BlackRock | Sustainable finance OBSERVATORY formerly 2° investing initiative

To what degree?

A climate scenario analysis of U.S. insurers' portfolios

FI1119U-652085-3021042

Summary

- Insurers are exposed to climate change related risks from multiple angles, both in their underwriting and their investing activities.[1]
- The financial impacts related to the transition to a low or zero-carbon economy are of particular concern as they implicate the potential reallocation of tens of trillions of dollars of investments.[2]
- We believe scenario analysis can help insurers understand climate risks, and potentially adapt their investment strategies to better manage them.
- By analyzing corporate bond holdings of U.S. insurers, we aim to understand the emissions trajectory of the investments and alignment to the 2-degree trajectory implied by the 2015 Paris Agreement.
- We base our analysis on data from the 2° Investing Initiative (2°ii), which produces climate and long-term metrics on a global scale, combined with BlackRock's asset-level expertise and modeling capabilities.

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The backdrop

On December 12, 2015, representatives from 196 countries unanimously adopted the **Paris Agreement** to limit global warming to less than two degrees Celsius (2°C) above pre-industrial levels. Signatories have pledged to reduce their carbon emissions along agreed upon trajectories—or pathways—that will help achieve the overarching goal of the Paris Agreement. Additionally, the Agreement also sets an explicit goal of making finance flows consistent with a safe climate pathway, thus setting the stage for rapid policy changes that will affect many facets of our economy.

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1 AODP, May 2018. **2** AODP, May 2018.

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Risk on two fronts

The implications of climate change are playing out across two broad channels—physical and transition related. Physical risks of climate change manifest in the form of rising sea levels, droughts, wildfires and storms, as discussed in BlackRock's ***Getting Physical***.[3] Transition risks (and opportunities) play out along technological, regulatory and social channels. Insurance companies are exposed to both these types of climate-risks; this piece aims to focus **specifically on these transition risks on investment portfolios** for insurers by performing **scenario analysis** on investment portfolios. The 2° Investing Initiative (2°ii) produces climate and long-term metrics on a global scale. We use the data they have provided, combined with BlackRock's asset-level expertise and climate modeling capabilities, to examine the transition risks faced by investment portfolios.

What is scenario analysis

The purpose of scenario analysis is to better understand how an entity might perform under different future states, i.e., its resiliency/robustness or its ability to tolerate disruptions or adapt to changes or uncertainties. In the case of climate change it allows an entity to explore and develop an understanding of how physical or transition risks and opportunities might plausibly affect its business over time. Scenario analysis therefore evaluates a range of hypothetical outcomes by considering a variety of alternative plausible future states under a given set of assumptions and constraints. A critical aspect of scenario analysis is that selection of a set of scenarios that cover a reasonable variety of future outcomes. Scenario does not equal sensitivity analysis (to one factor) nor is it a forecast. Scenarios are not intended to represent a full description of the future but rather to highlight central elements of a possible future and to draw attention to key factors that will drive future developments. They are hypothesized constructs and tools to enhance critical strategic thinking. They should challenge conventional wisdom about the future.[4]

3 BlackRock, April 2019. **4** Adapted from TCFD, June 2017 "The use of Scenario Analysis in Disclosures of Climate-Related Risks and Opportunities."

What do climate-related risks mean for insurers?

Insurance companies are in the unique position of having to manage climate change-related risks on both sides of the balance sheet. As extreme weather events such as floods, droughts, hurricanes and heatwaves become more frequent and more severe, insurers will likely see their payouts increase while the probability of these natural hazards becomes harder to assess and price in their policies. On the other hand, as some of the largest investors in the world, insurers also face the risks that all the companies they invest in are grappling with: how to adapt and thrive in a world transitioning towards a low-carbon economy.

As summarized by the Asset Owners Disclosure Project (AODP), "Climate change poses risks for insurance companies, and so do responses to it by markets, businesses, consumers and governments. These risks arise through three channels: the **physical** effects of climate change, the impact of changes associated with a **transition** to a lower carbon economy, and potential **liability** risk for those businesses whose activities have contributed to climate change. All three of these categories of risk can have impacts on the business operations, underwriting and financial reserving of insurance companies".[5] While all these risks are important to insurers, this paper specifically examines how exposed insurance companies' investments may lead to climate-related **transition risks**—see highlighted box in the table below.

Climate-related risks to insurers

Relevant risks for insurers both on the underwriting and investing side

Climate change related risks	Underwriting	Potential Investment Impact
Physical risks	• Pricing risks arising from changing risk profiles to insured assets and property, changing mortality profiles and demographic trends • Claims risk arising from unexpected confluence of extreme events • Strategic/Market Risks arising from changing market dynamics	• Impacts of physical climate events and trends on assets, firms, and sectors, affecting profitability and cost of business, leading to impacts on financial assets and portfolios
Transition risks	• Strategic/Market Risks arising from contraction of market demand in certain sectors (e.g. fossil fuels) • Strategic/Market Risks arising from market trends, technological innovation, and policy changes related to climate change affecting products and services demanded by consumers	• Risks arising from market, policy, technological, and social changes, affecting business models and profitability of companies and sectors (e.g. energy, industry, transport, agriculture), leading to impacts on financial assets and portfolios
Liability risks	• Tort or negligence claims arising from insurance services provided • Liability risks stemming from Directors & Officers policies	• Risks arising from litigation relating to the consideration of climate change in investment decision-making, or inadequate disclosure of climate risks

BlackRock June 2019. Adapted from IAIS/SIF, July 2018: "Issues paper on climate change risks to the insurance sector." Figure summarizes the climate change related risks that are relevant for insurers, both on the underwriting and on the investment side.

5 AODP, May 2018.

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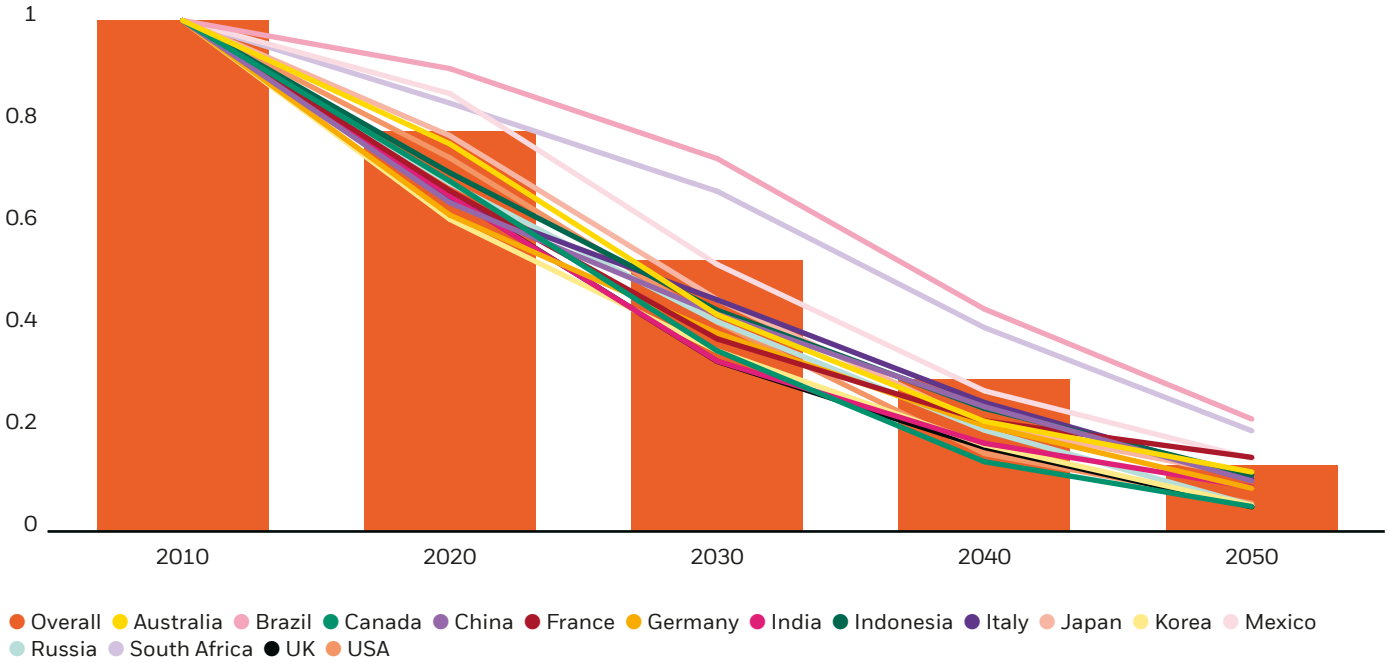
The low-carbon energy transition & pathways

Non-renewable sources provided more than 75% of the world's energy per the latest data from the UN in 2016.[6] To zero out emissions by the end of this century, we'd have to replace most of that with low-carbon sources—wind, solar, geothermal, etc. This transition is already on its way—renewable sources accounted for more than 50% of the global energy capacity additions over the past six years.[7] We would also likely have to find a way to suck carbon out of the atmosphere and put it back underground (a technology known as carbon capture and sequestration, or CCS). Depending on the rate of year-over-year emissions reductions and the speed at which CCS technology becomes available allowing for "negative net emissions," we can help identify a pathway of emissions that is consistent with the Paris Agreement goal.

In an effort to achieve these goals while minimizing impact to the economy, we need to drastically reduce the **energy intensity of GDP** (Energy/GDP), i.e. produce the same amount using less energy. We would also need to reduce the **carbon intensity of energy** (CO2/Energy), i.e. find energy sources that produce less carbon emissions per unit of energy. The former comes about through energy efficiency and conservation, while the latter is achieved through a combination of decarbonizing electricity and fuels and switching to low-carbon and eventually zero-carbon sources in most energy end-uses. This is a challenging proposition. According to a study published in 2015 by Deep Decarbonization Pathways Project, in order to stay on an emissions pathway broadly consistent with the Paris goal of limiting global warming to "well below" 2 degrees, the carbon intensity of GDP would need to decrease between 80% and 96% vs 2010 across 16 of the world's biggest emitters (encompassing both developed and emerging economies) by 2050.[8] See the chart below.

Pathways to deep decarbonization

Required reduction from energy-related CO2 emissions per unit of GDP



Pathways to Deep Decarbonization, December 2015. Notes: The chart shows the required reduction from energy-related CO2 emissions per unit of GDP. In order to stay on an emissions pathway broadly consistent with the Paris goal of limiting global warming to "well below" 2 degrees, the carbon intensity of GDP would need to decrease between 80% and 96% vs 2010 across 16 of the world's biggest emitters (encompassing both developed and emerging economies) by 2050. For illustrative purposes only. Forecasts are based on estimates and assumptions there is no guarantee that they will be achieved.

6 UN, June 2019. **7** Ibid. **8** Pathways to Deep Decarbonization, 2015.

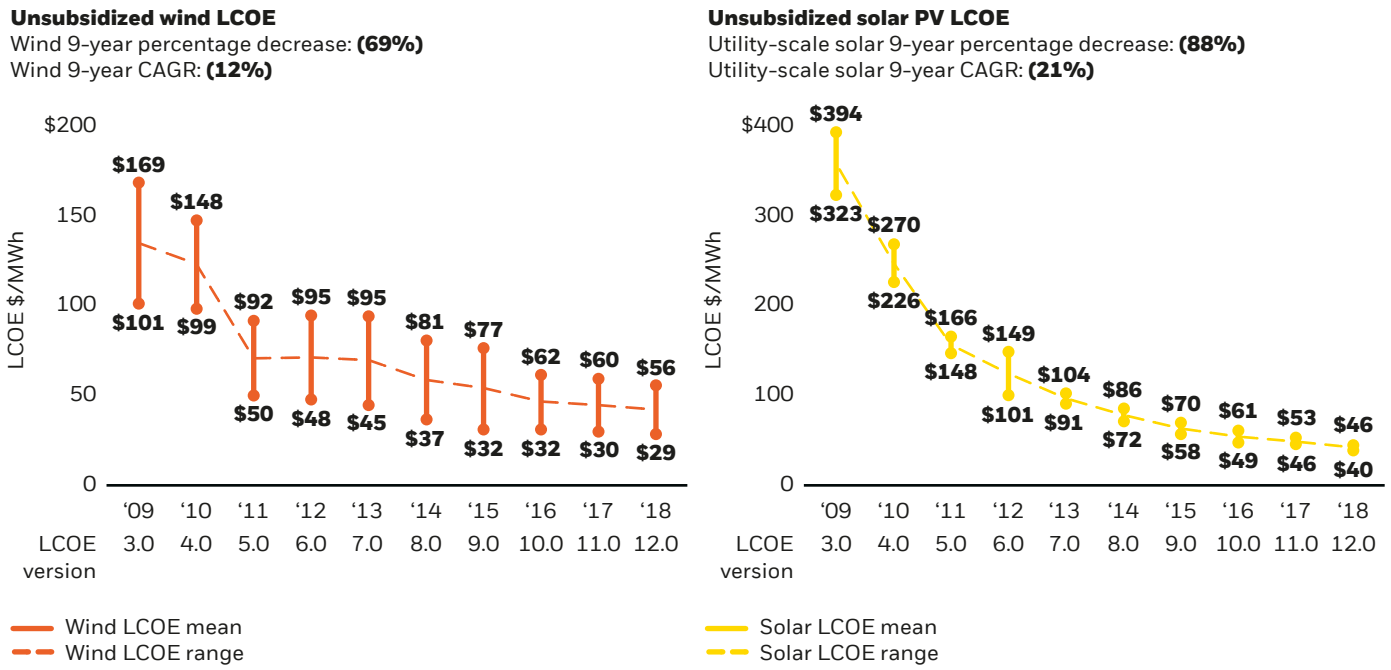
Although many possible pathways exist to decarbonize energy systems, any credible scenario would incorporate some combination of the three elements described on page 5. Energy efficiency and conservation reduces potential electricity demand. Decarbonizing electricity and fuels is a necessary condition to make fuel switching options beneficial from an emissions perspective, like in the example of electric use in industrial or transport activities. And fuel switching can support energy efficiency when the associated options are more energy efficient, like electric vehicles compared to internal combustion engines. This highlights that a low/zero carbon economy cannot be achieved if any of these pillars are implemented at insufficient scale.[9]

Idea in focus: the "carbon bubble"

The Paris Agreement came at the tail end of a decade in which the relative costs of low-carbon technologies such as wind and solar declined dramatically. This has fundamentally altered the economics of power systems while showcasing an achievable pathway to decarbonize the world's energy systems—something that had seemed difficult to achieve without immense financial sacrifices just at the end of the 20th century. As cheaper low-carbon alternatives challenged more expensive fossil sources such as coal, the idea that some fossil fuels assets could become obsolete due to policy and technological advances became a new reality. See the chart below.

Dramatic reduction in levelized cost of energy for wind and solar

The effects of technological advances and operational efficiency



Lazard, November 2018. Technological advances and operational efficiency, among other factors, have caused a dramatic decline in wind and utility-scale solar PV levelized cost of energy (LCOE). Lazard's LCOE analysis consists of creating a power plant model representing an illustrative project for each relevant technology and solving for the dollar-per-megawatt hour ($/MWh) figure that results in a levered IRR equal to the assumed cost of equity. For illustrative purposes only. Forecasts are based on estimates and assumptions there is no guarantee that they will be achieved.

9 Pathways to Deep Decarbonization, 2015.

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The dramatic decline in costs for low-carbon energy sources has raised questions regarding the value of fossil fuel reserves. The idea that a large share of the world's fossil assets could become "stranded" once the **"carbon bubble"** bursts was first described by the London-based think-tank Carbon Tracker in 2013 in a report titled "Unburnable Carbon".[10] That study estimated that about 60-80% of the world's fossil fuel reserves—reserves that publicly listed oil and gas companies have on their books as assets, and are a major driver of their valuation—are 'unburnable' if the world is to have a chance of not exceeding global warming of 2°C. The study concluded that between US$4 trillion and US$6 trillion in fossil fuels investments such as coal mines, oil wells, power stations, pipelines and conventional vehicles could potentially be written down if the commitments countries made under the Paris Agreement are enacted.

Case study – the U.S. coal industry: a cautionary tale of transition risk

The example of the U.S. coal industry is a cautionary tale for investors who missed the signs of a transforming energy system. The share of total U.S. electricity generation from coal has fallen from over 45% in 2009[11] to 27.4% in 2018.[12] This has been driven in part by the reduction in costs for renewable energy shown in the chart at the left entitled "Dramatic Reduction". In fact, the U.S. Energy Information Administration (EIA) estimated that electricity from renewable sources surpassed coal for the first time ever in April 2019.[13] This has translated into losses for investors as well—many coal producers in the U.S. have declared bankruptcy in the last few years,[14] including the three largest coal producing companies in the U.S. per the latest EIA annual coal report.[15]

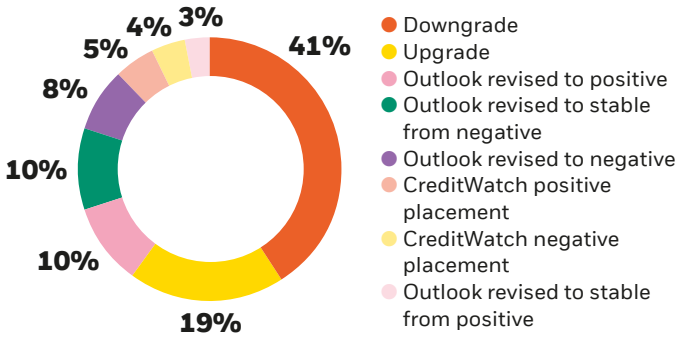
Are climate-related transition risks material for investors?

A study published in June 2018 in the journal Nature Climate Change,[16] seems to suggest that a sharp slump in the value of fossil fuels would cause the carbon bubble to burst very suddenly, triggering a discounted global wealth loss of US$1-4 trillion. If true, that would be equivalent to up to 4.5% of the world's projected nominal GDP in 2018 (US$87.5 trillion).

Credit rating agencies have also been grappling with these questions. According to a 2018 Moody's analysis,[17] 11 sectors with $2.2 trillion in rated debt have elevated credit exposure to environmental risks, which may result in a credit downgrade. A further 22 sectors with $10.1 trillion in rated debt face moderate credit exposure to environmental risks. S&P conducted a two-year review of how environmental & climate (E&C) factors affected corporate ratings between July 16, 2015, and Aug. 29, 2017.[18] They found 717 cases where these concerns were relevant to the rating, and 106 cases where E&C factors—both event-driven and those occurring over a longer time horizon—resulted in a change of rating, outlook, or a CreditWatch action. The chart below summarizes those findings.

Ratings actions related to E&C risk

How rating agencies are responding to environmental and climate factors



S&P, November 2017. S&P Ratings found 717 cases where environmental and climate factors were relevant for credit ratings including many instances of rating downgrades upgrades and downgrades. S&P mapped material cases to the definitions set by the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD) to E&C risks and opportunities in their corporate credit ratings to analyze ratings actions related to E&C risk.

Given this landscape, investors have become more aware of the short-to-medium term risks associated with the transition to a low-carbon economy driven by efforts to address climate change, and have begun pressing companies to disclose climate change related risks. Shareholder engagement was and remains a key part of these efforts and resulted in some highly publicized proxy votes. This can be evidenced by the increasing number of climate change related shareholder proposals which has increased in number from less than 20 in 2013 to 75 or more expected for 2019.[19]

10 Carbon Tracker, October 2013. **11** EIA, March 2012. **12** EIA, March 2019. **13** EIA, June 2019. **14** Bloomberg, May 2019. **15** EIA, November 2018. **16** Nature Climate Change, June 2018, "Macroeconomic impact of stranded fossil fuel assets". **17** Moody's, September 2018. **18** S&P, November 2017. **19** ISS Analytics, Feb 2019.

Case study: electrification and the automotive industry

The global share of electric cars has risen to more than 2.5% in 2018 and the market for vehicle electrification is rapidly expanding.[20] Over the past decade, technological improvements and efficiency gains have significantly lowered costs of battery technology which has increased adoption, with all major manufacturers announcing plans for the electric vehicle market. Furthermore, manufacturers must also comply with fuel economy and emissions regulations in place in various jurisdictions. Deloitte estimates that in order to meet the EU fleet average CO2 emissions targets, the overall electric vehicle market share will need to reach 10% by 2025 and 22% by 2030.[21] These technological changes and policy actions have put pressure of the automotive industry to the extent that manufacturers are pooling their fleets to get around emissions fines.[22] In a recent report, S&P has also identified significant R&D and capital expenditures required to meet the strict emissions targets as well as transition to electric vehicles as significant risk factors.[23]

What are insurers' sentiments about environmental and climate-related risks?

The eight annual BlackRock Global Insurance Report[24]—which summarizes the key findings gained from surveying senior executives in the insurance and reinsurance industry across 25 countries—showed that environmental change has moved quickly up the agenda for insurers' globally. This year's global survey of 360 senior insurance and reinsurance executives conducted over July-August 2019, encompassing insurance companies of all sizes and across Life, P&C, and Health industries, highlights that insurers are focusing much more intensely on identifying previously unpriced or underpriced environmental risks in their portfolios. Relative to the previous year, 67% are incorporating more ESG considerations into their investment strategy and process. There is a big increase in respondents citing environmental (and especially climate change related) risk as a key macro risk in their portfolio in the past 2 years, from 6% in 2017 to 23% in 2018 and 19% in 2019. Additionally, 16% in 2019 consider it to be a major driver of change in their industry, compared to only 6% in 2017, when it ranked far behind every macro risk. Growing pressure from regulators, along with political momentum following the COP21 summit in Paris, are identified as key drivers to that shift. In 2019, respondents also cited technology advances as a key driver of change, believing that technology can help in the context of unearthing individual risk, such as the impact of climate change on portfolios. "A new area – and one we are digging into deeper as we collect more data – is climate change and the associated physical and transition risks using, quote and unquote, brown and green scenarios." says a North America Life Insurer's Chief Investment Officer. While green bonds are not a direct hedge against exposure to climate risk in a specific portfolio, the asset class is helping to mitigate climate risk in general, and by investing in green bonds insurers are contributing to this effort. As an example of the rise of importance of this asset class, the BlackRock Global Insurance Report shows that appetite globally to increase allocations to green bonds has surged since 2017. Globally, 36% of insurers expected to allocate more to green bonds in 2019, against 13% in 2017.[26]

Overall, AODP finds that 56% of their sample of insurers are invested in low-carbon assets, with exposures up to 3.8% of total AUM, averaging approximately 1% of their total internal assets under management. Due to recent high-profile campaigns and corporate failures in the coal sector, insuring, underwriting and investing in thermal coal assets has also proved to be controversial for insurers.[27] The percentage of AUM invested in low-carbon assets, however, only provides an imperfect and incomplete measure of the resilience of a portfolio to climate-related transition risks. The scenario analysis presented in this paper will help insurers to get a better understanding of what kind of emissions trajectory their investments are actually tracking.

20 IEA, June 2019. **21** Deloitte, 2019. **22** FT, April 2019. **23** S&P, August 2018. **24** BlackRock, September 2019. **25** AODP, May 2018. **26** BlackRock, September 2019, September 2018. **27** AODP, May 2018.

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Scenario analysis of insurance portfolios

Industry-led efforts such as the **Task Force on Climate-related Financial Disclosures (TCFD)**, launched in 2015 under the auspices of the Financial Stability Board (FSB) following a request from the G20 Finance Ministers, have produced a vast body of work. Such industry-led efforts have helped set a coherent framework for the identification, assessment, management and disclosure of climate risks and opportunities across sectors, with specific guidance for application by financial institutions—including insurers as both underwriters and asset owners. The TCFD's recommendations call for companies to disclose governance, risk management practices, strategies and metrics and targets used to assess and manage relevant climate-related risks and opportunities. One of the key tools that the TCFD recommends asset owners and companies could use to understand and manage these risks and opportunities is "scenario analysis".

However, the AODP notes that the use of scenario analysis among insurers remains in its infancy, and that only 10% of the companies included in a survey conducted by them have undertaken scenario analyses, with a further 8% considering their approach in the future.[28] In this study, we aim to fill that gap, presenting a methodology for scenario analysis of climate-related transition risks for the portfolios of U.S. insurers and analyzing the results of such an analysis.

Trajectories for emission reductions and different "below 2 degree" scenarios

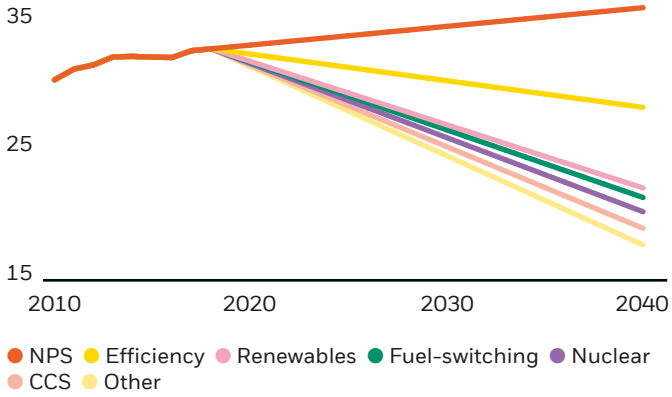
Transition scenarios typically present plausible assumptions about the development of climate policies and the deployment of "climate-friendly" technologies to limit greenhouse gas (GHG) emissions. Transition scenarios draw conclusions that can be often based on modeling, about how policy and technology regarding energy supply and GHG emissions interact with economic activity, energy consumption and GDP among other key factors.

Several entities ranging from NGOs, industry groups, research institutions, think tanks, government ministries and intergovernmental organizations have produced and continue to produce a number of transition scenarios. The International Energy Agency (IEA)'s flagship annual publication—the World Energy Outlook (WEO)—has published energy scenarios compatible with a 2-degree trajectory for the past decade. In the WEO published in 2017, the IEA morphed that into a new scenario that provides an integrated way to achieve three critical policy goals simultaneously: climate stabilization, cleaner air and universal access to modern energy. This new scenario—called the Sustainable Development Scenario ("SDS")—provides a benchmark for measuring progress towards a more sustainable energy future, in contrast with the WEO's other scenarios that track current ("Current Policies Scenario", or CPS) and planned policies to address governments' stated commitments to climate goals ("New Policies Scenario" or NPS).

28 AODP, May 2018.

Additional CO2 emissions reductions in the SDS vs. NPS

What the world's fuel mix and efficiency gains must look like going forward



IEA, June 2019. The chart shows the how the "Sustainable Development Scenario" (SDS) achieves its emissions goals versus the "New Policies Scenario" (NPS). SDS lays out what the worlds fuel mix and efficiency gains will need to look like on a go forward basis in order to stay within the limits of the Paris Agreement, with CCS accounting for 7% of the cumulative emissions reductions needed by 2040.

The chart above shows how the SDS achieves its emission reductions versus the NPS. This is the "below 2 degree" scenario that has become the de facto benchmark for most scenario analysis exercises and is the one that was used to benchmark future emissions associated with insurers' portfolios in this study. This energy scenario lays out what the world's fuel mix and efficiency gains will need to look like on a go forward basis in order to stay within the limits of the Paris Agreement. It is worth noting that the IEA scenarios have come under criticism by experts for allowing a greater role for fossil fuels through 2030-2040 versus comparable 2-degree scenarios, underplaying the role of renewables (by underestimating their declining cost trajectories), and boosting the role of nuclear energy in the decarbonization process. All these are valid criticisms, and we look forward to the IEA improving on its scenarios so that the analysis contained in this report can also be bettered.

Setting up the analysis: universe selection

The National Association of Insurance Commissioners (NAIC) statutory reporting requirements mandate that all U.S. insurers disclose the full holdings of their investment portfolios annually.[29] These holdings are loaded into the BlackRock Solution's Aladdin Platform. Using this dataset of insurance companies' investment holdings from 2017 year-end, we consolidated the universe of corporate bond holdings and from the overall universe, constructed **three aggregate portfolios** representing the three lines of business of the U.S. insurance industry: Life, Health and Property & Casualty (P&C). Given the different nature of the liabilities of these businesses, the asset allocation of the different insurance businesses differs substantially. By constructing three separate aggregate portfolios, one for each line of business, we could perform the analysis across the three different lines of businesses and compare the results for the industries against each other, as well as against the overall insurance universe. We focused specifically on the corporate bond holdings within these portfolios due to the large allocation by the insurance industry to corporate bonds as well as due to corporate issuers in certain sectors facing outsized transition-related risks. The table below summarizes the overall scope of the analysis.

Overall universe for the analysis

Overview of analysis across three lines of businesses focusing on corporate bond holdings

Size of universe	$3.6 Trillion
Corporate bond universe	$1.83 Trillion
Emissions scenario	IEA Sustainable Development Scenario (SDS)
Benchmark	Bloomberg-Barclays U.S. credit index
Geography of assets	Global
Asset class	Corporate bonds
Aggregate portfolios	Life/Health/P&C Aggregate Portfolio
Portfolio time stamp	12/31/2017

BlackRock, with data from 2° Investing Initiative. July 2019.

29 NAIC, June 2019.

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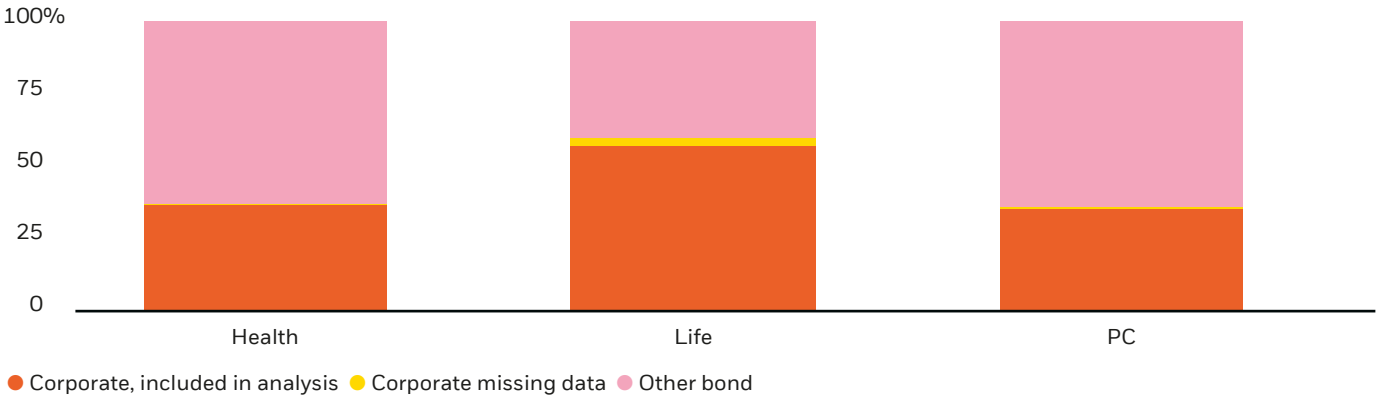
Transition risk analysis scope–asset class

Taking a closer look at the bonds within the scenario analysis



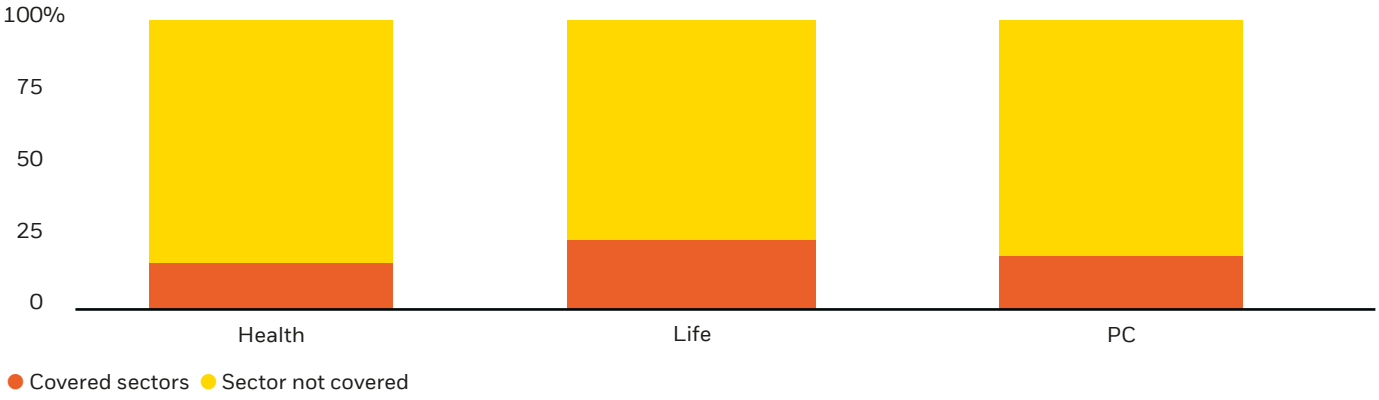
BlackRock, with data from 2° Investing Initiative. July 2019. Transition Risk Analysis Scope: Assets Included/Excluded. Although the total size of the universe is $3.6T, $1.85T was invested in corporate bonds. Some bonds could not be matched with a financial identifier, which reduced the coverage to about $1.83T.

The two charts on this page illustrate in detail the coverage universe that this scenario analysis applies to. Although the total size of the entire holdings universe is $3.6T, $1.85T was invested in corporate bonds. Some bonds could not be matched with a financial identifier, which were removed from the corporate bond universe and reduced the coverage to about $1.83T.

We also focused our analysis on specific corporate bond sectors that are exposed to transition risk. The analysis thus focused on fossil fuel extraction (coal, oil and natural gas), power (coal, gas, nuclear, hydro and renewable), and automotive sectors (internal combustion engine, electric and hybrid vehicles) as these account for between 70% and 90% of energy-related CO2 emissions in a typical investment portfolio.[30] An analysis of the emissions intensity of the aviation, shipping, cement and steel sectors is also included but it is not as detailed as for the sectors described above given that the datasets available for these sectors are not as granular. These sectors represent about 23% of the total corporate bond investments of U.S. insurers and totaled to about $416.5bn in investment holdings which we mapped to the analysis model's asset level databases in sectors affected by the energy transition, as shown below.

Transition risk analysis scope–sectors

Corporate bond holdings included in the analysis based on sectors more exposed to transition risks



Sources: BlackRock, with data from 2° Investing Initiative. July 2019. Transition Risk Analysis Scope: Corporate bond holdings Included in the analysis based on sectors more exposed to transition risks.

30 Paris Agreement Capital Transition Assessment, July 2019.

PACTA principles, parameters, scenarios from 2° Investing Initiative

Modeling principles

- The model calculates the expected benchmark exposure for each technology in the specific asset class by taking the current exposure in the respective asset class and geography and adding the trend line as defined in the scenario (e.g. the IEA´s 2°C compatible "sustainable development scenario" or SDS[31]). The build-out percentages take a simple "fair share principle" under which the companies in the investable universe are assumed to adjust production capacity in line with the scenario, consistent with their market share.
- The model assesses the scenario alignment of financial portfolios with a 5-year time horizon/forecast period. The time horizon is limited to the time horizon of capital expenditure planning for which data can be tracked at a meaningful level. While this time horizon may differ across sectors, a homogenous time horizon is taken to allow for the comparability of results.
- The model applies traditional financial accounting principles, notably where possible the equity share principle (e.g. 1% ownership of a company assumes 1% ownership of assets). Where data is not available, the majority owner is allocated 100% of the ownership.

Global parameters

The scenario analysis uses a general methodological framework which compares the technology build out plans with climate scenarios as explained above. While this core methodology is set, there are several parameters that can be set to answer specific research questions. The model parameters that were used in the analysis include:

- **Scenario** to compare the portfolio against that reflects a specific decarbonization transition pathway and technology beliefs as accurately as possible;
- **Accounting principle** (or Allocation Method) used to allocate build out plans to the portfolio, which determines whether the assessment is of the portfolio's contribution toward the transition (ownership approach) or the portfolio's exposure to transition risk (portfolio weight approach);
- **Scenario geography** to show the portfolio's regionally specific alignment based on location of physical assets, highlighting the most relevant regions to act on;
- **Benchmark portfolio** to either assess the portfolio's current build out plans against its own scenario-compatible targets (referred to as the "Aligned Portfolio"), or to compare the portfolio to a specific benchmark such as an asset class appropriate market portfolio under a scenario-compatible decarbonization pathway ("Aligned Benchmark");
- **Peer group** to compare the portfolio to a set of the most relevant peers available (given data availability restrictions).

Scenario

Scenarios represent potential technologies pathways to reach e.g. climate targets. While being based on the best available scientific research, there remain uncertainties around the outcomes. Furthermore, different scenarios/pathways can lead towards the same climate target depending on technology beliefs and preferences, as well as economic, social and other assumptions, etc.

The most prominent climate technology pathways providers are the Intergovernmental Panel on Climate Change (IPCC) scenario community (International Institute for Applied Systems Analysis, Potsdam Institute for Climate Impact Research) as well as the IEA. There are also several other organizations that publish technology roadmaps. In our analysis, we use the scenarios provided by IEA—Sustainable Development Scenario (SDS), Beyond 2 Degree Scenario (B2DS), New Policies Scenario (NPS) and Current Policy Scenario (CPS). The table below gives an overview of the scenarios. It also outlines sector and regionality coverage, the connected global warming in centigrade, as well as the key characteristics of the scenarios.

31 IEA, November 2018.

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Scenarios overview

The different emissions scenarios alongside key characteristics and scenario provider

Scenario provider	Scenario name	Sector	Regions	Key characteristics
IEA	Sustainable Development Scenario (2°C)	Power, Fossil fuels, Automotive	All*	Combines climate and social targets limiting global warming to 2°C above pre-industrial levels
IEA	Beyond 2 Degree Scenario (1.75°C)	Power, Automotive	Global, OECD, non-OECD*	Limiting global warming to 1.75°C above pre-industrial levels
IEA	RTS/NPS (reference/new policies)	Power, Fossil fuels, Automotive	All*	Pathway if all new policies come into place in an effective manner
IEA	CPS (current policies)	Power, Fossil fuels, Automotive	All*	Business as usual case without any changes in policies

Scenario Overview. 2dii, June 2019. Table shows the different emissions scenarios alongside key characteristics and provider of the scenario.

Accounting principle

Because bond and other credit instruments are financing instruments rather than ownership instruments, the analysis uses a **portfolio weight approach** which calculates the portfolios technology exposures based on the weighting of each position within the portfolio. The technology exposure is presented in weighted technology share (i.e. percentage values). The weighting of the technology share is done by the weight of the company in the portfolio.

If we were to use an **ownership approach** instead, which calculates the technology exposure based on the portfolio's ownership in companies, it would cause high volatility in results for credit portfolios. This is because the total debt outstanding as well as other potential denominators for the ownership calculation frequently change due to companies issuing new debt on a regular basis. The ownership approach would also lead to a decrease in ownership share by the investor when a company issues more debt. While this makes sense at first glance, it would also lead to a decreased risk exposure for brown technologies (the portfolio would be less exposed to brown technologies and thus be less exposed to risks). In reality, the risk would increase with higher debt. This is not a problem for equity as the outstanding shares do not change frequently, and the ownership as well as risk really decreases/increases with the percentage of shares a portfolio owns.

Scenario geography

The scenario geography is based on the asset location (i.e. production location) and allows a deep dive into the regionality of the production, technology mix and scenario alignment of the portfolio. While the benchmarking of the **production** is always done at the most granular regional level that is available to realize the most accurate scenario analysis, we are using a **global scenario** for simplicity and uniformity.

Benchmark portfolio

The benchmark portfolio parameter sets the starting point of the benchmark and thus sets the focus of the analysis. We are using a "2-degree aligned portfolio" as a benchmark for this analysis. A hypothetical "2-degree aligned portfolio" is a portfolio where investments are in line with the 2-degree emissions trajectory as defined by the IEA Sustainable Development Scenario. By using our analysis universe's current technology exposure as a starting point of the analysis, we focus on the forward-looking production plans of the portfolio and compare the aggregated capex plans of all portfolios positions with the scenario technology build-out rates.

Data sources

The model sources, where possible, forward-looking asset—level data for key technologies (e.g. future production plans) in order to provide geography—specific assessments for climate relevant sectors mapped to the company level. It thus bypasses wherever possible backward-looking, corporate level reporting, although such reporting can be used for validating forward—looking parameters (e.g. GHG emissions). The analysis relies on the following data sources:

- GlobalData. Power plant data, including plants classified as active, announced, financed, partially active, permitting, temporarily shut down, under construction, under rehabilitation & modernization, and Oil and Gas production data and forecast until 2018 – 2023, as well as coal mining data;
- WardsAuto/AutoForecastSolutions. Light passenger duty vehicle including light trucks and BAU production forecasts 2018 – 2023;
- RightShip. Ship data, including ship type and carbon efficiency developed by Carbon War Room;
- FlightGlobal. Airplane data for passenger flights, cargo and combined aircrafts, including number of seats or tons transported, plane model, etc;
- Other sectors databases: PlantFacts (steel plant data, including status and type); CemNet and Global Cement Directory (cement plant databases); combined with EY´s emissions intensity model per plant by type;
- Bloomberg. Financial data with information about sector classification, share price, unique identifiers, etc.

The financial data and peer data is taken as of the December 31, 2017, the same date as all portfolio data in this analysis.

Notes on interpreting results and model limitations

The following briefly highlights key caveats to the model and the results:

- The forward-looking data is based on current 'revealed' plans from companies and is subject to change. The estimates should thus not be interpreted as final predictions, but rather the current plans of companies if they don't change. Another way to interpret the results is the call for action with regard to the required change to align with the 2°C economic trend. Given the 5-year time horizon, there is a high degree of certainty that plans will still change in some way over time. Similarly, the participating financial institutions can of course alter their portfolio exposures over time. The analysis however seeks to be a point in time assessment of future exposures under current conditions.
- The model takes a diversified 'market portfolio' as a basis, focusing on key technologies reflected in the IEA roadmaps. By extension, thematic portfolios invested in breakthrough technologies and/or Socially Responsible Investing (SRI) portfolios with a range of environmental, social, and governmental considerations may not value these elements.

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Results and main takeaways

The scenario analysis of U.S. insurance portfolios allows us to assess U.S. insurers' portfolios against different emissions trajectories and study any misalignments from expected emissions trajectories. It helps us understand the magnitude of the current exposure of the U.S. insurers' aggregate corporate bond portfolios to sectors affected by **climate related transition risks** and the expected deviation of this using a hypothetical "2-degree aligned portfolio" in a 5-year time period. Our analysis tells us that the current exposure in the U.S. insurers' corporate bond portfolios to economic activities affected by the transition to a low-carbon economy **is higher** than what the "2-degree aligned portfolio" would have. The sector allocations of the three U.S. insurance portfolios exceed that of a "2-degree aligned portfolio" as evidenced by the portfolios **tracking to the 4-6 degrees scenario**. See chart entitled **Implied average warming of U.S. insurers' portfolios**.

Looking at sectors affected by climate related transition risks:

- **Fossil fuel:** The primary driver of this deviance from a "2-degree aligned portfolio" is the exposure to coal producers in the U.S. insurers' portfolios. In fact, U.S. insurers' portfolios have a higher exposure to coal producers than the Barclays Credit Index.
- **Power capacity: U.S. insurers are severely underinvested in renewable power, and the portfolios tracking towards a >6-degree scenario.** Renewables make up a very small part of the benchmark but are a big contributor to a 2-degree trajectory. Utilities included in the U.S. insurers' portfolios don't have sufficient capex spending in renewables to align themselves to a sustainable emissions trajectory. For these reasons, both the Bloomberg-Barclays U.S. Credit Index and the U.S. insurance industry's allocations are tracking towards a >6-degree scenario.
- **Automotive: U.S. insurers are also severely underinvested in hybrid and electric vehicles.** Auto companies that make up a large percentage of the index haven't invested significant capex into electric/hybrid vehicles. Both the index and the U.S. insurance industry portfolios' hybrid vehicle production is **tracking towards a >6-degree scenario**, and electric vehicle production is tracking towards a 4-6 degree scenario (though the benchmark is tracking more positively than the portfolio). This would suggest that the auto industry isn't transitioning fast enough toward non-internal combustion engine vehicles.

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Implied average warming of U.S. insurers' portfolios

Implied average warming in 2100 vs pre-industrial era in U.S. insurers' portfolios

Tech	LEH-CRED	Health	Life	PC
Coal	5.7	1.5	6.37	3.35
Gas	1.5	1.5	1.5	1.5
Oil	3.77	3.93	3.72	3.73
CoalCap	6.5	6.5	6.5	6.5
GasCap	1.72	2.14	1.79	1.98
RenewablesCap	6.44	6.5	6.43	6.5
NuclearCap	1.5	5.96	1.5	6.17
ICE	4.95	4.91	4.86	4.95
Hybrid	6.5	6.5	6.5	6.5
Electric	5.17	5.19	5.23	5.17
Temperature	**3.7**	**4.1**	**3.7**	**4**

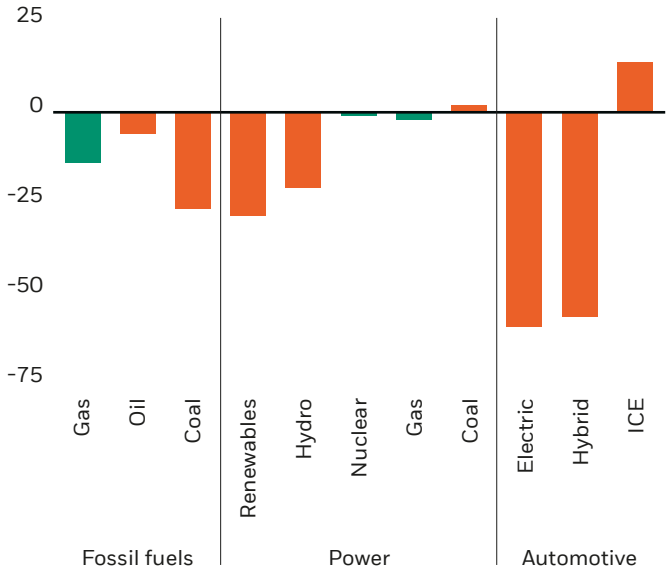
BlackRock, with data from 2° Investing Initiative. July, 2019. The table shows Implied average warming in 2100 resulting from technologies included in analyzed U.S. insurers' portfolios vs pre-industrial era, expressed in Celsius. Darker shades represent deviance from the 2-degree alignment – green for under 2-degrees and red for over 2-degrees. LEH-CRED refers to the Bloomberg-Barclays U.S. Credit Index and is used as a proxy benchmark from the aligned 2-degree alignment in 2023, both in terms of temperature and technology trajectory. Health, Life and PC refers to the Health, Life and P&C insurance aggregate portfolios respectively. Note: Temperatures between scenario targets are computed by linear interpolation between the portfolio's planned production and production consistent with the boundary scenarios. For planned production beyond either of the outermost scenarios—SDS or CPS—a temperature of 2degree or 6degree is substituted instead, respectively, While the IAM model underlying the IEA scenarios accounts for interactions between technology deployments, these technology temperatures are interpolated as if they were independent form one another. They are rough diagnostic approximations and not internally consistent scientific indicators. Note: For illustrative purposes only. Forecasts are based on estimates and assumptions. There is no guarantee that they will be achieved as forecasted.

Implied average warming of U.S. insurers' portfolios and ***Deviation from the 2-degree aligned portfolio in 2023*** illustrate the deviation of the U.S. insurers' portfolios and the Bloomberg-Barclays U.S. Credit Index as a proxy benchmark from the 2-degree aligned portfolio in 2023 (5-year time period), both in terms of temperature and technology trajectory. We see the deviation based on how the corporate bond portfolios as well as the benchmark's implied average warming is higher than 2 degrees.

To understand why the implied average warming U.S. insurers' portfolios are higher than 2 degrees, we can analyze the percentage difference in production between the U.S. insurers' portfolios and the hypothetical 2-degree aligned portfolio if it were to follow the SDS transition by 2023. The chart below illustrates this gap. For lower carbon technologies, a negative value represents an underexposure to the technology compared to the aligned portfolio. For higher carbon technologies, a positive value represents an over exposure to the technology compared to the aligned portfolio. As shown, the biggest gaps are in the coal mining, renewable and hydroelectric power capacity and electric and hybrid vehicles whereby the U.S. insurers' portfolios have significant over-exposure to higher carbon technologies and underexposure to lower carbon technologies.

Deviation from the 2-degree aligned portfolio in 2023

Effects of under-exposure to low-carbon technologies and over-exposure to high-carbon technologies



BlackRock, with data from 2° Investing Initiative. July, 2019. The figure shows the deviation of the U.S. insurers' portfolio from the hypothetical "2-degree aligned portfolio" in 2023 in terms of allocation to different sectors. The chart shows under-exposure to low-carbon technologies and over exposure to high-carbon technologies like coal. Forecasts are based on estimates and assumptions there is no guarantee that they will be achieved.

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What would a 2-degree aligned portfolio look like?

The chart below shows the alignment of fossil fuels, selected power technologies and automobile technologies in the U.S. insurers' portfolio relative to the IEA transition scenarios: Beyond 2°C Scenario "B2DS" (i.e. well below 2°C), SDS (2°C), NPS (4°C), Current Policy Scenarios "CPS" (6°C) and the benchmark. For each technology, the value plotted for the portfolio (solid line) is the planned evolution or 'trajectory' of fossil fuel production, installed capacity and automobile production allocated to the corporate bond portfolio over the next 5 years. The lines separating the color-coded background areas plot the portfolio's 'target production' for each technology under the IEA scenarios. The dotted line shows the planned trajectory of installed capacity in the specific technology for the bond benchmark, scaled to the same starting point as the portfolio.

Analyzing these charts, one can devise a 3-step strategy that seeks to improve the implied emissions trajectory of these portfolios:

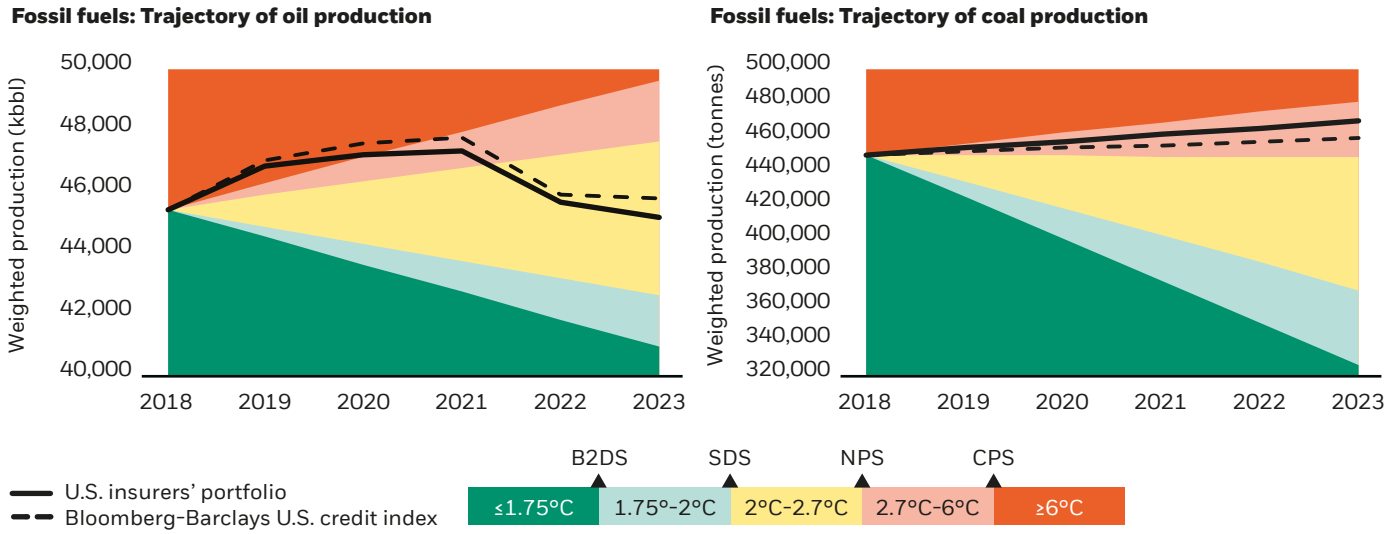
Step 1:

Reduce exposure to coal mining and oil extraction

This would entail divesting a certain percentage of the U.S. insurers' portfolios from coal mining and oil & gas companies, especially those that privilege oil vs. gas capex spending in the 2018-2023 period. This would bring future production figures down and align the portfolio to a 2-degree trajectory.

Coal mining and oil extraction

Alignment of fossil fuels—the first step in improving the implied emissions trajectory of U.S. insurers' portfolios



BlackRock, with data from 2° Investing Initiative. July, 2019. The figure shows the U.S. insurers' portfolios' planned evolution or 'trajectory' of fossil fuel production allocated over the next 5 years (solid line). The lines separating the color-coded background areas plot the portfolio's 'target production' for oil and coal production under the IEA scenarios. The dotted line shows the planned trajectory of installed capacity in the oil and coal production for the benchmark, scaled to the same starting point as the portfolio. Forecasts are based on estimates and assumptions there is no guarantee that they will be achieved.

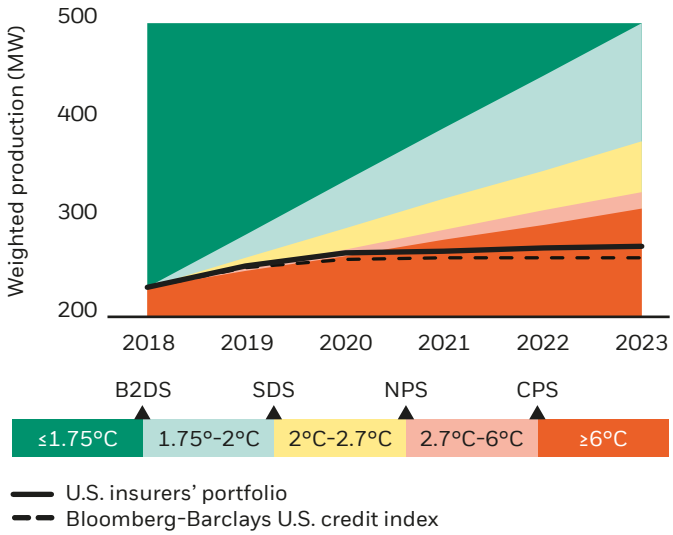
Step 2:

Increase exposure to renewable energy capex by selecting debt from utilities that are investing in renewable assets.

The chart to the right shows that renewable capacity based on how the U.S. insurers' portfolios' investments that falls short of what a 2-degree compliant portfolio would look like. Furthermore, to help make the determination of which utilities are investing more CapEx in renewables, we also had granularity for planned fuel mix in 2023 for the largest holdings (by market value) of utilities in the corporate bond portfolios of U.S. insurers. The aggregation of the fuel mix are shown in the chart below and can be compared to the portfolio's currently planned fuel mix, the portfolio's target fuel mix under the SDS, and the aligned benchmark's fuel mix all as of 2023.

Renewable power capacity

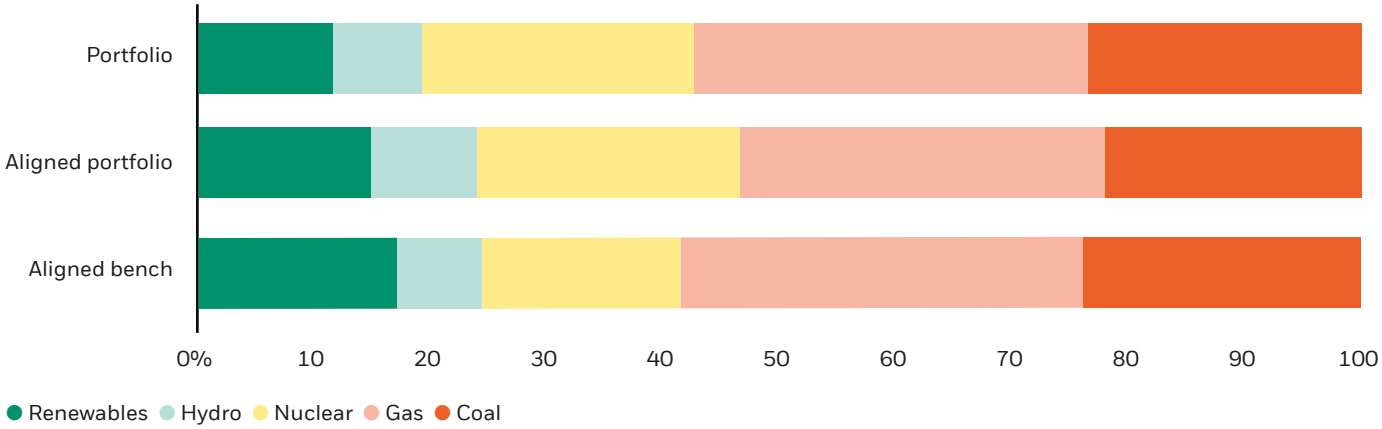
Renewable capacity of U.S. insurers' portfolios' investments vs renewable capacity of a 2-degree compliant portfolio



BlackRock, with data from 2° Investing Initiative. July, 2019. The figure shows the U.S. insurers' portfolios' planned evolution or 'trajectory' of renewable power capacity allocated over the next 5 years (solid line). The lines separating the color-coded background areas plot the portfolio's 'target production' for renewable power capacity under the IEA scenarios. The dotted line shows the planned trajectory of renewable power capacity for the benchmark, scaled to the same starting point as the portfolio. Forecasts are based on estimates and assumptions there is no guarantee that they will be achieved.

Technology breakdown of power companies within the U.S. insurers' portfolios

U.S. insurers' portfolios current planned fuel mix vs the planned fuel mix in 2023



BlackRock, with data from 2° Investing Initiative. July, 2019. The figure shows the currently planned fuel mix in 2023 for the U.S. Insurers' portfolio and can be compared against the portfolio's currently planned fuel mix, the portfolio's target fuel mix under the SDS, and the aligned benchmark's fuel mix all as of 2023. Forecasts are based on estimates and assumptions there is no guarantee that they will be achieved.

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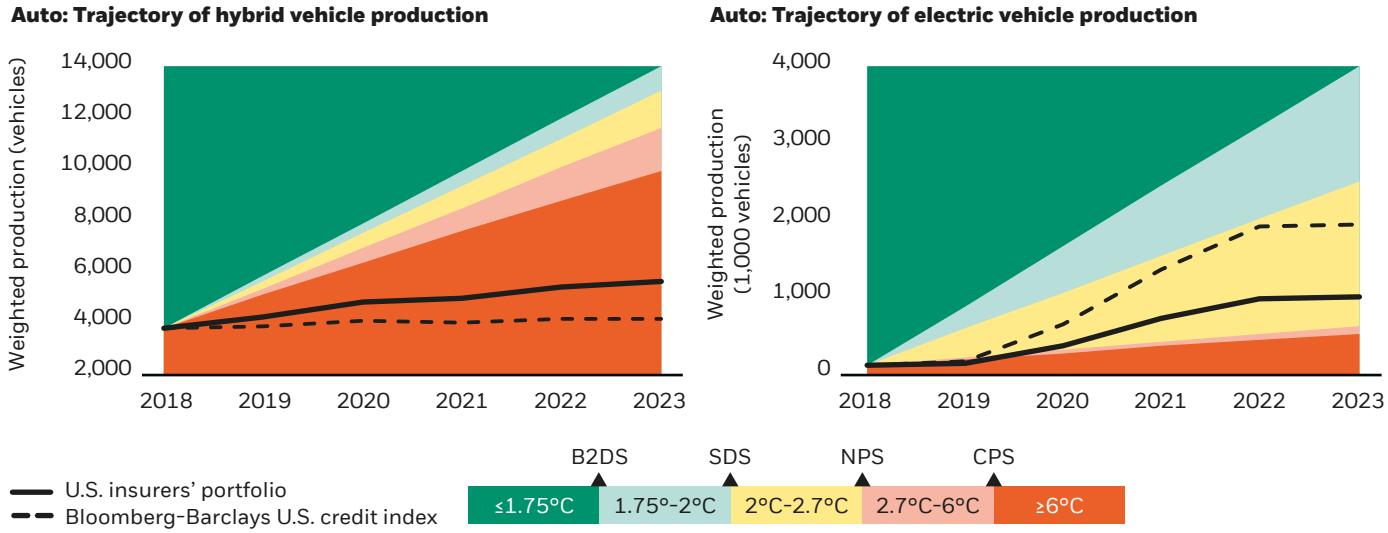
Hybrid vehicle and electric vehicle production

Trajectory of hybrid vehicle production of aggregate insurers' portfolios vs a 2-degree compliant portfolio



BlackRock, with data from 2° Investing Initiative. July, 2019. The figure shows the U.S. insurers' portfolios' planned evolution or 'trajectory' of alternative vehicle production allocated over the next 5 years (solid line). The lines separating the color-coded background areas plot the portfolio's 'target production' for alternative vehicles under the IEA scenarios. The dotted line shows the planned trajectory of alternative vehicle production for the bond benchmark, scaled to the same starting point as the portfolio. Forecasts are based on estimates and assumptions there is no guarantee that they will be achieved.

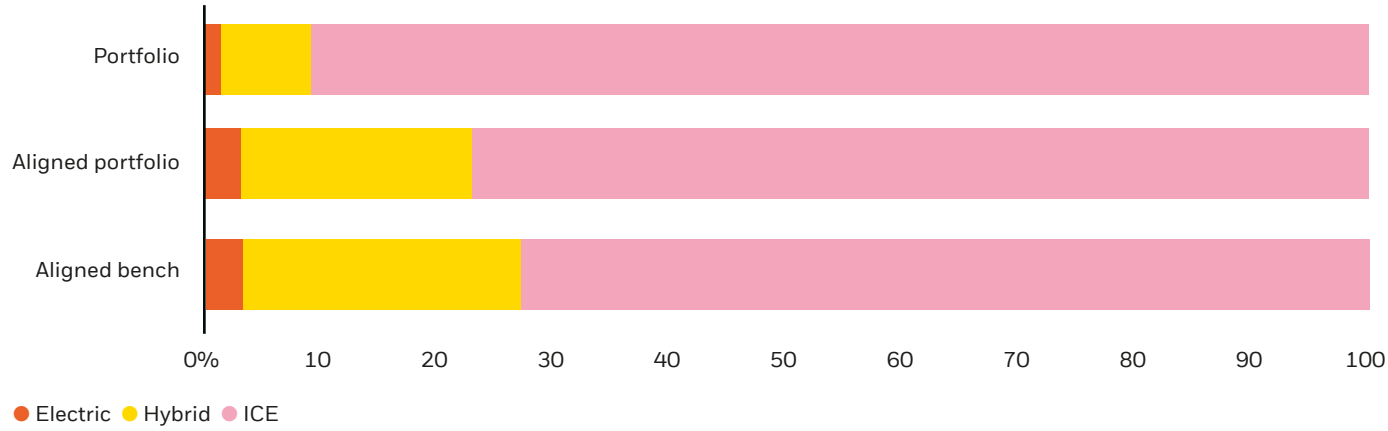
Step 3:

Increase exposure to alternative vehicles capex by selecting debt from car manufacturers that are investing in hybrid and electric vehicles.

The chart above shows that based on the aggregate universe portfolio's (of the three U.S. insurance industries combined) investments in hybrid and electric vehicle, it falls short of what a 2-degree compliant would look like. Similar to the previous step, the chart below can help make the determination of the portfolio's CapEx in alternative vehicles (hybrid or electric), by showing the currently planned production mix of engine technologies in 2023.

Technology breakdown of automotive companies within the U.S. insurers' portfolios

Currently planned production mix of engine technologies in 2023 for largest holdings of automotive manufacturers



BlackRock, with data from 2° Investing Initiative. July, 2019. Figure shows automobile manufacturers in U.S. insurers' portfolios' CapEx in alternative vehicles (hybrid or electric). Forecasts are based on estimates and assumptions there is no guarantee that they will be achieved.

Conclusions

The first step in understanding climate risks in portfolios is to gain an understanding of what the portfolio owns. While climate scenarios are not predictions and the IEA scenario used in this analysis is one of several versions of a low emissions future; the analysis of how a portfolio is aligned with forward versions of economies under a 2-degree transition can help investors contextualize this risk. The low carbon scenario is not the only scenario of the future in which climate risk manifests. The "business as usual" current scenario, with its own ramifications on sea-level rise, storms, temperatures and drought, is another scenario which requires a strategic response plan as well.

While insurers have a multitude of factors to consider, climate risks have evolved from long-term to medium-term issues. Analysis such as this, which demonstrates a 5 year outlook, should lead investors to re-examine holdings as they determine how likely we are to achieve the goals set by the Paris Climate Agreement, or how likely technology or consumer preferences will affect certain sectors.

Once an assessment has been made on material climate risks in the portfolio, insurers can start to craft company ESG policies, or at minimum create a timeline of milestones needed. Through analysis such as this our goal is to educate clients to make deliberate choices, rather than be victim to unintended consequences.

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Appendix

Sector	Data provider	Data granularity / analysis	Source date
Automotive	WardsAuto/ AutoForecast Solutions	Scenario Analysis	31/12/2017
Aviation	FlightGlobal (FlightAscend)	Emission Intensity	31/12/2017
Cement	CemNet & Global Cement Directory	Emission Intensity	30/06/2017
Coal	GlobalData	Scenario Analysis	28/02/2018
Power	GlobalData	Scenario Analysis	28/02/2018
Oil & Gas	GlobalData	Scenario Analysis	28/02/2018
Shipping	RightSHip	Emission Intensity	28/02/2018
Steel	PlantFacts	Emission Intensity	31/12/2017

Source: 2dii, June 2019. Notes: Table shows the asset level data used in the analysis alongside granularity and the source date of the dataset.

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To what degree?

A climate scenario analysis of U.S. insurers' portfolios

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