Trucost
ESG Analysis

S&P Global

TCFD Scenario Analysis:

Integrating future carbon price risk into portfolio analysis

TCFD[1] SCENARIO ANALYSIS: INTEGRATING FUTURE CARBON PRICE RISK INTO PORTFOLIO ANALYSIS

With 195 nations committed to curbing global warming by substantially reducing annual greenhouse gas (GHG) emissions, a course has been set to change the shape of the current economy. Private markets will play a key role in this transition by redirecting capital to lower-carbon solutions, but further stimulus is required to make effective change quickly.

Policy interventions can build economic incentives to move away from high-carbon activities by placing financial responsibility for the social cost of climate change onto the polluter. The Carbon Pricing Leadership Coalition, which brings together governments, companies and academics to encourage the adoption of effective carbon policy, is explicit: "Carbon pricing is a necessary part of a larger package of policies that can reduce GHG emissions."[2]

Organizations are encouraged to conduct scenario analysis to understand the resilience of their bottom lines against a 'new normal' backdrop, where emitting carbon incurs increasing financial penalties. Scenario analysis is a technique used by businesses and investors to evaluate the resilience of a company under a range of possible future conditions. Knowing where to start, however, is not altogether straightforward. There are countless potential scenarios and time horizons to evaluate. Obtaining relevant and reliable data is also a major challenge.

To help investors navigate carbon price risk, Trucost has compiled a dataset of possible future carbon prices that can be used to stress test a company's current ability to absorb future costs. Integral to this analysis is the quantification of a Total Risk Premium – the difference between what a company pays for emitting carbon today and what it may pay in the future under three different policy scenarios. By examining the potential impact of increased costs on profits, Trucost's dataset offers market participants forward-looking estimates of financial risk for over 15,000 listed companies.

In this paper, we will:

- Examine the drivers of carbon price risk for a universe of 500 large-cap listed companies.
- Calculate the Carbon Earnings at Risk for a hypothetical portfolio (based on the universe mentioned above) to show how the dataset can be used to report in line with TCFD best practice requirements.
- Demonstrate how the dataset can be extended to understand potential Value at Risk for equity and credit investors.

[1] Task Force on Climate Related Financial Disclosures.
[2] "What is Carbon Pricing", Carbon Pricing Leadership Coalition, accessed December 2018, https://www.carbonpricingleadership.org/what/

PART ONE: QUANTIFYING COMPANY-LEVEL CARBON PRICE RISK

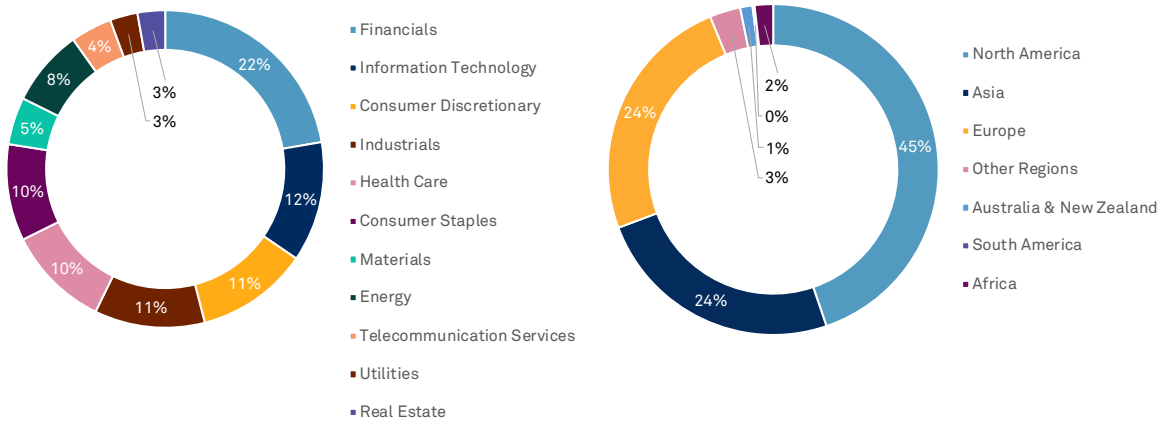
In order to make more informed financial decisions, investors, lenders, and insurance underwriters need to understand how climate-related risks and opportunities are likely to impact an organization's future financial position as reflected in its income statement, cash flow statement, and balance sheet…

TFCD

Carbon pricing mechanisms are an essential policy tool to reduce GHG emissions and direct capital towards cleaner energy and lower-carbon solutions. There are currently 52 carbon pricing schemes either in operation or scheduled for implementation at a regional, national, or sub-national level, covering about 20% of annual global GHG emissions.[3] More schemes are likely to appear in order to achieve the Nationally Determined Contributions (NDCs) made by the 195 countries that ratified the Paris Agreement.

The number of companies that use an internal carbon price to manage climate risks has grown from 150 in 2014 to almost 1,400 today according to CDP disclosure.[4] Whilst the growth rate is encouraging, the number signals that the majority of investable companies may be underprepared. There is a critical need for investors to evaluate portfolio companies' preparedness and the potential impact different carbon pricing scenarios could have on financial performance.

Figure 1: Universe by GICS[5] Sector and Headquarter Region



[3] Carbon Pricing Dashboard, The World Bank, accessed December 2018, https://carbonpricingdashboard.worldbank.org/
[4] Commit to Putting a Price on Carbon, CDP, accessed December 2018, https://www.cdp.net/en/campaigns/commit-to-action/price-on-carbon
[5] Global Industry Classification Standard.

Trucost has examined 500 of the world's largest listed companies to identify carbon price risk amongst entities that are widely held by the investment community. Figure 1 shows the distribution of companies in the universe by sector and region.[6] A large proportion of these organizations operate in high emissions-producing industries as qualified by the IPCC (energy systems, transport, industry, buildings and forestry)[7] which are key focus areas for investors, lenders and insurance companies considering climate-related risks.

Figure 2: Absolute Emissions by GICS Sector and Headquarter Region

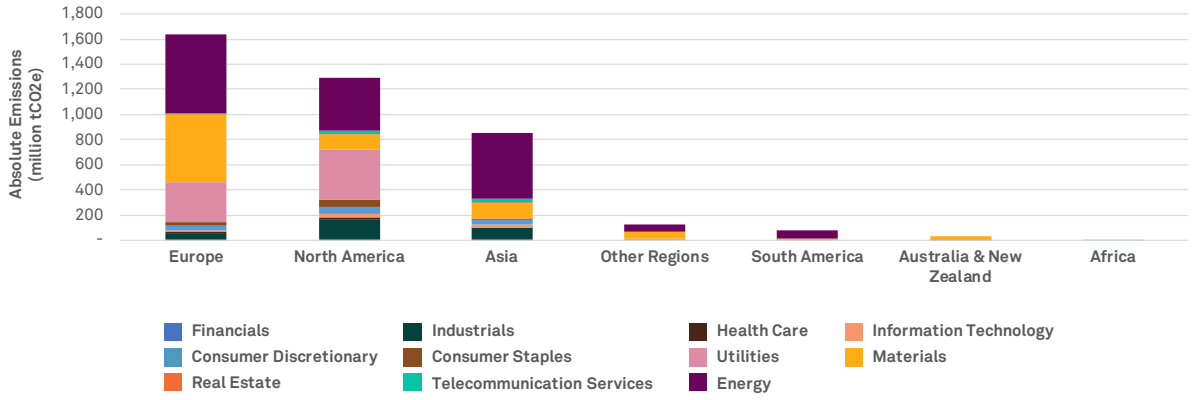


Figure 2 shows the total GHG emissions for all universe companies within each region. Sectors are sized according to their contribution.[8] Trucost drew on publicly-available GHG emissions data, which was reported by 80% of the universe,[9] and its proprietary models to fill the gaps. European headquartered companies emitted the most GHGs due to sizeable contributions from companies in the Energy, Materials, and Utilities sectors.

From Figure 2 we may deduce that our universe is most exposed to European regulation and that the focus of further carbon price risk analysis should be on European companies. The scale of emissions is not, however, the only factor driving carbon price risk. The location of site-level operations, the timing and nature of the carbon pricing policy, and a company's ability to absorb additional costs will each play into the final risk calculation. Low margin companies may need to reassess their business models in light of future cost increases. The market conditions of the sector will play a significant role.

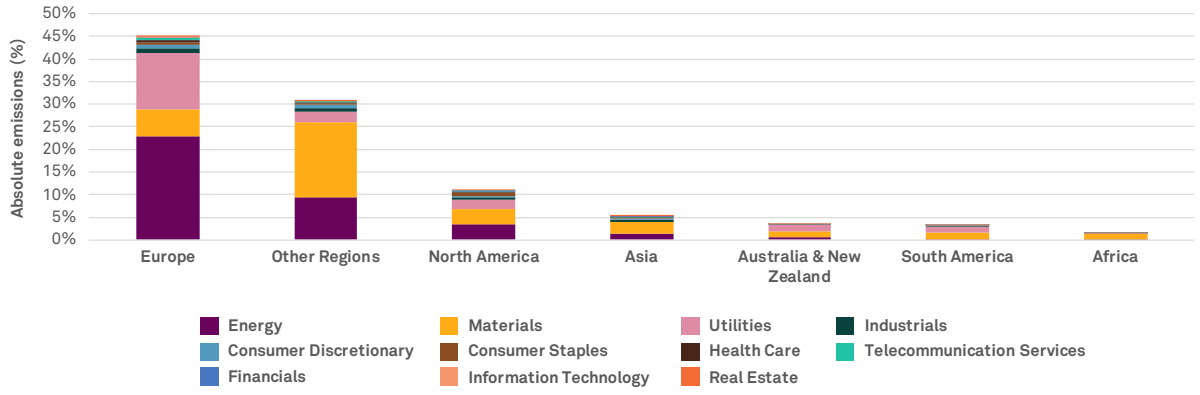
[6] The underlying analysis draws on country-specific data but, for visual clarity throughout the paper, we have presented results at a regional level.
[7] Climate Change 2014 – Mitigation of Climate Change, IPCC, page 9, 2014.
[8] The latest available emissions data was collected for each company's operational activities (Scope 1) and their purchased electricity (Scope 2).
[9] Disclosed data refers to partial and full emissions data disclosed by companies in this universe.

Location Matters

Carbon pricing mechanisms can take several forms, including emissions trading schemes, taxes on carbon or fuel, and the removal of fossil fuel subsidies. The policy mechanism chosen by a government will depend on country-specific economic circumstances. Company-level exposure to carbon pricing mechanisms will be contingent on where emissions are released, rather than where a company is headquartered.

Trucost has used location-based emissions data, where disclosed, or revenue data by geography as a proxy to determine where emissions are produced. Figure 3 shows the location of operations across the globe for the 122 European headquartered companies within this universe. Whilst the European companies as a group emitted the most GHGs, only 45% of these emissions will be subject to European carbon pricing schemes.

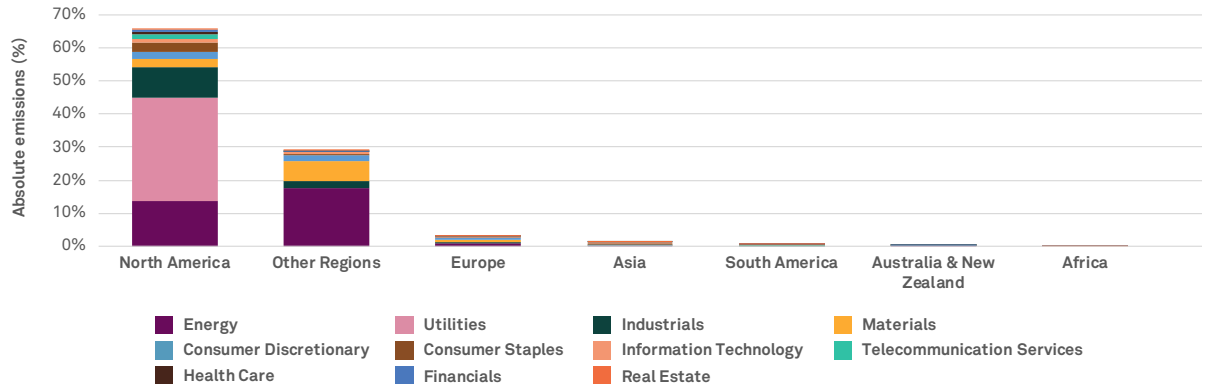
Figure 3: Distribution of Emissions for European Headquartered Companies



The remaining 55% of emissions are subject to carbon pricing mechanisms across all the regions to varying degrees, but particularly countries in Other Regions[10] (31% of emissions), North America (11% of emissions), and Asia (5% of emissions). Compare this to the 223 companies headquartered in North American countries, where 65% of emissions are produced within the region (Figure 4).

[10] Trucost has collated emissions data for 41 countries and two autonomous territories representing 80% of global emissions. Countries that are not covered by the Carbon Price database have been grouped into the category 'Other Regions'. Trucost has applied a GDP-weighted average price for these countries using data from the Carbon Price database.

Figure 4: Distribution of Emissions for North American Headquartered Companies



American, Canadian, and Mexican headquartered companies in this universe are, on average, less exposed to pricing schemes that are not under jurisdictional control. However, lack of geographical diversification can mean greater risk exposure should prices start to rise rapidly in that location. Sectors with fixed assets that are less able to shift operations may suffer. Stress testing a company or portfolio under different pricing scenarios and timeframes will help to isolate hot spots of risk.

Determine the Scenarios

> ***Each scenario, and the set of scenarios taken as a whole, should contribute specific insights into the future that relate to strategic and/or financial implications of climate related risks and opportunities.***
>
> **TCFD Technical Supplement**

It is common with scenario analysis to define at least three alternative states against which to measure potential future outcomes. Trucost has devised a low scenario set of carbon prices based on the full implementation of the existing NDCs, which would limit global warming to between 2.7 and 3.0 degrees Celsius above pre-industrial levels.[11]

Our high scenario estimates the price pathway that would be required to limit global warming to 2 degree Celsius. This pathway assumes a seven-fold increase in the current average price of carbon, to USD $120 per metric ton by 2030, in Organization for Economic Co-operation and Development (OECD) countries.[12] The moderate scenario achieves the same end goal but imagines a different implementation pathway. Delayed action is assumed in the short term with a sharp uptick in prices later on.

[11] 2100 Warming Projections, Climate Action Tracker, accessed December 2018, https://climateactiontracker.org/global/temperatures/
[12] "Talking Points: Internal carbon pricing stress testing for climate risk", Trucost, page 1, July 2017, https://www.trucost.com/wp-content/uploads/2017/07/talking-points-internal-carbon-pricing-stress-testing-for-climate-risk_v2.pdf.

Figure 5: Carbon Price Scenarios 2016-2050

Base Line	Low	Medium	High
2016 Carbon Price	Assumes the full implementation of country NDCs, some of which do not meet the Paris Agreement goal.	Assumes achievement of the Paris Agreement target, but with action delayed in the short term. Countries with NDCs that are not aligned to the 2°C goal in the short term are assumed to increase their climate mitigation efforts in the medium and long term.	Assumes policies are implemented to reduce GHG emissions in line with the 2°C by 2100 target (the Paris Agreement).

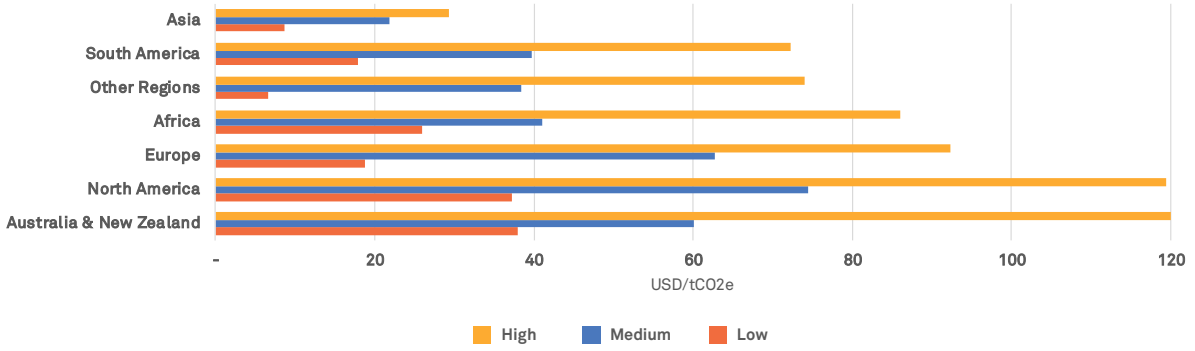
These three scenarios set the parameters for Trucost's comprehensive database of sector-level carbon prices, covering 44 jurisdictions and a range of timeframes from a 2016 baseline through to 2050. In this study, we have stress tested the impact to earnings across our universe of companies under a high scenario using 2030 prices.

Calculate the Total Risk Premium

Trucost has quantified the differences between sector- and location-specific carbon prices paid today (per metric ton) and an array of possible future prices. We refer to these differentials as Risk Premiums. Using the appropriate Risk Premium as a factor by which to multiply a company's location-based emissions, we can calculate the additional cost that entity could be faced with. We call this the *Total* Risk Premium.

Based on 2030 prices, Trucost has calculated the average Total Risk Premium per metric ton of carbon in each operating location for the European Utilities in this universe. Figure 6 presents the results for all three scenarios.

Figure 6: 2030 Total Risk Premium Intensities – European Utilities



The difference in Total Risk Premiums per metric ton of emissions between scenarios is wide-ranging. For North American-based operations, there is a percentage difference of 220% between the low and high scenarios. There is also a large spread across regions for a single scenario. On average, Asian-based operations have the lowest premium intensity under a high 2030 scenario at USD $29 per metric ton. Operations in Australia and New Zealand face the highest average premium intensity at USD $120 per metric ton.

Companies that pay a low price at present could face much higher costs in the future. For the European Utilities in this universe, Trucost estimates a more than sixteen-fold increase between the average Total Risk Premium per metric ton of emissions payable in 2020 and the average Total Risk Premium per metric ton of emissions payable in 2030 in European countries.

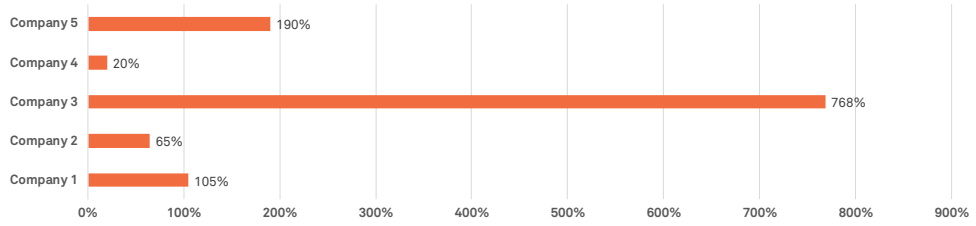
Quantify Potential Earnings at Risk

When the Total Risk Premium is deducted from a company's profits, we see that even same-sector companies with similar emissions profiles can be faced with very different financial impacts. Portfolio companies with a higher profit margin will have a better chance of absorbing future cost increases. The Earnings at Risk metric provides a useful indicator of potential vulnerability.

With any forward-looking analysis, a number of assumptions must be used to calculate possible future outcomes. By holding company earnings and absolute emissions constant, Trucost limits the number of variables. Rather than assessing a company's *future* ability to pay potential carbon costs, we assess the ability of a company to pay future costs now. Trucost has calculated current earnings using a three year trailing average in order to smooth out volatility in financial performance.

Figure 7 shows the percentage of EBIT[13] at risk for European Utilities in this universe based on the high scenario Total Risk Premium for 2030.

Figure 7: Percentage Earnings at Risk for European Utilities



Companies 4 and 5 offer gas distribution services, whilst companies 1, 2, and 3 are all Electric Utilities. Companies 1 and 3 had almost identical revenues in 2016, but Company 3's EBIT was just 6% of the EBIT generated by Company 1. The results reflect the significantly larger exposure faced by Company 3 should it have to pay 2030 carbon prices now. Evaluating an entity's preparedness for carbon price increases could help to alleviate price shocks in future.

[13] Earnings before interest and taxes.

PART TWO: UNDERSTANDING PORTFOLIO EXPOSURE

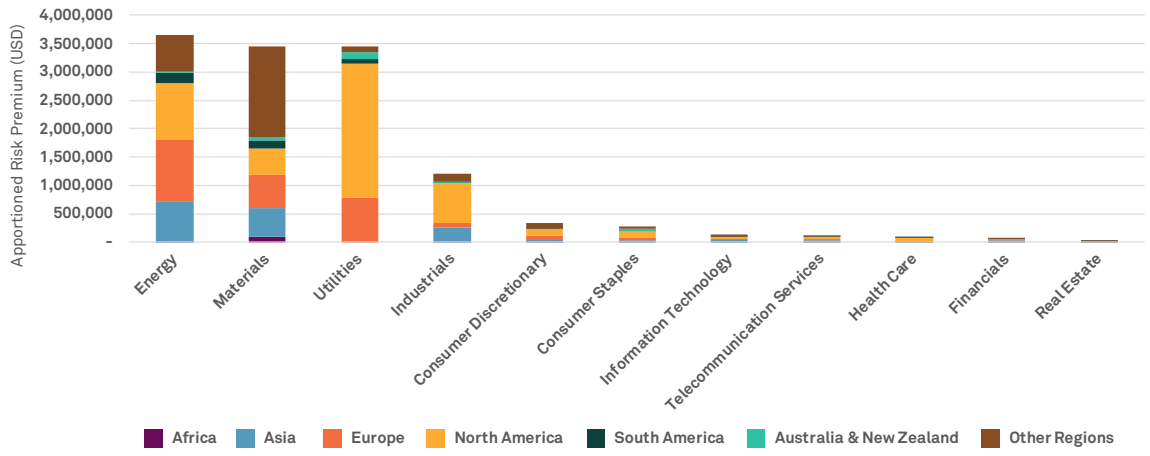
Whilst traditional carbon footprinting[14] is valuable in understanding the carbon intensity of a portfolio and relative exposure versus a benchmark, it does not provide a reliable indicator of carbon price risk exposure. Scenario analysis helps to identify potentially disruptive forces to expected financial outcomes and, in so doing, helps investors to report forward-looking estimates of financial risk in line with TCFD recommendations.

Our research highlights that investment portfolios are not homogenously exposed to carbon price risk due to differing industry and regional exposures and varying abilities of companies to absorb increased costs. A portfolio that looks similar to its benchmark, based on financial characteristics today, could have very different risk-return characteristics in the future due to the impact of carbon pricing mechanisms on earnings.

Apportioned Risk Premium

Portfolio-wide exposure can be determined using well-understood footprinting techniques and outputs, such as 'owned' Earnings at Risk. Let us assume our universe of companies is now a portfolio into which we have invested USD $2 million for each holding. Total Risk Premiums and earnings have been apportioned to the portfolio on an ownership basis using market capitalization to determine the apportionment factor.[15]

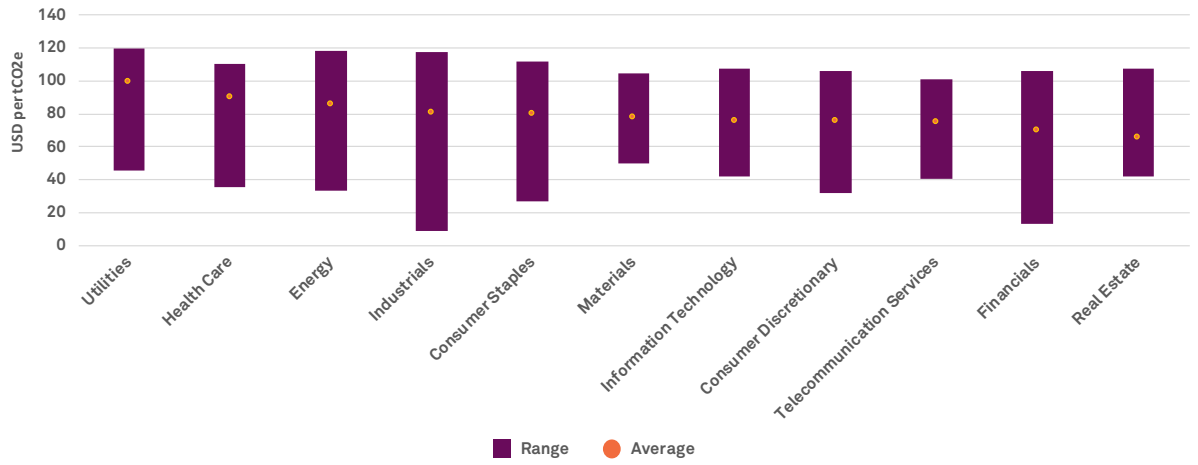
Figure 8: Apportioned Risk Premium



[14] Carbon footprinting is the exercise of measuring the GHG emissions associated with an activity, organization, product or portfolio over a certain time period.
[15] Trucost has used an apportionment-based approach to footprinting in this paper but it is also possible to calculate the footprint using a weighted average approach. For more information, see Trucost's Carbon Earnings at Risk Methodology document.

Figure 8 shows the range in the portfolio's Apportioned Risk Premiums spans between USD $27,000 for Real Estate and USD $3,659,000 for Energy. Utilities with operating sites in North America reveal the greatest portfolio exposure to owned premiums. Materials companies operating in Other Regions are also exposed, as are Energy assets in Asia, Europe, and North America. Particular portfolio risk arises around sectors that require capital-intensive infrastructure, which may have limited flexibility to move operations elsewhere in response to rising costs.

Figure 9: Range in Apportioned Risk Premium Intensity



The range within sectors is also striking. Figure 9 shows the Apportioned Risk Premium per metric ton of apportioned emissions for each company within a GICS sector. Industrials exhibits the widest range with a difference of USD $108 per metric ton between the least and most exposed entities. Companies that are already paying a high carbon price, or are located in countries where future prices are relatively low, will have a smaller Total Risk Premium.

Figure 10: Apportioned Earnings at Risk Under a 2030 High Scenario

Deducting the Apportioned Risk Premium from apportioned earnings can determine risk hot spots within the portfolio, as illustrated in Figure 10. Whilst the Energy, Materials, and Utilities companies in our portfolio have a similarly high absolute Apportioned Risk Premium, the Energy sector's larger apportioned EBIT means that it remains profit-making. The Utilities and Materials companies, meanwhile, plunge into the red.

It is the impact to profit margins, however, that exposes those entities facing the greatest threat from carbon price increases. Companies with a large profit margin have a cushion with which to absorb additional costs. They may not have to pass costs onto customers whilst their lower-margin competitors might be forced to increase their prices. The financial impact quickly expands beyond an entity's ability to pay additional costs and onto its ability to retain revenues.

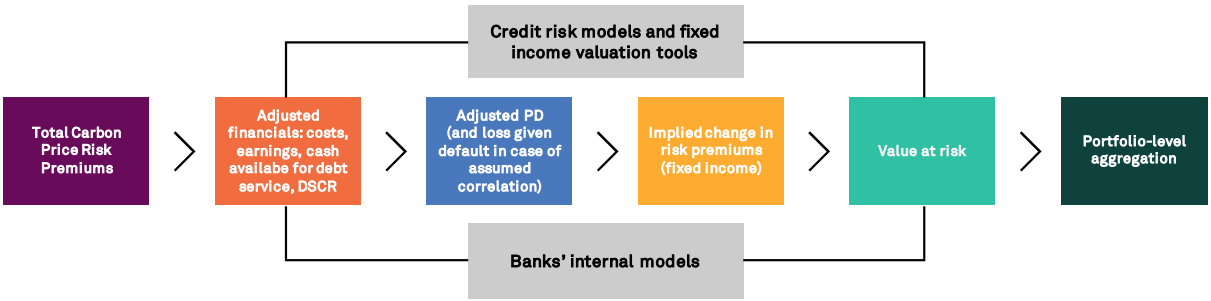
The Financials sector appears to be low risk in this analysis, but Scope 3 downstream emissions have not been taken into account. Exposure to carbon price risk through investments or loan books could have a considerable impact on business profitability. The forward-looking Earnings at Risk metric enables investors to engage with companies on their preparedness for policy changes, their financial resilience, and their plans to adapt.

PART THREE: FROM EARNINGS AT RISK TO VALUE AT RISK

Total Risk Premiums can also be integrated into asset valuation models. Cost increases or changes in earnings can be used to create adjusted cash flows which are key inputs to fundamental, as well as statistically-modelled, approaches to valuation for both credit and equity investors.

For credit investors and lenders, the stressed earnings and their indirect effect on cash flow and other financial ratios will have an impact on a company's overall credit quality. As a result, the associated probabilities of default (PDs) will be affected, potentially impacting financial risk premiums used in the valuation of fixed income instruments. In this way, the overall Value at Risk implications for the portfolio can be calculated. The PD and associated loss figures can be integrated in a bank's internal credit risk frameworks. The adjusted projected costs can be fed into the cash flows, leading to adjusted debt service coverage ratios.

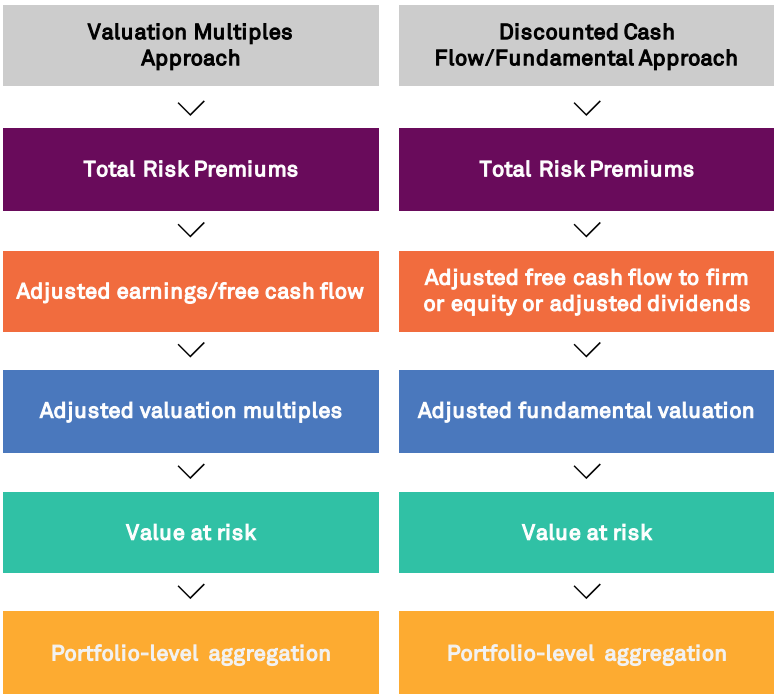
Figure 11: Credit Risk Path of Integrating Total Risk Premiums in Portfolio Risk Analysis



For equity or company valuation, there are two major approaches that can be taken to integrate Carbon Earnings at Risk. The first method is to revise valuation multiples. Ratios, such as share price or enterprise value to EBIT, are commonly used as quick methods to value companies operating in the same industry and/or sharing similar characteristics. The Value at Risk from future carbon pricing can be assessed by integrating the adjusted earnings into a company's multiple and measuring the deviation from the original multiple or a peer group average.

The second approach is to integrate the scenario and future-year based Total Risk Premiums into the cash flow projections for the number of years required. The adjusted cash flows will feed into the bottom-line free cash flow assessments used in firm or equity valuations.

Figure 12: Equity Risk Path of Integrating Total Risk Premiums in Portfolio Risk Analysis



CONCLUSION

It is well recognized that the effects of climate change present considerable threats to social, environmental, and financial stability, and we are likely to see the widespread implementation of policy instruments to address such risks over a short- and medium-term time horizon. Whether it be through taxation or trading schemes, carbon pricing mechanisms build an economic incentive for companies to move away from fossil fuels, propelling behavioral change and driving innovation. Many governments and business leaders see this as the growth opportunity of the future.[16]

However, this necessary intervention does introduce a different source of financial risk. The use of scenario analysis helps market participants to frame the possible range of financial impacts on an investment universe or loan book from climate pricing mechanisms. This is turn can help to pinpoint potentially mispriced assets or facilitate more informed decision-making around capital allocation.

Trucost's Carbon Earnings at Risk dataset is one in a series of scenario analysis and low-carbon transition tools that leverage our existing products and expertise. It has been designed to help investors meet TCFD recommendations to incorporate forward-looking estimates of financial risk but also to help investors engage with the companies into which they invest on their strategies to address climate-related risks. By identifying organizations whose profit margin could be compromised by increased carbon costs over a medium or long-term horizon, we have a new measure of sustainability - one that speaks an investor's language.

For more information about Trucost's Carbon Earnings at Risk data, please contact tc-investor@spglobal.com.

[16] Climate Change Next Century's Biggest Biz Opportunity: Anand Mahindra, The Economic Times, January 2018, https://economictimes.indiatimes.com/news/company/corporate-trends/climate-change-next-centurys-biggest-biz-opportunity-anand-mahindra/articleshow/62652949.cms