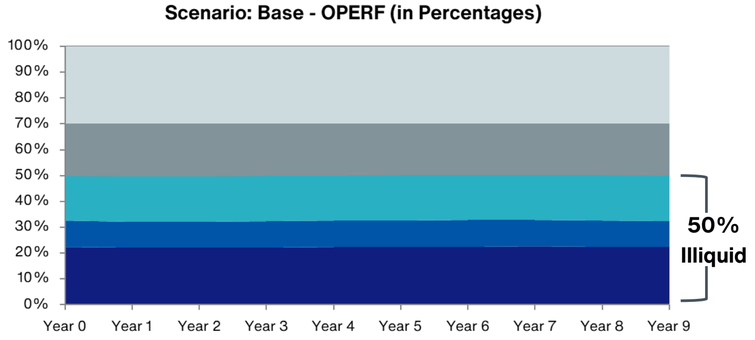
Option 1



Option 2



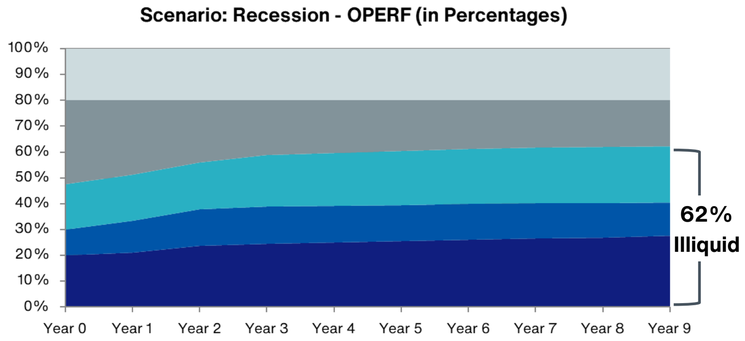
Option 3



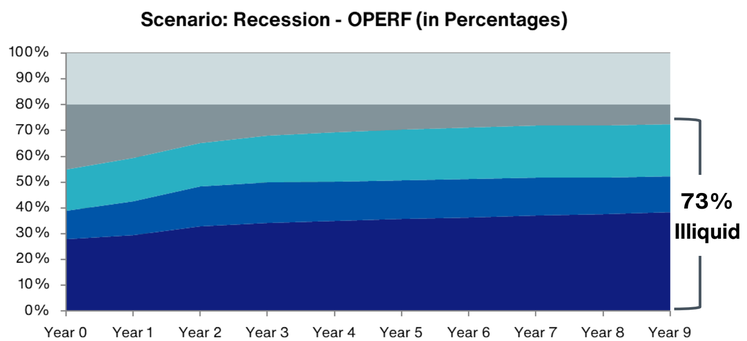
Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis
Recession

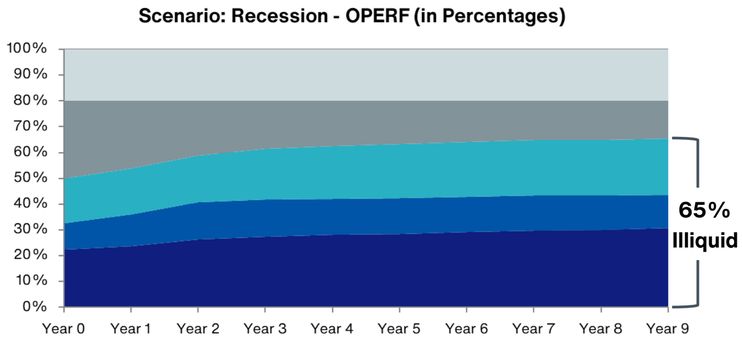
Current Policy



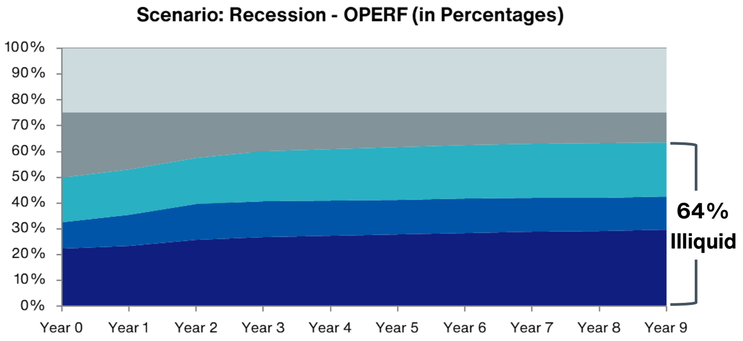
Actual



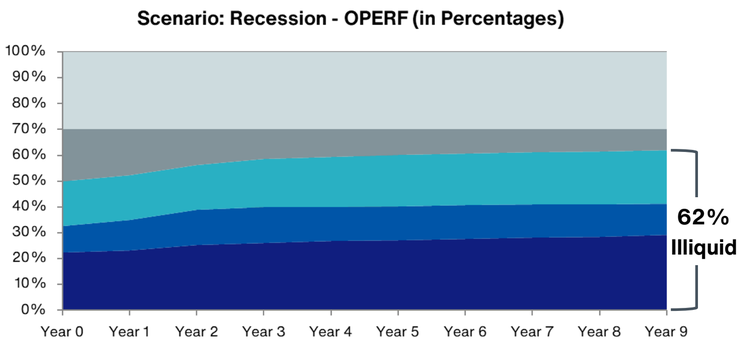
Option 1



Option 2

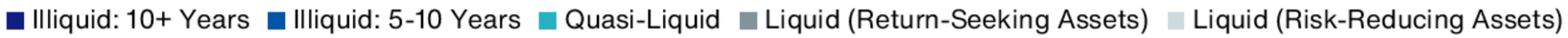


Option 3

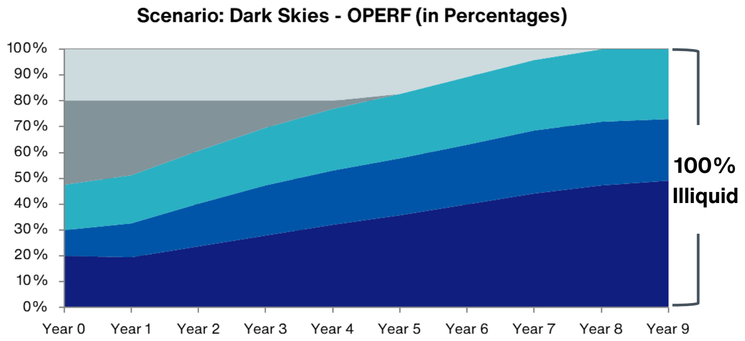


Note: Year 0 represents a starting point of June 30, 2022

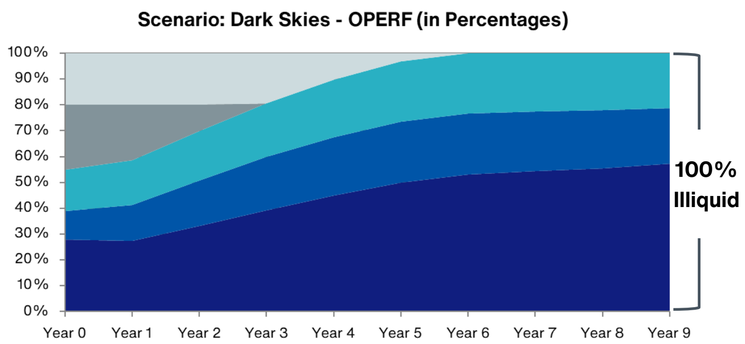
Liquidity Analysis
Dark Skies



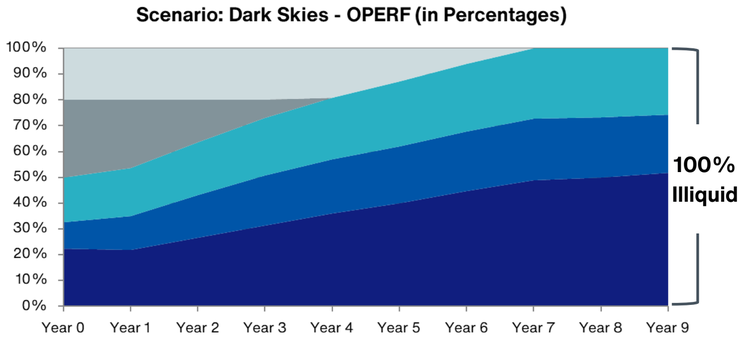
Current Policy



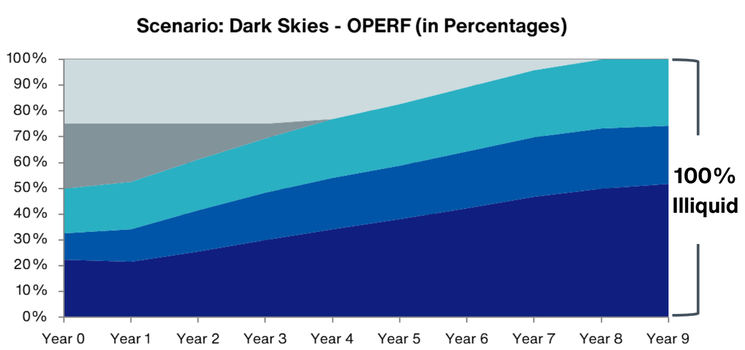
Actual



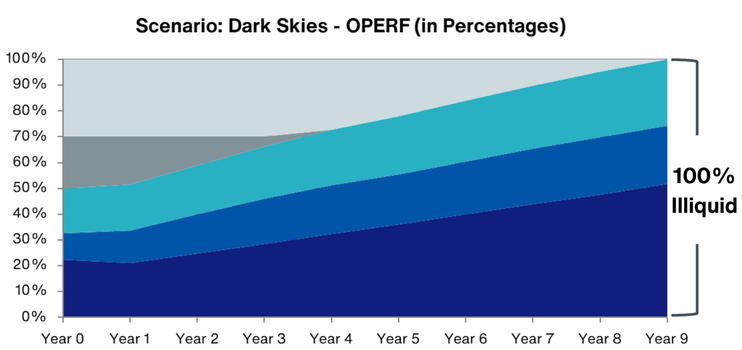
Option 1



Option 2



Option 3



Note: Year 0 represents a starting point of June 30, 2022

Conclusions

Across all five portfolios, OPERF is expected to have sufficient liquidity in the modeled Base Case and Recession economic scenarios

In a Dark Skies economic scenario, the Plan's assets are projected to be 100% illiquid in 6 to 9 years based on the liquidity profile of each portfolio which would compromise plan operations and force selling on the secondary market.

Dark Skies Scenario	Current Policy	Actual	Option 1	Option □	Option 3
Pro□ected □ of Years to be 100% Illiquid	□ yrs.	6 yrs.	7 yrs.	□ yrs.	□ yrs.

OPERF's liquidity is strained due to the combined impact of asset returns, biennium rate setting, and employer contribution rate collars that slow the replenishing of Plan assets

As the risk reducing asset allocation increases from Option portfolio 1 to 3, the lower risk profile and additional liquidity extends the number of years it takes for Plan assets to become 100% illiquid

Potential remedies for the Dark Skies scenario include 1) accepting this risk; 2) paring back commitments, selling on the secondary market, and/or redeeming quasi-liquid assets a few years into a deep bear market; 3) adjusting the target asset allocation; and 4) adjusting the funding policy

This analysis is highly sensitive to the assumed contributions

If OPERF receives less contributions than assumed, especially in a Dark Skies environment, then illiquid and quasi-liquid investments drift even further from target and the potential for liquidity issues increases

Appendix

- Liquidity Analysis Background
- Current Policy (80% R-S)
- Actual Allocation (80% R-S)
- Option 1
- Option 2
- Option 3
- Assumptions and Methods
- Economic Scenarios
- About This Material

Liquidity Analysis Background

Section: Appendix

Background

Aon Investments' approach to analyzing liquidity risk from alternatives

Intended as a stress-testing model

Develops multi-year projections of assets and spending needs

Uses different scenarios for economic environments and other relevant events

Shows how the portfolio's liquidity profile could evolve with a given investment strategy

Incorporates the profile of the liabilities as well as expected future contributions

Background

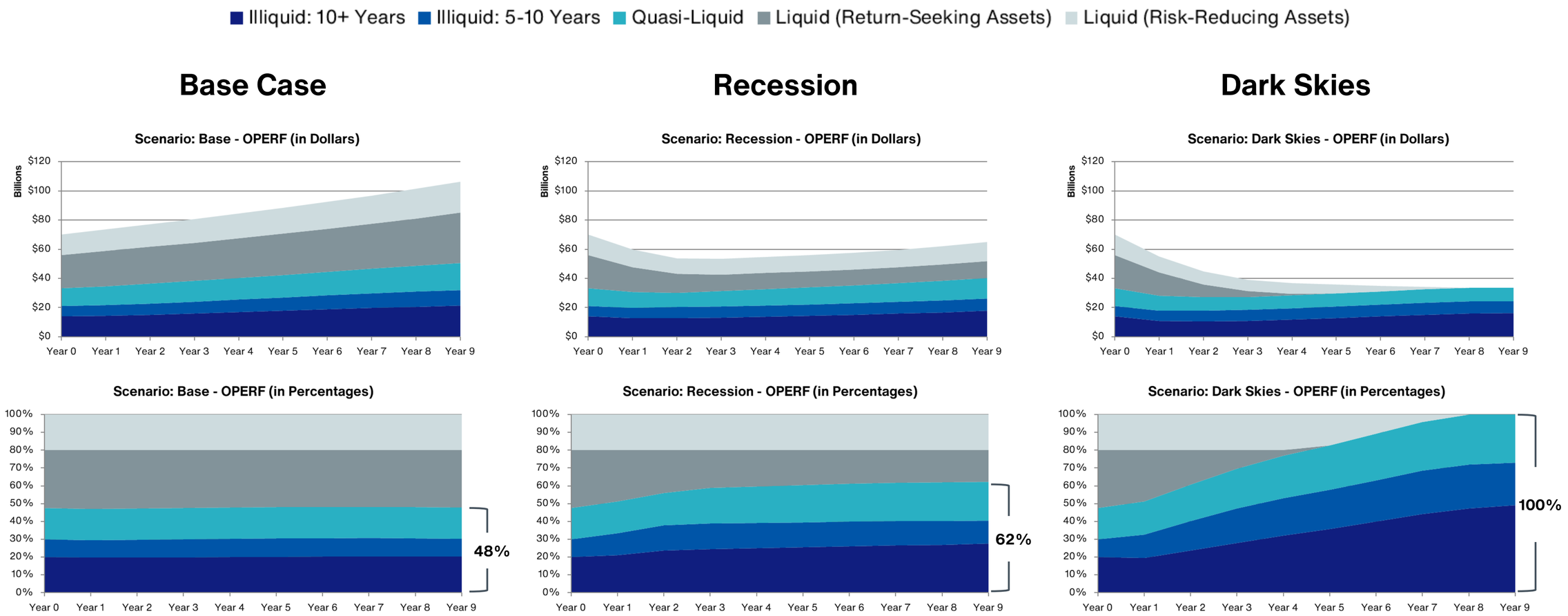
Process inputs and outputs

Current Policy (80% R-S)

Section: Appendix

Liquidity Analysis

Current Policy (80% Return-Seeking)



Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Current Policy (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Base Case economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Liquid Return-Seeking	33	33	33	33	32	32	32	32	32	32
Total Liquid	**53%**	**53%**	**53%**	**53%**	**52%**	**52%**	**52%**	**52%**	**52%**	**52%**
Quasi-Liquid	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Illiquid: 5-10 Year Lock-up	10	10	10	10	10	10	10	10	10	10
Illiquid: 10+ Year Lock-up	20	20	20	20	20	20	20	20	20	20
Total Quasi + Illiquid	**48%**	**47%**	**47%**	**47%**	**48%**	**48%**	**48%**	**48%**	**48%**	**48%**

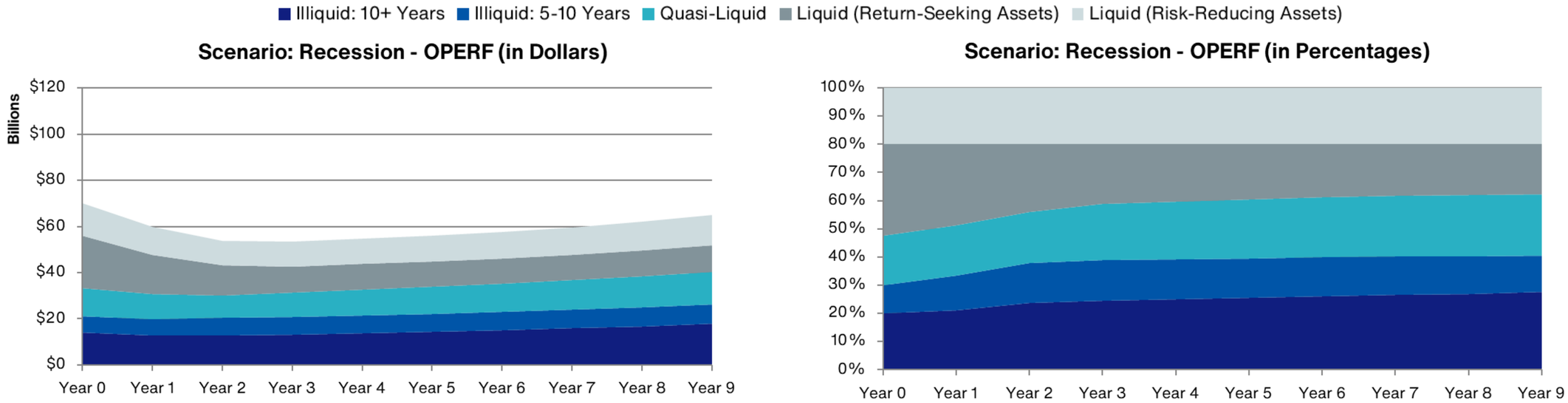
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	72%	73%	75%	77%	79%	81%	84%	86%	89%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.1	$3.3	$3.8	$4.3	$4.5	$4.6	$4.7

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Recession economic scenario – Current Policy (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Recession economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but recessionary markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 62% of the Plan due to the shrinking market value of the total Plan in this scenario
- There would not be a concern with the ability to pay benefits
- The OIC may need to redeem some quasi-liquid assets to stay close to its target allocation (48% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Recession economic scenario – Current Policy (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Recession economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Liquid Return-Seeking	33	29	24	21	20	20	19	18	18	18
Total Liquid	**53%**	**49%**	**44%**	**41%**	**40%**	**40%**	**39%**	**38%**	**38%**	**38%**
Quasi-Liquid	18%	18%	18%	20%	21%	21%	21%	21%	22%	22%
Illiquid: 5-10 Year Lock-up	10	12	14	14	14	14	14	14	13	13
Illiquid: 10+ Year Lock-up	20	21	24	24	25	26	26	27	27	28
Total Quasi + Illiquid	**48%**	**51%**	**56%**	**59%**	**60%**	**60%**	**61%**	**62%**	**62%**	**62%**

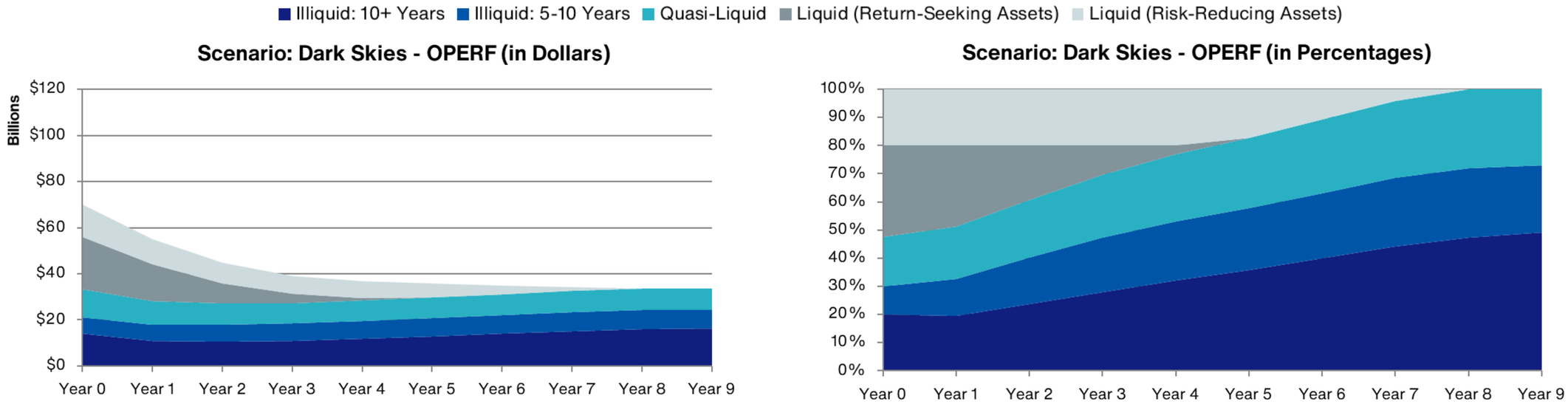
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	58%	52%	50%	51%	51%	52%	53%	54%	56%
Total Contribution Amt (in $B)	$2.5	$2.7	$3.0	$3.5	$4.1	$4.7	$5.3	$5.8	$6.3	$6.7

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Dark Skies economic scenario – Current Policy (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Dark Skies economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but subpar markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 100% of the Plan due to the shrinking market value of the total Plan in this scenario
- In this scenario, the OIC may want to pare back future commitments to stay closer to the target allocations; however, the allocation would still be significantly different from the target allocation (48% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Dark Skies economic scenario – Current Policy (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Dark Skies economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	20%	20%	20%	20%	20%	17%	11%	4%	0%	0%
Liquid Return-Seeking	33	29	19	10	3	0	0	0	0	0
Total Liquid	**53%**	**49%**	**39%**	**30%**	**23%**	**17%**	**11%**	**4%**	**0%**	**0%**
Quasi-Liquid	18%	19%	21%	22%	24%	25%	26%	27%	28%	27%
Illiquid: 5-10 Year Lock-up	10	13	17	19	21	22	23	24	25	24
Illiquid: 10+ Year Lock-up	20	20	24	28	32	36	40	44	47	49
Total Quasi + Illiquid	**48%**	**51%**	**61%**	**70%**	**77%**	**83%**	**89%**	**96%**	**100%**	**100%**

Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	54%	43%	37%	35%	33%	32%	31%	30%	30%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.6	$4.2	$4.7	$5.1	$5.5	$5.9	$6.4

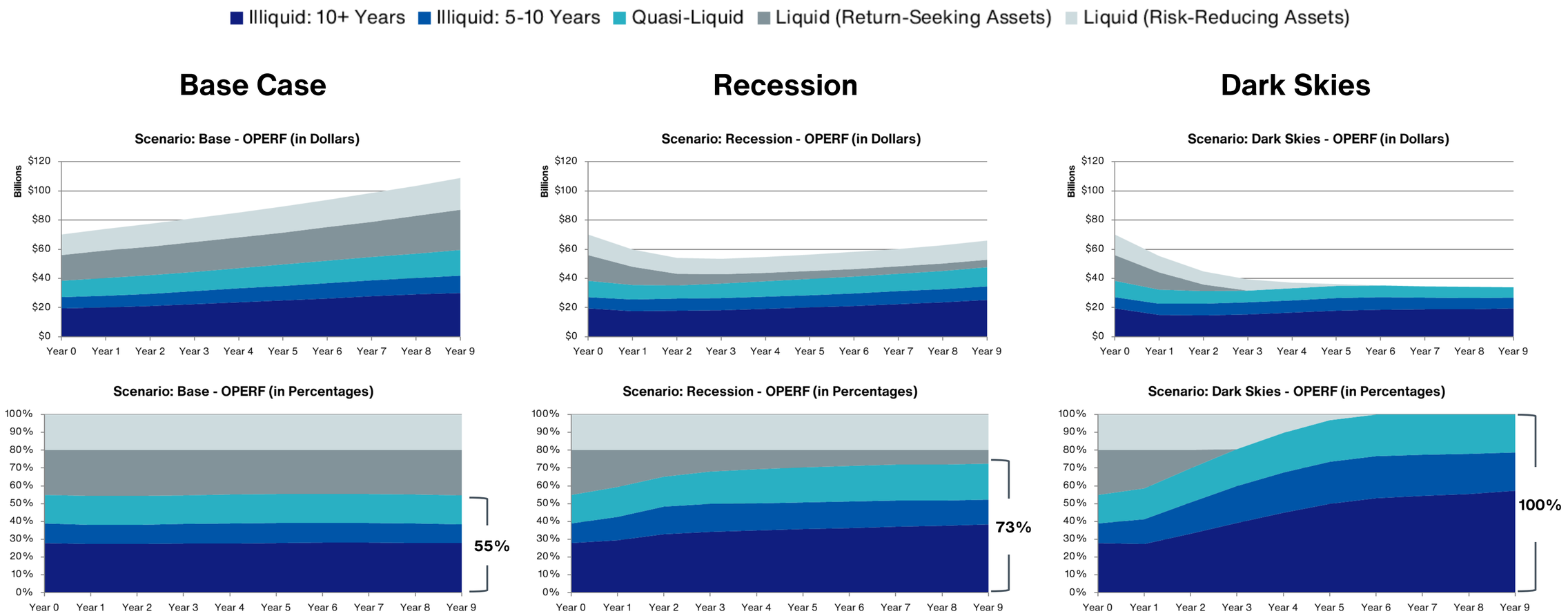
Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Actual Allocation (80% R-S)

Section: Appendix

Liquidity Analysis

Actual Allocation (80% Return-Seeking)

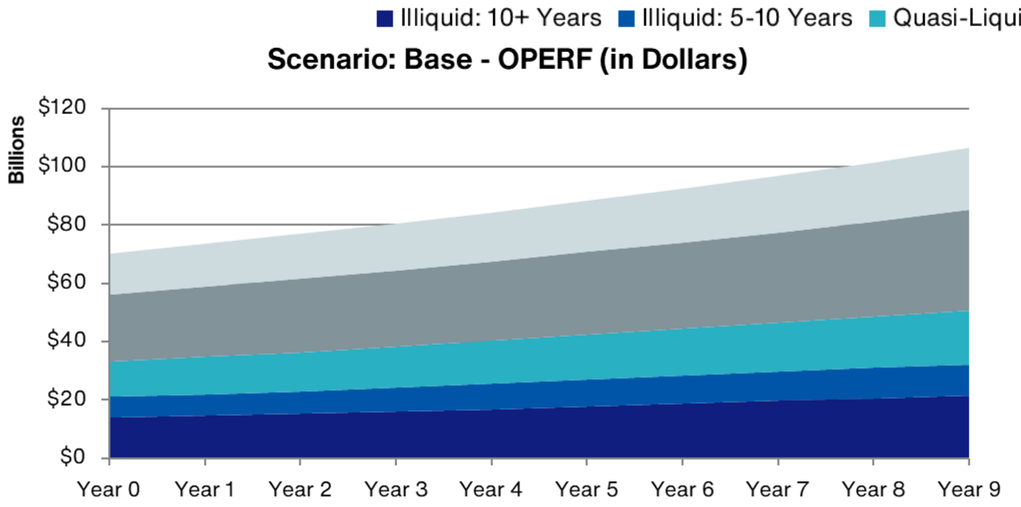


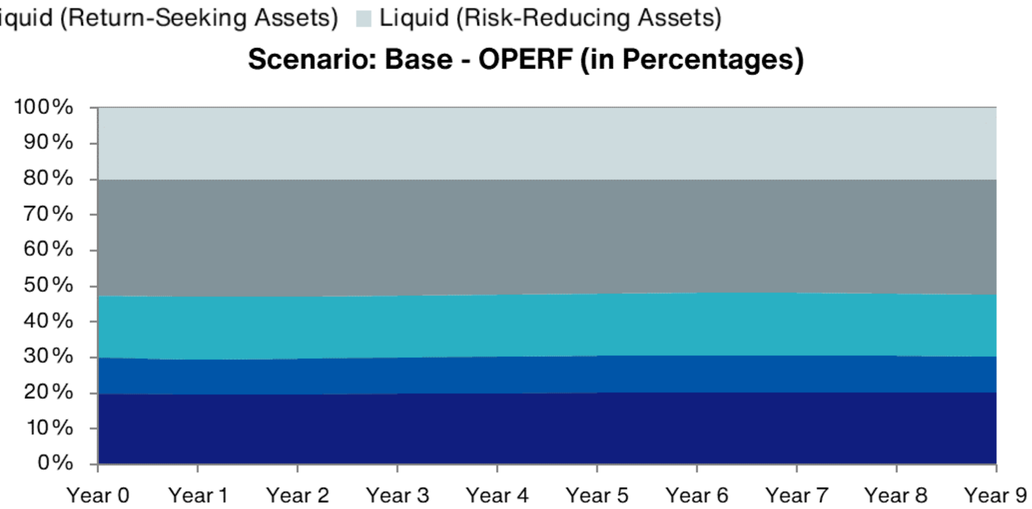
Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Current Policy (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Base Case economic scenario, assuming commitments are continued as expected





Key Takeaway:

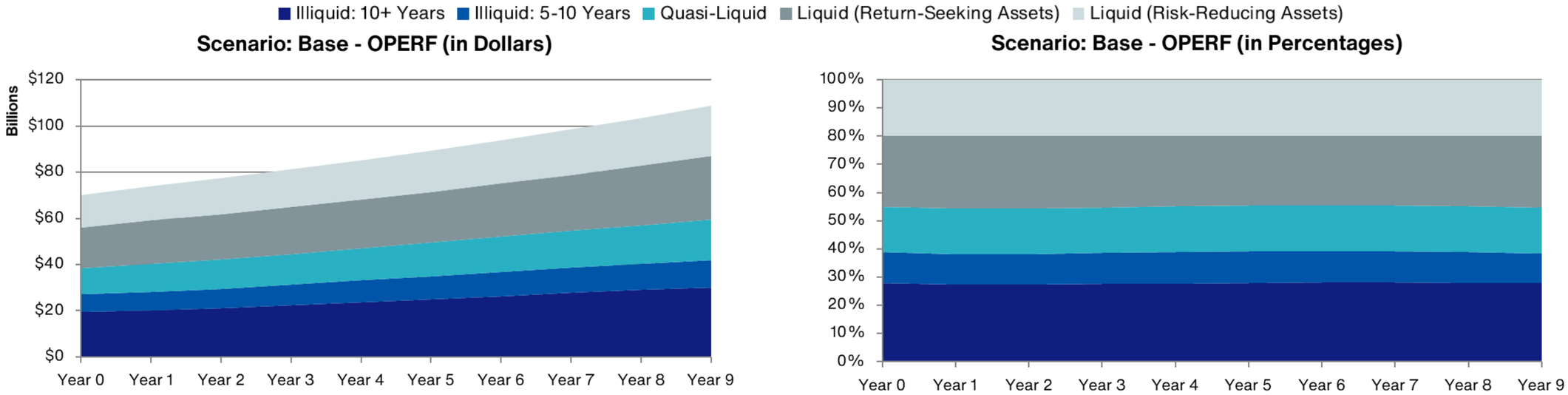
- Total illiquid and quasi-liquid assets are projected to stay near 48% of the Plan and can be maintained near the target with no cash flow problems

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Actual Allocation (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Actual allocation in the Base Case economic scenario, assuming commitments are continued as expected



Key Takeaway:

- Total illiquid and quasi-liquid assets are projected to stay near 55% of the Plan and can be maintained near the target with no cash flow problems

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Actual Allocation (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Actual allocation in the Base Case economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Liquid Return-Seeking	25	26	26	25	25	25	25	25	25	25
Total Liquid	**45%**	**46%**	**46%**	**45%**	**45%**	**45%**	**45%**	**45%**	**45%**	**45%**
Quasi-Liquid	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
Illiquid: 5-10 Year Lock-up	11	11	11	11	11	11	11	11	11	11
Illiquid: 10+ Year Lock-up	28	27	27	28	28	28	28	28	28	28
Total Quasi + Illiquid	**55%**	**54%**	**54%**	**55%**	**55%**	**55%**	**55%**	**55%**	**55%**	**55%**

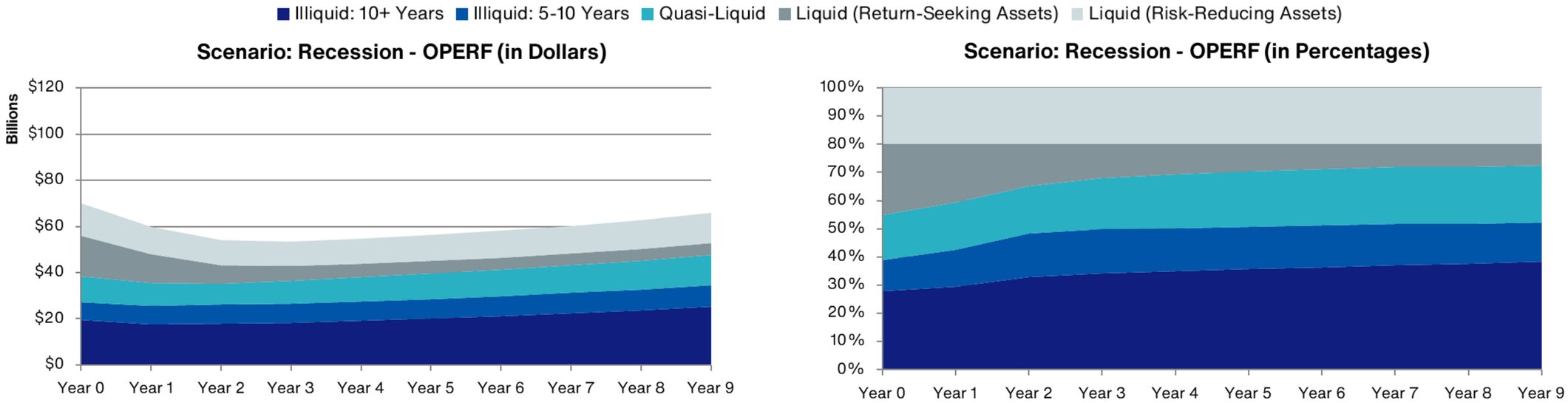
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	72%	74%	76%	78%	80%	83%	85%	88%	91%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.1	$3.3	$3.8	$4.3	$4.4	$4.6	$4.6

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Recession economic scenario – Actual Allocation (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Actual allocation in the Recession economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but recessionary markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 73% of the Plan due to the shrinking market value of the total Plan in this scenario
- There would not be a concern with the ability to pay benefits
- The OIC may need to redeem some quasi-liquid assets to stay close to its target allocation (55% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Recession economic scenario – Actual Allocation (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Actual allocation in the Recession economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Liquid Return-Seeking	25	21	15	12	11	10	9	8	8	7
Total Liquid	**45%**	**41%**	**35%**	**32%**	**31%**	**30%**	**29%**	**28%**	**28%**	**27%**
Quasi-Liquid	16%	17%	17%	18%	19%	19%	20%	20%	20%	20%
Illiquid: 5-10 Year Lock-up	11	13	15	16	15	15	15	15	14	14
Illiquid: 10+ Year Lock-up	28	30	33	34	35	36	36	37	37	38
Total Quasi + Illiquid	**55%**	**59%**	**65%**	**68%**	**69%**	**70%**	**71%**	**72%**	**72%**	**73%**

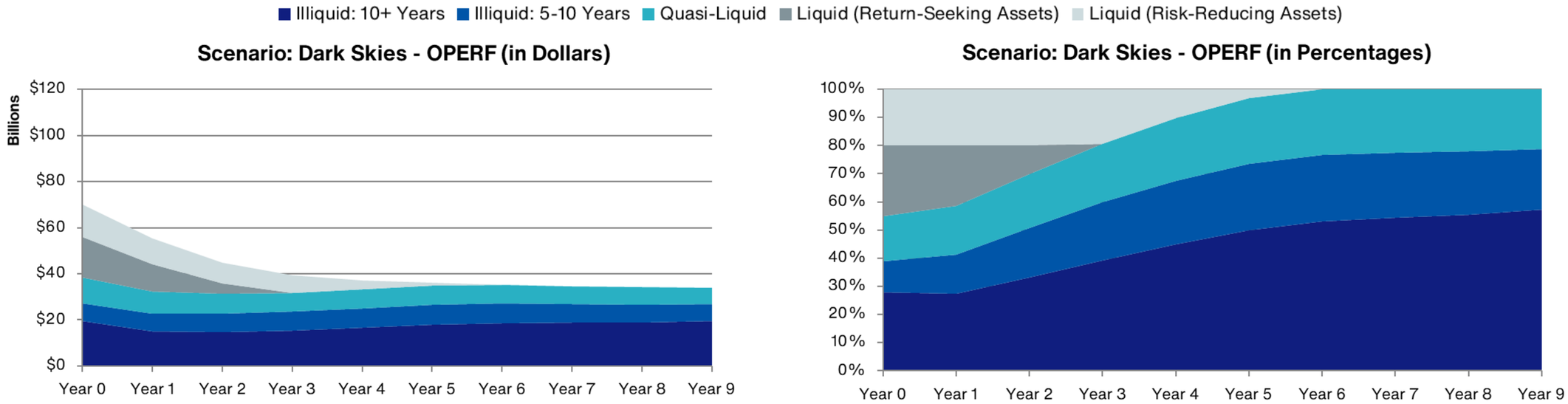
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	58%	52%	50%	51%	52%	52%	54%	55%	57%
Total Contribution Amt (in $B)	$2.5	$2.7	$3.0	$3.5	$4.1	$4.7	$5.3	$5.8	$6.3	$6.7

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Dark Skies economic scenario – Actual Allocation (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Actual allocation in the Dark Skies economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but subpar markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 100% of the Plan due to the shrinking market value of the total Plan in this scenario
- In this scenario, the OIC may want to pare back future commitments to stay closer to the target allocations; however, the allocation would still be significantly different from the target allocation (55% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Dark Skies economic scenario – Actual Allocation (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Actual allocation in the Dark Skies economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	20%	20%	20%	19%	10%	3%	0%	0%	0%	0%
Liquid Return-Seeking	25	21	10	0	0	0	0	0	0	0
Total Liquid	**45%**	**41%**	**30%**	**19%**	**10%**	**3%**	**0%**	**0%**	**0%**	**0%**
Quasi-Liquid	16%	17%	19%	21%	22%	23%	23%	23%	22%	21%
Illiquid: 5-10 Year Lock-up	11	14	18	21	23	24	24	23	23	22
Illiquid: 10+ Year Lock-up	28	27	33	39	45	50	53	54	55	57
Total Quasi + Illiquid	**55%**	**59%**	**70%**	**81%**	**90%**	**97%**	**100%**	**100%**	**100%**	**100%**

Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	54%	43%	37%	35%	34%	32%	31%	31%	30%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.6	$4.2	$4.7	$5.1	$5.5	$5.9	$6.4

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Option 1 (80% R-S)

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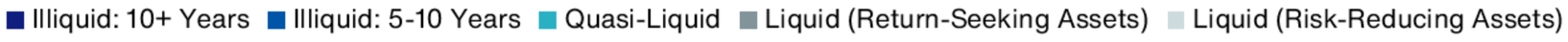
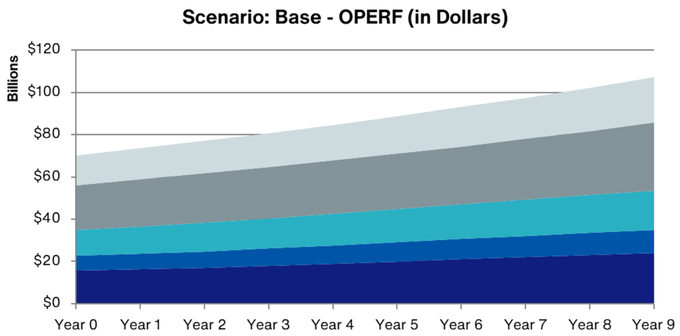
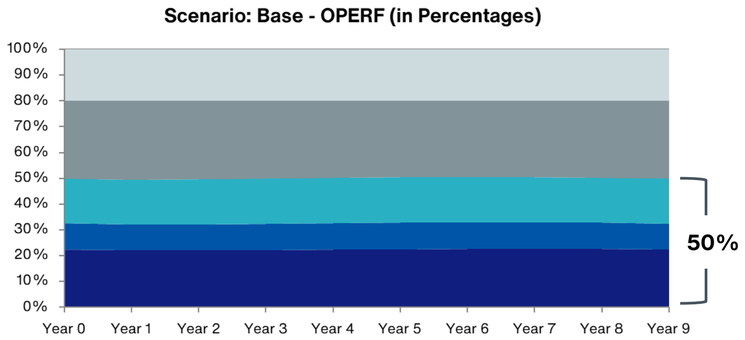
Liquidity Analysis
Option 1 (80% Return-Seeking)

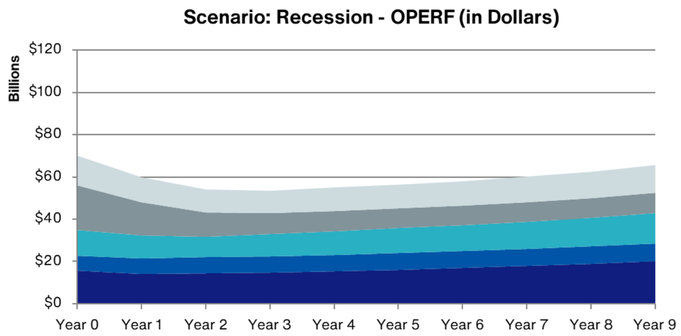


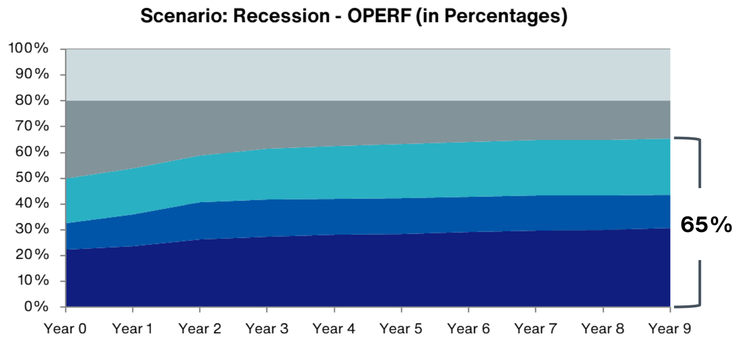
Base Case



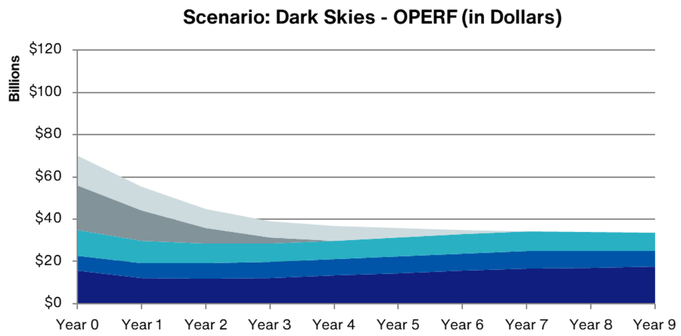


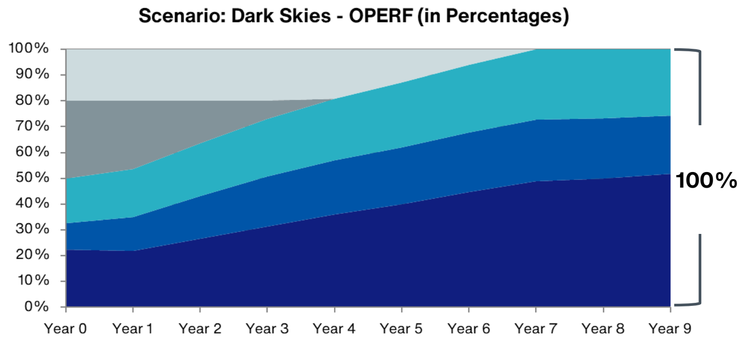
Recession





Dark Skies



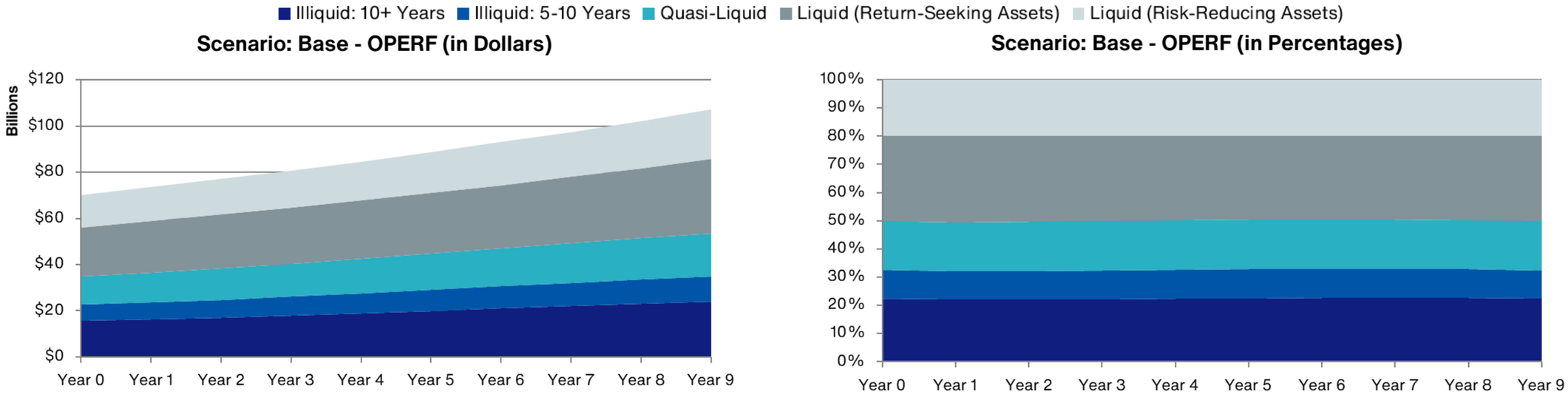


Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Option 1 (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 1 allocation in the Base Case economic scenario, assuming commitments are continued as expected



Key Takeaway:

- Total illiquid and quasi-liquid assets are projected to stay near 50% of the Plan and can be maintained near the target with no cash flow problems

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Option 1 (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 1 allocation in the Base Case economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Liquid Return-Seeking	30	30	30	30	30	30	30	30	30	30
Total Liquid	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Quasi-Liquid	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Illiquid: 5-10 Year Lock-up	10	10	10	10	10	10	10	10	10	10
Illiquid: 10+ Year Lock-up	23	22	22	22	22	22	23	23	23	22
Total Quasi + Illiquid	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**

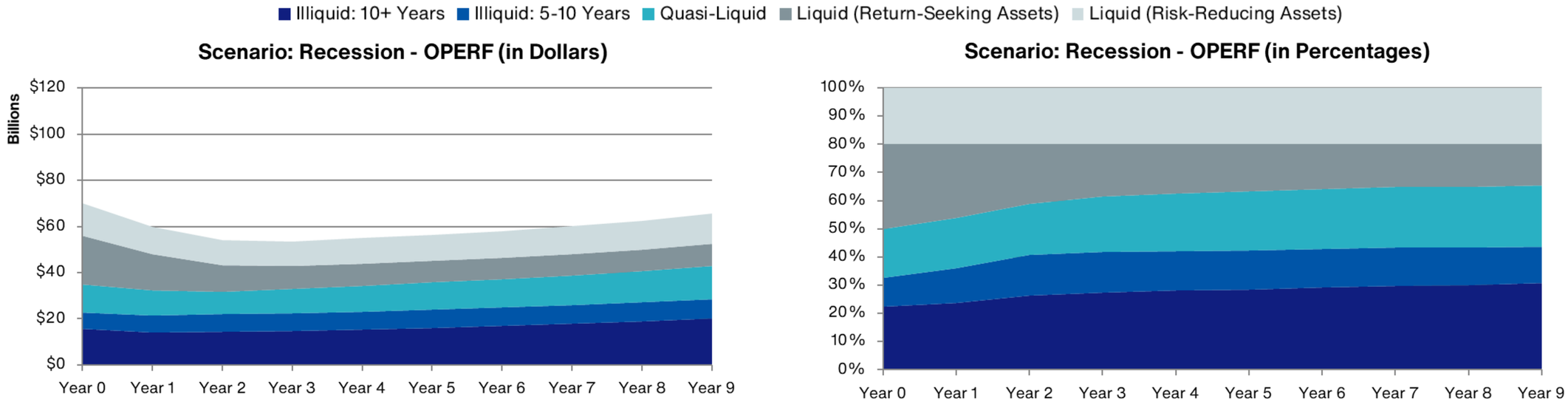
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	72%	73%	75%	77%	80%	82%	84%	87%	90%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.1	$3.3	$3.8	$4.3	$4.5	$4.6	$4.7

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Recession economic scenario – Option 1 (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 1 allocation in the Recession economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but recessionary markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 65% of the Plan due to the shrinking market value of the total Plan in this scenario
- There would not be a concern with the ability to pay benefits
- The OIC may need to redeem some quasi-liquid assets to stay close to its target allocation (50% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Recession economic scenario – Option 1 (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 1 allocation in the Recession economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Liquid Return-Seeking	30	26	21	18	18	17	16	15	15	15
Total Liquid	**50%**	**46%**	**41%**	**38%**	**38%**	**37%**	**36%**	**35%**	**35%**	**35%**
Quasi-Liquid	18%	18%	18%	20%	20%	21%	21%	21%	22%	22%
Illiquid: 5-10 Year Lock-up	10	12	14	14	14	14	14	14	13	13
Illiquid: 10+ Year Lock-up	23	24	26	27	28	29	29	30	30	31
Total Quasi + Illiquid	**50%**	**54%**	**59%**	**62%**	**62%**	**63%**	**64%**	**65%**	**65%**	**65%**

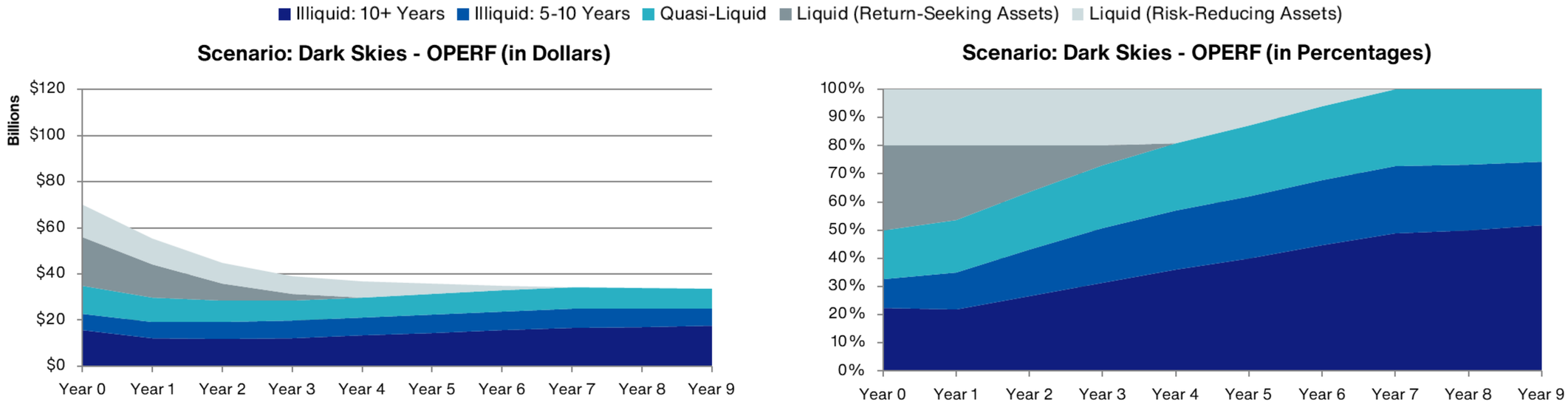
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	58%	52%	51%	51%	52%	52%	53%	55%	57%
Total Contribution Amt (in $B)	$2.5	$2.7	$3.0	$3.5	$4.1	$4.7	$5.3	$5.8	$6.3	$6.7

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Dark Skies economic scenario – Option 1 (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 1 allocation in the Dark Skies economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but subpar markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 100% of the Plan due to the shrinking market value of the total Plan in this scenario
- In this scenario, the OIC may want to pare back future commitments to stay closer to the target allocations; however, the allocation would still be significantly different from the target allocation (50% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Dark Skies economic scenario – Option 1 (80% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 1 allocation in the Dark Skies economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	20%	20%	20%	20%	19%	13%	6%	0%	0%	0%
Liquid Return-Seeking	30	26	16	7	0	0	0	0	0	0
Total Liquid	**50%**	**46%**	**36%**	**27%**	**19%**	**13%**	**6%**	**0%**	**0%**	**0%**
Quasi-Liquid	18%	19%	21%	22%	24%	25%	26%	27%	27%	26%
Illiquid: 5-10 Year Lock-up	10	13	16	19	21	22	23	24	23	23
Illiquid: 10+ Year Lock-up	23	22	27	31	36	40	45	49	50	52
Total Quasi + Illiquid	**50%**	**54%**	**64%**	**73%**	**81%**	**87%**	**94%**	**100%**	**100%**	**100%**

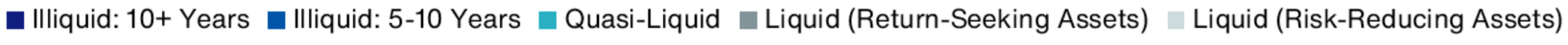
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	54%	43%	37%	35%	33%	32%	31%	30%	30%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.6	$4.2	$4.7	$5.1	$5.5	$5.9	$6.4

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

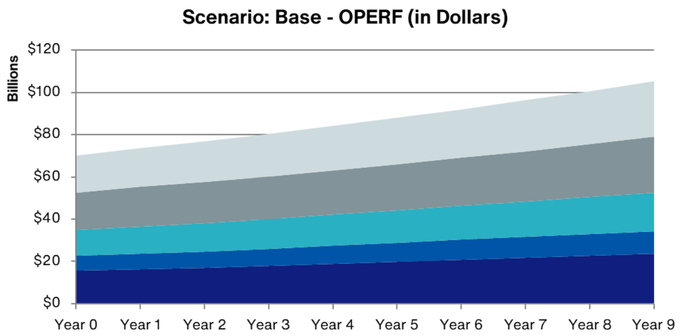
Option 2 (75% R-S)

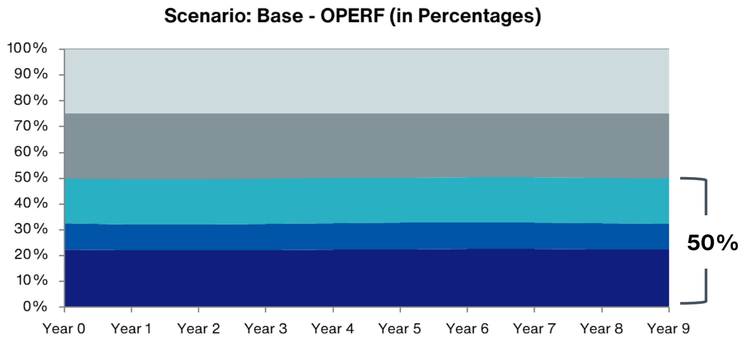
Section: Appendix

Liquidity Analysis
Option 2 (75% Return-Seeking)

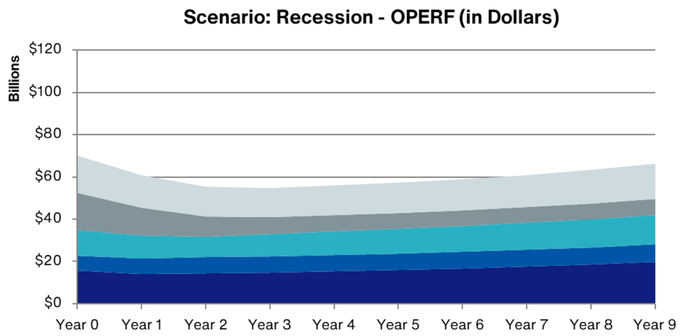


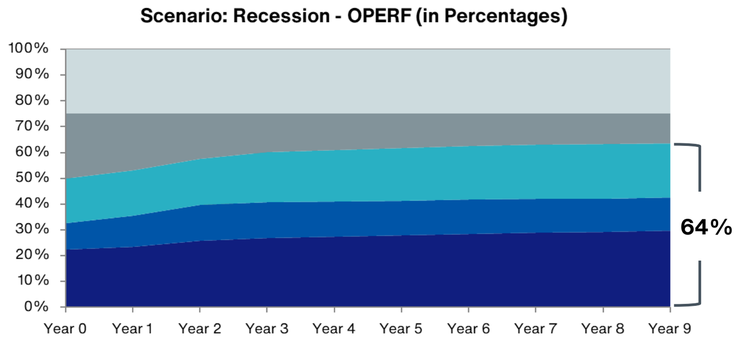
Base Case



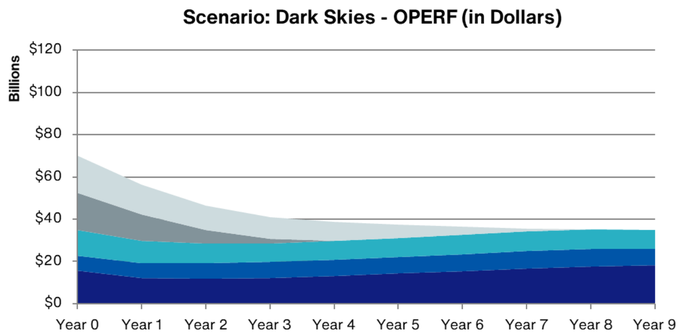


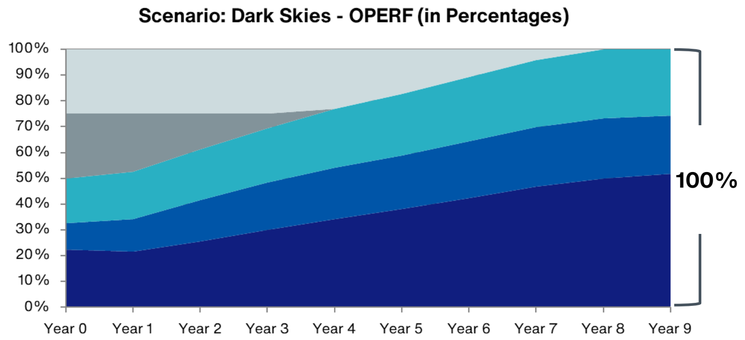
Recession





Dark Skies



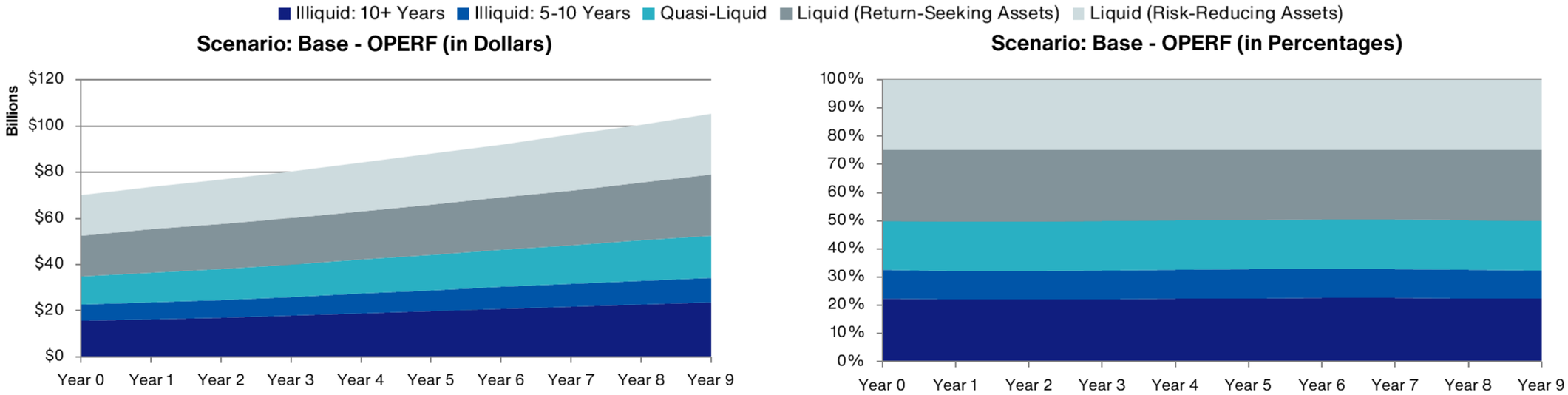


Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Option 2 (75% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 2 allocation in the Base Case economic scenario, assuming commitments are continued as expected



Key Takeaway:

- Total illiquid and quasi-liquid assets are projected to stay near 50% of the Plan and can be maintained near the target with no cash flow problems

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Option 2 (75% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 2 allocation in the Base Case economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Liquid Return-Seeking	25	25	25	25	25	25	25	25	25	25
Total Liquid	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Quasi-Liquid	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Illiquid: 5-10 Year Lock-up	10	10	10	10	10	10	10	10	10	10
Illiquid: 10+ Year Lock-up	23	22	22	22	22	22	23	23	22	22
Total Quasi + Illiquid	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**

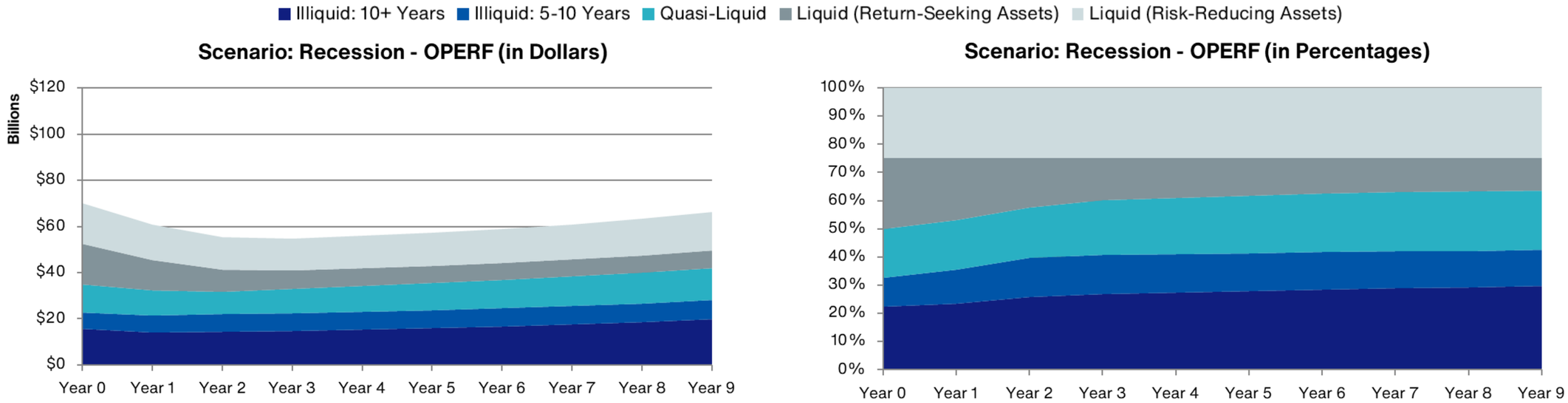
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	72%	73%	75%	77%	79%	81%	83%	86%	88%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.1	$3.3	$3.8	$4.3	$4.5	$4.6	$4.7

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Recession economic scenario – Option 2 (75% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 2 allocation in the Recession economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but recessionary markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 64% of the Plan due to the shrinking market value of the total Plan in this scenario
- There would not be a concern with the ability to pay benefits
- The OIC may need to redeem some quasi-liquid assets to stay close to its target allocation (50% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Recession economic scenario – Option 2 (75% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 2 allocation in the Recession economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Liquid Return-Seeking	25	22	18	15	14	13	13	12	12	11
Total Liquid	**50%**	**47%**	**43%**	**40%**	**39%**	**38%**	**38%**	**37%**	**37%**	**36%**
Quasi-Liquid	18%	18%	18%	19%	20%	20%	21%	21%	21%	21%
Illiquid: 5-10 Year Lock-up	10	12	14	14	14	14	13	13	13	13
Illiquid: 10+ Year Lock-up	23	23	26	27	27	28	28	29	29	30
Total Quasi + Illiquid	**50%**	**53%**	**57%**	**60%**	**61%**	**62%**	**62%**	**63%**	**63%**	**64%**

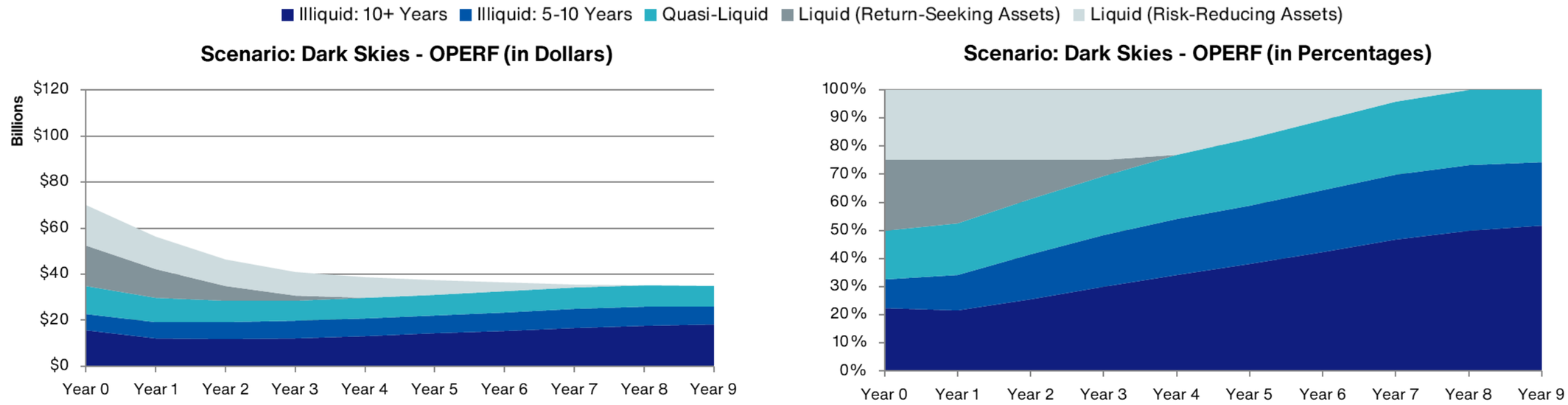
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	59%	53%	52%	52%	52%	53%	54%	56%	57%
Total Contribution Amt (in $B)	$2.5	$2.7	$3.0	$3.5	$4.1	$4.7	$5.2	$5.8	$6.3	$6.7

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Dark Skies economic scenario – Option 2 (75% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 2 allocation in the Dark Skies economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but subpar markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 100% of the Plan due to the shrinking market value of the total Plan in this scenario
- In this scenario, the OIC may want to pare back future commitments to stay closer to the target allocations; however, the allocation would still be significantly different from the target allocation (50% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Dark Skies economic scenario – Option 2 (75% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 2 allocation in the Dark Skies economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	25%	25%	25%	25%	23%	17%	11%	4%	0%	0%
Liquid Return-Seeking	25	22	14	6	0	0	0	0	0	0
Total Liquid	**50%**	**47%**	**39%**	**31%**	**23%**	**17%**	**11%**	**4%**	**0%**	**0%**
Quasi-Liquid	18%	18%	20%	21%	23%	24%	25%	26%	27%	26%
Illiquid: 5-10 Year Lock-up	10	13	16	18	20	21	22	23	24	23
Illiquid: 10+ Year Lock-up	23	22	26	30	34	38	42	47	50	52
Total Quasi + Illiquid	**50%**	**53%**	**61%**	**69%**	**77%**	**83%**	**89%**	**96%**	**100%**	**100%**

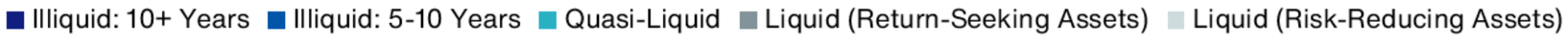
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	55%	45%	39%	36%	35%	33%	32%	32%	31%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.4	$4.0	$4.6	$5.1	$5.5	$5.9	$6.4

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

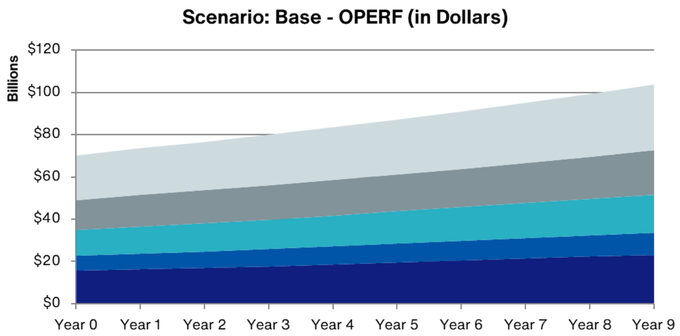
Option 3 (70% R-S)

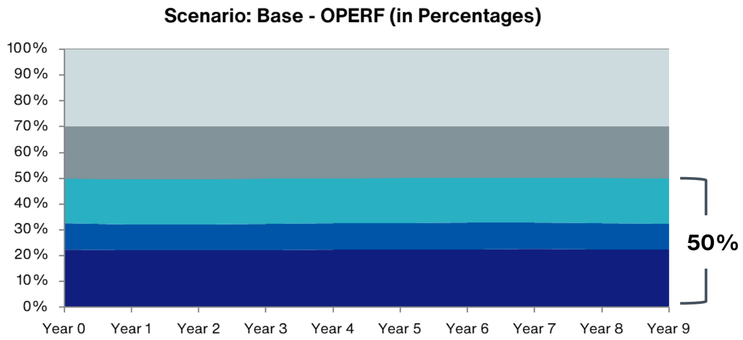
Section: Appendix

Liquidity Analysis
Option 3 (70% Return-Seeking)

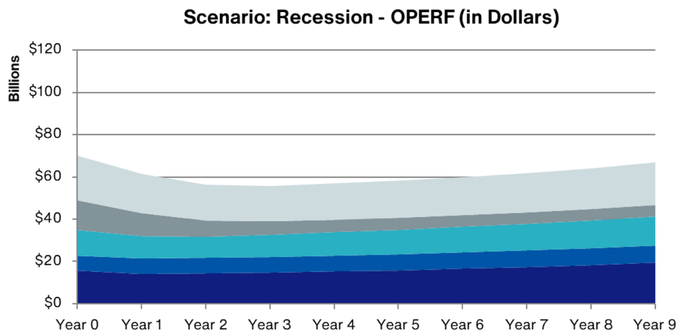


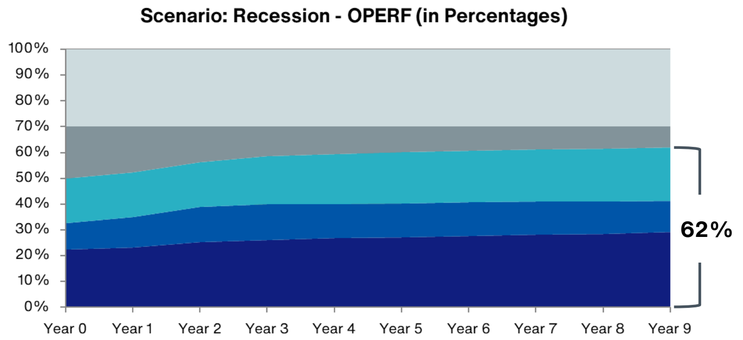
Base Case



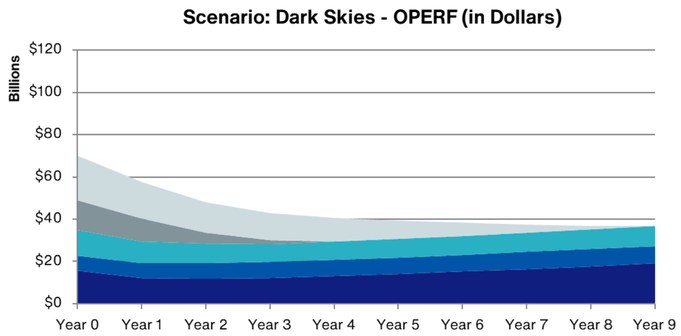


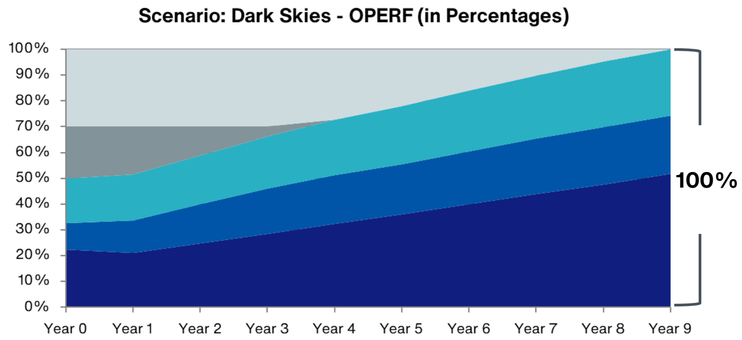
Recession





Dark Skies



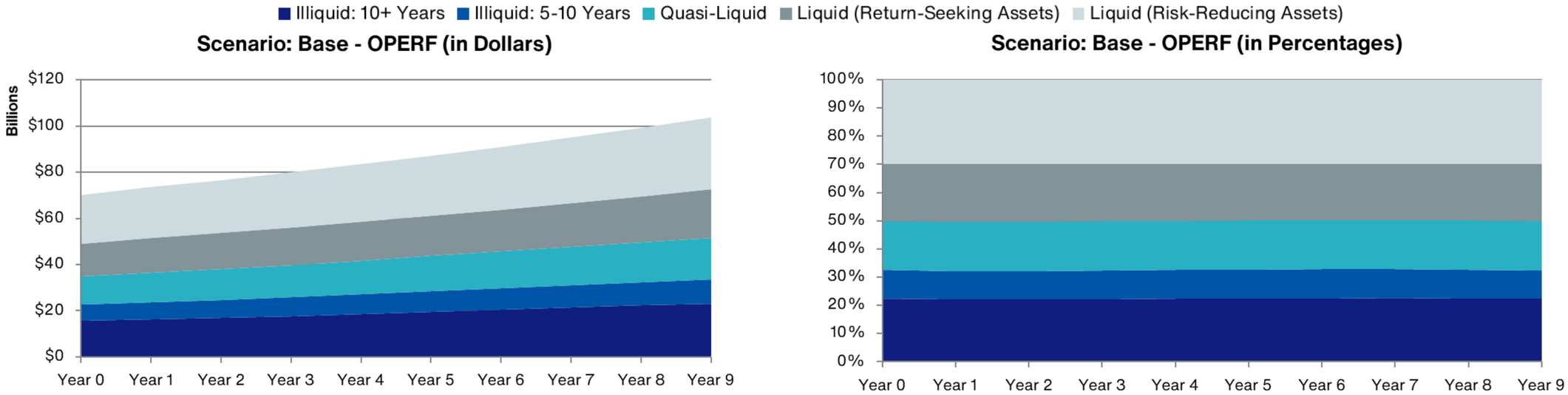


Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Option 3 (70% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 3 allocation in the Base Case economic scenario, assuming commitments are continued as expected



Key Takeaway:

- Total illiquid and quasi-liquid assets are projected to stay near 50% of the Plan and can be maintained near the target with no cash flow problems

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Base Case economic scenario – Option 3 (70% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 3 allocation in the Base Case economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Liquid Return-Seeking	20	20	20	20	20	20	20	20	20	20
Total Liquid	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**
Quasi-Liquid	18%	18%	18%	18%	18%	18%	18%	18%	18%	18%
Illiquid: 5-10 Year Lock-up	10	10	10	10	10	10	10	10	10	10
Illiquid: 10+ Year Lock-up	23	22	22	22	22	22	23	23	22	22
Total Quasi + Illiquid	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**	**50%**

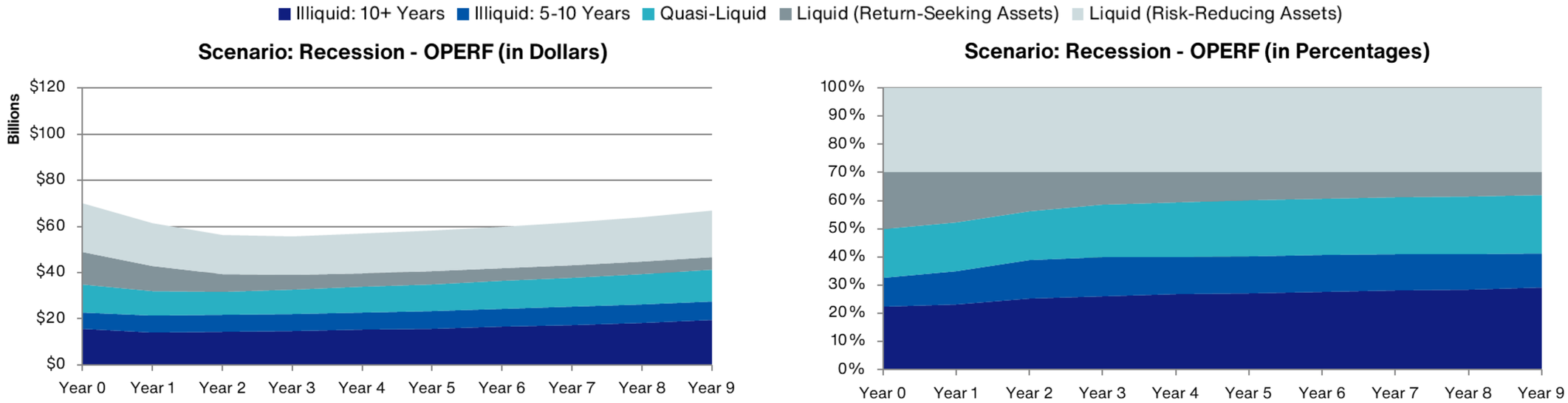
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	72%	73%	75%	76%	78%	80%	82%	84%	87%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.1	$3.3	$3.8	$4.3	$4.5	$4.6	$4.7

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Recession economic scenario – Option 3 (70% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 3 allocation in the Recession economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but recessionary markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 62% of the Plan due to the shrinking market value of the total Plan in this scenario
- There would not be a concern with the ability to pay benefits
- The OIC may need to redeem some quasi-liquid assets to stay close to its target allocation (50% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Recession economic scenario – Option 3 (70% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 3 allocation in the Recession economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Liquid Return-Seeking	20	18	14	11	11	10	9	9	9	8
Total Liquid	**50%**	**48%**	**44%**	**41%**	**41%**	**40%**	**39%**	**39%**	**39%**	**38%**
Quasi-Liquid	18%	17%	17%	19%	19%	20%	20%	20%	21%	21%
Illiquid: 5-10 Year Lock-up	10	12	14	14	13	13	13	13	13	12
Illiquid: 10+ Year Lock-up	23	23	25	26	27	27	28	28	28	29
Total Quasi + Illiquid	**50%**	**52%**	**56%**	**59%**	**59%**	**60%**	**61%**	**61%**	**61%**	**62%**

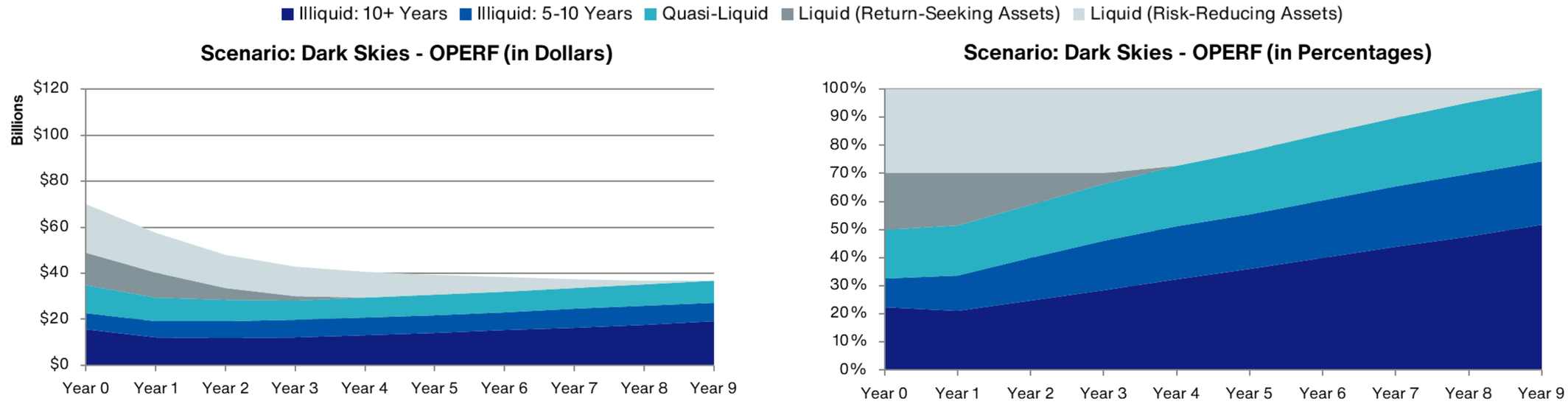
Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	60%	54%	53%	53%	53%	54%	55%	56%	58%
Total Contribution Amt (in $B)	$2.5	$2.7	$3.0	$3.5	$4.1	$4.7	$5.2	$5.8	$6.3	$6.7

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Liquidity Analysis

Dark Skies economic scenario – Option 3 (70% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 3 allocation in the Dark Skies economic scenario, assuming commitments are continued as expected



Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but subpar markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 100% of the Plan due to the shrinking market value of the total Plan in this scenario
- In this scenario, the OIC may want to pare back future commitments to stay closer to the target allocations; however, the allocation would still be significantly different from the target allocation (50% illiquid assets)

Note: Year 0 represents a starting point of June 30, 2022

Liquidity Analysis

Dark Skies economic scenario – Option 3 (70% R-S)

The exhibit below shows the projected liquidity lock-up of the Option 3 allocation in the Dark Skies economic scenario, assuming commitments are continued as expected

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Risk-Reducing Assets	30%	30%	30%	30%	27%	22%	16%	10%	5%	0%
Liquid Return-Seeking	20	19	11	4	0	0	0	0	0	0
Total Liquid	**50%**	**49%**	**41%**	**34%**	**27%**	**22%**	**16%**	**10%**	**5%**	**0%**
Quasi-Liquid	18%	18%	19%	20%	22%	23%	24%	25%	25%	26%
Illiquid: 5-10 Year Lock-up	10	12	15	17	19	20	21	21	22	23
Illiquid: 10+ Year Lock-up	23	21	25	29	32	36	40	44	48	52
Total Quasi + Illiquid	**50%**	**51%**	**59%**	**66%**	**73%**	**78%**	**84%**	**90%**	**95%**	**100%**

Other Metrics	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Funded Ratio (MVA / AL)	70%	56%	46%	41%	38%	37%	35%	34%	33%	33%
Total Contribution Amt (in $B)	$2.5	$2.7	$2.9	$3.4	$4.0	$4.6	$5.1	$5.5	$5.9	$6.4

Note: Year 0 represents a starting point of June 30, 2022; Percentages may not sum to 100% due to rounding

Assumptions and Methods

Section: Appendix

Liquidity Analysis
Assumptions

We started with the target asset allocations, then see how the actual allocations would change in different economic scenarios, continuing new commitments to private assets, as expected.

Actuarial projections provided by the plan actuary (Milliman) based on the unique economic scenario assumptions

- Milliman's projections are based on the same information used for results provided to Meketa and Oregon State Treasury (OST) on August 22, 2022. This reflects the same model used for our financial modeling presentation to the PERS Board at their December 2021 meeting, and that presentation should be referenced for information on the data, assumptions, methods, reliance, and disclaimers regarding the model. Known 2021 full-year OPERF returns and inflation were incorporated for all purposes and the deterministic scenarios Aon provided was used for calendar years 2022 through 2031.
- Please note that throughout Milliman's projection the valuation interest is assumed to remain at the current Board-adopted 6.90% for all scenarios and allocations.

Asset experience through June 30, 2022 (assumed to be a -8% year-to-date return) included in this analysis

Assets modeled in this analysis do not include side accounts

Assumes the portfolio starts at the target asset allocation levels for illiquid assets, maintaining close to the portfolio targets over the next 10 years

Our Capital Market Assumptions

As of June 30, 2022 (30 Years)

		Expected Real Return[1]	Expected Nominal Return[1]	Expected Nominal Volatility
	Equity			
1	Global Equity IMI	5.3%	7.8%	18.5%
	Fixed Income			
2	Core Fixed Income	1.3%	3.7%	4.5%
	Alternatives			
3	Hedge Funds - CTAs	3.5%	6.0%	15.5%
4	Hedge Funds - Global Macro	3.0%	5.5%	12.5%
5	Alternative Risk Premia	5.0%	7.5%	9.5%
6	Risk Parity	3.9%	6.4%	10.5%
7	Core Real Estate	2.6%	5.1%	15.5%
8	Non-Core Real Estate	4.2%	6.7%	25.5%
9	Private Equity	7.6%	10.2%	25.5%
10	Infrastructure	5.2%	7.7%	15.0%
	Inflation			
11	Inflation	0.0%	2.4%	2.0%

[1] Expected returns are using Aon Investments Q3 2022 30-Year Capital Market Assumptions. Assumptions do not include fees/expenses. All expected returns are geometric (long-term compounded; rounded to the nearest decimal) and net of investment fees. Expected returns presented are models and do not represent the returns of an actual client account. Not a guarantee of future results.

Our Capital Market Assumptions

As of June 30, 2022

	Nominal Correlations	1	2	3	4	5	6	7	8	9	10	11
1	Global Equity IMI	**1.00**	0.02	0.16	0.23	0.32	0.75	0.36	0.47	0.63	0.35	0.08
2	Core Fixed Income	0.02	**1.00**	-0.03	0.14	0.08	0.42	0.05	0.04	0.03	0.05	-0.02
3	Hedge Funds - CTAs	0.16	-0.03	**1.00**	0.70	0.06	0.10	0.03	0.05	0.07	0.03	-0.02
4	Hedge Funds - Global Macro	0.23	0.14	0.70	**1.00**	0.09	0.28	0.06	0.09	0.11	0.06	0.01
5	Alternative Risk Premia	0.32	0.08	0.06	0.09	**1.00**	0.26	0.13	0.17	0.21	0.13	0.07
6	Risk Parity	0.75	0.42	0.10	0.28	0.26	**1.00**	0.23	0.32	0.37	0.23	0.18
7	Core Real Estate	0.36	0.05	0.03	0.06	0.13	0.23	**1.00**	0.97	0.32	0.18	0.06
8	Non-Core Real Estate	0.47	0.04	0.05	0.09	0.17	0.32	0.97	**1.00**	0.37	0.22	0.07
9	Private Equity	0.63	0.03	0.07	0.11	0.21	0.37	0.32	0.37	**1.00**	0.32	0.06
10	Infrastructure	0.35	0.05	0.03	0.06	0.13	0.23	0.18	0.22	0.32	**1.00**	0.06
11	Inflation	0.08	-0.02	-0.02	0.01	0.07	0.18	0.06	0.07	0.06	0.06	**1.00**

Aon’s Capital Market Assumptions

Background

Long-term (10- and 30-year forecasts) forward-looking assumptions (asset class geometric return, volatility, and correlations)

Building Block approach, primarily based on consensus expectations and market-based inputs

Best estimates of annualized returns (50/50 better or worse)

Market returns: no active management value added (except for certain assets classes, such as hedge funds)

Net of investment fees

Updated quarterly

We show Aon’s long-term (i.e., 30-year) capital market assumptions throughout this material

Aon's Capital Market Assumption Framework

Building Block Approach

Expected return estimates for equity and fixed income are developed using a building block approach

Expected returns based on observable information in the equity and fixed income markets and consensus estimates for major economic and capital market inputs, such as earnings and inflation

Where necessary, judgment-based modifications are made to these inputs

Return assumptions for other asset classes are based on historical results, current market characteristics, and professional judgment from our specialist research teams

Example: Public Equities

INCOME (Earnings Yield x Sustainable Payout Ratio)	+	GROWTH (Real EPS Growth)	+	INFLATION	=	TOTAL (Equity Return)
Earnings yield moves directly with market; Sustainable payout ratio is a constant and based on Aon's assumptions		Based on Aon's in-house trend analysis, I/B/E/S estimates and Consensus Economics		Based on consensus forecasts; Primary source is Consensus Economics		FORWARD LOOKING ASSUMPTION

Explanation of Capital Market Assumptions

As of June 30, 2022 (30 Years)

The following capital market assumptions were developed by Aon's Global Asset Allocation Team and represent the long-term capital market outlook (i.e., 30 years) based on data at the end of the second quarter of 2022. The assumptions were developed using a building block approach, reflecting observable inflation and interest rate information available in the fixed income markets as well as Consensus Economics forecasts. Our long-term assumptions for other asset classes are based on historical results, current market characteristics, and our professional judgment.

Inflation – Expected Level (2.4%)

Based on Consensus Economics long-term estimates and our near-term economic outlook, we expect U.S. consumer price inflation to be approximately 2.4% during the next 30 years.

Real Returns for Asset Classes

Fixed Income

- **Cash (0.5%)** – Over the long run, we expect the real yield on cash and money market instruments to produce a real return of 0.5% in a moderate to low-inflationary environment.
- **TIPS (1.0%)** – We expect intermediate duration Treasury Inflation-Protected Securities to produce a real return of about 0.0%.
- **Core Fixed Income (i.e., Market Duration)** (1.3%) – We expect intermediate duration Treasuries to produce a real return of about 0.5%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 0.8%, resulting in a long-term real return of 1.3%.
- **Core Plus Bonds (1.7%)** – Modeled as 20% 5 duration gov't with real return of 0.5% and 80% 5 duration corporate bonds with real return of 2.0%.
- **Long Duration Bonds – Government and Credit (1.9%)** – We expect Treasuries with a duration comparable to the Long Government Credit Index to produce a real return of 1.1%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 0.8%, resulting in an expected real return of 1.9%.

Explanation of Capital Market Assumptions

As of June 30, 2022 (30 Years)

- **Long Duration Bonds – Credit (2.4%)** – We expect Treasuries with a duration comparable to the Long Credit Index to produce a real return of 1.1%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 1.3%, resulting in an expected real return of 2.4%.
- **Long Duration Bonds – Government (1.1%)** – We expect Treasuries with a duration of ~12 years to produce a real return of 1.1% during the next 30 years.
- **High Yield Bonds (3.3%)** – We expect intermediate duration Treasuries to produce a real return of about 0.5%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 2.8%, resulting in an expected real return of 3.3%.
- **Bank Loans (3.7%)** – We expect LIBOR to produce a real return of about 1.1%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults) to be 2.6%, resulting in an expected real return of 3.7%.
- **Non-US Developed Bonds: 50% Hedged (0.9%)** – We forecast real returns for non-US developed market bonds to be 0.9% over a 30-year period after adjusting for a 50% currency hedge. We assume a blend of one-third investment grade corporate bonds and two-thirds government bonds. We also produce assumptions for 0% hedged and 100% hedged non-US developed bonds.
- **Emerging Market Bonds (Sovereign; USD) (3.3%)** – We forecast real returns for emerging market sovereign bonds denominated in US dollars to be 3.3% over a 30-year period.
- **Emerging Market Bonds (Corporate; USD) (2.7%)** – We forecast real returns for emerging market corporate bonds denominated in US dollars to be 2.7% over a 30-year period.
- **Emerging Market Bonds (Sovereign; Local) (3.9%)** – We forecast real returns for emerging market sovereign bonds denominated in local currency to be 3.9% over a 30-year period.
- **Multi Asset Credit (MAC) (4.4%)** – We assume real returns from beta exposure to high yield, bank loans and emerging market debt to add 3.6% plus 0.8% from alpha (net of fees) over a 30-year period.

Explanation of Capital Market Assumptions

As of June 30, 2022 (30 Years)

- **Private Debt-Direct Lending (4.6%) –** The base building block is bank loans 3.7% + spread 0.9% (net of management fees and performance incentives). There is 100% leverage included in the assumption with the nominal cost of financing at LIBOR + 2.5%.

Equities

- **Large Cap U.S. Equity (4.8%)** – This assumption is based on our 30-year outlook for large cap U.S. company dividends and real earnings growth. Adjustments are made for valuations as needed.
- **Small Cap U.S. Equity (5.3%)** – Adding a 0.5% return premium for small cap U.S. equity over large cap U.S. equity results in an expected real return of 5.3%. This return premium is theoretically justified by the higher risk inherent in small cap U.S. equity versus large cap U.S. equity, and is also justified by historical data. In recent years, higher small cap valuations relative large cap equity has reduced the small cap premium.
- **Global Equity (Developed & Emerging Markets) (5.3%)** – We employ a building block process similar to the U.S. equity model using the developed and emerging markets that comprise the MSCI All-Country World Index. Our roll-up model produces an expected real return of 5.3% for global equity.
- **International (Non-U.S.) Equity, Developed Markets (5.1%)** – We employ a building block process similar to the U.S. equity model using the non-U.S. developed equity markets that comprise the MSCI EAFE Index.
- **Emerging Market Stocks (5.7%)** - We employ a building block process similar to the U.S. equity model using the non-U.S. emerging equity markets that comprise the MSCI Emerging Markets Index.
- **Equity Risk Insurance Premium Strategies-High Beta (3.8%) –** We expect real returns from 50% equity + 50% cash beta of 3.0% plus 0.8% insurance risk premium over the next 30 years.

Explanation of Capital Market Assumptions

As of June 30, 2022 (30 Years)

Alternative Asset Classes

- **Hedge Fund-of-Funds Universe (2.1%)** – The generic category “hedge funds” encompasses a wide range of strategies accessed through “fund-of-funds” vehicles. We also assume the *median* manager is selected and also allow for the additional costs associated with Fund-of-Funds management. A top-tier portfolio of funds (hedge fund-of-funds buy-list) could add an additional 1.1% in return at similar volatility based on alpha, lower fees and better risk management.
- **Hedge Fund-of-Funds Buy List (3.2%)** – The generic category of top-tier “hedge funds” encompasses a wide range of strategies accessed through “fund-of-funds” vehicles. We assume additional costs associated with Funds-of-Funds management. To use this category the funds must be buy rated or we advise on manager selection.
- **Broad Hedge Funds Universe (3.5%)** – Represents a diversified portfolio of direct hedge fund investments. This investment will tend to be less diversified than a typical “fund-of-funds” strategy as there will be fewer underlying managers and will not include the extra layer of fees found in a Fund-of-Funds structure.
- **Broad Hedge Funds Buy List (4.8%)** – Represents a diversified portfolio of top-tier direct hedge fund investments. This investment will tend to be less diversified than a typical “fund-of-funds” strategy as there will be fewer underlying managers and will not include the extra layer of fees found in a Fund-of-Funds structure. To use this category the funds must be buy rated or we advise on manager selection.
- **Core Real Estate (2.6%)** -- Our real return assumption for core real estate is based a gross income of about 2.6%, management fees of roughly 1%, 25% leverage and future capital appreciation near the rate of inflation during the next 30 years. We assume a portfolio of equity real estate holdings that is diversified by property and by geographic region.
- **Non-Core Real Estate (4.2%)** -- Core real estate is levered approximately 100% as the base building block for this assumption. We subtract financing costs for the leverage and 2% management costs. We also assume nominal alpha of 3% over core real estate. We assume a 50/50 mix of value-add and opportunistic investments.

Explanation of Capital Market Assumptions

As of June 30, 2022 (30 Years)

- **U.S. REITs (3.9%)** – Our real return assumption for U.S. REITs is based on income of about 3.9% and future capital appreciation near the rate of inflation during the next 30 years. REITs are a sub-set of U.S. small/mid cap equity universe.
- **Commodities (3.5%)** – Our commodity assumption is for a diversified portfolio of commodity futures contracts. Commodity futures returns are composed of three parts: spot price appreciation, collateral return, and roll return (positive or negative change implied by the shape of the future curve). We believe that spot prices will converge with CPI over the long run (i.e., 2.4%). Collateral is assumed to be LIBOR cash (1.1%). Also, we believe the roll effect will be near zero, resulting in a real return of about 3.5% for commodities.
- **Private Equity (7.6%)** – Our private equity assumption reflects a diversified fund of funds with exposure to buyouts, venture capital, distressed debt, and mezzanine debt.
- **Infrastructure (5.2%)** – Our infrastructure assumption is formulated using a cash flow based approach that projects cash flows (on a diversified portfolio of assets) over a 30-year period. Income and capital growth as well as gearing levels, debt costs and terms, relevant tax and management expenses are all taken into consideration. Our approach produces an expected real return of 5.2% for infrastructure.
- **Equity Risk Insurance Premium Strategies-Low Beta (2.9%) –** We assume real returns from cash of 0.5% + 2.4% from alpha.
- **Alternative Risk Premia (ARP) (5.0%) –** Real return target LIBOR 1.1% plus 3.9% alpha (net of fees)
- **eLDI (2.8%) –** Combination of various long credit strategies (1/6 real estate debt, 1/3 securitized debt, 1/6 CMOs, 1/3 private placements)
- **Closed-End Real Assets (5.5%) –** Modeled as 50% Non-Core Real Estate and 50% Infrastructure

Explanation of Capital Market Assumptions

As of June 30, 2022 (30 Years)

Volatility / Correlation Assumptions

Assumed volatilities are formulated with reference to implied volatilities priced into option contracts of various terms, as well as with regard to historical volatility levels. For asset classes which are not marked to market (for example real estate), we “de-smooth” historical returns before calculating volatilities. Importantly, we consider expected volatility trends in the future – in recent years we assumed the re-emergence of an economic cycle and a loss of confidence in central bankers would lead to an increase in volatility. Correlation assumptions are generally similar to actual historical results; however, we do make adjustments to reflect our forward-looking views as well as current market fundamentals.

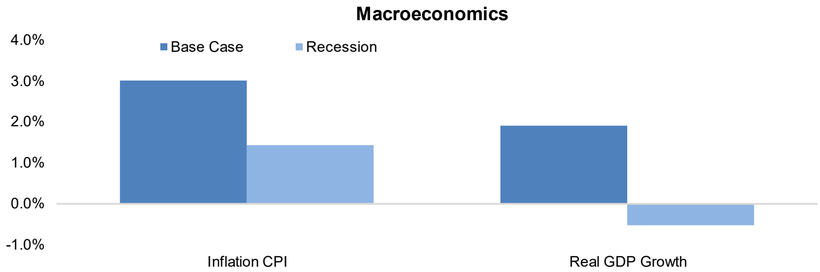
Economic Scenarios

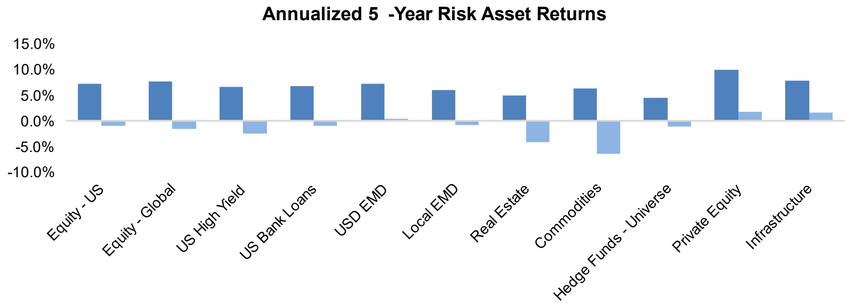
Section: Appendix

Recession Scenario
Description

The US economy slips back into recession in 2022/2023

- Global growth is much weaker than the base case. Concerns that inflation will remain high for longer lead to central banks rapidly tightening monetary policies.
- Tightening financial conditions, combined with spillover effects from geopolitical volatility and reduced consumer and business spending, as real incomes are squeezed by high inflation, lead to a deep recession in the US in 2022/23.
- The economic slowdown leads to developed economies implementing modest fiscal stimulus measures and monetary policy becomes more accommodative. Policy actions are only partially effective as they are tackling the demand side of the equation.
- Inflation is lower than the base case. However, inflation starts to rise in later years as the post-recession recovery gets underway.
- Treasury yields fall while TIPS yields remain at low levels as the US enters recession. Yields rise in later years as a recovery gets underway. Corporate spreads rise significantly due to the poor economic situation and increased risks of downgrades or defaults.
- Most risk assets make losses in the first two years but rebound in later years as the economy recovers.





Returns from 30 June 2022
Source: Aon
The opinions referenced are as of the date of publication and are subject to change due to changes in the market or economic conditions and may not necessarily come to pass. Information contained herein is for informational purposes only and should not be considered investment advice.

Recession Scenario

Data

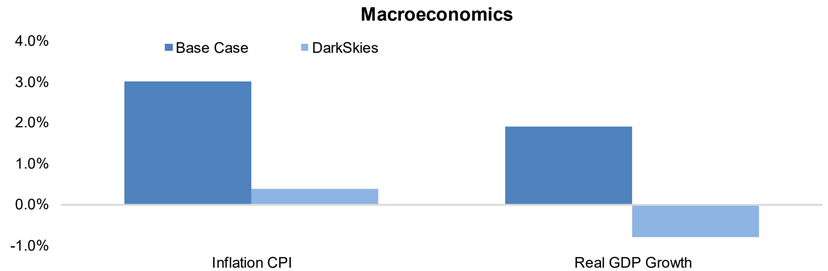
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Yields (BOY)											
Treasury yield 5y	3.0%	0.8%	0.6%	1.3%	1.6%	1.9%	1.9%	2.0%	2.1%	2.2%	2.4%
Long Treasury yield 15y	3.2%	1.0%	0.9%	1.8%	2.1%	2.4%	2.5%	2.6%	2.7%	2.8%	2.8%
TIPS yield 5y	0.6%	-1.0%	-1.1%	-0.6%	-0.5%	-0.3%	-0.3%	-0.2%	0.0%	0.2%	0.5%
Long TIPS yield 15y	1.0%	-0.7%	-0.8%	-0.2%	0.0%	0.1%	0.3%	0.4%	0.5%	0.7%	0.8%
Breakeven price inflation 15y	2.2%	1.7%	1.7%	2.0%	2.1%	2.2%	2.2%	2.2%	2.2%	2.1%	2.0%
A Corporate bond yield 5y	4.5%	5.0%	5.5%	5.5%	5.1%	5.1%	4.9%	4.7%	4.5%	4.4%	4.4%
Long A Corporate bond yield 10y	4.6%	4.5%	4.8%	5.2%	5.0%	4.9%	4.9%	5.0%	5.0%	5.1%	5.1%
A Corporate spread 5y	1.5%	4.3%	4.9%	4.2%	3.6%	3.2%	3.0%	2.7%	2.5%	2.2%	2.0%
Long A Corporate spread 10y	1.4%	3.6%	4.1%	3.7%	3.2%	3.0%	2.8%	2.6%	2.4%	2.3%	2.1%
Expected nominal return on assets											
Equity – US		-17.2%	-9.1%	11.5%	6.6%	6.6%	6.7%	6.7%	6.8%	6.9%	6.9%
Equity – Global		-19.6%	-10.5%	12.5%	7.0%	7.0%	7.0%	7.1%	7.2%	7.2%	7.3%
A Corporate bonds 5y		2.1%	1.4%	3.3%	5.4%	4.2%	4.8%	4.7%	4.5%	4.3%	4.2%
Long A Corporate bonds 10y		3.7%	-1.1%	-1.7%	5.6%	3.2%	3.5%	3.9%	4.1%	4.6%	4.8%
Treasury 5y		13.1%	1.7%	-1.6%	0.5%	0.9%	2.1%	2.1%	2.0%	2.0%	1.9%
Long Treasury 15y		40.3%	3.9%	-10.5%	-0.3%	-0.5%	1.8%	2.0%	2.2%	2.3%	2.1%
TIPS 5y		9.9%	1.0%	-1.7%	0.1%	0.4%	1.0%	1.1%	1.1%	1.2%	1.4%
Long TIPS 15y		32.4%	2.6%	-7.6%	0.0%	0.0%	0.8%	0.9%	1.0%	0.9%	1.1%
US High Yield		-15.3%	-11.8%	7.2%	5.4%	4.0%	5.4%	5.4%	5.3%	5.4%	5.3%
Bank Loans		-10.2%	-7.1%	6.3%	3.7%	3.6%	3.9%	4.2%	4.5%	4.7%	4.9%
USD Emerging Market Debt		-11.2%	-6.9%	9.2%	6.4%	6.2%	6.7%	6.7%	6.7%	6.7%	6.7%
Local Emerging Market Debt		-12.4%	-8.1%	8.0%	5.3%	5.0%	5.5%	5.5%	5.5%	5.5%	5.5%
Real Estate		-13.2%	-8.1%	-3.0%	0.5%	4.4%	4.4%	4.5%	4.6%	4.6%	4.7%
Commodities		-26.0%	-20.1%	8.9%	5.5%	5.5%	5.6%	5.6%	5.7%	5.8%	5.9%
Hedge Funds - FoHF – Universe		-13.4%	-8.2%	7.4%	6.2%	4.4%	4.5%	4.5%	4.5%	4.5%	4.5%
Private Equity		-19.8%	-9.9%	14.7%	9.2%	9.2%	9.2%	9.3%	9.4%	9.5%	9.5%
Infrastructure - US		-4.9%	-0.6%	2.9%	3.7%	7.3%	7.4%	7.4%	7.5%	7.5%	7.5%
Cash		2.8%	0.3%	0.4%	0.8%	1.1%	1.2%	1.4%	1.6%	1.7%	1.8%
CPI		2.4%	1.5%	0.8%	1.1%	1.4%	1.5%	1.6%	1.7%	1.8%	1.9%

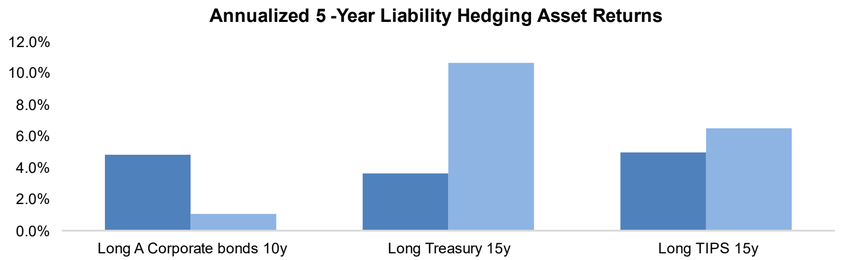
Scenario information as of June 30, 2022

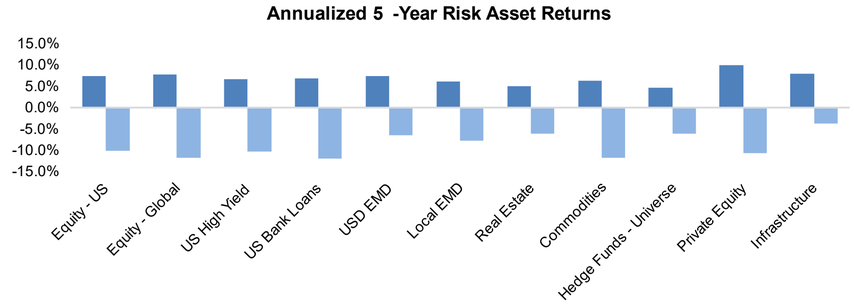
Dark Skies Scenario
Description

A deep recession followed by a longer period of stagnant growth

- A worsening Russia-Ukraine war, which expands beyond Ukraine's borders, and a renewed flare up of the pandemic, disrupts to the global economy, as additional restrictions are required over the next few years. China experiences a sharp deterioration in economic growth, due to stricter Covid restrictions and structural issues.
- Worsening geopolitical instability and central banks' aggressive monetary tightening has a severe impact on world economic growth. Economic weakness in developed and emerging market economies and severe levels of financial distress (due to high debt levels and political crisis) lead to a global recession followed by stagnation.
- Inflation falls sharply in 2022 and sluggish growth over the following years means that inflation stays low.
- Treasury yields fall and remain at low levels as the US enters recession. Corporate spreads rise significantly due to the poor economic situation and increased risks of downgrades or defaults.
- Risk assets make losses in the first few years. There is no pronounced bounce in growth and the economic situation remains poor for a long time, which weighs on returns in later years.







Returns from 30 June 2022
Source: Aon
The opinions referenced are as of the date of publication and are subject to change due to changes in the market or economic conditions and may not necessarily come to pass. Information contained herein is for informational purposes only and should not be considered investment advice.

Dark Skies Scenario

Data

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Yields (BOY)											
Treasury yield 5y	3.0%	0.2%	-0.6%	-0.7%	-0.7%	-0.5%	-0.2%	0.0%	0.3%	0.6%	0.9%
Long Treasury yield 15y	3.2%	0.4%	-0.1%	-0.2%	-0.1%	0.0%	0.3%	0.6%	0.9%	1.2%	1.4%
TIPS yield 5y	0.6%	-1.1%	-1.7%	-1.9%	-1.8%	-1.7%	-1.5%	-1.3%	-1.1%	-0.8%	-0.4%
Long TIPS yield 15y	1.0%	-1.1%	-1.5%	-1.6%	-1.5%	-1.4%	-1.2%	-0.9%	-0.7%	-0.4%	-0.2%
Breakeven price inflation 15y	2.2%	1.5%	1.4%	1.4%	1.4%	1.4%	1.5%	1.6%	1.6%	1.6%	1.6%
A Corporate bond yield 5y	4.5%	5.8%	5.6%	5.2%	4.6%	4.3%	4.2%	4.1%	4.1%	4.0%	4.0%
Long A Corporate bond yield 10y	4.6%	4.9%	4.8%	4.5%	4.1%	3.9%	4.0%	4.1%	4.2%	4.3%	4.4%
A Corporate spread 5y	1.5%	5.6%	6.2%	5.9%	5.2%	4.8%	4.4%	4.1%	3.8%	3.4%	3.1%
Long A Corporate spread 10y	1.4%	4.6%	5.0%	4.8%	4.4%	4.0%	3.8%	3.6%	3.3%	3.1%	2.9%
Expected nominal return on assets											
Equity – US		-26.2%	-18.6%	-9.8%	3.7%	3.7%	4.0%	4.4%	4.7%	5.1%	5.5%
Equity – Global		-29.5%	-21.0%	-11.1%	3.7%	3.7%	4.1%	4.5%	4.9%	5.3%	5.7%
A Corporate bonds 5y		-1.9%	1.7%	1.5%	2.2%	0.9%	0.3%	0.8%	1.2%	1.6%	1.9%
Long A Corporate bonds 10y		-1.0%	0.4%	1.8%	3.1%	1.1%	-0.4%	0.2%	0.7%	1.3%	1.8%
Treasury 5y		15.5%	3.6%	-0.4%	-1.0%	-1.4%	-1.8%	-1.5%	-1.2%	-1.0%	-0.7%
Long Treasury 15y		52.5%	8.9%	1.7%	-0.3%	-1.5%	-3.2%	-2.8%	-2.5%	-2.1%	-2.0%
TIPS 5y		8.8%	1.2%	-1.3%	-2.0%	-2.1%	-2.0%	-1.7%	-1.4%	-1.1%	-0.7%
Long TIPS 15y		37.0%	4.8%	-0.1%	-2.1%	-2.4%	-3.6%	-3.2%	-3.0%	-2.7%	-2.4%
US High Yield		-19.6%	-15.2%	-11.2%	-1.6%	-2.9%	-3.1%	-2.1%	-1.1%	-0.2%	0.6%
Bank Loans		-23.3%	-19.9%	-12.5%	-0.8%	-1.1%	-0.5%	0.2%	0.9%	1.6%	2.2%
USD Emerging Market Debt		-17.2%	-12.4%	-6.9%	2.9%	2.4%	2.4%	2.9%	3.4%	3.8%	4.3%
Local Emerging Market Debt		-18.4%	-13.6%	-8.0%	1.8%	1.2%	1.2%	1.7%	2.2%	2.7%	3.1%
Real Estate		-14.9%	-10.5%	-4.9%	-0.6%	1.5%	1.9%	2.2%	2.6%	2.9%	3.2%
Commodities		-33.1%	-25.1%	-1.6%	4.1%	4.1%	4.3%	4.5%	4.7%	5.0%	5.2%
Hedge Funds - FoHF – Universe		-16.3%	-11.1%	-5.5%	1.5%	1.5%	1.8%	2.1%	2.4%	2.7%	3.0%
Private Equity		-30.6%	-21.4%	-10.5%	5.6%	5.6%	6.0%	6.5%	6.9%	7.3%	7.8%
Infrastructure - US		-11.8%	-7.5%	-3.7%	1.3%	3.9%	4.3%	4.7%	5.0%	5.4%	5.8%
Cash		2.8%	-0.1%	-0.5%	-0.6%	-0.5%	-0.3%	-0.1%	0.2%	0.4%	0.7%
CPI		1.0%	-0.2%	0.2%	0.4%	0.6%	0.8%	0.9%	1.1%	1.3%	1.5%

Scenario information as of June 30, 2022

About This Material

Section: Appendix

About This Material

This material includes a summary of calculations and consulting related to the finances of the Oregon Public Employees Retirement Fund (OPERF). The following variables have been addressed:

- Contributions, Liquidity, Net Outflow

This analysis is intended to assist the Investment Committee with a review of the associated issues and options, and its use may not be appropriate for other purposes. This analysis has been prepared solely for the benefit of the Investment Committee. Any further dissemination of this report is not allowed without the written consent of Aon Investments USA Inc.

Our calculations were generally based on the methodologies identified in the actuary's valuation report for OPERF. We believe the methodology used in these calculations conforms to the applicable standards identified in the report.

Models are used to develop alternative scenarios based on the underlying valuation model and project financial results under those scenarios. The models were developed by experts outside and within Aon. Where outside models were used, the models were reviewed by experts within Aon. The models were selected as appropriate for these projections by the undersigned.

Experience different than anticipated could have a material impact on the ultimate costs of the benefits. In addition, changes in plan provisions or applicable laws could have a significant impact on cost. Actual experience may differ from our modeling assumptions.

Our calculations were based on data provided by the plan actuary. The actuarial assumptions and methods and plan provisions reflected in these projections are the same as those used for the 2021 actuarial valuation for OPERF as noted in the actuarial reports, except where noted in this report. Unless specifically noted, our calculations do not reflect any other changes or events after December 31, 2021. Reflecting events after December 31, 2021 would impact the results of the projection.

In conducting these projections, we have relied on plan design, demographic and financial information provided by other parties, including the plan's actuary and plan sponsor. While we cannot verify the accuracy of all of the information, the supplied information was reviewed for consistency and reasonableness. As a result of this review, we have no reason to doubt the substantial accuracy or completeness of the information and believe that it has produced appropriate results.

These projections have been conducted in accordance with generally accepted actuarial principles and practices, including applicable Actuarial Standards of Practice as issued by the Actuarial Standards Board. The undersigned actuary is familiar with the near-term and long-term aspects of pension valuations and meet the Qualification Standards of the American Academy of Actuaries necessary to render the actuarial opinions contained herein. All sections of this report are considered an integral part of the actuarial opinions.

To our knowledge, no colleague of Aon Investments USA Inc. providing services to OPERF has any direct financial interest or indirect material interest in OPERF. Thus, we believe there is no relationship existing that might affect our capacity to prepare and certify this report for OPERF.

Aon Investments USA Inc.

Phil Kivarkis, FSA, CFA

Legal Disclosures and Disclaimers

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Aon Investments USA Inc.
200 E. Randolph Street
Suite 700
Chicago, IL 60601
ATTN: Aon Investments Compliance Officer

From: Oregon State Treasury Public Records oregontreasury@govqa.us
Subject: Public Records Request :: R000304-013123
Date: February 14, 2023 at 7:43:26 AM
To: Rick Pope rspope@icloud.com

--- Please respond above this line ---

OREGON STATE TREASURY

Response

REQUESTER	Rick Pope
DATE	February 14, 2023
REFERENCE NO.	R000304-013123

OREGON STATE TREASURY

Request for Public Records

REQUESTER	**Rick Pope**

DATE February 10, 2023

REFERENCE NO. R000304-013123

You submitted the following request for public records:

> *"I am requesting any climate-specific policy document Treasury has for how to address climate risk in OPERF's portfolio. There is no climate-specific document in OIC investment policies provided to me."*

Hi,

We have no further records responsive to this request to provide. Treasury has integrated environmental-related risks as one of its core factors within the investment decision-making framework. Consistent with fiduciary standards and state laws, Treasury considers all material risks and benefits when making an investment decision with the primary objective of delivering sustainable returns for our beneficiaries.

I'd like to point you to the Oregon Investment Council's webpage where resources are available, such as the Council's 'Investment and Management Beliefs' and a 'Statement of Investment Objectives and Policy Framework', and can provide more information about what guides our investment staff's work in performing their fiduciary responsibilities.

If you have any questions or need additional information, please reply to this email.

Sincerely,

Treasury Public Records Team
867 Hawthorne Ave. SE | Salem, OR 97301-5241
P: 503-373-7609

To monitor the progress or update this request please log into the Public Records Center

APPENDIX A
Private Equity Investments Valuation Policy

Public Company Securities

1. Public securities should be valued at the closing price or bid on the last day of the quarter of the performance measurement period.

2. In the event that two or more investment managers or general partners hold the same security with identical provisions and structure, but different valuations, Staff and the Advisor will establish the most appropriate valuation.

Non-Public Company Securities

1. Non-publicly traded securities should be valued at fair value. These types of securities are not traded on an active exchange and thus do not have readily determinable market prices established by arm's-length transactions; moreover, there exists no broadly accepted methodology for determining fair value, and valuations of such securities may contain subjective elements. Determination of the fair value of such securities should be based on the best available and most applicable valuation metrics that can be obtained. Valuation metrics may differ substantially, depending on the stage, industry, competitive position and geography of the company.

2. The General Partner (GP) of each limited partnership will determine valuations for the investments within its limited partnerships. If negotiated as part of the applicable Limited Partnership Agreement (LPA), these valuations may be reviewed and/or approved by a committee of limited partners (i.e., an Advisory Board, Investors' Committee, etc.) established for the limited partnership.

3. Staff are not typically experts in the valuation of non-public securities, but do have broad experience in private equity investment management; accordingly, Staff will a) apply such experience to determine whether or not valuations reported by GPs and the Advisor are reasonably stated and b) assess the risk of material misstatement. Staff will utilize the best available and most applicable information in forming these assessments. Such information may include, but will not be limited to the following:

    a. Valuation analyses and adjustments performed by the Advisor, GP or investment manager;
    b. Audited financial statements of Program investments and limited partnerships;
    c. GP-prepared quarterly and annual limited partnership reports;
    d. Where applicable, limited partner committee reviews/approvals of valuations when Staff serve on such committees; and
    e. General Staff knowledge of company performance, comparable transactions and valuations, industry trends, market environment and other relevant factors.

If the valuation provided by a GP or the Advisor is not U.S. GAAP fair value, Staff may request additional information from the GP or Advisor, if needed, in order to estimate fair value.

4. Staff is responsible for ensuring Program investments are recorded in OST's book of record at fair value, and this responsibility may not be delegated to third parties. To fulfill this particular responsibility, Staff will:

    a. Maintain an alert and appropriate level of professional skepticism regarding private equity valuations;
    b. Review the Advisor's quarterly report, including limited partnership quarterly summaries which detail valuations and changes thereto;
    c. On an annual basis, meet with the Advisor to update or confirm Staff's understanding of the Advisor's procedures and analyses regarding limited partnership valuation;
    d. To the fullest extent practical, participate in limited partner committee reviews and/or limited partnership valuation approvals if Staff serves on such committees;
    e. Review limited partnership annual reports and audited financial statements; and
    f. On an exception basis, investigate any valuations that are materially different from fair value estimates or expectations, and document the results of such investigation and any proposed changes in limited partnership valuation. Such exceptions may include, but are not limited to, qualified or adverse audit opinions, financial statements prepared on a basis other than U.S. GAAP, material adverse events (e.g., a company bankruptcy), limited partnership valuation policy that is other than fair value, and a qualitative Staff assessment that a particular valuation may not reflect fair value.

OPERF Performance Summary – Commentary

→ Both equity and fixed income markets saw significant negative returns in light of economic concerns and uncertainty around the ability of the Fed to combat inflation through rate hikes without spurring a recession.

→ In spite of this negative backdrop, several of the factors that have been a drag on the OPERF portfolio over the last several years have been a tailwind to relative performance in 2022. These include the value bias, as well as the exposure to global low volatility strategies. Each of these areas contributed meaningfully to relative outperformance.

→ OPERF posted a return of -3.1% for the third quarter, relative to a benchmark return of -5.8% and peer median return of -3.8%. Year to date performance of -4.4% was well ahead of the benchmark return of -11.2%.

→ Performance for the quarter ranks in the top quartile of the InvestMetrics public plan peer universe of all DB plans over $10 billion, with longer-term performance over all time periods shown ranking in the top decile.

→ By far the most meaningful contributor to absolute performance for the Quarter and year to date period was the Real Assets Portfolio, producing a 15.6% positive return in 2022 thus far.

→ On a relative basis, private equity returns, which were well ahead of their Russell 3000 +300 benchmark, helped produced benchmark-relative outperformance. Note that the lag in valuations here contributes positively, and a future pullback in these returns is expected.

→ The OPERF Portfolio maintains a significant overweight relative to the target in private equity - actual allocation of 27.4% versus a target allocation of 20%.

2. Foreign Currency Risk

Foreign currency risk for deposits is the risk that changes in exchange rates will adversely affect the fair value of the deposits. Foreign currency risk is controlled via contractual agreements with the investment managers. As of June 30, 2022, the sum of $277.8 million in cash and cash equivalents was exposed to foreign currency risk. The U.S. dollar balances of these deposits, organized by currency denomination, are presented in Table 12 on page 57.

3. Restricted Cash Equivalents

PERS' cash and cash equivalents as of June 30, 2022, include collateral of $594.2 million held by investment managers. Swap collateral is offset by a related liability with a net settlement feature. Collateral is restricted and is not available to pay current liabilities.

B. Investments

Table 7 on page 50 lists the fair value of investments held by the state of Oregon for PERS as of June 30, 2022.

1. Fair Value Measurements

Fair value is defined as the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. Observable inputs are developed based on market data obtained from sources independent of the reporting entity. Unobservable inputs are developed based on the best information available about the assumptions market participants would use in pricing the asset.

The classification of investments within the fair value hierarchy is based upon the activity level in the market for the security type and the inputs used to determine their fair value. The three levels of the hierarchy are described below:

Level 1 – Unadjusted quoted prices for identical instruments in active markets.
Level 2 – Quoted prices for similar instruments in active markets, quoted prices for identical or similar instruments in markets that are not active, and model-derived valuations in which all significant inputs are observable.
Level 3 – Valuations derived from valuation techniques in which significant inputs are unobservable.

Inputs used to measure fair value might fall in different levels of the fair value hierarchy. Categorization within the hierarchy is based on the lowest level input that is significant to the fair value measurement.

Equity securities are generally valued based on quoted prices from an active market and are therefore categorized in level 1. In the absence of quoted market prices, such as equity securities that trade infrequently or not at all, valuations are based on the last traded price or a price provided by investment managers.

Debt securities classified as level 2 are valued using the latest bid prices or evaluated quotes from independent pricing vendors. The third-party vendors use a variety of methods when pricing these securities that incorporate relevant observable market data to arrive at an estimate of what a buyer in the marketplace would pay for a security under current market conditions. When independent price sources are not available, debt securities are priced based on the last traded price or a valuation provided by the investment manager and are categorized in level 3.

Funds priced using a net asset value (NAV) that is published daily and validated with a sufficient level of observable activity are categorized in level 1. If observable activity is limited yet supports that the NAV represents an exit value of the security at the measurement date, the securities are categorized in level 2. Investments that are measured at NAV as a practical expedient, such as most private equity, real assets, diversifying strategies, opportunity, and real estate investments, are excluded from the fair value hierarchy if the NAV per share (or its equivalent) was calculated in a manner consistent with the Financial Accounting Standards Board's measurement principles for investment companies. Funds not meeting this criteria are categorized in level 3.

Exchange-traded derivatives, including futures, rights, and warrants, that are actively traded are valued using quoted prices and are categorized in level 1. Derivative contract valuations, such as swaps and options, are modeled using observable pricing inputs and techniques that do not entail material subjectivity and are therefore categorized in level 2. Level 3 derivatives include securities valued at a price that has been determined by the investment manager's valuation committee.

Investments in real estate, other than real estate investment trusts, which are generally valued based on an active market price and are categorized in level 1, have been valued based on the NAV per share (or its equivalent), as provided by the general partner. This type includes 64 commingled real estate funds, structured as limited partnerships, where the funds have a finite term. Distributions from the funds will be received as the underlying investments of the funds are liquidated. Liquidation is expected to take place during the five-year period following the termination of the investment period, which extends to 2035. Investments in real estate also include 16 joint ventures where the investments are expected to be held for the long term and generate cash flow that will represent a significant component of the total return. Real

estate also includes investments in 13 open-ended funds that permit quarterly redemption of shares, subject to certain requirements being met.

Private equity consists of approximately 207 funds, organized as limited partnerships and limited liability companies, participating in diversified strategies including leveraged buyouts, venture capital, growth equity, fund-of-funds, co-investments, and special situations. The fair values of the private equity investments have been determined using the NAV per share (or its equivalent) as provided by the general partner or managing member. These funds have a finite term. Distributions will be received as the underlying investments of the funds are liquidated, which is expected to occur over the next 12 to 14 years.

Real asset and diversifying asset investments seek to provide diversification and inflation-hedging characteristics to the fund. They include investments with a focus on infrastructure and natural resources. Real assets consists of 83 investments in commingled funds organized as limited partnerships and limited liability companies. The fair values of the investments have been determined using a NAV per share (or its equivalent) of the investments. For real asset infrastructure and natural resource investments, which includes 68 of the 83 funds, the funds have a finite term. Distributions will be received as the underlying investments of the funds are liquidated, which is expected to occur over the next 10 to 14 years. The remaining 15 funds are open-ended, permitting periodic redemption of shares, subject to certain requirements being met. They consist of 14 funds investing in diversifying hedge strategies, and one fund investing in a risk parity strategy.

The opportunity portfolio includes strategies that fall outside of other asset classes and include 24 funds investing in a broad range of performing and distressed

TABLE 8

Investments and Derivative Instruments Measured at Fair Value

		Fair Value Measurements Using		
	6/30/2022	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Investments by Fair Value Level				
Debt Securities				
U.S. Treasury Obligations	$ 7,405,478,728	$ –	$ 7,405,478,728	$ –
U.S. Treasury Obligations - Strips	706,365,325	–	706,365,325	–
U.S. Treasury Obligations - TIPS	142,561,012	–	142,561,012	–
U.S. Federal Agency Mortgage Securities	852,601,921	–	852,599,948	1,973
U.S. Federal Agency Mortgage TBAs	1,327,169,790	–	1,303,699,872	23,469,918
U.S. Federal Agency Debt	101,343,055	–	101,343,055	–
U.S. Federal Agency Strips	429,313	–	429,313	–
Non-Government Debt Securities	1,395,606,265	–	1,395,606,265	–
Corporate Bonds	2,050,010,369	–	1,985,046,984	64,963,385
Bank Loans	1,348,659,219	–	1,210,694,354	137,964,865
Municipal Bonds	35,833,562	–	35,833,562	–
Collateralized Mortgage Obligations	660,247,450	–	659,619,113	628,337
Commercial Mortgage Backed Securities	90,313,624	–	90,313,624	–
Asset-Backed Securities	889,688,710	–	847,377,648	42,311,062
Domestic Fixed Income Funds	960,016,206	–	960,016,206	–
Global Fixed Income Funds	893,258,617	–	893,258,617	–
Repurchase Agreements	39,700,000	–	39,700,000	–
Total Debt Securities[1]	18,899,283,166	–	18,629,943,626	269,339,540
Public Equity				
Domestic Equity Securities	11,035,418,382	10,988,766,827	–	46,651,555
International Equity Securities	6,804,294,094	6,791,873,048	–	12,421,046
Domestic Equity Funds	3,597,615,173	–	3,597,615,173	–
Global Equity Funds	684,340,569	–	684,340,533	36
International Equity Funds	758,844,722	534,841,768	129,134,738	94,868,216
Target Date Fund	789,884,105	–	789,884,105	–
Oregon Savings Growth Plan - Self Directed	38,822,527	38,822,527	–	–
Total Public Equity	23,709,219,572	18,354,304,170	5,200,974,549	153,940,853
Real Estate Investment Trusts	591,019,171	591,019,171	–	–
Total Investments by Fair Value Level	**$ 43,199,521,909**	**$ 18,945,323,341**	**$ 23,830,918,175**	**$ 423,280,393**

TABLE 8 continues on the next page