



# GPIF Climate Related Portfolio Risk Assessment

*Trucost Analysis Supporting  
GPIF's Disclosure in line with  
TCFD Recommendations (Summary)*

August 2019

Trucost  
ESG Analysis

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**S&P Global**



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## About Trucost

Trucost is part of S&P Global.

A leader in carbon and environmental data and risk analysis, Trucost assesses risks relating to climate change, natural resource constraints, and broader environmental, social, and governance factors. Companies and financial institutions use Trucost intelligence to understand their ESG exposure to these factors, inform resilience and identify transformative solutions for a more sustainable global economy. S&P Global's commitment to environmental analysis and product innovation allows us to deliver essential ESG investment related information to the global marketplace.

For more information, visit [www.trucost.com](http://www.trucost.com).

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S&P Global (NYSE: SPGI) is a leading provider of transparent and independent ratings, benchmarks, analytics and data to the capital and commodity markets worldwide.

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**FORWARD LOOKING SCENARIO ANALYSIS**

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# Introduction to Climate-Related Reporting

The effects of climate change pose considerable and far-reaching risks to the global economy. Among those most directly affecting businesses include physical risks posed by increased climate variability and more frequent extreme weather events, which may result in property damage, challenges linked to business continuity, and disruption to global supply chains. Businesses also face risks associated with the transition to a low-carbon economy, including policy changes designed to discourage carbon-intensive energy use or favour more resource-efficient industries and operations.

At the request of the G20, the Financial Stability Board (FSB) reviewed how the reporting on climate-related issues in financial reporting could be improved in order to better reflect the risks and opportunities facing financial institutions and non-financial businesses alike. In June 2017, the FSB Taskforce for Climate-Related Financial Disclosure (TCFD) published recommendations on the disclosure of “information needed by investors, lenders, and insurance underwriters to appropriately assess and price climate-related risks and opportunities.”

The TCFD provides a voluntary disclosure framework organized around four themes, designed to facilitate better disclosure. These are **governance, strategy, risk management**, and **metrics and targets**. In order for organizations to disclose in line with TCFD recommendations, they must be able to quantify or qualify the risks and opportunities facing them, linked to climate related issues, and be able to describe policies, procedures and systems in place to monitor and address climate related issues on an on going basis.

This report by Trucost provides both forward-looking and historical metrics that may be used by asset owners and/or asset managers to support their climate-related disclosures in line with TCFD recommendations, and inform internal processes for risk management and strategy development within an organization.

The report is comprised of two parts:

## 1. Historical Performance

- Carbon Footprint Metrics
- Carbon Disclosure Metrics
- Fossil Fuel & Stranded Assets Exposure Metrics

## 2. Forward-Looking Metrics and Scenario Analysis

- 2 Degree Alignment: Energy Generation Mix
- 2 Degree Alignment: GHG Transition Pathway
- Carbon Earnings at Risk

See Appendix 1 for more information on the TCFD’s recommended disclosures for asset owners and asset managers, as well as the grey ‘call-out’ boxes throughout the report which link recommendations to specific metrics.

# Portfolio & Benchmark Coverage Rates

Portfolio and Benchmark Coverage Rates for Carbon, Stranded Assets and Energy Transition Analysis:

|                        | Coverage Rate (%) | Value Analysed (mJPY) | Instruments | Companies |
|------------------------|-------------------|-----------------------|-------------|-----------|
| Domestic Equities 16FY | 99.10             | 34,962,423            | 2141/2207   | 2140      |
| TOPIX 16FY             | 99.90             | -                     | 1977/1997   | 1977      |
| Domestic Equities 17FY | 99.96             | 40,447,538            | 2241/2321   | 2241      |
| TOPIX 17FY             | 99.98             | -                     | 2056/2061   | 2056      |
| Domestic Equities 18FY | 99.59             | 38,254,652            | 2264/2380   | 2264      |
| TOPIX 18FY             | 99.49             | -                     | 2093/2124   | 2093      |
| Foreign Equities 16FY  | 99.95             | 34,602,631            | 2575/2612   | 2453      |
| ACWI 16FY              | 99.84             | -                     | 2157/2159   | 2121      |
| Foreign Equities 17FY  | 99.87             | 38,269,178            | 2730/2785   | 2595      |
| ACWI 17FY              | 99.90             | -                     | 2169/2173   | 2136      |
| Foreign Equities 18FY  | 99.74             | 41,385,404            | 2641/2715   | 2528      |
| ACWI 18FY              | 99.81             | -                     | 2428/2447   | 2346      |
| Domestic Bonds 16FY    | 78.40             | 3,026,092             | 351/408     | 329       |
| Domestic Bonds 17FY    | 79.81             | 3,026,092             | 364/412     | 341       |
| Domestic Bonds 18FY    | 82.75             | 2,840,507             | 375/421     | 351       |
| Foreign Bonds 16FY     | 73.59             | 1,886,568             | 1023/1531   | 839       |
| Foreign Bonds 17FY     | 73.28             | 2,159,115             | 1233/1811   | 992       |
| Foreign Bonds 18FY     | 72.92             | 2,188,122             | 1298/1886   | 1004      |

## REPORT INFORMATION:

**Analysis Date:** 09/07/2019

**Holdings Date:** 31/03/2017, 31/03/2018, 31/03/2019

## A NOTE ON MAPPING:

All portfolio and benchmark holdings were provided to Trucost by the client.

Equity instruments are mapped to the issuing entity, providing that entity exists in the Trucost database with suitably recent environmental and financial data available (up to a maximum of 3 years prior to the analysis year).

**Asset Classes:** Corporate Equity and Debt  
**Apportioning Factor:** Enterprise Value

Debt instruments are mapped to the first publically listed entity in the instrument's parent chain (starting with the bond's issuer, followed by the bond issuer's immediate parent, and finally its ultimate parent), providing that entity exists in the Trucost database with suitably recent environmental and financial data available. Bonds with no public parent are excluded.



# Carbon Footprint Metrics

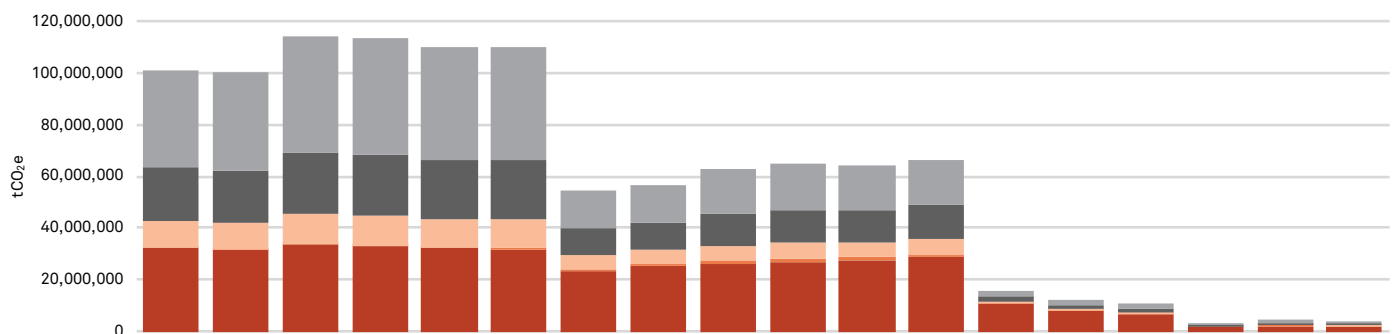
## Carbon Apportioned by Scope

Carbon audits offer a systematic assessment of the carbon related impacts within a portfolio or index at a given point in time. Emissions associated with investee companies may range from those generated by direct operations, to those generated throughout the entire value chain. The charts below show the total carbon that has been apportioned to each of the portfolios

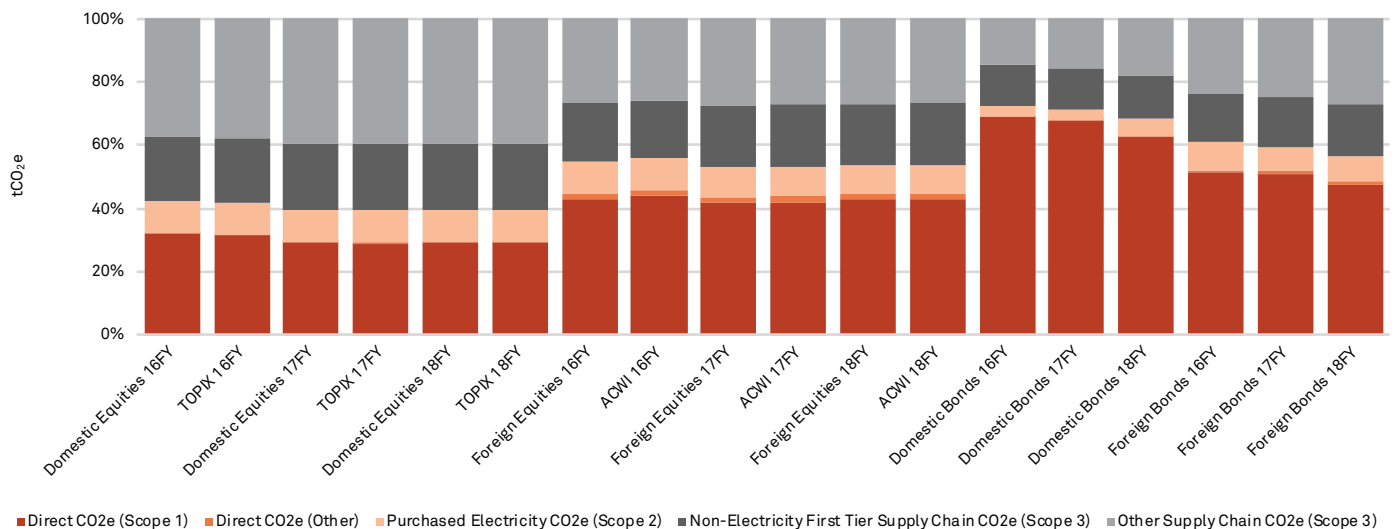
analysed, broken out by scope. It represents each portfolio's absolute contribution towards climate change.

For more information on apportioning please see Appendix 2, or for more information on the different scopes see Appendix 3.

**Total Apportioned Carbon by Scope (tonnes)**



**Total Apportioned Carbon by Scope (%)**



# Carbon Footprint Metrics

## Carbon Apportioned by Scope

Below are the tabulated results from the charts above. These figures may be used to support internal and/or external reporting, as well as for the setting and tracking of climate-related targets. See the box at the bottom for how these relate to the TCFD guidance documents.

### Portfolio and Benchmark Total Apportioned Carbon by Scope:

|                        | Direct<br>(Scope 1)<br>tCO <sub>2</sub> e | Direct<br>(Other)<br>tCO <sub>2</sub> e | Purchased<br>Electricity<br>(Scope 2)<br>tCO <sub>2</sub> e | Non-Electricity 1st<br>Tier Supply Chain<br>(Scope 3)<br>tCO <sub>2</sub> e | Other Supply<br>Chain<br>(Scope 3)<br>tCO <sub>2</sub> e | Down-stream*<br>(Scope 3)<br>tCO <sub>2</sub> e |
|------------------------|---|---|---|---|--|---|
| Domestic Equities 16FY | 32,538,692                                | 57,866                                  | 10,128,486  | 20,598,447  | 37,662,293   | 197,975,878                                     |
| TOPIX 16FY             | 31,716,759                                | 61,472                                  | 10,116,055  | 20,562,396  | 37,738,183   | 195,759,214                                     |
| Domestic Equities 17FY | 33,644,844                                | 76,528                                  | 11,628,672  | 23,974,592  | 45,008,560   | 229,201,597                                     |
| TOPIX 17FY             | 32,927,293                                | 74,166                                  | 11,568,812  | 23,891,201  | 44,822,417   | 228,790,272                                     |
| Domestic Equities 18FY | 32,093,240                                | 88,454                                  | 11,166,641  | 22,953,634  | 43,381,416   | -   |
| TOPIX 18FY             | 31,972,366                                | 83,253                                  | 11,213,503  | 23,075,931  | 43,336,922   | -   |
| Foreign Equities 16FY  | 23,344,039                                | 968,156                                 | 5,440,076   | 10,116,164  | 14,431,063   | 113,751,298                                     |
| ACWI 16FY              | 25,255,709                                | 974,835                                 | 5,500,831   | 10,420,410  | 14,759,714   | 122,951,186                                     |
| Foreign Equities 17FY  | 26,122,722                                | 1,250,188                               | 5,837,558   | 12,227,064  | 17,348,091   | 144,857,476                                     |
| ACWI 17FY              | 27,133,358                                | 1,352,076                               | 5,932,102   | 12,652,072  | 17,647,798   | 144,271,880                                     |
| Foreign Equities 18FY  | 27,477,464                                | 1,228,125                               | 5,799,137   | 12,459,213  | 17,288,342   | -   |
| ACWI 18FY              | 28,567,364                                | 1,307,000                               | 6,040,923   | 12,908,207  | 17,786,229   | -   |
| Domestic Bonds 16FY    | 10,786,981                                | 2,221                                   | 555,516   | 1,984,429   | 2,313,073  | 13,388,528                                      |
| Domestic Bonds 17FY    | 8,213,652                                 | 3,316                                   | 451,467   | 1,566,891   | 1,889,414  | 10,227,225                                      |
| Domestic Bonds 18FY    | 6,986,694                                 | 4,633                                   | 588,926   | 1,556,243   | 1,970,906  | -   |
| Foreign Bonds 16FY     | 1,650,116                                 | 17,495                                  | 292,670   | 483,275   | 754,439  | 5,756,618                                       |
| Foreign Bonds 17FY     | 2,201,845                                 | 45,994                                  | 335,525   | 668,197   | 1,083,266  | 9,283,495                                       |
| Foreign Bonds 18FY     | 2,030,036                                 | 54,371                                  | 317,597   | 706,492   | 1,156,776  | -   |

\* Scope 3 downstream data for 2018 not yet available.

#### TCFD GUIDANCE FOR ASSET OWNERS / MANAGERS: METRICS & TARGETS RECOMMENDED DISCLOSURE (A)

Asset owners / managers should describe metrics used to assess climate-related risks and opportunities in each fund / product or investment strategy. Where relevant, asset owners / managers should also describe how these metrics have changed over time. Where appropriate, asset owners / managers should provide metrics considered in investment decisions and monitoring.

#### TCFD GUIDANCE FOR ASSET OWNERS / MANAGERS: METRICS & TARGETS RECOMMENDED DISCLOSURE (B)

Asset owners / managers should provide the weighted average carbon intensity, where data are available or can be reasonably estimated, for each fund / product or investment strategy. In addition, asset owners / managers should provide other metrics they believe are useful for decision making along with a description of the methodology used.

Source: FSB TCFD (2017) Implementing the Recommendations of the TCFD



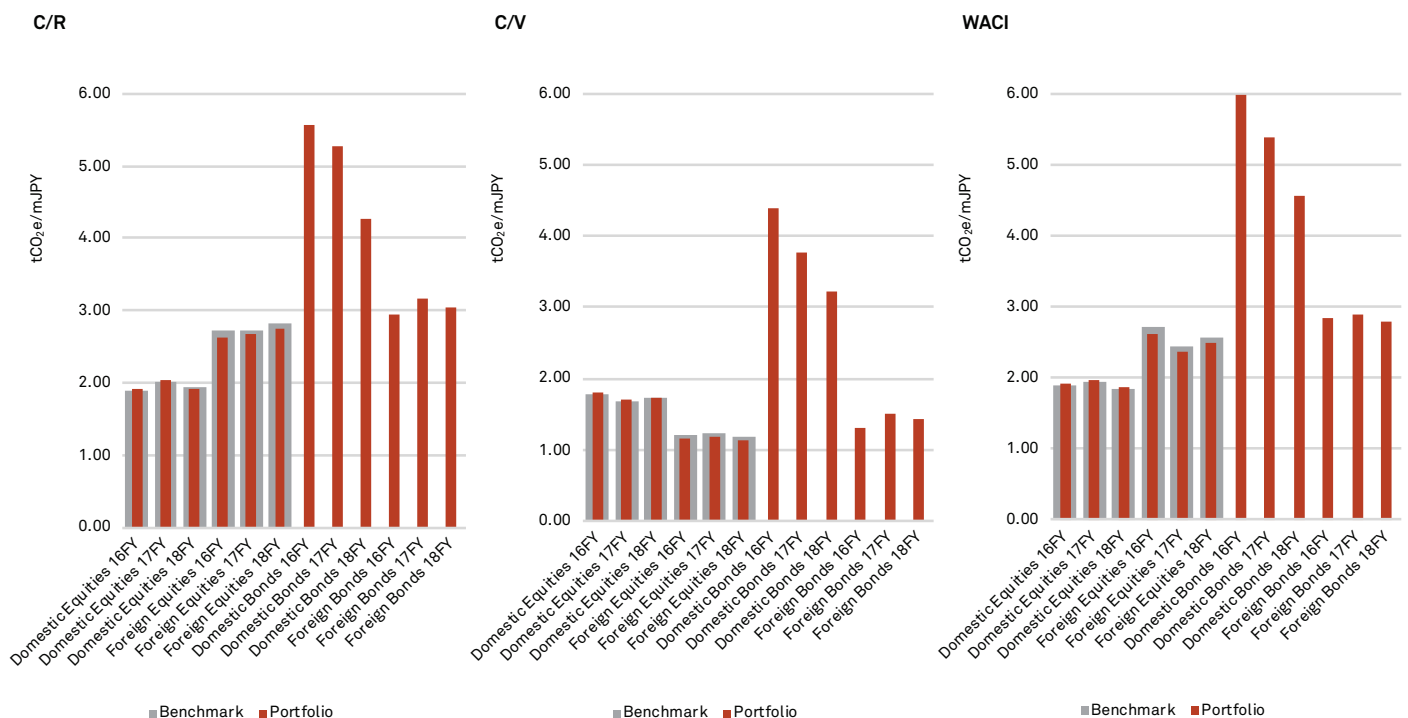
# Carbon Footprint Metrics

## Carbon Intensity by Method

Portfolios with larger assets under management will typically also have larger absolute carbon footprints than smaller portfolios due to their size. In order to facilitate fair comparison between portfolios, benchmarks and across years, it is therefore important to normalize these absolute quantities. The three most common approaches to normalization are:

- 1. Carbon to Revenue (C/R):**  
Dividing the apportioned CO<sub>2</sub>e by the apportioned annual revenues.
- 2. Carbon to Value Invested (C/V):**  
Dividing the apportioned CO<sub>2</sub>e by the amount invested.
- 3. Weighted Average Carbon Intensity (WACI):**  
Summing the product of each holding's weight in the portfolio with the company level C/R intensity (no apportioning).

The charts below show the intensity for all portfolios using all three calculation methods. The scopes used for the intensity were **Direct** and **First Tier Indirect Emissions**.



# Carbon Footprint Metrics

## Carbon Intensity by Method

Below are the tabulated results from the charts above. These figures may be used to support internal and/or external reporting, as well as for the setting and tracking of climate-related targets.

Portfolio Relative Efficiency vs. Benchmark, per Intensity Method:

|                        | C/R<br>(tCO <sub>2</sub> e/m) | Relative<br>Efficiency | C/V<br>(tCO <sub>2</sub> e/m) | Relative<br>Efficiency | WACI<br>(tCO <sub>2</sub> e/m) | Relative<br>Efficiency |
|------------------------|-------------------------------|------------------------|-------------------------------|------------------------|--------------------------------|------------------------|
| Domestic Equities 16FY | 1.92                          | -1.7%                  | 1.81                          | -1.4%                  | 1.91                           | -1.6%                  |
| TOPIX 16FY             | 1.89                          | -                      | 1.79                          | -                      | 1.88                           | -                      |
| Domestic Equities 17FY | 2.04                          | -0.7%                  | 1.71                          | -1.3%                  | 1.97                           | -1.6%                  |
| TOPIX 17FY             | 2.03                          | -                      | 1.69                          | -                      | 1.94                           | -                      |
| Domestic Equities 18FY | 1.92                          | 0.5%                   | 1.73                          | 0.1%                   | 1.88                           | -1.2%                  |
| TOPIX 18FY             | 1.93                          | -                      | 1.73                          | -                      | 1.86                           | -                      |
| Foreign Equities 16FY  | 2.63                          | 3.4%                   | 1.15                          | 5.4%                   | 2.62                           | 3.2%                   |
| ACWI 16FY              | 2.72                          | -                      | 1.22                          | -                      | 2.71                           | -                      |
| Foreign Equities 17FY  | 2.68                          | 2.0%                   | 1.19                          | 3.5%                   | 2.38                           | 3.1%                   |
| ACWI 17FY              | 2.74                          | -                      | 1.23                          | -                      | 2.45                           | -                      |
| Foreign Equities 18FY  | 2.76                          | 2.0%                   | 1.13                          | 3.8%                   | 2.48                           | 3.4%                   |
| ACWI 18FY              | 2.82                          | -                      | 1.18                          | -                      | 2.57                           | -                      |
| Domestic Bonds 16FY    | 5.56                          | -                      | 4.40                          | -                      | 5.99                           | -                      |
| Domestic Bonds 17FY    | 5.28                          | -                      | 3.77                          | -                      | 5.40                           | -                      |
| Domestic Bonds 18FY    | 4.27                          | -                      | 3.22                          | -                      | 4.55                           | -                      |
| Foreign Bonds 16FY     | 2.96                          | -                      | 1.30                          | -                      | 2.85                           | -                      |
| Foreign Bonds 17FY     | 3.15                          | -                      | 1.51                          | -                      | 2.90                           | -                      |
| Foreign Bonds 18FY     | 3.03                          | -                      | 1.42                          | -                      | 2.78                           | -                      |

Both C/R and WACI measure company intensities on a revenue basis. In the WACI method, the tilt toward or away from high (or low) intensity companies is determined by their value of holdings (VOH) weight in the portfolio, whereas in the C/R method it is determined by their relative contribution to the total apportioned revenues.

In contrast to C/R and WACI, C/V measures company intensities on a valuation basis. However as with WACI, the tilt towards or away from high (or low) intensity companies is determined by their VOH weight in the portfolio. WACI will be higher than C/V if — on average — the tilt is towards companies whose annual revenues are lower than their valuations.

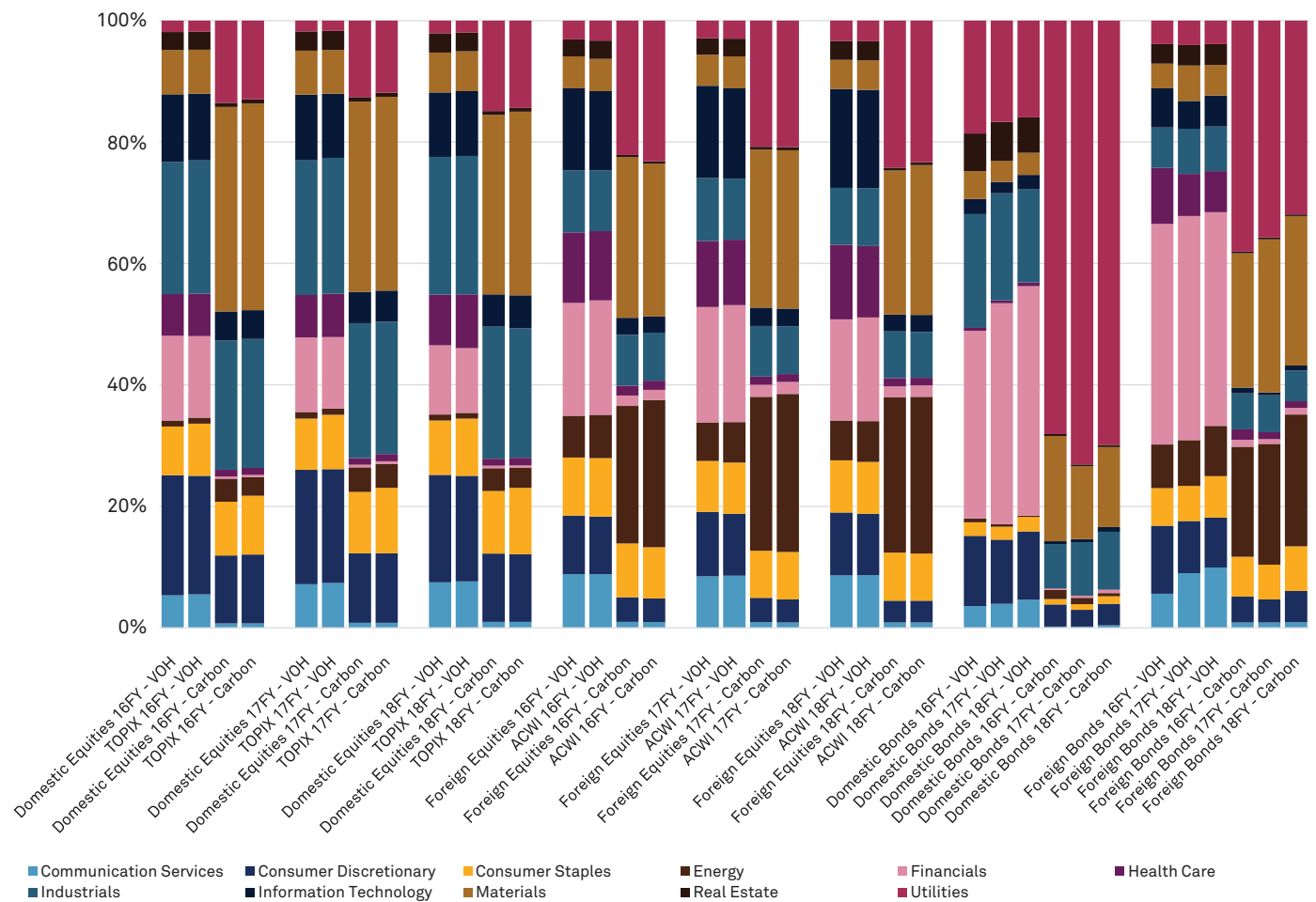


# Carbon Footprint Metrics

## Sector VOH Share vs. Carbon Share

The chart below compares each sector's value-based weight in a portfolio or benchmark to its share of the total apportioned carbon emissions.

VOH vs. Carbon Share by Sector



# Carbon Footprint Metrics

## Sector Intensities

The table below shows the tCO<sub>2</sub>e/mJPY C/R intensities of the portfolio and benchmarks at the GICS sector level.

Portfolio and Benchmark C/R Sector Intensities:

|                        | Communication Services | Consumer Discretionary | Consumer Staples | Energy | Financials | Health Care | Industrials | Information Technology | Materials | Real Estate | Utilities |
|------------------------|------------------------|------------------------|------------------|--------|------------|-------------|-------------|------------------------|-----------|-------------|-----------|
| Domestic Equities 16FY | 0.43                   | 0.82                   | 2.00             | 3.10   | 0.07       | 0.46        | 1.76        | 0.90                   | 8.55      | 0.78        | 16.68     |
| TOPIX 16FY             | 0.42                   | 0.82                   | 2.01             | 3.07   | 0.07       | 0.46        | 1.70        | 0.90                   | 8.56      | 0.70        | 15.97     |
| Domestic Equities 17FY | 0.39                   | 0.94                   | 2.26             | 4.59   | 0.07       | 0.50        | 1.98        | 1.01                   | 8.69      | 0.77        | 16.91     |
| TOPIX 17FY             | 0.39                   | 0.94                   | 2.26             | 4.51   | 0.07       | 0.49        | 1.92        | 1.02                   | 8.74      | 0.69        | 16.80     |
| Domestic Equities 18FY | 0.40                   | 0.89                   | 2.12             | 4.55   | 0.07       | 0.48        | 1.80        | 0.98                   | 7.96      | 0.67        | 17.35     |
| TOPIX 18FY             | 0.40                   | 0.90                   | 2.13             | 4.33   | 0.07       | 0.48        | 1.77        | 1.00                   | 8.08      | 0.62        | 17.72     |
| Foreign Equities 16FY  | 0.44                   | 0.84                   | 1.81             | 6.65   | 0.30       | 0.39        | 1.72        | 0.69                   | 11.19     | 1.05        | 20.71     |
| ACWI 16FY              | 0.45                   | 0.83                   | 1.75             | 6.93   | 0.30       | 0.38        | 1.75        | 0.69                   | 11.17     | 1.06        | 20.82     |
| Foreign Equities 17FY  | 0.43                   | 0.86                   | 1.82             | 6.44   | 0.35       | 0.35        | 1.75        | 0.74                   | 10.53     | 1.34        | 18.17     |
| ACWI 17FY              | 0.44                   | 0.86                   | 1.79             | 6.46   | 0.36       | 0.35        | 1.73        | 0.73                   | 10.69     | 1.37        | 18.30     |
| Foreign Equities 18FY  | 0.43                   | 0.81                   | 1.78             | 6.21   | 0.35       | 0.37        | 1.72        | 0.71                   | 10.28     | 1.25        | 19.33     |
| ACWI 18FY              | 0.44                   | 0.83                   | 1.81             | 6.28   | 0.36       | 0.37        | 1.71        | 0.72                   | 10.69     | 1.25        | 19.40     |
| Domestic Bonds 16FY    | 0.42                   | 0.94                   | 1.61             | 3.10   | 0.08       | 0.51        | 1.80        | 0.63                   | 14.14     | 0.74        | 22.36     |
| Domestic Bonds 17FY    | 0.38                   | 0.88                   | 1.62             | 5.23   | 0.07       | 0.48        | 2.14        | 0.73                   | 12.65     | 0.75        | 23.54     |
| Domestic Bonds 18FY    | 0.39                   | 0.84                   | 1.69             | 5.13   | 0.07       | 0.43        | 2.10        | 0.85                   | 10.89     | 0.86        | 21.16     |
| Foreign Bonds 16FY     | 0.45                   | 0.80                   | 1.70             | 7.36   | 0.16       | 0.38        | 1.82        | 0.58                   | 12.20     | 0.67        | 28.81     |
| Foreign Bonds 17FY     | 0.35                   | 0.86                   | 1.39             | 7.69   | 0.12       | 0.44        | 1.94        | 0.43                   | 9.13      | 0.91        | 28.35     |
| Foreign Bonds 18FY     | 0.35                   | 0.94                   | 2.04             | 7.72   | 0.14       | 0.52        | 1.59        | 0.55                   | 9.71      | 0.73        | 25.82     |

Less Carbon Intensive

More Carbon Intensive

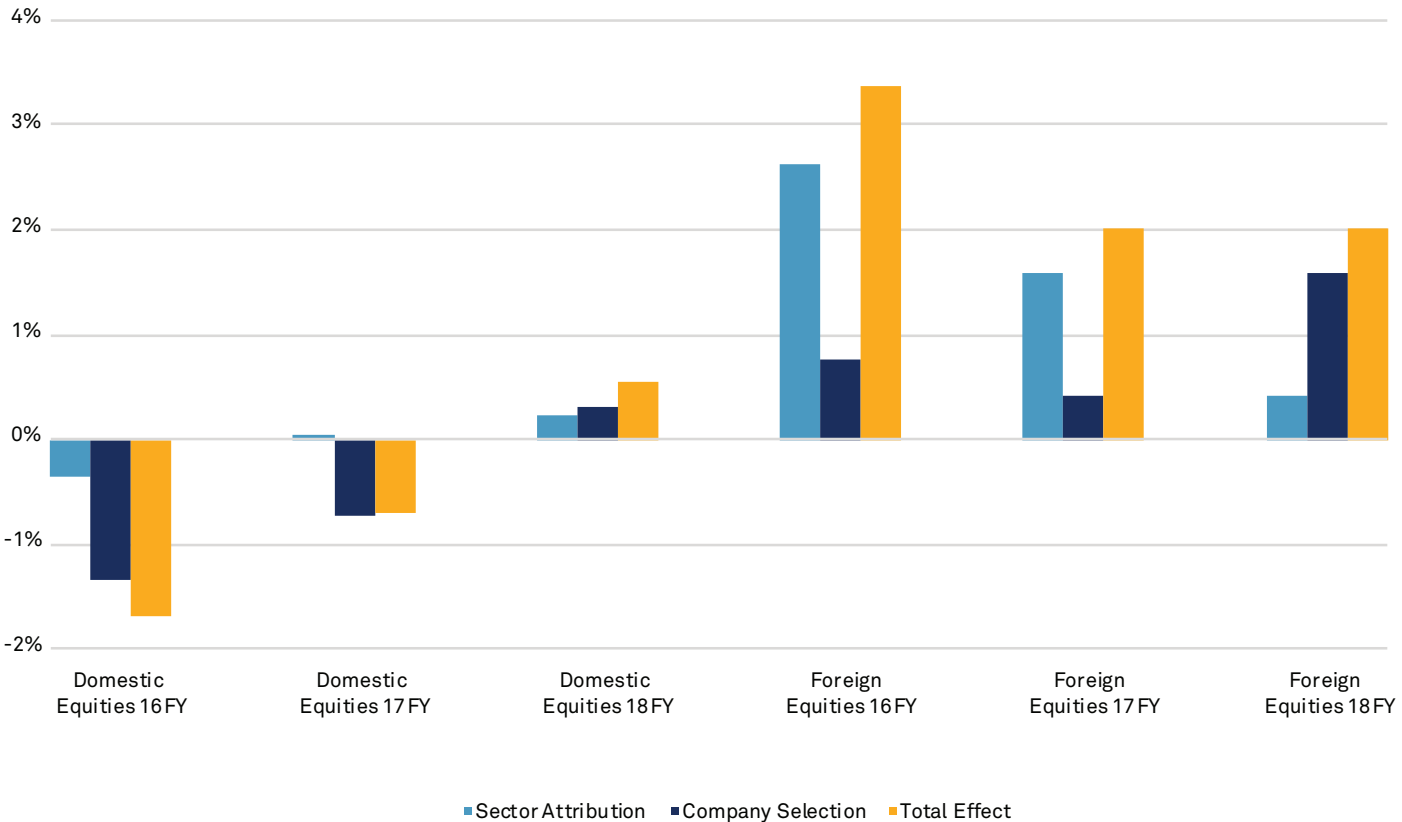
# Carbon Footprint Metrics

## Attribution Analysis

The principal reasons for the carbon intensity of a portfolio to differ from the benchmark are a) **sector allocation** decisions and b) **company selection** decisions. Sector allocation decisions can cause the carbon intensity of a portfolio to diverge from its benchmark when it is over or underweight markedly high or markedly low carbon sectors. For example, if a portfolio is overweight a high carbon sector, then it is more likely to have a higher overall intensity than the benchmark. However, if the companies selected within a high carbon sector are the most carbon efficient, then it is still possible that the portfolio may have a lower overall intensity.

The chart below shows the relative contribution of **sector allocation** and **company selection** effects towards the 'Total Effect' of each portfolio versus their respective benchmark. Sector allocation effects are determined using the 11 GICS Sector classifications, and the analysis uses the Carbon-to-Revenue intensity metric.

Performance Attribution





# Carbon Footprint Metrics

## Key Takeaways

### Total Carbon

- Due to their size, GPIF's equity portfolios have considerably more carbon apportioned to them versus the bond portfolios.
- In 18FY, the total direct plus first tier indirect carbon apportioned to the foreign equities portfolio was around 30% less than to the domestic equities. This was largely driven by high-emitters in the domestic Materials and Utilities sectors.
- Year-on-year, the direction of change in the direct plus first tier indirect absolute carbon footprint was the same as that for total VOH in both equity portfolios. In other words, as total assets under management (AUM) increased or decreased, so too did the footprint. With respect to the bond portfolios, the same trend was present between 16FY and 17FY, whereas between 17FY and 18FY the opposite was true. Both slightly increased their AUM while decreasing their absolute footprint. Sustaining economic returns whilst at the same time decreasing total carbon emissions (in other words 'decoupling') is a key focus for many climate-conscious investors.

### Carbon Intensity

- Domestic bonds were the most carbon intensive portfolios across all methods, largely due to their relatively high exposure to the Utilities sector. However, this portfolio also saw the largest changes in intensity over the period, with the WACI falling by almost a quarter between 16FY and 18FY. Foreign equities and bonds were broadly aligned in their respective intensities, with the bonds being only slightly more intensive across all methods. Domestic equities were the least intensive using the C/R and WACI methods, but were higher than their foreign counterparts using C/V. This indicates a relatively stronger ability to generate revenues vs. shareholder value.
- The equity portfolios neither significantly outperformed nor underperformed their benchmarks. Nevertheless, 18FY saw both the domestic and foreign portfolios slightly outperform the benchmark, versus just the foreign portfolio in previous years. In all cases of outperformance, both sector allocation and company selection effects contributed positively.
- Changes in carbon intensities over time can be caused by a multitude of factors, for example by changes in the percentage owned/financed of investees, or by fluctuations in exchange rates. However, broadly speaking, there are three key drivers:
  1. **Valuation Changes:** If, all else being equal, valuations rise for all companies held — for example in a bull market — then this may contribute towards a year-on-year fall in C/V intensities, but no change to C/R or WACI intensities. If valuations fall only for the carbon intensive companies held, then this may contribute towards a year-on-year rise in C/V intensities (as their carbon-to-value ratio worsens), but a fall in WACI intensities (as their relative weight in the portfolio decreases). The opposite would be true of a rise in valuations for carbon intensive companies.
  2. **Revenue Changes:** If, all else being equal, revenues rise for all companies held — for example in a booming economy — then this may contribute towards a year-on-year fall in both the C/R and WACI intensities, but cause no change to the C/V intensity.

# Carbon Footprint Metrics

## Key Takeaways

- 3. Constituent Weight Changes:** If, all else being equal, the VOH weight in the portfolio of carbon intensive companies is increased (by increasing the share of their equity or debt held), then this may contribute to towards year-on-year increases across all three methodologies. The opposite would be true for decreasing their weight in the portfolio (by decreasing the share of their equity or debt held), or for increasing the weight of carbon efficient companies.

### TCFD Relevance

- The TCFD identifies GHG emissions intensity, as well as absolute emissions levels, as types of transition risk metrics.
- WACI is the primary intensity metric recommended by the TCFD for portfolio footprinting. Portfolios exposed to more carbon intensive companies and sectors by percentage of overall value of holdings will tend to have a higher WACI. The TCFD recommends this approach because it can be applied across asset classes and avoids calculating 'ownership' of emissions.
- The TCFD also encourages asset owners and asset managers to provide other metrics useful for decision making, including the absolute carbon emissions, C/R intensity and C/V intensity metrics provided in this report.

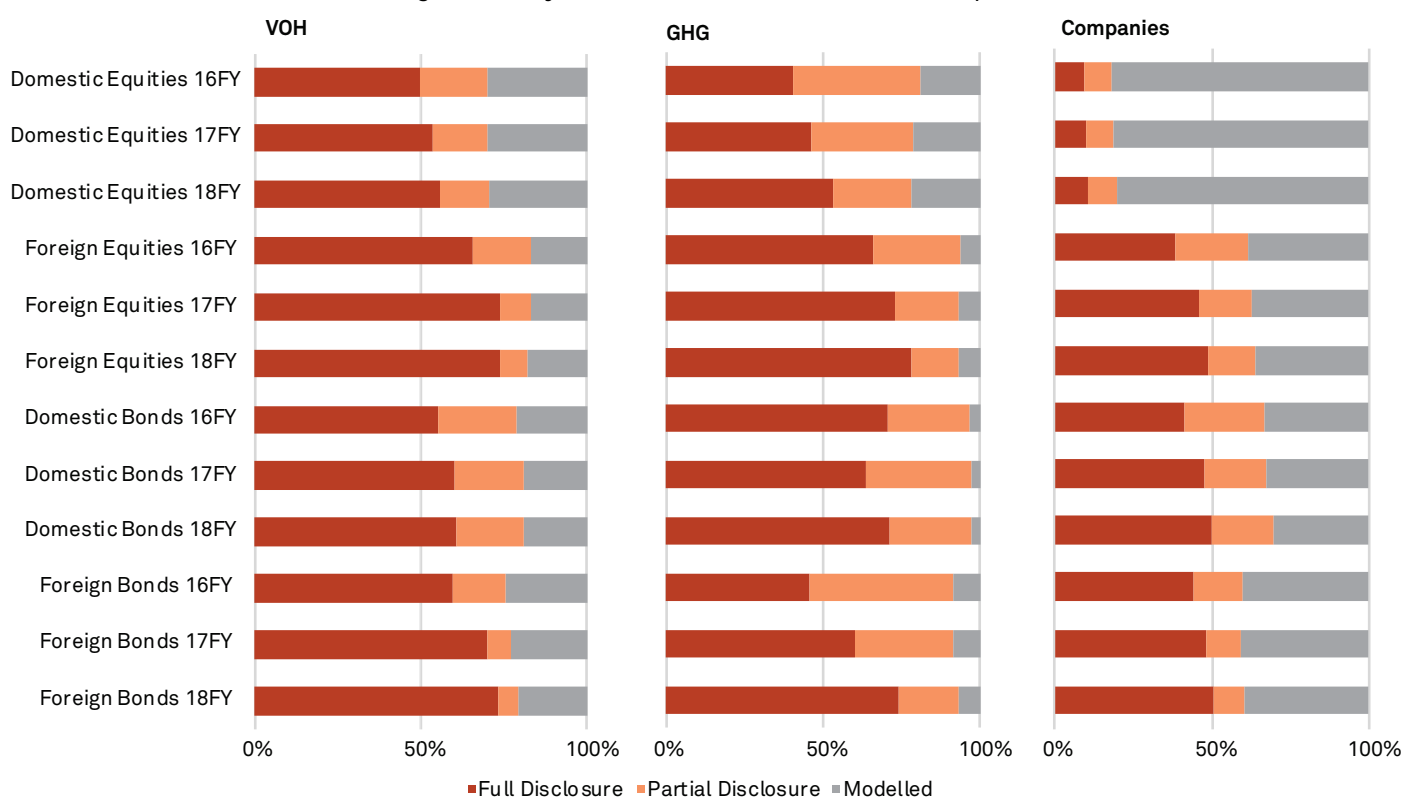
# Carbon Disclosure Metrics

## Disclosure Analysis

In the charts below, the overall level of disclosure in each portfolio is assessed using the following approaches:

- **VOH:** The sum of the weights of each holding within each of the three disclosure categories.
- **GHG:** The sum of each holding's share of the total apportioned Scope 1 CO<sub>2</sub>e within each of the three disclosure categories.
- **Companies:** The number of companies, shown as a percent of all companies analysed, within each of the three disclosure categories.

Portfolio and Benchmark Coverage Rates by Value, GHGs, and Number of Companies:



TCFD GUIDANCE FOR ASSET OWNERS / MANAGERS: RISK MANAGEMENT RECOMMENDED DISCLOSURE (A)

Asset owners / managers should describe, where appropriate, engagement activity with investee companies to encourage better disclosure and practices related to climate-related risks to improve data availability and asset owners' / managers' ability to assess climate related risks.

Source: FSB TCFD (2017) Implementing the Recommendations of the TCFD

# Carbon Disclosure Metrics

## Key Takeaways

### Disclosure Analysis

- Disclosure (taken as both full and partial) was highest using the GHG method and lowest using the number of companies method. This suggests that while there is a long tail of non-disclosing companies, those that contribute significantly to the absolute GHG footprint tend to be disclosing (and, to a lesser extent, those that contribute more to the portfolio value also tend to be disclosing).
- The number of companies (as a percent of the total) falling into the full disclosure category increased between 2016 and 2018 for all portfolios.
- The domestic equities portfolio had a markedly lower rate of disclosure — by number of companies — than any other portfolio. This indicates a relatively underdeveloped landscape of climate-related reporting in Japan, and underlines the timeliness of recent GPIF initiatives to improve reporting — such as with the launch of the S&P/JPX Carbon Efficient Index.

### TCFD Relevance

- The TCFD recommends that asset owners and asset managers should describe, where appropriate, engagement activity with investee companies to encourage better disclosure and practices related to climate-related risks.
- The holdings that have been identified as top contributors based on modelled data, particularly those identified by Climate100+ as 'systematically important emitters', could be engaged with to encourage better disclosure on climate-related performance and risks.



# Fossil Fuel & Stranded Assets Exposure Metrics

## Financial Exposure to Fossil Fuel Activities

Future emissions from fossil fuel reserves far outweigh the allowable carbon budget that will limit global warming to 2 degrees Celsius above pre-industrial levels. Industry experts refer to assets that may suffer from unanticipated or premature write-downs, devaluations or conversion to liabilities as 'stranded assets'.

Trucost assesses exposure to such assets by showing the combined value of holdings with business activities in either fossil fuel extraction or fossil fuel energy generation industries. This helps to identify potentially stranded assets that would become more apparent as economies move towards 2 degree alignment.

Extraction-related activities include the following:

- **Crude petroleum and natural gas extraction**
- **Tar sands extraction**
- **Natural gas liquid extraction**
- **Bituminous coal underground mining**
- **Bituminous coal and lignite surface mining**
- **Drilling oil and gas wells**
- **Support activities for oil and gas operations**

Energy-related activities include the following:

- **Coal power generation**
- **Petroleum power generation**
- **Natural gas power generation**

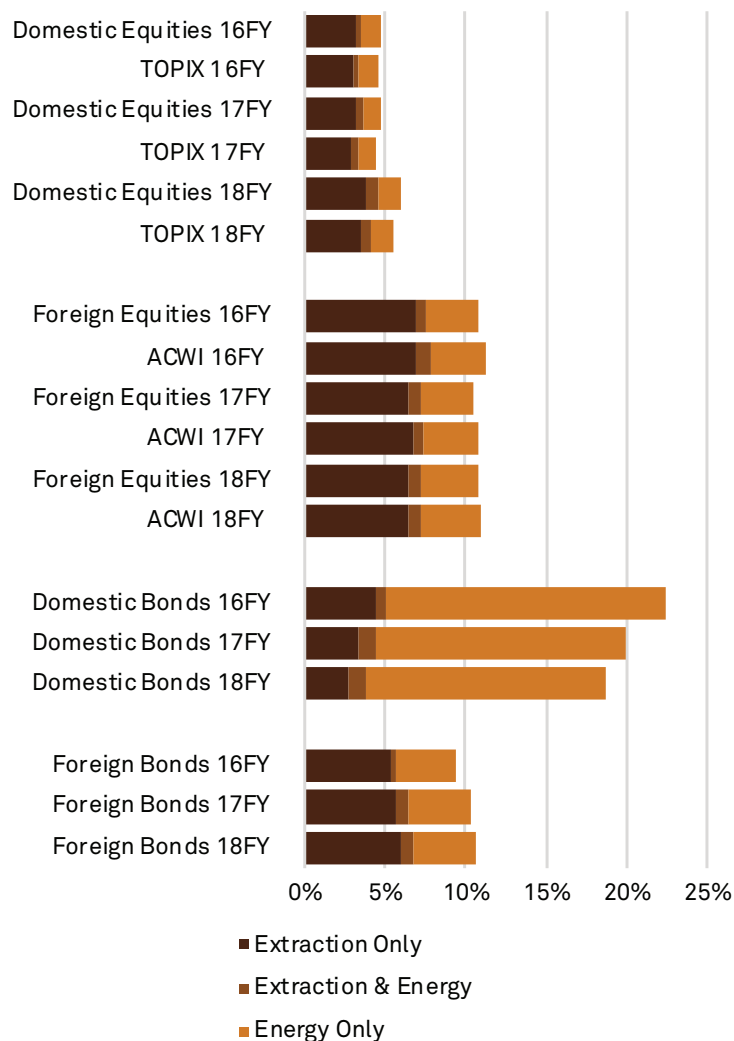
# Fossil Fuel & Stranded Assets Exposure Metrics

## Financial Exposure to Fossil Fuel Activities

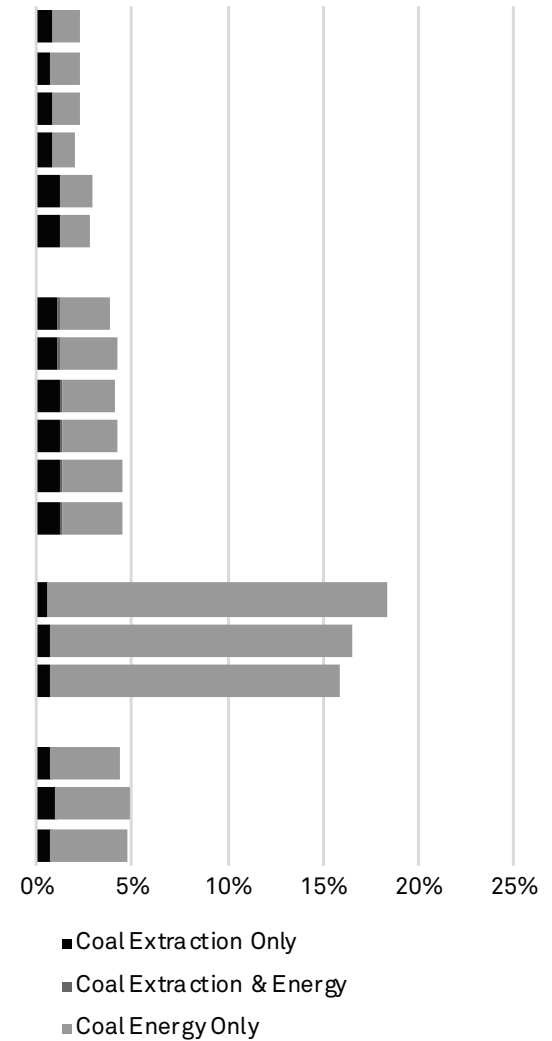
The left-hand chart shows the percentage share of the portfolio's total value invested in companies that derive anything above 0% of their total revenues from extraction, fossil fuel energy, or a combination of both.

The right-hand chart shows the same but for coal related activities only.

### VOH Exposure to Fossil Fuel Activities



### VOH Exposure to Coal Activities

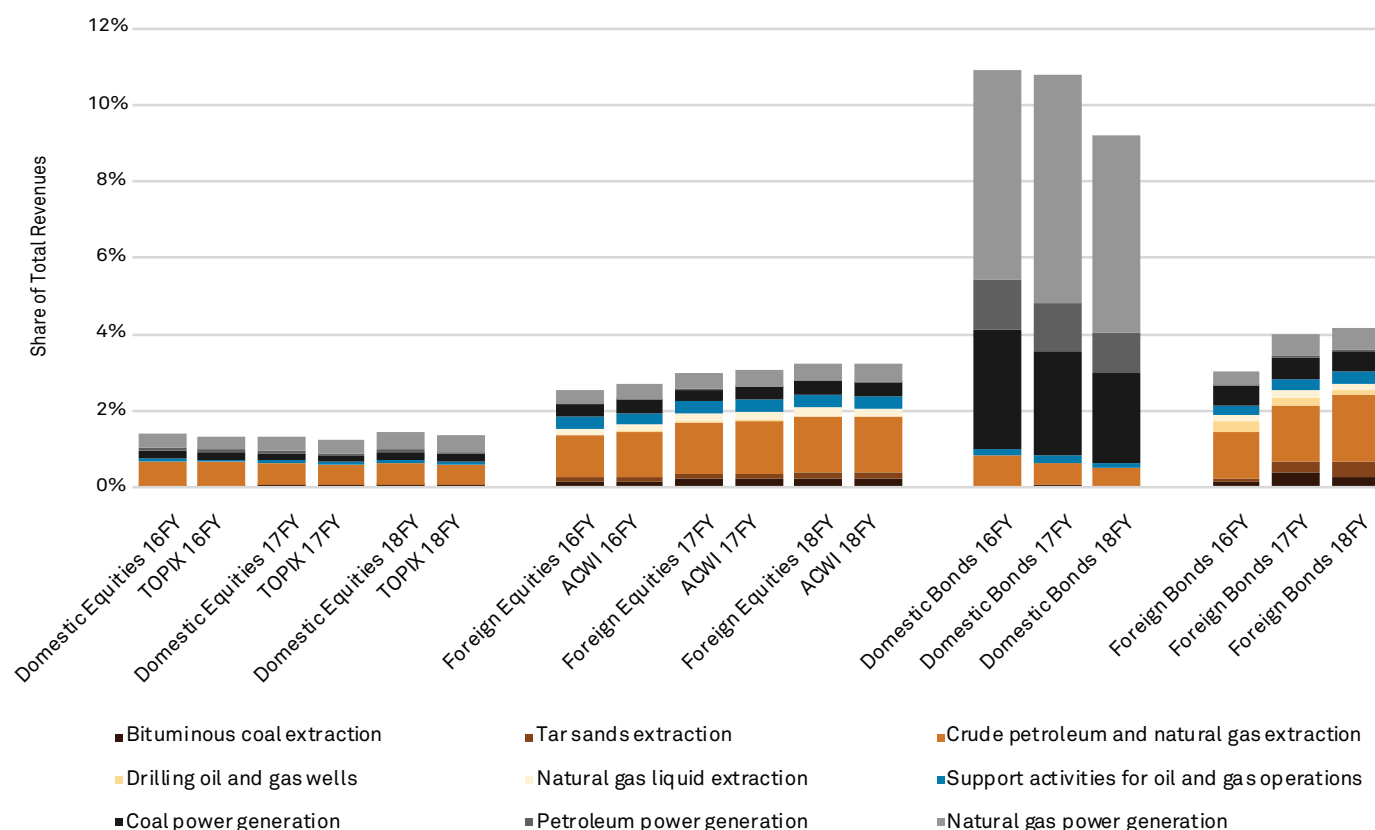


# Fossil Fuel & Stranded Assets Exposure Metrics

## Fossil Fuel Activities Revenue Breakdown

The previous page gives an indication of the combined weight in the portfolio of companies engaging in fossil fuel related activities above a given revenue threshold. The chart below, however, gives an indication of the level of revenue dependency that investees have in these activities, broken-out by type.

### Fossil Fuel Related Revenue Share



#### TCFD GUIDANCE FOR ASSET OWNERS / MANAGERS: RISK MANAGEMENT RECOMMENDED DISCLOSURE (B)

Asset owners should describe how they consider the positioning of their total portfolio with respect to the transition to a lower-carbon energy supply, production, and use. This could include explaining how asset owners actively manage their products' positioning in relation to this transition. Asset managers should describe how they manage material climate-related risks for each product or investment strategy.

Source: FSB TCFD (2017) Implementing the Recommendations of the TCFD

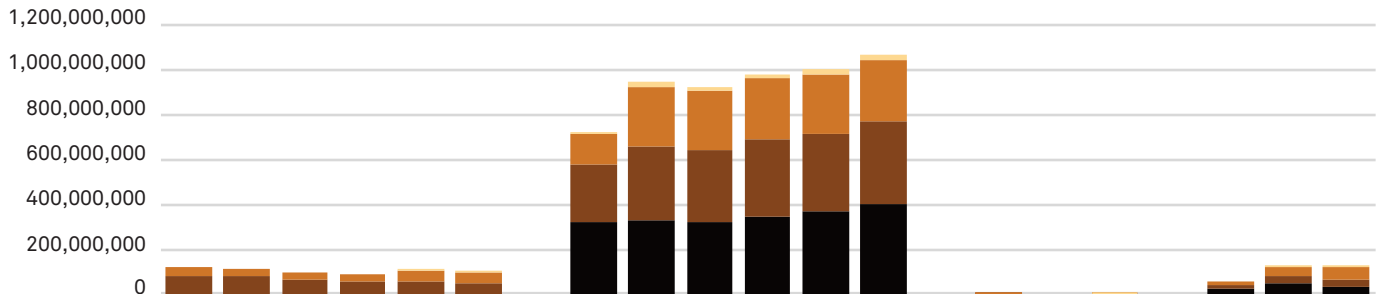
# Fossil Fuel & Stranded Assets Exposure Metrics

## Emissions from Reserves & CAPEX

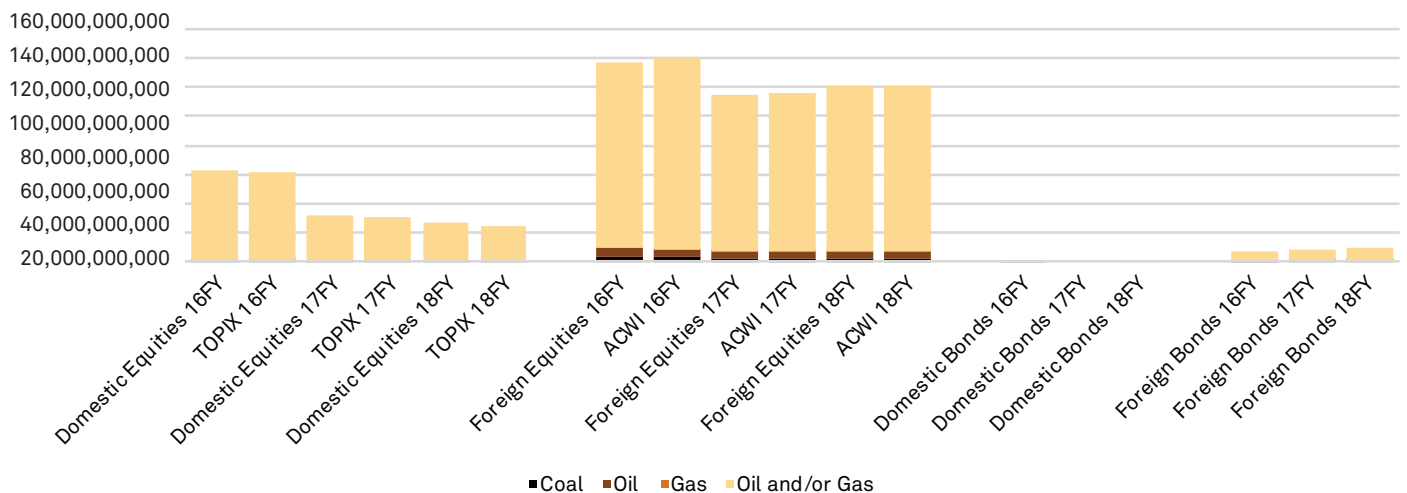
Trucost is able to analyse two additional metrics that provide additional insights relevant to stranded asset risk. First, are the carbon emissions embedded within company owned fossil fuel reserves which can be considered ‘unburnable’ if 2°C targets are to be achieved. Second, are the capital expenditures set aside for future fossil fuel related activities such as further exploration and extraction. Both metrics are based on disclosures published by investees.

The first chart below shows the total tonnes of apportioned “future” CO<sub>2</sub> from reserves, broken down by reserve type. The second chart shows the total apportioned capital expenditure on fossil fuel related activities, again broken out by reserve type.

### Embedded Emissions



### Fossil Fuel Related CAPEX





# Fossil Fuel & Stranded Assets Exposure Metrics

## Key Takeaways

### Financial Exposure to Fossil Fuel Related Activities

- Of the most recent holdings (18FY), the highest exposure to fossil fuel extraction or power generation revenues is found in the domestic bonds portfolio (18.86%), while the lowest was in the domestic equities portfolio (5.96%). Exposure in the foreign equities and foreign bonds portfolios was broadly equal (around 10–11% in 18FY).
- In comparison to their benchmarks, the equities were broadly in-line (slightly over-exposed in domestic equities, slightly under-exposed in foreign equities).
- Over time, financial exposure to fossil fuel activities can change due to either active or passive reasons. Investors may actively reduce exposure by divesting from companies engaged in fossil fuel related activities. Alternatively exposure may change passively, for example if valuations of companies engaged in fossil fuel related activities rise or fall relative to other companies in a portfolio.
- Coal power generation is considered one of the most critical sectors to transition away from if global carbon reduction targets are to be achieved.
- The domestic bond portfolio is, by a significant margin, the most exposed to companies generating revenues from coal related activities. This is largely due to the concentrated nature of the portfolio and the significant share of holdings in Japanese utilities companies involved in coal power generation.

### Fossil Fuel Related Activities Breakdown

- For the domestic bonds portfolio — the most financially exposed of all portfolios — apportioned revenues from natural gas power generation makes up the largest share (5% in 18FY), followed by coal (2%), then petroleum power generation (1%). Together with the revenues from all other fossil fuel related activities, they account for almost 9% of the total revenues apportioned to the portfolio.
- All portfolios derive between 0.5% and 1.5% of total apportioned revenues from crude petroleum and natural gas extraction.
- A high dependancy on fossil fuel related revenues is more likely in concentrated portfolios with high exposures to the Utilities and Energy sectors, such as in the domestic bonds portfolio.

### Reserves and CAPEX

- Total apportioned emissions from reserves, as well as total apportioned fossil fuel related CAPEX, was greatest in the foreign equities portfolio. These figures were considerably lower in the domestic equities portfolio, which can in part be explained by its lower overall exposure to companies engaged in extraction and energy, but may also be explained by reserve-related disclosure gaps among Japanese companies.

# Fossil Fuel & Stranded Assets Exposure Metrics

## Key Takeaways

### TCFD Relevance

- The TCFD identifies emissions per unit of fossil fuel reserve — or ‘embedded emissions’ — as a climate related metric associated with transition risk.
- Companies deriving significant revenues from fossil fuel related activities, dependent on fossil fuel reserves for their market valuations, or investing heavily in fossil fuel related activities (such as exploration), run the risk of becoming ‘stranded assets’.
- In the TCFD’s supplemental guidance for the financial sector, there are also recommendations to disclose exposure to ‘carbon related assets’ (e.g. companies engaged in fossil fuel extraction and power generation) which can be expressed in units of currency, or — as shown in the analysis above — as a percentage of total portfolio value.

# 2 Degree Alignment: Energy Transition

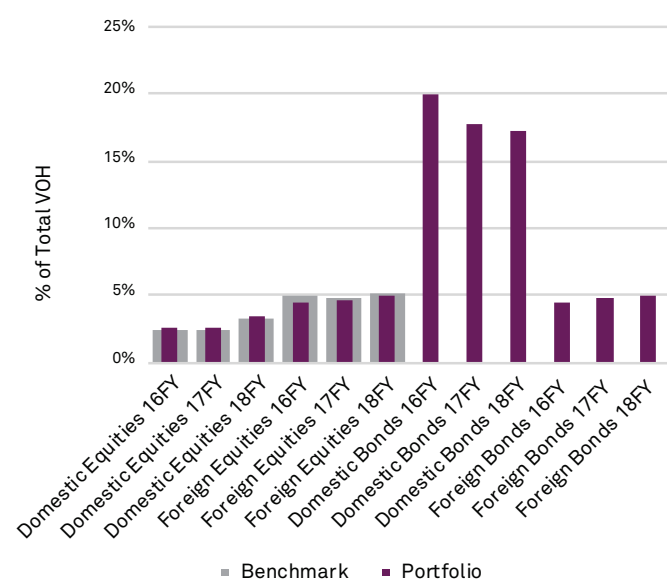
## Financial Exposure to Energy Generation & Energy Revenue Breakdown

The energy sector will play a critical role in any strategy geared towards achieving 2 degree alignment targets. Energy generating companies can be considered climate-aggravators (fossil fuels) or climate-mitigators (renewables). The full list of energy types considered is shown below:

- **Fossil Fuels:** coal, petroleum, natural gas
- **Renewables:** solar, wind, wave & tidal, geothermal, hydroelectric, biomass
- **Other:** nuclear, landfill gas, any other unclassified power generation

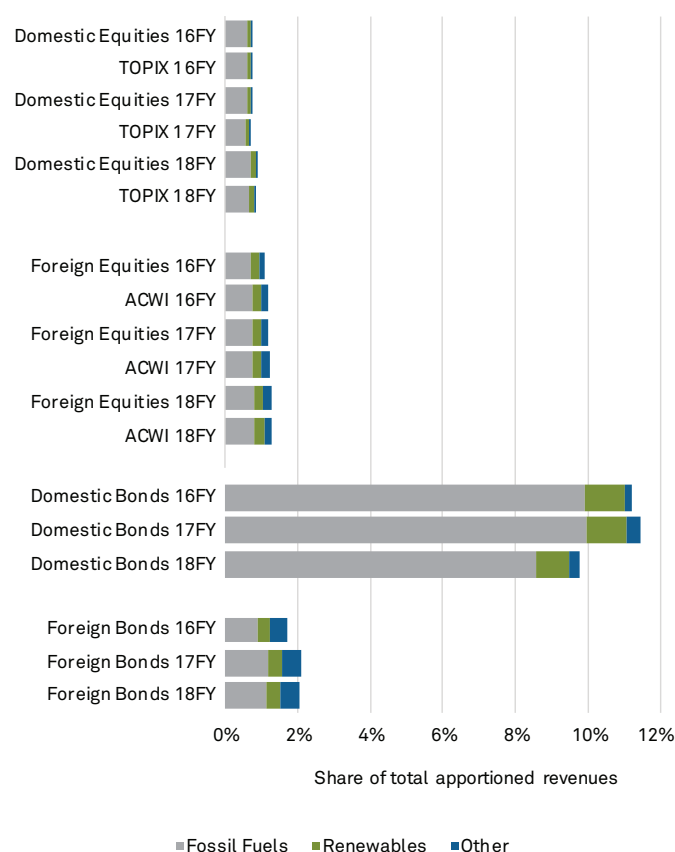
To determine the overall level of exposure each portfolio or benchmark has to energy generation, the chart below shows the percentage share of the total value invested in companies that derive anything above 0% of their total revenues from energy generating activities.

VOH Exposure to Energy Generation Activities



In order to highlight the level of revenue dependency that investees have in energy generating activities, the chart below shows the apportioned energy revenues associated with each portfolio. Furthermore, the revenues are broken out by type — fossil fuel aggravator, renewable mitigator, or other.

Energy Revenue Share

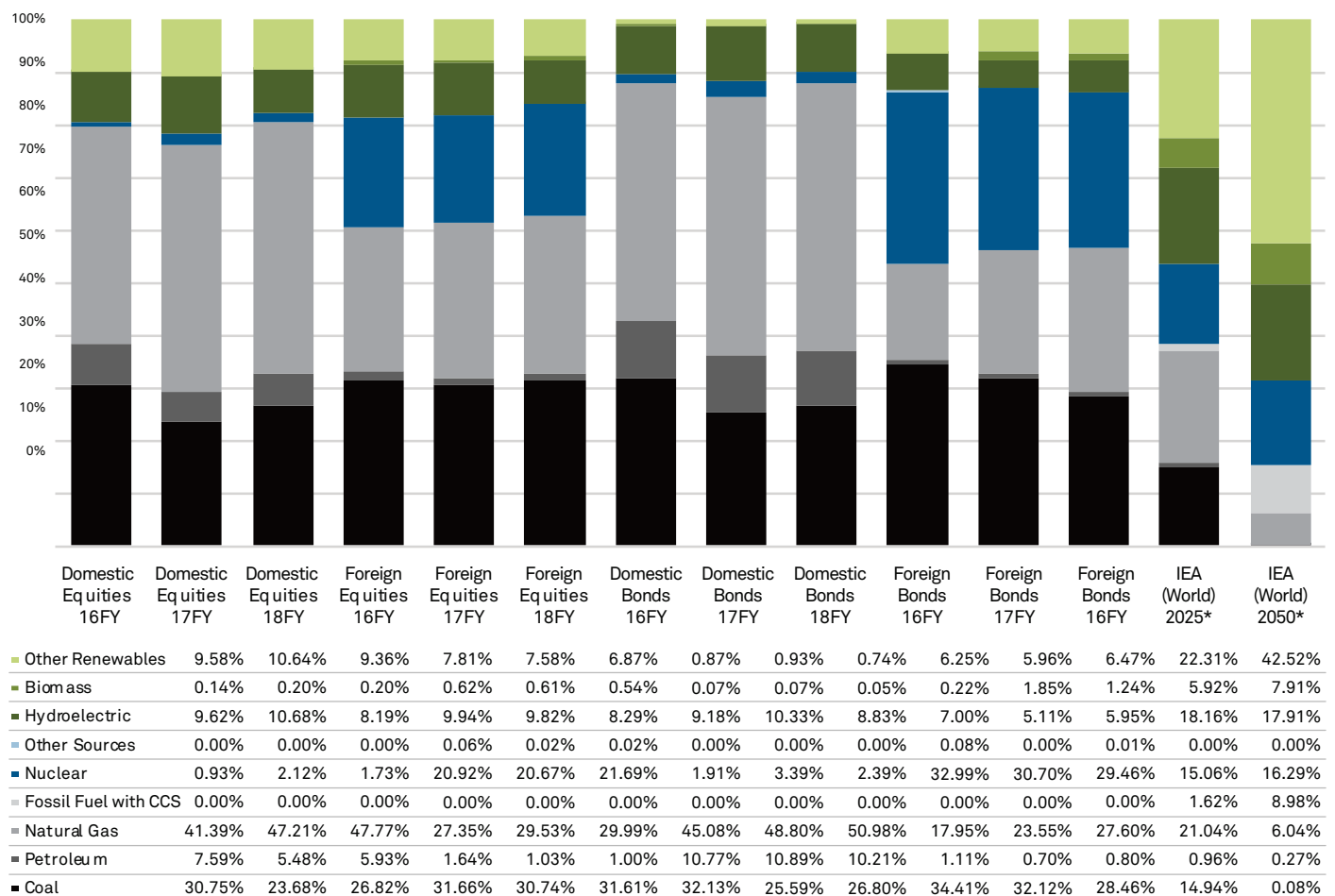


# 2 Degree Alignment: Energy Transition

## Energy Generation Mix

In addition to energy revenue analysis, Trucost collects disclosed information relating to the amount of physical units of power (GWh) generated by companies in a portfolio. Understanding a portfolio's energy mix allows it to be compared not just against benchmarks that reflect the economy of today, but also against forward looking benchmarks that — as suggested by the International Energy Agency — are what is required for the low-carbon economy of tomorrow.

Portfolio, Benchmark and IEA Scenario Energy Mix - Percent Share per Generation Type:



\* The content within the table above was prepared by S&P Trucost Limited, with data derived from the 2 Degree Scenarios developed by the International Energy Agency. ©OECD IEA 2017. The content within the table above does not necessarily reflect the views of the International Energy Agency.



# 2 Degree Alignment: Energy Transition

## Key Takeaways

### Financial Exposure to Energy Generation

- As a percentage of VOH, the domestic bonds portfolio is the most exposed to energy generation related revenues, standing at 17% in 18FY. Again, this reflects the concentrated nature of the portfolio, and the significant share of holdings in debt issued by utility companies. The exposure of all other portfolios ranges from 3-5% of their total VOH.
- In the domestic equity and bond portfolios, almost 90% of all energy revenues are earned in the fossil fuel sectors, while approximately 10% are earned in the renewable energy sectors. In the foreign equity and bond portfolios the ratio is approximately 60% earned in the fossil fuel sectors compared to 20% earned in the renewable energy sectors.

### 2 Degree Alignment of Energy Mix

- All portfolios have a considerably higher share of fossil fuel power and lower share of renewable power in their energy mix than the IEA's 2025 2 degree aligned world energy mix.
- All portfolios have a sizable dependancy on coal power, ranging from approximately 25-30% of GWh generated. All also exhibited reductions in coal share between FY16 and FY17. However, all but the foreign bond portfolio then saw an uptick in coal power in FY18.
- Foreign equity and bond portfolios appear less dependant on fossil fuel power overall, with the share coming from natural gas power in domestic portfolios being supplanted by nuclear power in the foreign portfolios. One explanation for this, however, may be the lack of available disclosure on GWh production among Japanese power generating companies. Improved disclosure in the future would help increase the accuracy of this 2 degree alignment metric.

### TCFD Relevance

- The TCFD identifies energy generation mix as a type of transition risk metric. The 2 degree alignment of a portfolio's energy generation mix can thus be used to highlight the level of exposure to potential policy action aimed at transitioning to a low-carbon economy over different time horizons.

# 2 Degree Alignment: GHG Transition Pathway Assessment

## Adjusted Portfolio and Benchmark Coverage

Portfolio and Benchmark Coverage Rates for GHG Transition Pathway Analysis:

|                        | Original Value<br>Analysed (%) | Companies with<br>Insufficient<br>Disclosed Data (%) | Final Value<br>Analysed (%) | Final Value<br>Analysed (mJPY) |
|------------------------|--------------------------------|--|-----------------------------|--------------------------------|
| Domestic Equities 18FY | 99.59                          | 47.63  | 51.96                       | 19,877,840                     |
| TOPIX 18FY             | 99.49                          | 48.41  | 51.08                       | 19,541,533                     |
| Foreign Equities 18FY  | 99.74                          | 32.77  | 66.97                       | 27,715,301                     |
| ACWI 18FY              | 99.81                          | 32.51  | 67.30                       | 27,853,803                     |
| Domestic Bonds 18FY    | 82.75                          | 22.00  | 60.75                       | 1,725,499                      |
| Foreign Bonds 18FY     | 72.92                          | 11.22  | 61.70                       | 1,350,168                      |

### REPORT INFORMATION:

**Analysis Date:** 09/07/2019

**Holdings Date:** 31/03/2019

**Asset Classes:** Corporate Equity and Debt

**Apportioning Factor:** Enterprise Value

**Scope of Assessment:** Scope 1 and Scope 2 emissions

### A NOTE ON MAPPING:

Coverage rates for Trucost's 'GHG Transition Pathway' assessments are typically lower than for other Trucost analyses. This is because the analysis excludes companies which do not disclose GHG emissions, i.e. for which only modelled emissions are available during the historical time horizon of 2012 to the present. Modelled GHG emissions are excluded in order to avoid potential false inferences. The analysis presented focuses on whether companies achieve a level of decarbonization, year-on-year, consistent with a shrinking 2°C carbon budget over time. Relatively small differences in year-on-year pathways can result in different assessment results, rendering anticipated levels of modelling error for non-disclosers inconsistent with the calibration of the assessment.

# 2 Degree Alignment: GHG Transition Pathway Assessment

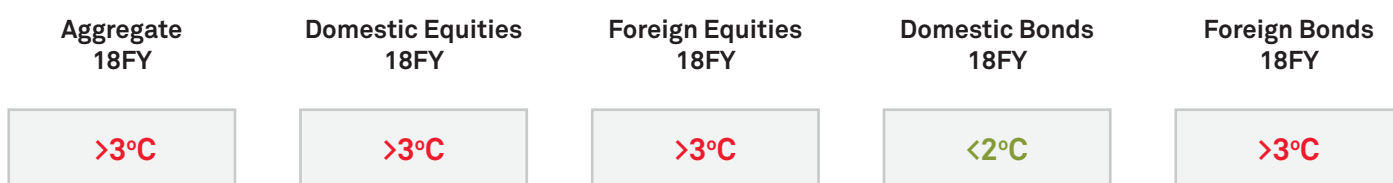
## Transition Pathways

Trucost's Transition Pathway Assessment enables investors to track their portfolios against the goal of limiting global warming to 2°C above pre-industrial levels. The assessment examines the adequacy of emissions reductions made over time, by investees, in meeting these targets. It incorporates both historical performance as well as forward-looking indicators (over a medium-term time horizon). This avoids the uncertainties of using only forward-looking data, and is of a sufficient time horizon to make the effect of any year-on-year volatility less significant. Historical data on greenhouse gas emissions and company activity levels is incorporated from a base year of 2012. Forward-looking data sources are used to track likely future transition pathways from the most recent year of disclosed data through to 2023.

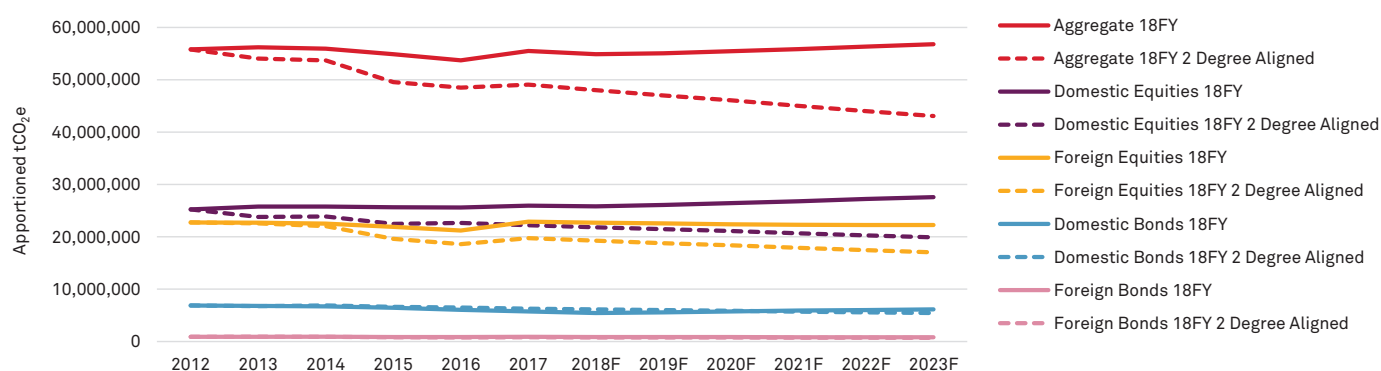
Trucost's approach is adapted from two methodologies highlighted by the Science Based Targets Initiative (SBTi), these being the Sectoral Decarbonization Approach (SDA) and the Greenhouse gas Emissions per unit of Value Added (GEVA) approach. The SDA is applied to companies with high-emitting, homogeneous business activities, while GEVA is applied to those with lower emitting, heterogeneous business activities. For more information on the methodology please refer to Appendix 5.

The boxes below show the level of warming that each portfolio is aligned with, while the chart at the bottom shows each portfolio's 2012-2023 trajectory and compares that to its own 2 degree aligned trajectory (starting from the 2012 base year).

### Temperature Trajectory for Latest Portfolio Holdings:



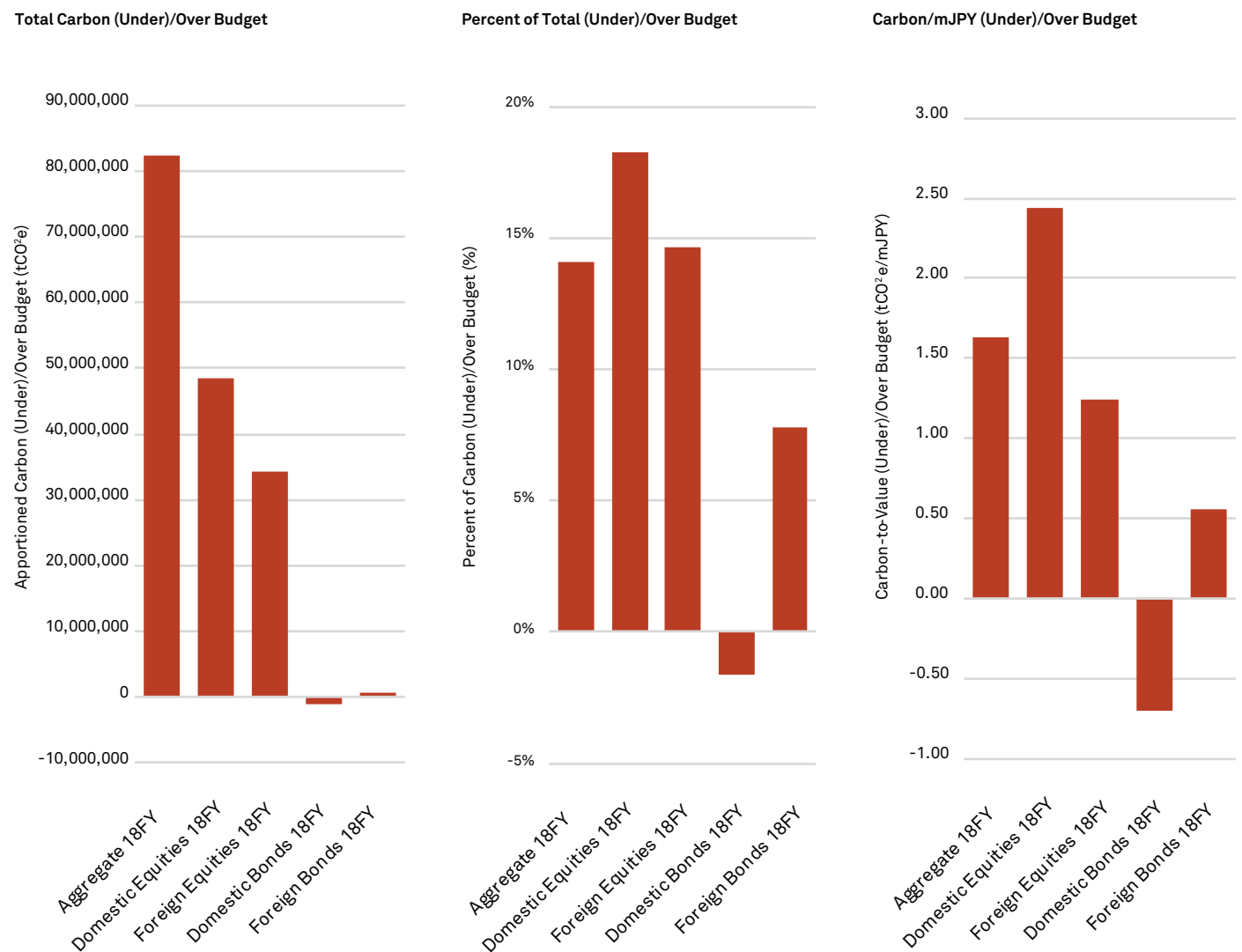
Portfolio apportioned emissions versus 2°C aligned levels, 2012-2023



# 2 Degree Alignment: GHG Transition Pathway Assessment

## Carbon Budget Assessment

In the charts below, each portfolio's performance against the 2°C carbon budget is shown first in absolute tonnes of carbon, second as a percent of the total portfolio level budget, and lastly normalized by the value invested. A positive number indicates *weaker* performance, as it means the portfolio is over budget, whereas a negative number indicates *stronger* performance, as it means the portfolio is under budget.



# 2 Degree Alignment: GHG Transition Pathway Assessment

## Sectoral Contributions

The tables below show at the sector level each portfolio's performance against the 2°C aligned carbon budget. A negative contribution indicates the number of MtCO<sub>2</sub>e under budget the sector is, while a positive number indicates by how much that sector is over budget. The alignment temperature indicates the probable trajectory companies in the specified sector are currently on.

### SDA Sectors Carbon Budget Performance and Temperature Trajectory:

| HOMOGENEOUS                             | Power Generation | Cement   | Steel    | Airlines | Aluminium |
|---|------------------|----------|----------|----------|-----------|
| <b>Contribution (MtCO<sub>2</sub>e)</b> |                  |          |          |          |           |
| Domestic Equities 18FY                  | 0.354            |          | 2.846    | 1.860    |           |
| Foreign Equities 18FY                   | -3.429           | 0.033    | 0.800    | 0.133    |           |
| Domestic Bonds 18FY                     | -3.944           |          | 0.280    | 0.055    |           |
| Foreign Bonds 18FY                      | -0.458           | -0.029   | 0.047    | 0.007    |           |
| <b>Alignment (°C)</b>                   |                  |          |          |          |           |
| Domestic Equities 18FY                  | >2.7             |          | >2.7     | >2.7     |           |
| Foreign Equities 18FY                   | <1.75            | 2 to 2.7 | 2 to 2.7 | 2 to 2.7 |           |
| Domestic Bonds 18FY                     | <1.75            |          | >2.7     | >2.7     |           |
| Foreign Bonds 18FY                      | <1.75            | <1.75    | >2.7     | >2.7     |           |

Companies with predominantly homogenous business activities which fall into one of the five sectors in the chart on the left have been assessed using the SDA approach. This means that required carbon intensity reductions are calculated in sector specific units of production (for example tonnes of steel produced, or number passenger miles flown), and each company's share of the overall sector budget is calculated using market share.

All other companies have been assessed using the GEVA approach. This means that required carbon intensity reductions are calculated in carbon per \$ of value added (gross profit), and determined by the IPCC's CO<sub>2</sub>e/GDP intensity reduction rates required at the global level.

### GEVA Sectors Carbon Budget Performance and Temperature Trajectory:

| HETEROGENEOUS                           | Communic. Serv. | Consumer Discret. | Consumer Staples | Energy | Financials | Health Care | Industrials | Information Tech. | Materials | Real Estate | Utilities |
|---|-----------------|-------------------|------------------|--------|------------|-------------|-------------|-------------------|-----------|-------------|-----------|
| <b>Contribution (MtCO<sub>2</sub>e)</b> |                 |                   |                  |        |            |             |             |                   |           |             |           |
| Domestic Equities 18FY                  | 1.549           | 2.312             | 5.054            | 4.020  | 0.260      | 0.783       | 11.137      | 5.229             | 10.877    | 0.942       | 1.358     |
| Foreign Equities 18FY                   | 0.380           | 0.401             | 7.321            | 21.352 | -0.014     | 0.028       | 1.656       | -4.124            | 8.187     | 0.563       | 1.065     |
| Domestic Bonds 18FY                     | 0.106           | 0.123             | 0.136            | 0.077  | 0.054      | 0.001       | 1.060       | 0.075             | 0.480     | 0.109       | 0.169     |
| Foreign Bonds 18FY                      | 0.028           | 0.048             | -0.001           | 0.751  | -0.025     | -0.012      | 0.041       | -0.031            | 0.346     | 0.016       | 0.022     |
| <b>Alignment (°C)</b>                   |                 |                   |                  |        |            |             |             |                   |           |             |           |
| Domestic Equities 18FY                  | >5              | 3 to 4            | >5               | >5     | >5         | >5          | >5          | >5                | >5        | >5          | >5        |
| Foreign Equities 18FY                   | 4 to 5          | 2 to 3            | >5               | >5     | <2         | 2 to 3      | 3 to 4      | <2                | >5        | >5          | >5        |
| Domestic Bonds 18FY                     | >5              | 3 to 4            | >5               | >5     | >5         | >5          | >5          | >5                | >5        | >5          | >5        |
| Foreign Bonds 18FY                      | >5              | 3 to 4            | <2               | >5     | <2         | <2          | >5          | <2                | >5        | >5          | >5        |



# 2 Degree Alignment: GHG Transition Pathway Assessment

## Key Takeaways

- Each portfolio and benchmark was assessed for their level of alignment with global climate goals, based on a transition pathway approach in which the rate of decarbonization of each holding was assessed against rates required to achieve below 2°C of warming. Most portfolios and benchmarks were assessed as consistent with greater than 3°C of warming. The exception was the domestic bonds portfolio, assessed as consistent with below 2°C of warming.
- The granularity of scenario data available allows the portfolio and benchmark level results to be summarized into three groupings those consistent with less than 2°C, those consistent with 2-3°C, and those consistent with greater than 3°C of warming.
- A key limitation to the results is that not all holdings could be assessed due to a lack of disclosed historical data available. Portfolio-level conclusions may of course differ from those presented, should the coverage rates change in future analyses. Coverage in the domestic equities portfolio were impacted the most by the disclosure gaps.
- Looking beyond the headline results, more differentiation in performance can be observed between portfolios. Results were weakest for the domestic equity portfolio, where emissions were 18.3% over requirements to achieve a 2°C carbon budget over the 2012-2023 time horizon. For the foreign equity portfolio emissions were 14.7% over budget, and for foreign bonds 7.8% over. In contrast, the domestic bonds were 1.6% under budget. The aggregate portfolio had emissions 14.1% over budget. For the portfolios with benchmarks provided, the results were broadly aligned.
- Looking at results by sector provides insight into the underlying drivers of the portfolio-level results. Key drivers of the portfolios failing to decarbonize at a rate consistent with 2°C were holdings in the Energy and Materials sectors. Holdings in these sectors tended to have transition pathways consistent with greater than 5°C of warming and made large contributions to the total apportioned emissions being above the 2°C budget in absolute terms. Holdings in the Consumer Staples and Industrials sectors were also significant contributors to emissions being over the 2°C budget in some portfolios.
- Power generators tended to be among the best performers, and in the aggregate their relatively fast rates of decarbonization were consistent with below 1.75°C. The exception was the domestic equities portfolio where they were consistent with greater than 2.7°C headline result, driven by significant holdings of power generating utilities that are reducing emissions at a slower rate than their foreign counterparts.
- Results for the domestic equity and bond portfolios tended to have systematically slower rates of decarbonization and worse performance across Airlines, Consumer Discretionary, Financials, and Information Technology sectors than the Foreign portfolios.

### TCFD Relevance

- The TCFD recognizes that GHG emissions are a key focal point of policy, regulatory, market, and technology responses to limit climate change. Companies with emissions significantly above what is required to be in line with a low-carbon transition pathway, are likely to be impacted more by current or future constraints on GHG emissions. The GHG Transition Pathway Assessment presented aims to highlight leaders and laggards at the company level, as well as overall portfolio performance and performance by sector.

# Carbon Earnings At Risk

## Adjusted Portfolio and Benchmark Coverage

Portfolio and Benchmark Coverage Rates for Carbon Earnings at Risk Analysis:

|                        | Original Value<br>Analysed (%) | Companies<br>with Negative<br>Earnings (%) | Final Value<br>Analysed (%) | Final Value<br>Analysed (mJPY) |
|------------------------|--------------------------------|--|-----------------------------|--------------------------------|
| Domestic Equities 18FY | 99.59                          | 0.62                                       | 98.97                       | 38,027,868                     |
| TOPIX 18FY             | 99.49                          | 0.54                                       | 98.90                       | -                              |
| Foreign Equities 18FY  | 99.74                          | 3.52                                       | 96.23                       | 39,930,127                     |
| ACWI 18FY              | 99.81                          | 3.37                                       | 96.45                       | -                              |
| Domestic Bonds 18FY    | 82.75                          | 1.76                                       | 81.30                       | 2,790,569                      |
| Foreign Bonds 18FY     | 72.92                          | 5.36                                       | 69.01                       | 2,070,802                      |

### REPORT INFORMATION:

**Analysis Date:** 09/07/2019

**Holdings Date:** 31/03/2019

**Asset Classes:** Corporate Equity and Debt

**Apportioning Factor:** Enterprise Value

**Scenario:** High

**Scenario Reference Year:** 2030

**Earnings Metric:** EBIT

**Financial Impact Methodology:** Weighted-average

**Discount Rate:** 0%

**Risk Threshold:** 10%

### A NOTE ON MAPPING:

The mapping of equity and debt instruments to companies in the Trucost database begins with the same logic as described earlier for standard portfolio analysis. Carbon Earning at Risk (CEaR) analysis will then exclude any companies that either have insufficient financial data available (e.g. EBIT, EBITDA), or that have reported negative earnings. It should, however, be noted that companies with negative earnings can face the highest risks due to difficulties that they may face in absorbing additional unforeseen costs.

# Carbon Earnings At Risk

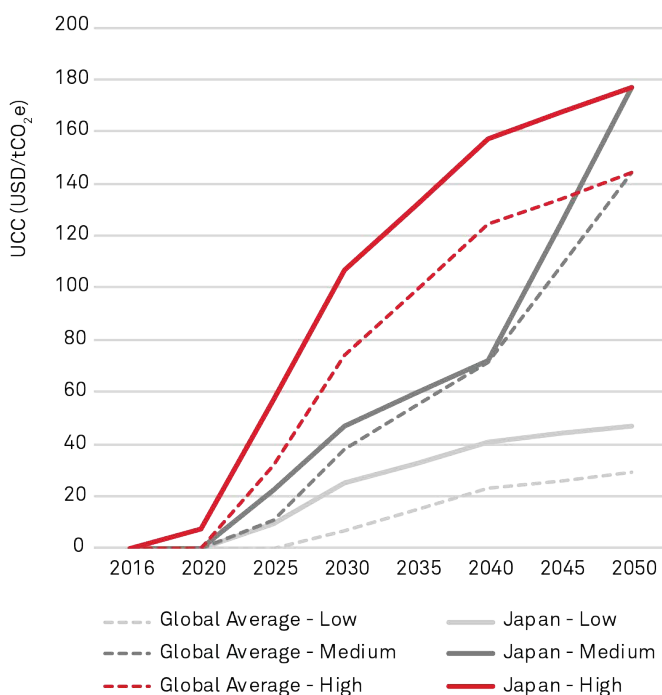
## Unpriced Cost of Carbon

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 global GHG emissions. More schemes are likely to appear in order to achieve the Nationally Determined Contributions (NDCs) made by countries that ratified the 2015 Paris Agreement.

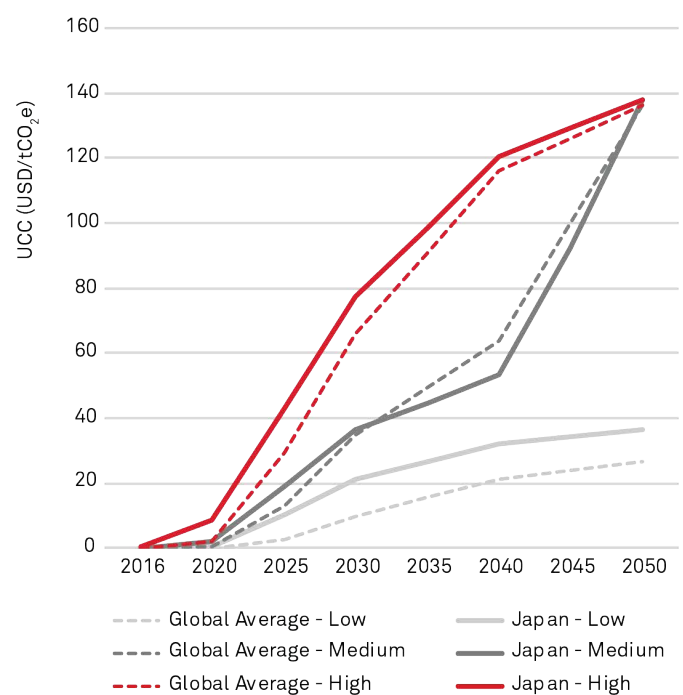
To help investors navigate carbon price risk, Trucost has compiled a dataset of possible future carbon prices that can be used to stress test each investee's current ability to absorb future costs. Integral to this analysis is the quantification of a Unpriced Cost of Carbon (UCC) — the difference between what a company pays for emitting carbon today and what it may pay in the future. The UCC will vary depending on both the sector a company operates in and the regions in which they emit. It also depends on the scenario and reference year chosen. High and Medium scenarios both arrive, by 2050, at a price deemed to be sufficient to keep global warming to within 2°C above pre-industrial levels (however in the latter action is delayed in the short to medium term). The Low scenario is not 2°C aligned, but assumes the implementation of the NDCs. The analysis does not speak to the likelihood of carbon pricing policies being implemented. For more information on the UCC methodology please refer to Appendix 6.

The charts below illustrate how the UCC varies depending on the country (Japan vs. a global average), reference year and scenario. The left-hand chart illustrates the UCC within the Electricity sector, while the right-hand chart illustrates the average UCC across all sectors.

Japan vs Global Average UCC - Electricity Sector



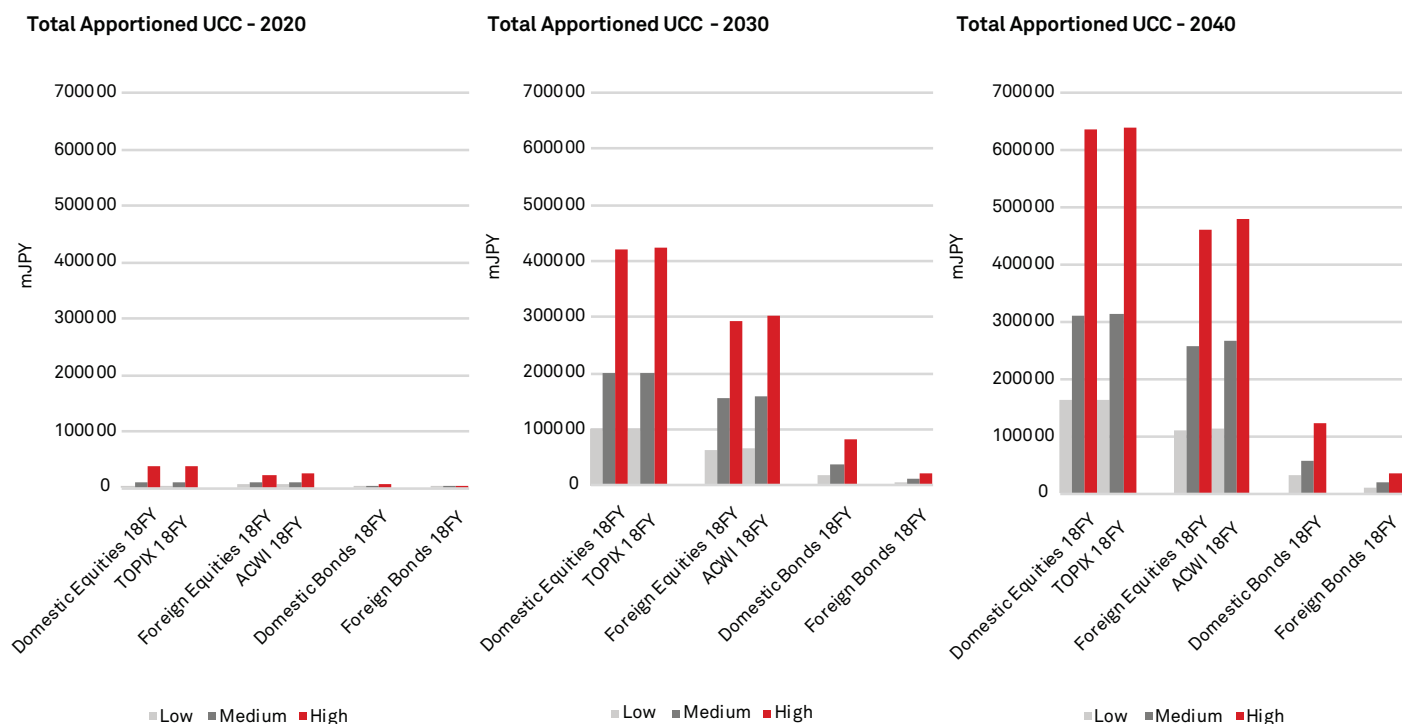
Japan vs Global Average UCC - Average Of All Sectors



# Carbon Earnings At Risk

## Unpriced Cost of Carbon

The charts below show the total UCC apportioned to each portfolio for all scenarios and for the reference years 2020, 2030 and 2040.



### TCFD GUIDANCE FOR ASSET OWNERS / MANAGERS: STRATEGY RECOMMENDED DISCLOSURE (B)

Asset owners should describe how climate-related risks and opportunities are factored into relevant investment strategies. This could be described from the perspective of the total fund or investment strategy or individual investment strategies for various asset classes.

Asset managers should describe how climate-related risks and opportunities are factored into relevant products or investment strategies. Asset managers should also describe how each product or investment strategy might be affected by the transition to a lower-carbon economy.

### TCFD GUIDANCE FOR ASSET OWNERS / MANAGERS: STRATEGY RECOMMENDED DISCLOSURE (C)

Asset owners that perform scenario analysis should consider providing a discussion of how climate-related scenarios are used, such as to inform investments in specific assets.

Source: FSB TCFD (2017) Implementing the Recommendations of the TCFD

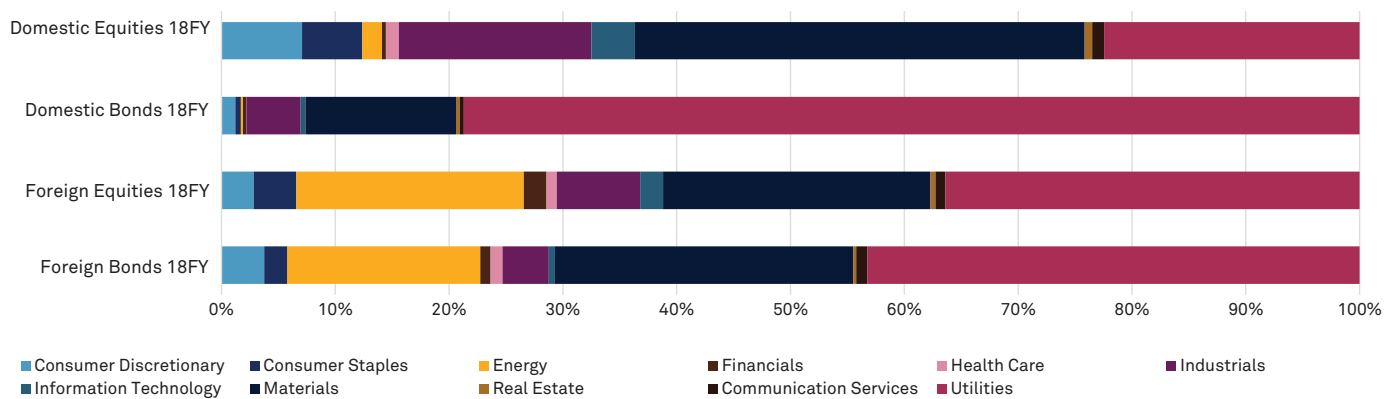
# Carbon Earnings At Risk

## Sector & Geography Breakdown

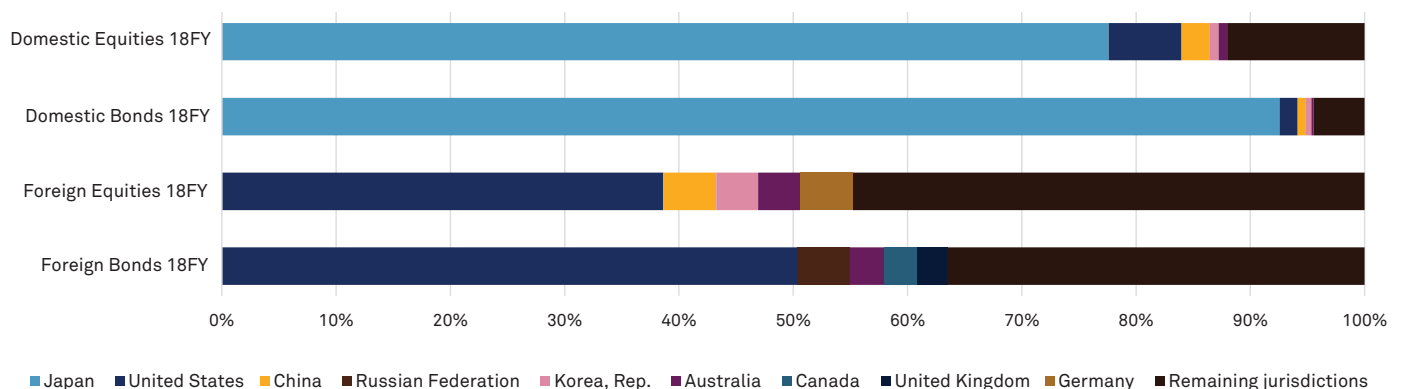
The apportioned UCC can be broken out by geography or sector as shown below. If the portfolio is tilted towards companies whose emissions are from countries or sectors with a higher UCC, it may result in higher overall financial risks.

In the geographic-split chart below, “Remaining jurisdictions” refers to countries that are not included in the 44 covered jurisdictions (mostly located in Africa, Latin America, South East Asia and Eastern Europe) as well as the 39 jurisdictions outside of the top 5.

### UCC Sector Breakdown



### UCC Geography Breakdown



# Carbon Earnings At Risk

## Financial Impacts

When the UCC 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' metrics provide 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.

### Portfolio and Benchmark Level Adjusted Financials:

|                        | Apportioned<br>UCC | EBIT at Risk | EBIT Margin<br>Reduction | EV/EBIT<br>Change due to UCC | VOH with >10%<br>EBIT at Risk | VOH with<br>Negative Margins |
|------------------------|--------------------|--------------|--------------------------|------------------------------|-------------------------------|------------------------------|
|                        | (JPY)              | (%)          | (% points)               | (%)                          | (%)                           | (%)                          |
| Domestic Equities 18FY | 420,653,573,541    | 25.47%       | -1.27%                   | 31.15%                       | 21.26%                        | 3.27%                        |
| TOPIX 18FY             | 423,008,431,938    | 26.21%       | -1.24%                   | 30.66%                       | 21.31%                        | 3.28%                        |
| Foreign Equities 18FY  | 293,550,942,406    | 17.30%       | -1.87%                   | 330.71%                      | 18.73%                        | 4.44%                        |
| ACWI 18FY              | 302,956,032,938    | 17.71%       | -1.92%                   | 353.30%                      | 19.23%                        | 4.55%                        |
| Domestic Bonds 18FY    | 82,771,268,538     | 81.08%       | -4.35%                   | 25.12%                       | 27.29%                        | 16.67%                       |
| Foreign Bonds 18FY     | 21,781,996,052     | 26.20%       | -2.39%                   | 1909.91%                     | 17.29%                        | 4.31%                        |

Below is a guide to different financial metrics provided:

- **Apportioned UCC:** The total additional costs arising (in)directly for a given scenario/year at the portfolio level.
- **EBIT at Risk:** The percentage of Earnings at Risk due to UCC. This highlights areas of risk across the portfolios and can be fed into financial analysis.
- **EBIT Margin Reduction:** Implied change in EBIT margins based on a scenario/year compared to the current margins. The metric allows for signaling of red flags in the portfolio where the deterioration of margin is significant.
- **EV/EBIT Change due to UCC:** Implied change in a valuation multiple due to reduced earnings in a scenario/year. This assess the overall implications on the valuations of companies.
- **VOH with EBIT at Risk:** Total value of holdings where EBIT at risk is above a certain threshold (e.g. 10%). Identifies companies that are facing the most significant carbon price risk across the portfolio.
- **VOH with Negative Margins:** Companies whose EBIT margin becomes negative after incorporating the UCC. This is used to flag companies that would potentially no longer operate profitably.

# Carbon Earnings At Risk

## Key Takeaways

### Unpriced Cost of Carbon

- The proportion of companies excluded due to negative earnings was highest in the foreign bonds portfolio at 5.36%, but also relatively high in the foreign equities portfolio at 3.52%. Companies with negative earnings may be most at risk to potential carbon price rises in the future.
- In both the equity and bond portfolios, the total apportioned UCC is greater for domestic rather than foreign investees. In essence, this means that the domestic companies held generate more emissions in parts of the world where current carbon tax regimes are expected to increase the most.

### Sector & Geography Breakdown

- The Utilities sector is driving the majority of the apportioned UCC for the domestic and foreign bonds portfolios (79% and 43% respectively). In the equity portfolios the Materials sector is also a major contributor, making up 40% of the domestic total and 23% of the foreign total.
- With respect to geographic exposure, predictably, almost all UCC for the domestic equity and bond portfolios originates in Japan (78% and 93% respectively). This means that companies in both portfolios are most exposed to any climate related policy actions that increase the cost of carbon in this jurisdiction.
- Exposure to carbon price increases outside of Japan is concentrated in the USA, with that jurisdiction contributing 39% and 50% respectively to the foreign equity and bond portfolios' total apportioned UCC.

### Financial Impacts

- Across portfolios, the domestic bonds has the highest risk exposure with a weighted-average EBIT at risk of around 80%. This means that were the 2030 High scenario carbon prices to be implemented today, then the additional costs would be approaching the total EBIT for the companies held.
- The domestic bonds portfolio also holds the largest share of companies with an EBIT at risk of over 10%, driving the aforementioned results.
- It should be noted that EBIT at risk is not necessarily linearly correlated to the other financial impact metrics provided, such as EBIT margin reduction (expressed as % point reduction). For example, companies with high revenues but also high operating costs, can exhibit a very high EBIT at risk % without having a similarly impacted EBIT margin reduction. We can see this with the domestic bonds portfolio, where the EBIT at risk metric differs by an order of magnitude to the other portfolios, which is not also reflected in the EBIT margin reduction.

### TCFD Relevance

- The TCFD recommends including disclosure on the financial aspects of climate-related risks, such as information on the projected revenue and cost implications of future carbon prices as a result of low-carbon regulation and policy changes. This metric can help assess exposure to carbon pricing risk under a 2°C scenario.



# Appendix

## 1. TCFD Recommended Disclosures and Supplementary Guidance for Asset Owners and Managers

TCFD Recommendations for Asset Owners and Managers:

|   | Governance   | Strategy   | Risk Management  | Metrics & Targets   |
|---|--|--|--|---|
| Recommended Disclosures for All Sectors                 | <ul style="list-style-type: none"> <li>a. Describe the board's oversight of climate-related risks and opportunities</li> <li>b. Describing management's role in assessing and managing climate-related risks and opportunities.</li> </ul> | <ul style="list-style-type: none"> <li>a. Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term.</li> <li>b. Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning.</li> <li>c. Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.</li> </ul>  | <ul style="list-style-type: none"> <li>a. Describe the organization's processes for identifying and assessing climate-related risks.</li> <li>b. Describe the organization's processes for managing climate-related risks.</li> <li>c. Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management.</li> </ul>  | <ul style="list-style-type: none"> <li>a. Disclose the metrics used by the organization to assess Describe the organization's risks and opportunities in line with its strategy and risk management process.</li> <li>b. Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks.</li> <li>c. Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets.</li> </ul>   |
| Supplemental Guidance for Asset Owners / Asset Managers |  | <p>Asset owners should describe how climate-related risks and opportunities are factored into relevant investment strategies. This could be described from the perspective of the total fund or investments strategy or individual investment strategies for various asset classes. Asset managers should describe how climate-related risks and opportunities are factored into relevant products or investment strategies. Asset managers should also describe how each products or investment strategy might be affected by the transition to a lower-carbon economy.</p> | <p>Asset owners / managers should describe, where appropriate, engagement activity with investee companies to encourage better disclosure and practices related to climate-related risks to improve data availability and asset owners' / managers' ability to assess climate-related risks.</p> <p>Asset owners should describe how they consider the positioning of their total portfolio with respect to the transition to a lower-carbon energy supply, production, and use. This could include explaining how asset owners actively manage their portfolios' positioning in relation to this transition. Asset managers should describe how they manage material climate-related risks for each product or investment strategy.</p> | <p>Asset owners / managers should describe metrics used to assess climate-related risks and opportunities in each fund / product or investment strategy. Where relevant, asset owners / managers should also describe how these metrics have changed over time. Where appropriate, asset owners / managers should provide metrics considered in investment decision and monitoring.</p> <p>Asset owners / managers should provide the weight average carbon intensity, where data are available or can be reasonably estimated, for each fund / product or investment strategy. In addition, asset owners / managers should provide other metrics they believe are useful for decision making along with a description of the methodology used.</p> |

Source: TCFD

# Appendix

## 2. Apportioning

Many of the exposure metrics calculated by Trucost rely on the apportioning of company owned resources/pollutants to the portfolio or benchmark. Apportioning, as an approach, is built on the principle of ownership. That is, if an investor owns — or in the case of debt holdings, finances — 1% of a company, then they also ‘own’ 1% of the company’s resources/pollutants.

For equity only portfolios the apportioning factor is usually obtained by dividing the value of holding by the company’s market capitalisation on the date of analysis. For debt only, or mixed portfolios, the larger of enterprise value and market capitalization on the date of holding is used as the denominator. This approach is used to minimize the risk of apportioning ‘spikes’ when an enterprise value approaches zero (or is negative).

The company level resources/pollutants are then multiplied by the apportioning factor to arrive at resource/pollutant quantities specific to each holding. The portfolio level resources/pollutants is the sum of all of these quantities.

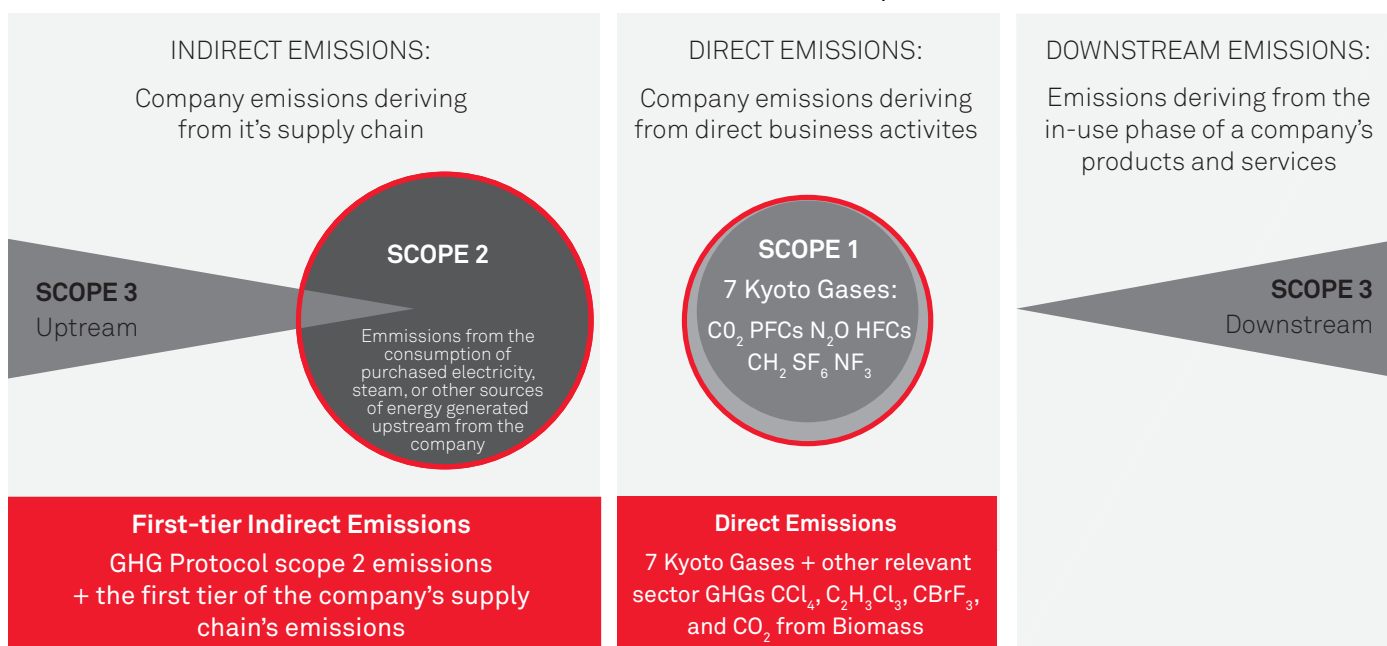
# Appendix

## 3. Scopes

The right scope of emissions to include in footprint calculations is dependent on the breadth of view that the analyst wishes to take. Restricting the scope to direct operational emissions only (scope 1) removes the risk of double counting carbon, but also limits the level of insight provided as much of what can be considered exposure to 'carbon risks' may exist in the supply chain of investees. Trucost recommends widening the scope of analysis to uncover more of these potential risks. The full list of scopes available is shown below:

- **Direct (Scope 1)** = CO<sub>2</sub>e emissions based on the Kyoto Protocol greenhouse gases generated by direct company operations.
- **Direct (Other)** = Additional direct emissions, including those from CCl<sub>4</sub>, C<sub>2</sub>H<sub>3</sub>Cl<sub>3</sub>, CBrF<sub>3</sub>, and CO<sub>2</sub> from Biomass.
- **Purchased Electricity (Scope 2)** = CO<sub>2</sub>e emissions generated by purchased electricity, heat or steam.
- **Non-Electricity First Tier Supply Chain (Scope 3)** = CO<sub>2</sub>e emissions generated by companies providing goods and services in the first tier of the supply chain.
- **Other Supply Chain (Scope 3)** = CO<sub>2</sub>e emissions generated by companies providing goods and services in the second to final tier of the supply chain.
- **Downstream (Scope 3)** = CO<sub>2</sub>e emissions generated by the distribution, processing and use of the goods and services provided by a company.

Trucost 'Direct' and 'First Tier Indirect' Emissions vs. GHG Protocol Scopes 1, 2 and 3:



## SCOPE 3

Scope 3 emissions (also known as ‘value chain emissions’) are generally the least reported on of all scopes at the company level. Trucost therefore adopts a unique approach to provide full coverage of both upstream and downstream scope 3.

### UPSTREAM

Trucost collects disclosures, where available, for first tier supply chain emissions falling into three possible categories, these being air, rail, and truck transportation. For all other upstream emissions, covering the full supply chain, Trucost uses a proprietary Environmentally-Extended Input-Output (EEI-O) model to estimate emissions based on business activities. For more information on the EEI-O, please refer to appendix 4.

### DOWNSTREAM

Downstream emissions are estimated using a combination of a ‘top-down’ and ‘bottom-up’ approach.

#### Top Down

Trucost estimates Scope 3 downstream intensities for each GICS sub-industry (155 in total) based on CDP disclosures covering the following eight categories — 1) Processing of sold products, 2) Use of sold products, 3) End-of-life treatment of sold products, 4) Franchises, 5) Investments, 6) Transportation and distribution, 7) Leased assets, and 8) Other.

For each of the eight Scope 3 downstream categories, if the company has published an externally verified value, then this is used. If for any of the relevant categories no data — or no externally verified data — is available, then sector average intensities calculated by Trucost are used.

#### Bottom Up

For key sectors — coal, oil or gas extraction and automotives — the following approach are used:

**Oil & Gas and Coal Extraction:** For fossil fuel production data (collected by Trucost and Capital IQ), emissions factors can be applied to calculate the CO<sub>2</sub>e generated in categories 1), 2) and 6). If a company has disclosed to CDP lower figures than those calculated in the bottom-up approach, then the calculated figures are used.

**Automobiles:** Annual emissions from vehicle use are a product of fleet emissions intensity (gCO<sub>2</sub>/km), number of vehicles sold (units) and lifetime mileage (km/lifetime). Given a difference in fuel economy and driving patterns across regions worldwide, Trucost has calculated Scope 3 emissions for the main operational regions for each auto manufacturer separately and then aggregated the figure on the global level. The countries/regions used in the current calculations cover the major automotive markets: EU, US, China, Japan, Korea, India.

For each auto manufacturer, Trucost collects average fleet emissions per region from public disclosures (including submissions to regulatory bodies). Whenever no data has been reported by the company or the regulator, regional averages have been included in the calculations. The number of vehicles sold per region has been taken directly from the auto manufacturers’ reporting. If disclosures are unavailable, the regional revenue splits have been used as a proxy. Average annual mileage per region has been taken from LCA country assessments, with the exception of sports cars where the annual mileage corresponds to the company-defined expected annual mileage of those cars.

Trucost’s unique approach to environmental data collection and modelling enables near complete coverage of most investment universes, despite often low levels of reporting among investees. A four step process is used as part of our data gathering exercise.

# Appendix

## 4. Data Collection

1. **Analyse Financial and Sector Data** — A company's financials are analysed, collecting consolidated revenues for all companies and specifying their reporting scopes and operational boundaries.
2. **Map Activities to Trucost's Environmentally Extended Input-Output (EEI-O) Model** — Trucost's EEI-O model uses 450+ business activities (broadly aligned to the NAICS, with some additional sectors included to distinguish key activities with materially different physical impacts) to model a company's environmental impacts by assigning portions of each company's revenues to one or more of these activities. The EEI-O model then estimates the pollutant emissions and resource use associated with each business activity, both directly (for a company's own operations) and across the supply chain, using the revenue sector breakdown.
3. **Incorporate Disclosures and Public Registry Data** — Trucost searches all publically disclosed data sources of companies to find usable environmental data that will be used to overwrite Trucost's modelled estimates. Trucost ensures the scope and time horizon of any environmental data found matches that of its financials.
4. **Company Engagement and Data Verification** — Trucost analysts quality check the entire research process internally, then share the results with each company directly via a secure online portal. Companies are given one month to respond to Trucost to verify its data or directly engage to provide either refined, additional or non-public information. If appropriate and applicable data is provided, Trucost will integrate this into its analysis before publishing the data to our subscribers.

All data collected as part of the process described above will be assigned a 'disclosure flag', indicating the source of each specific data-point. These flags will fall into one of three possible 'disclosure categories', Full Disclosure, Partial Disclosure or Modelled.

- **Full Disclosure** — Trucost has used data disclosed by a company in an un-edited form as it matches the reporting scope and accuracy required by the research process.
- **Partial Disclosure** — Trucost has used data disclosed by a company but has made adjustments to match the reporting scope required by its research process (e.g. where a company discloses its emissions deriving from 85% of its operational sites, this data is used to model 100% of its emissions). Values may also be derived from a previous year's disclosed data using changes in business activities and consolidated revenues.
- **Modelled** — In the absence of usable disclosures, the data has been modelled using Trucost's EEI-O model.

# Appendix

## 5. 2 Degree Transition Pathway Assessment

Trucost's transition pathway analysis adapts two approaches prominent in literature produced and referenced by the Science-Based Targets Initiative (SBTi). These are the Sectoral Decarbonization Approach (SDA), and the Greenhouse Gas Emissions per unit of Value Added (GEVA) approach.

### **SDA Approach:**

The SDA is applied to companies with high-emitting, homogeneous business activities. Its core principle is that companies in each industry must converge toward emissions intensities consistent with a 2°C scenario by 2050 from their unique starting points. It uses industry-specific 2°C scenario pathways, with companies measured using industry-specific emissions intensities and physical production levels (eg. tCO<sub>2</sub>e per GWh or per tonne of steel). Industry-specific transition pathways may be faster (eg. power), or slower (eg. cement) depending on an industry's available technologies, specific mitigation potential and cost of mitigation. Within a given industry, companies with low base year emissions and low production growth can reduce emissions at a gradual rate. Companies with high emissions or high production growth must make faster reductions.

The scenarios used in SDA assessments are International Energy Agency (IEA) scenarios from Energy Technology Perspectives (ETP) 2017. These provide SDA assessment parameters consistent with 1.75°, 2°, and 2.7°C of warming.

### **GEVA Approach:**

GEVA is applied to companies with lower emitting or heterogeneous business activities. It recognizes that many companies have diverse business activities, most of which do not have distinct transition pathways defined in climate scenarios. For these companies, GEVA entails applying a contraction of carbon intensity principle under which a company should make emissions reductions consistent with rates required for the overall economy, from each company's unique base year emissions intensity. It uses a non-industry specific, economy-wide 2°C scenarios, and emissions intensities with a financial, not physical or production denominator. Each company's transition pathway is measured as its GHG per unit of inflation-adjusted gross profit, representing its contribution to total global emissions and emissions intensity. This is compared with a global economy-wide emissions intensity pathway required for achieving below 2°C of warming.

The scenarios used in GEVA assessments are Representative Concentration Pathway (RCP) scenarios used in the AR5 report from the IPCC. These provide GEVA assessment parameters consistent with 2°, 3°, 4°, and 5°C of warming.

### **Assessment horizon and data sources:**

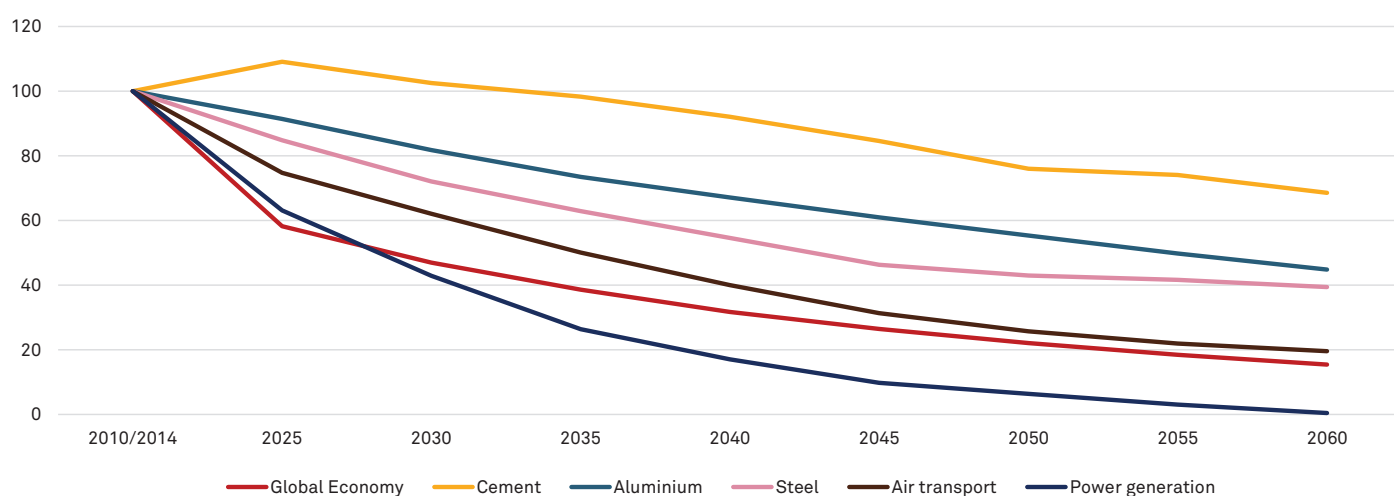
Transition pathways assessed incorporate both historical and forward-looking data in order to provide an assessment that has a medium term outlook. This minimizes the uncertainties involved in using only forward-looking data, and is of a sufficient time horizon to make the effect of any year-to-year volatility less significant. Historical data on greenhouse gas emissions and company activity levels is incorporated from a base year of 2012. Forward-looking data sources are used to track likely future transition pathways beyond the most recent year of disclosed data through to 2023. Forward-looking data is incorporated based on an established data hierarchy made up of the following sources:

1. Disclosed emissions reduction targets.
2. Asset-level data sources that provide signals of potential future changes in production from high-emitting sources.
3. Company-specific historical emissions trends for companies assessed on the basis of homogeneous business activities.
4. Subindustry-specific average historical emissions trends for companies assessed on the basis of heterogeneous business activities.
5. No change in emissions intensity beyond the latest year.

The portfolio assessments use combined Scope 1 and Scope 2 emissions as the assessment boundary.

The chart below illustrates the different decarbonization pathways for the five sectors covered in the SDA approach, as well as that used for the remaining sectors in the GEVA approach ('Global Economy' in the legend). Each sector's unique intensity unit has been indexed to 100 to allow for easy comparison. Sectors in which carbon saving technologies and/or processes are most cost effective are expected to decarbonize more rapidly, and terminate on a lower overall intensity, than sectors where such measures are not. For example, carbon intensity reductions are expected to be greater in the field of power generation than cement production.

## 2 Degree Aligned Decarbonization Pathways per Sector





# Appendix

## 6. Unpriced Carbon Costs

Trucost has assembled a database of publically available information on current carbon prices across over 44 jurisdictions as of January 2017. The Unpriced Cost of Carbon (UCC) is the estimated additional financial cost per tonne of greenhouse gas emissions in a future year. It is the difference between current carbon prices and possible future carbon prices for a given sector, geography and year.

Rising carbon prices entail direct financial implications for businesses where regulations impose a higher price on greenhouse gas emissions from the direct operations of the business. Companies also face indirect financial risks associated with the pass-through of rising carbon prices applied to the emissions of suppliers who in-turn seek to recover the additional regulatory costs in part or in full through increased prices. Pass-through factors are used to estimate the proportion of the increased carbon prices on scope 2 emissions that are passed through from suppliers to companies.

The Carbon Price Risk Premium varies by geography due to government policy differences, and by sector due to the differential treatment of sectors in many climate change policies. The sectors are based on OECD's research and includes:

- |                              |   |
|------------------------------|---|
| 1. Agriculture and Fisheries | 5. Offroad Transport                      |
| 2. Electricity               | 6. Residential and Commercial Real Estate |
| 3. Industry                  | 7. Road Transport                         |
| 4. Air Transportation        |   |

Each of Trucost's 464 business activities have been mapped to one of these seven categories.

### SCENARIOS:

#### High Carbon Price Scenario:

This scenario represents the implementation of policies that are considered sufficient to reduce greenhouse gas emissions in line with the goal of limiting climate change to 2°C by 2100 (the Paris Agreement). This scenario is based on research by OECD and IEA.

#### Medium Carbon Price Scenario:

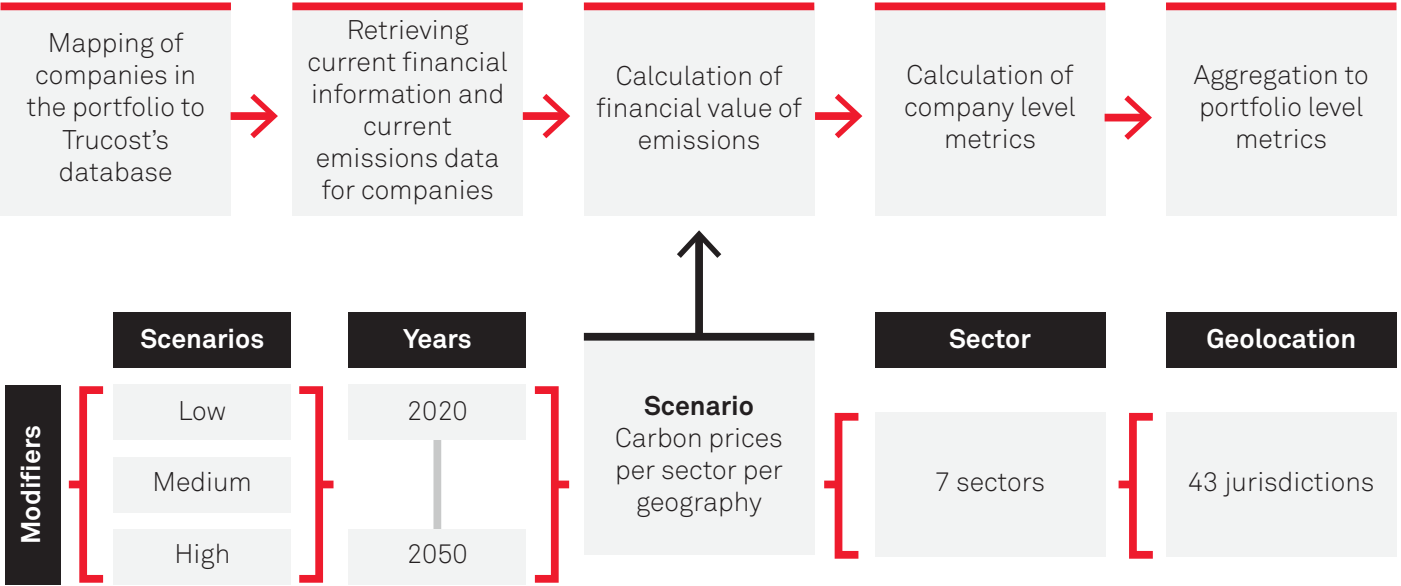
This scenario assumes that policies will be implemented to reduce greenhouse gas emissions and limit climate change to 2 degrees Celsius in the long term, but with action delayed in the short term. This scenario draws on research by OECD and IEA along with assessments of the sufficiency of country Nationally Determined Contributions by Climate Action Tracker by Ecofys, Climate Analytics and New Climate Team. Countries with Nationally Determined Contributions 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.

Low Carbon Price Scenario:

This scenario represents the full implementation of country Nationally Determined Contributions under the Paris Agreement, based on research by OECD and IEA.

Which Carbon Price Risk Premium is applicable for individual companies will depend on the choice of scenario, companies' sector of operations as well as their geographical exposure. The analysis covers Trucost's standard 464 sectors used for classification of companies that were mapped to the sectors based on OECD's classification for carbon pricing. The geographical exposure to different Carbon Price Risk Premiums is derived based on companies' geographical emissions as reported through the Carbon Disclosure Project (CDP). In case companies do not report to the CDP, Trucost uses the geographical breakdown of companies' revenues as a proxy for emissions' distribution. Together the sector exposure and country level emissions profiles allow for a very granular level bottom up calculation of carbon price risk exposure.

Schema for the Application of UCC to a Portfolio:



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