

Trucost Carbon Earnings at Risk (CEaR)

Methodology

S&P Global Sustainable1 – July 2024



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Terms and Definitions

Carbon Price Risk Premium: The Carbon Price Risk Premium is the difference between the current price paid per metric ton of greenhouse gas emissions and the possible future price for a particular sector/geography/scenario/year combination. It is a factor by which to multiply location-based company **Scope 1 and Scope 2 emissions to determine a company's Unpriced Carbon Cost.**

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 included are: Agriculture and Fisheries, Electricity, Industry, International Aviation, Offroad Transport, Residential and Commercial Real Estate as well as Road Transport. Carbon Price Risk Premiums are available for 44 regions (42 countries, "other countries", Hong Kong and Macau).

EBIT: Earnings before interest and tax.

EBITDA: Earnings before interest, tax, depreciation and amortization.

EBIT(DA) Margin: Assessment of a company's operating profitability (using EBIT or EBITDA) as a percentage of its total revenue.

EV: A company's enterprise value is a measure of its total value, calculated as the market capitalization plus debt, minority interest and preferred shares, minus total cash and cash equivalents.

Valuation Multiples: Metrics used for estimating a value and type (e.g. growth/value) on a relative basis of a company. The analysis currently uses EV/EBIT and EV/EBITDA multiples.

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Introduction and Context

Research by leading institutions find that carbon prices in the most advanced economies will need to increase to around \$140 per ton by 2030 if the parties are to meet the goals of the Paris Agreement¹. Measures to increase the costs of carbon-emitting activities are transforming the underlying economics to favor lower-carbon technologies and products across all sectors, but especially in carbon-intensive industries.

In 2023, 52 national jurisdictions and 42 subnational jurisdictions, representing almost the totality of global GHG emissions, implemented some sort of carbon pricing mechanism². The number of companies incorporating the potential impact of this in their risk management processes increased by 80% over a five-year period: in 2020, over 2,000 companies were pricing their emissions to manage carbon price risk³.

In 2017, S&P Global Sustainable1 (S1) launched the Corporate Carbon Pricing Tool in order to help businesses understand their potential exposure to future carbon price increases. The tool helps companies to set internal carbon prices aligned to regional policy trends based on their sector and geographical exposure. This enables them to stress test their financials and their capacity to withstand regulatory pressure and pass through costs, benchmark their exposure to regulation against competitors, or prioritize low carbon innovation in locations where the potential exposure is more material. S1 has developed a dataset of scenario-based future and current carbon prices based on present emission trading schemes, carbon and fossil fuel taxes.

This dataset serves as a foundation for Sustainable1's Carbon Earnings at Risk dataset, which was developed for the investment community to address two key best practice requirements outlined by the TCFD: conducting scenario analysis and developing forward-looking estimates of financial risk. The analysis assesses the potential impact to company earnings today, if companies had to pay a future price for their greenhouse gas emissions.

This document outlines S1's approach to analyzing equity and debt portfolios with respect to potential earnings at risk. The methodology allows investors to measure the potential carbon price risk exposure associated with holdings' Scope 1 and 2 emissions.

S1's Carbon Earnings at Risk analysis enables market participants to:

- Examine the potential financial impact of carbon prices at a constituent and portfolio level under a range of scenarios.
- Report forward-looking estimates of financial risk.
- Distinguish carbon price risk from broader carbon risk such as physical risks or possible stranded assets.
- Assess results against a chosen benchmark.

¹ IEA. (2023). World Energy Outlook 2023: <https://iea.blob.core.windows.net/assets/86ede39e-4436-42d7-ba2a-edf61467e070/WorldEnergyOutlook2023.pdf>

² The World Bank. (2023). Carbon Price Dashboard: <https://carbonpricingdashboard.worldbank.org/>

³ CDP. (2021). Putting a price on Carbon: <https://www.cdp.net/en/research/global-reports/putting-a-price-on-carbon/download>.

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Data Sources

S1 has utilized the following public and proprietary financial and environmental data sources to derive its analysis:

- The future carbon prices are determined by S1 based on the latest scenarios from the International Energy Agency (IEA) ⁴.
- Country and sector specific current carbon prices are determined by S1 based on data from World Bank⁵, OECD, International Carbon Action Partnership (ICAP)⁶ and other available sources.
- Financial data comes from a variety of sources such as S1 and S&P Global Market Intelligence: For EBIT, EBITDA and revenue, 3 year trailing averages are taken in order to smooth potential irregularities in financial performance.
- Companies' emissions are obtained from S1's Trucost Environmental database.
- Companies' geographical emissions breakdown is derived from public reporting to the Carbon Disclosure Project (CDP)⁷ or from revenues geographic breakdowns.

⁴ IEA. (2023). World Energy Outlook 2023: <https://iea.blob.core.windows.net/assets/86ede39e-4436-42d7-ba2a-edf61467e070/WorldEnergyOutlook2023.pdf>

⁵ The World Bank. (2023). Carbon Pricing Dashboard: https://carbonpricingdashboard.worldbank.org/map_data

⁶ ICAP (2024). ETS Map: <https://icapcarbonaction.com/en/ets-prices>.

⁷ CDP. (2023). Carbon Disclosure Project. Retrieved from: <https://www.cdp.net/en>

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Methodology Overview

Developing the Carbon Price Risk Premium

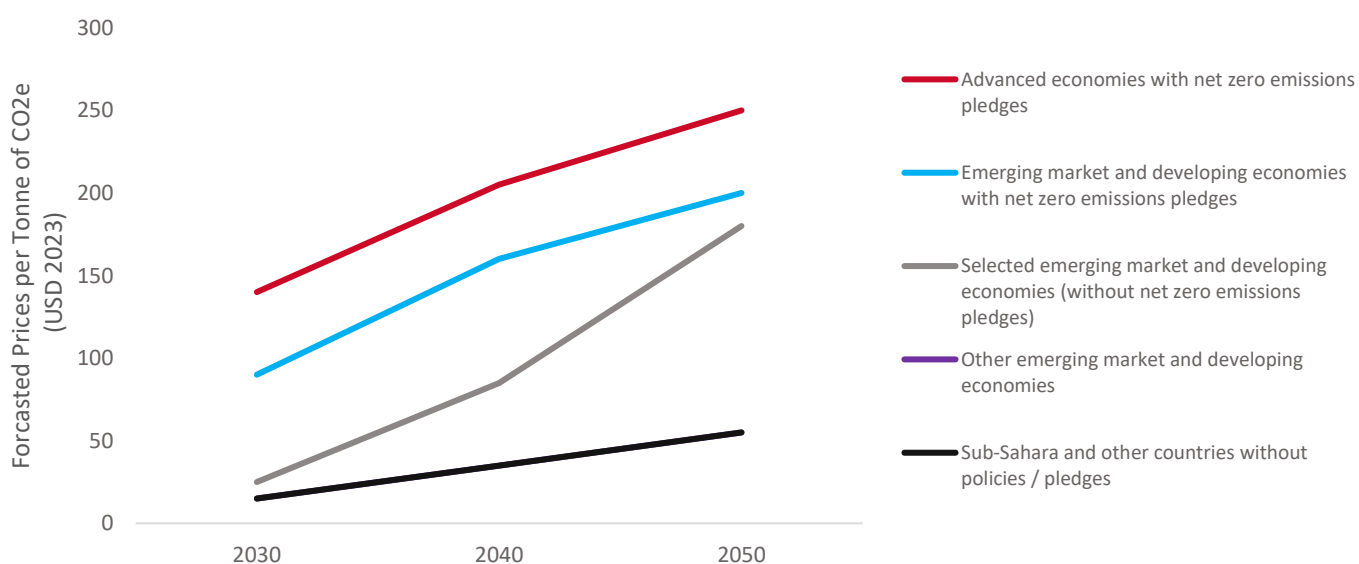
In creating the framework for the Carbon Earnings at Risk analysis, S1 has used its dataset of future carbon prices based on the latest scenarios from the International Energy Agency (IEA) and current carbon prices (e.g. global emissions trading schemes, fossil fuel and carbon taxes). The IEA scenarios are widely referenced, accepted and used by the market for scenario analysis purposes.

The approach deploys three possible scenarios:

- **High Carbon Price Scenario:** This scenario is aligned with the IEA's Net Zero Emissions (NZE) by 2050 Scenario and represents the implementation of policies that are considered sufficient to reduce greenhouse gas emissions in line with the goal of limiting climate change to 1.5°C by 2100 (the Paris Agreement) with 50% probability.
- **Medium Carbon Price Scenario:** This scenario is aligned with the IEA's Announced Pledges Scenario (APS) and assumes that governments will meet in full- and on-time pledges to reduce greenhouse gas emissions and limit climate change to 1.7 degrees Celsius by 2100 (with a 50% probability).
- **Low Carbon Price Scenario:** This scenario is aligned with the IEA's Stated Policies (STEPS) Scenario, which looks at what countries are doing in practice and can be accordingly regarded as a business as usual (BAU) scenario. This scenario is associated with a temperature rise of 2.4 degrees Celsius by 2100 (with a 50% probability)

Error! Reference source not found. and Table 1 show the projected future carbon price for selected scenarios and years.

Figure 1: Potential future carbon price trajectories in the High Carbon Price Scenario



Source: Sustainable1. Graph is provided for illustrative purposes.

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Table 1: Sample Future Carbon Prices by Country Group and Scenario

<i>USD 2023 per tonne of CO2</i>				
High	2025	2030	2040	2050
Advanced economies with net zero emissions pledges	108	140	205	250
Emerging market and developing economies with NZE pledges	55	90	160	200
Selected emerging market and developing economies (without NZE pledges)	13	25	85	180
Other emerging market and developing economies	8	15	35	55
Sub-Saharan and other countries without NZE policies / pledges	8	15	35	55
<i>USD 2023 per tonne of CO2</i>				
Medium	2025	2030	2040	2050
Advanced economies with net zero emissions pledges	104	135	175	200
Emerging market and developing economies with NZE pledges	25	40	110	160
Selected emerging market and developing economies (without NZE pledges)	0	0	17	47
Other emerging market and developing economies	0	0	17	47
Sub-Saharan and other countries without NZE policies / pledges	0	0	0	0
<i>USD 2023 per tonne of CO2</i>				
Low	2025	2030	2040	2050
Advanced economies with net zero emissions pledges	75	97	115	126
Emerging market and developing economies with NZE pledges	18	29	72	101
Selected emerging market and developing economies (without NZE pledges)	0	0	7	24
Other emerging market and developing economies	0	0	7	24
Sub-Saharan and other countries without NZE policies / pledges	0	0	0	0
Country/Region specific				
<i>Canada</i>	100	130	150	155
<i>Chile, Colombia</i>	7	13	21	29
<i>China</i>	17	28	43	53
<i>European Union</i>	92	120	129	135
<i>Korea</i>	33	42	67	89

NZE: Net Zero Emissions

Advanced economies with net zero emissions pledges: OECD countries except Mexico.

Emerging market and developing economies with net zero emissions pledges: China, India, Indonesia, Brazil and South Africa

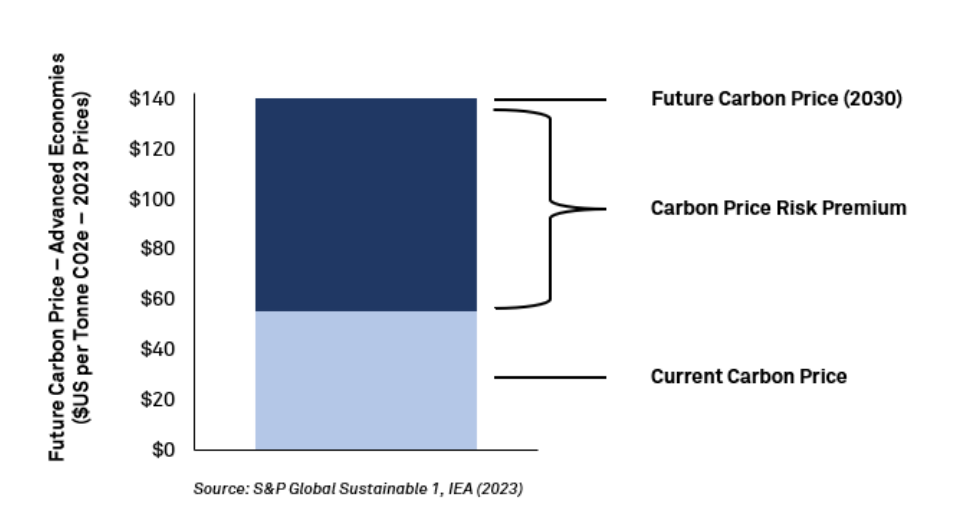
Selected emerging market and developing economies (without net zero emissions pledges): North Africa, Middle East, Russia and Southeast Asia (excluding Indonesia)

Source: IEA, 2023; Sustainable1 Analysis

When assessing potential risks under a certain scenario, the focus is not primarily in the future carbon price, as part of this carbon price is already embedded in current regulations and costs of a business. The risk is rooted in the additional costs, termed by S1 as ‘the Carbon Price Risk Premium’. This Carbon Price Risk Premium, which varies by sector, geography, year and scenario, reflects the additional financial cost paid (per metric ton of emissions) from the price that is currently paid, due to potential future pricing or tax increases.

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Figure 2: The Carbon Price Risk Premium represents the cost increase from an existing price under a specific scenario



Source: Sustainable1. Chart is provided for illustrative purposes.

Rising carbon prices will have 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, as suppliers seek to recover the additional regulatory costs in part or in full through increased prices. S1 has reviewed published research on the ability of the Utilities sector to pass through carbon costs in the form of higher electricity prices. This review has been used to estimate the proportion of the increase in carbon prices on scope 2 emissions that are passed from suppliers to companies and has been incorporated into the dataset.

Applying the Carbon Price Risk Premium in Portfolio Carbon Risk Analysis

In order to quantify a company's potential exposure to carbon price increases, it is necessary to understand what sector it operates in and in what jurisdictions it is emitting greenhouse gases. For sector mapping, S1's standard 464 sectors have been mapped to the Organization for Economic Cooperation and Development (OECD)'s sector classification for carbon pricing⁸:

1. Agriculture and Fisheries
2. Commercial and Residential Real Estate
3. Electricity
4. Industry
5. International Aviation
6. Offroad Transport
7. Road Transport

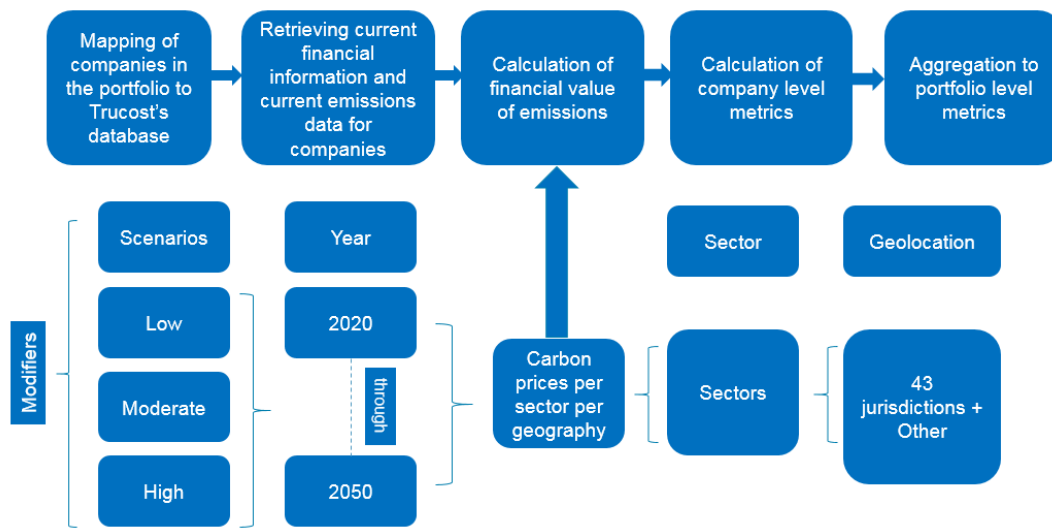
⁸ OECD/IEA. (2016). Effective Carbon Rates. Retrieved from Pricing CO2 through Taxes and Emissions Trading Systems. Retrieved from: <http://www.oecd.org/tax/effective-carbon-rates-9789264260115-en.htm>

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A company's primary S1 sector determines its OECD sector classification. A company's geographical emissions are taken from reported data to the Carbon Disclosure Project (CDP)⁹. Where companies do not report to the CDP, S1 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 granular-level bottom-up calculation of carbon price risk exposure. Applying the relevant Carbon Price Risk Premiums to companies' Scope 1 and Scope 2 emissions determines the total company-level Unpriced Carbon Cost.

International Aviation Risk Premiums are calculated as an average of the Global Aviation risk premiums and country-specific Off-Road Transport risk premiums (which include domestic aviation).

Figure 3: The process of Carbon Earnings at Risk analysis



Source: S&P Global Sustainable1

⁹ CDP. (2023). Carbon Disclosure Project. Retrieved from: <https://www.cdp.net/en>

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Portfolio Aggregation

Portfolio Carbon Earnings at Risk analysis requires the aggregation of each holding's impact to the portfolio level. Below are two different methodologies that are used in the analysis.

Portfolio's Impact and 'Exposure':

S1 calculates the percentage of the Unpriced Carbon Cost an investor is exposed to ('apportionment factor') based on the share of holdings in the companies' market capitalization or enterprise value. 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 and associated risks. The portfolio level resources and associated risks are the sum of all these quantities.

Portfolio's Weighted Exposure:

For the remainder of the portfolio metrics, we use a Weighted Average approach. This approach assesses the portfolio's relative exposure to carbon price risk by investment weight (% of total value invested in the portfolio). The weighted average aggregation of individual companies' earnings at risk helps to bring higher risk exposures to the surface and shed light on whether the portfolio has too much of its value invested in these companies.

Portfolio Carbon Earnings at Risk Indicators

The table below describes each of the financial metrics included in the Carbon Earnings at Risk analysis, available for all major world currencies. All metrics are available using a weighted-average methodology, with the exception of the Unpriced Carbon Cost, which is presented on an apportioned basis. Besides the below impact metrics, the analysis also provides insights into the portfolio's relative performance against a chosen benchmark.

Table 2: List of major metrics and considerations

Metric	Description	Use Case
Unpriced Carbon Cost	The total additional costs arising (in)directly in a scenario/year for a particular company	At the company and site level, location-based Unpriced Carbon Cost can serve as inputs for deeper analysis of financial risk implications
Apportioned Unpriced Carbon Cost	The Unpriced Carbon Cost multiplied by the percentage ownership an investor holds in a company	The apportioned Unpriced Carbon Cost offers investors a view as to the relative risk exposure of each of their holdings as well as an approach for reporting forward-looking estimates of financial risk that aligns with TCFD guidelines

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EBIT(DA) at risk	The percentage of Earnings at Risk due to Unpriced Carbon Cost	Highlights areas of risk across the portfolio and can be fed into financial analysis
Reduction of EBIT(DA) margins	Implied change in EBIT(DA) 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
Value of Holdings above a risk threshold	Total Value of Holdings where EBIT(DA) at risk is above a certain threshold (e.g. 10%)	Identifies companies that are facing the most significant carbon price risk across the portfolio
Change in multiples	Implied change in a valuation multiple due to reduced earnings in a scenario/year	Assessment of the overall implications on the valuations of companies
Top geographical, sector and emission scope exposure	Exposure to countries, sectors or scopes of emissions due to the apportioned Unpriced Carbon Cost	Assessment of hotspot areas within a portfolio

EBIT and EBITDA are preferred choices when it comes to selecting financials as proxies to measure risk exposure. On the one hand, carbon prices affect costs hence there is no direct link to revenues, but rather earnings. Yet not all earning indicators are suitable for use in this analysis. For example, net income is influenced by extraordinary items and financial costs. On the other hand, EBIT and EBITDA are indicators of core earnings capacity widely used by analysts for financial assessments and valuations. The preference between EBIT and EBITDA normally depends on the specific sectors, however one or the other should be used consistently in the analysis when calculating the metrics for a portfolio.

There are additional considerations to take into account with regards to the financials of the companies. Earnings can be volatile due to non-recurring costs or revenues, and increases in raw material costs that are not categorized in extraordinary items in the income statement. To smooth these possible volatilities, S1 uses the latest 3 year trailing averages of Revenue, EBIT and EBITDA when calculating earnings at risk metrics. Sustainable1 does not take forecasted EBIT(DA) data into account when quantifying Earnings at Risk.

Inputs

For Sustainable1 to calculate the Carbon Earnings at Risk portfolio footprint, just two inputs are required:

- Company identifiers (e.g. ISIN)
- Value of holdings or weights and the total value of holdings

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Monitoring and Review

All new methodologies and any material changes to existing methodologies are reviewed and approved by an independent methodology governance committee.

Assumptions and Limitations

- Future carbon prices are estimated based on hypothetical future scenarios and may not reflect the actual carbon price in future years. As such, the scenarios are not projections for the future and are used without a probability estimate for the actual policy pathways to materialize. Probability factors can be applied to the Unpriced Carbon Cost by clients based on their own views.
- Companies are classified according to their primary sector.
- Where no geographical breakdown of emissions is available, a proxy of geographical revenue is used. This proxy is not necessarily fully aligned with the locations of emissions production.
- Present-day financials and emissions are used throughout the analysis, without assumptions on future trajectories. Clients however can use constituent level Unpriced Carbon Cost data to integrate in their financial projections.

Maintenance/Updates

We periodically review our methodology as appropriate.

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Significant Updates

- July 2024: S1 adopted a new source of future carbon price projections – transitioning to the IEA 2023 future carbon price scenarios¹⁰ and retiring the previously used scenarios based on IEA and IRENA (2017)¹¹ and Climate Action Tracker¹². The updated future carbon price scenarios published by the IEA in 2023 reflect the most recent advances in global climate policy and changes in the economy and energy system.
- July 2024: S1 expanded the geographic coverage included in the carbon price database to reflect:
 - o Updated country specific current carbon price data sourced from the OECD and other sources¹³
 - o Updated country groupings for which the IEA projects future carbon prices in each of the three scenarios¹⁴.

¹⁰ EA. (2023). World Energy Outlook 2023. <https://iea.blob.core.windows.net/assets/86ede39e-4436-42d7-ba2a-edf61467e070/WorldEnergyOutlook2023.pdf>

¹¹ OECD/IEA. (2017). Perspectives for the energy transition. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Mar/Perspectives_for_the_Energy_Transition_2017.pdf.

¹² The Climate Action Tracker Consortium. Climate Action Tracker. <https://www.climateactiontracker.org/>.

¹³ OECD. (2023). <https://stats.oecd.org/?datasetcode=ecr>

¹⁴ IEA. (2023). World Energy Outlook 2023. <https://iea.blob.core.windows.net/assets/86ede39e-4436-42d7-ba2a-edf61467e070/WorldEnergyOutlook2023.pdf>

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Appendix: Carbon Price Database

The geographic coverage included in the carbon price database is summarized in Table 3 below.

Table 3: Sustainable1 Carbon Price Database: Geographic Coverage

Countries	Country Grouping
Argentina	Other emerging market and developing economies
Australia	Advanced economies with net zero emissions pledges
Austria	Advanced economies with net zero emissions pledges
Bangladesh	Sub-Saharan and other countries without policies / pledges
Belgium	Advanced economies with net zero emissions pledges
Brazil	Emerging market and developing economies with net zero emissions pledges
Burkina Faso	Sub-Saharan and other countries without policies / pledges
Canada	Advanced economies with net zero emissions pledges
Chile	Advanced economies with net zero emissions pledges
China	Emerging market and developing economies with net zero emissions pledges
Colombia	Advanced economies with net zero emissions pledges
Costa Rica	Advanced economies with net zero emissions pledges
Cote d'Ivoire	Other emerging market and developing economies
Cyprus	Advanced economies with net zero emissions pledges
Czech Republic	Advanced economies with net zero emissions pledges
Denmark	Advanced economies with net zero emissions pledges
Dominican Republic	Sub-Saharan and other countries without policies / pledges
Ecuador	Other emerging market and developing economies
Egypt	Selected emerging market and developing economies (without net zero pledges)
Estonia	Advanced economies with net zero emissions pledges
Ethiopia	Other emerging market and developing economies
Finland	Advanced economies with net zero emissions pledges
France	Advanced economies with net zero emissions pledges
Germany	Advanced economies with net zero emissions pledges
Ghana	Other emerging market and developing economies
Greece	Advanced economies with net zero emissions pledges
Guatemala	Other emerging market and developing economies
Hong Kong	Emerging market and developing economies with net zero emissions pledges
Hungary	Advanced economies with net zero emissions pledges
Iceland	Advanced economies with net zero emissions pledges
India	Emerging market and developing economies with net zero emissions pledges
Indonesia	Emerging market and developing economies with net zero emissions pledges
Ireland	Advanced economies with net zero emissions pledges
Israel	Advanced economies with net zero emissions pledges
Italy	Advanced economies with net zero emissions pledges
Jamaica	Sub-Saharan and other countries without policies / pledges
Japan	Advanced economies with net zero emissions pledges
Kenya	Other emerging market and developing economies
Korea, Rep.	Advanced economies with net zero emissions pledges
Kyrgyzstan	Sub-Saharan (Excluding South Africa) and Other Asian countries without pledges
Latvia	Advanced economies with net zero emissions pledges
Lithuania	Advanced economies with net zero emissions pledges
Luxembourg	Advanced economies with net zero emissions pledges
Macau	Emerging market and developing economies with net zero emissions pledges
Madagascar	Sub-Saharan and other countries without policies / pledges
Malaysia	Selected emerging market and developing economies (without net zero pledges)

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Mexico	Selected emerging market and developing economies (without net zero emissions pledges)
Morocco	Selected emerging market and developing economies (without net zero pledges)
Netherlands	Advanced economies with net zero emissions pledges
New Zealand	Advanced economies with net zero emissions pledges
Nigeria	Other emerging market and developing economies
Norway	Advanced economies with net zero emissions pledges
Panama	Other emerging market and developing economies
Paraguay	Other emerging market and developing economies
Peru	Other emerging market and developing economies
Philippines	Selected emerging market and developing economies (without net zero pledges)
Poland	Advanced economies with net zero emissions pledges
Portugal	Advanced economies with net zero emissions pledges
Russian Federation	Selected emerging market and developing economies (without net zero pledges)
Rwanda	Sub-Sahara and other countries without policies / pledges
Singapore	Advanced economies with net zero emissions pledges
Slovak Republic	Advanced economies with net zero emissions pledges
Slovenia	Advanced economies with net zero emissions pledges
South Africa	Emerging market and developing economies with net zero emissions pledges
Spain	Advanced economies with net zero emissions pledges
Sri Lanka	Other emerging market and developing economies
Sweden	Advanced economies with net zero emissions pledges
Switzerland	Advanced economies with net zero emissions pledges
Turkey	Advanced economies with net zero emissions pledges
Uganda	Sub-Sahara and other countries without policies / pledges
Ukraine	Other emerging market and developing economies
United Kingdom	Advanced economies with net zero emissions pledges
United States	Advanced economies with net zero emissions pledges
Uruguay	Other emerging market and developing economies

Source: S&P Sustainable 1 Analysis

“Not Included” means that there are no country specific carbon price data

For those countries not included in the database, the CEAR dataset will continue to use a category called Other, in which risk premiums are determined as the average of the available country specific’ risk premiums, weighted by each country’s GDP.

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