Rio Tinto

Scope 1, 2 and 3 Emissions Calculation Methodology

2023 Addendum

Introduction

Our *Scope 1, 2 and 3 Emissions Calculation Methodology* is a technical guide to our greenhouse gas (GHG) emissions reporting, where we provide additional information to underpin the integrity of the reported data.

In 2023, we updated and restated our Scope 2 emissions reporting and made minimal change to the foundations of our Scope 1 and Scope 3 calculation methods. As such, for 2023 we have produced an Addendum to our *2022 Scope 1, 2 and 3 Emissions Calculation Methodology* (the 2022 Methodology Report) outlining the key changes applied during the year, as the majority of the technical accounting detail in 2022 is still current and relevant. This 2023 Addendum should be read in conjunction with the 2022 Methodology Report.

About Scope 1, 2 and 3 emissions

Scope 1 emissions are direct emissions from our operations including process emissions and emissions from fuel use. Scope 2 emissions are from using purchased electricity and steam in our operations. Scope 3 value chain emissions are upstream and downstream from our operations generated by our suppliers and customers.

Scope 3 emissions calculation methods have improved over the past three years, with notable step changes in accuracy for:

- Marine shipping: moving a significant portion of reporting to more accurate fuel-based methods
- Higher emission consumables and raw materials: moving to quantity-based calculations
- Processing of bauxite and alumina: moving to site-specific and customer-specific models.

We have continued to work on the precision of our reporting, incorporating more fuel-based transport, supplier travel and customer data. Our procurement team reviewed the emissions factors and taxonomy for our business spend categories and vendor allocations which we rely on for Category 1 & 2. We have also been working to reduce the number of estimates and improve the assumptions used.

Please refer to our *2023 Climate Change Report* and *2023 Sustainability Fact Book* for the full set of emissions tables.

Scope 1 and 2 reporting

We now report additional energy emissions in the *2023 Sustainability Fact Book* to further align with the *GHG Protocol Corporate Standard*. This includes disclosure of Scope 1 emissions by GHG type separately, dual market-based and location-based Scope 2 reporting, and inclusion of biogenic CO_2 emissions from use of renewable fuels.

Scope 1 and 2 reporting is split by global decarbonisation program and by product group.

Scope 2 reporting review

In 2023, we updated our Scope 2 reporting methodology to enhance the integrity and transparency of our reporting GHG emissions from purchased electricity.

This review aligns our Scope 2 reporting with the principles of relevance, completeness, consistency, transparency and accuracy outlined in the GHG Protocol Scope 2 guidance document, an amendment to the GHG Protocol Corporate Standard (the Scope 2 Guidance). The Scope 2 Guidance recommends dual reporting of corporate Scope 2 emissions with both:

- Market-based methods accounting for commercial decisions to purchase the rights to renewable units of power
- Location-based Scope 2 reporting that reflects the location of the operation and the electricity intensity of the grid.

Most of our sites have been in operation and reporting GHG emissions prior to the existence of renewable energy markets in the countries they are located and before Scope 2 reporting was differentiated into two methodologies. Historically, our Scope 2 emissions factors have been either a supplier's electricity generation intensity or a location-based factor, whichever was seen to be more accurate and representative of the electricity supply. When local regulatory reporting evolved and set standards, Rio Tinto aligned corporate and local reporting to those requirements such as an update to state-based National Greenhouse and Energy Reporting (NGER) factors in 2009 in Australia.

Our review and standardisation to market-based and location-based Scope 2 reporting is intended to update our methodology using the latest available reporting guidance while keeping up with an increasing focus on greater emissions transparency in corporate disclosures.

As part of the extensive review of our Scope 2 reporting across assets in 35 countries, we worked with external consultants to identify the existing renewable energy markets in each country, to establish their boundaries and determine what residual mix factors (RMFs) were available in each country. An RMF is the emissions intensity from the mix of electricity generation sources within a boundary after the contractual rights to zero emissions claims have been deducted. These are typically used for market-based Scope 2 reporting when the emitter does not hold the rights to energy attribute certificates (also known as renewable energy certificates (RECs)) for the relevant power supply. Our review identified some issues with the availability and quality/comparability of market-based RMFs in some areas. While markets are still evolving, so too are the maturity of the factors.

The selection of emissions factors for market-based Scope 2 reporting, follow the selection hierarchy as set out in the Scope 2 Guidance. A brief summary of this hierarchy is below:

Emission factor	Example
Energy attribute certificates or equivalent	Contracted RECs
Contracts conveying the renewable rights	Contracts with attributes in regions where certificates don't exist
Supplier/utility rates	Emission rate given to retail electricity users for entire energy supply
Residual mix factors	Generation intensity that factors out energy attribute purchases
Grid-average emission factors	International Energy Agency national factors

Determining the emissions factors at our operations

In respect of energy purchases where Rio Tinto and associated joint venture partners have exclusive contractual claims over energy attributes, zero market-based emissions are reported. In these cases, RECs are being purchased and surrendered equivalent to the quantity of electricity supplied. In 2023 reporting, this relates to Escondida Copper, Resolution Project, Oyu Tolgoi and Kennecott Utah Copper facilities.

To calculate Scope 2 emissions at Richards Bay Minerals, we use emissions factors published by the South African utility Eskom.

Where we haven't purchased the energy attribute certificate we use RMFs selected from publicly available and reputable sources like European Association of Issuing Bodies (AIB) by country, and Green-e factors available for internal USA grids.

For Iceland, almost 100% of electricity generated in the country is from renewable sources (primarily hydro-power) and consequently has a very low location-based emissions factor. Although Iceland's grid is not physically connected to Europe, it is part of the European Energy Certificate System that allows the sale of energy attributes of renewable energy into Europe. We have not purchased the energy attribute certificates and so for market-based reporting use the RMF for Iceland that is provided by the National Energy Authority of Iceland (NEA). This RMF is similar to the overall European mix factor which includes large amounts of electricity generated from fossil fuels. Given this, although ISAL (our aluminium smelter in Iceland) has not changed physical electricity supply, the site has seen a significant increase in reported Scope 2 emissions when using the market-based method.

Where renewable energy markets are not in place, International Electricity Agency (IEA) country-based Scope 2 factors are used for applicable sites.

In Australia we have chosen to use more accurate and relevant state-based residual mix factors rather than use the country-based RMFs. Annual RMFs are not published in New Zealand yet and in Canada there are no recent annually reported RMFs available for use.

In Australia, NGER legislation requires the use of location-based factors within a state/territory boundary. One of the benefits of dual-reporting is to be able to compare purchasing decisions against grid emissions, so the location and market factors should be set on the same boundary. While state-based factors have been available and used in NGER reporting for over a decade, a single national RMF has been only recently published in NGER.

In order to align the boundary of the factors, equivalent state-based RMFs have been calculated by a third party consultant and independently assured by KPMG, our auditor. The calculations use reputable data sources including AEMO (Australian Energy Market Operator) data, that is adjusted for inter-state transfers and has deducted the quantity of RECs (LGCs in Australia) reported on the Government's REC Registry. This approach to calculating Scope 2 factors has been used for our Queensland, New South Wales and Tasmanian assets that are connected to the National Electricity Market. They are Bell Bay Smelter, Boyne Smelters, Gladstone Power Station, Tomago Smelter, Queensland Alumina and Yarwun Alumina Refineries.

Our New Zealand Aluminium Smelter is located in the far south of New Zealand's South Island. This part of the country predominantly generates electricity from hydro and other renewables and most of the time exports electricity to the North Island. An RMF for South Island was deemed to be more accurate and appropriate than the RMF for the whole country. This is calculated using publicly available data sources including the New Zealand Ministry of Business, Innovation & Employment and the New Zealand EMI Electricity Authority.

Our Canadian operations that import electricity from the grid are based in three provinces. For Quebec, we have used an RMF published by Hydro Quebec as the sole/dominant grid operator.

Implications for our metrics and targets

Today, our primary metric for Group emissions reporting is a market-based methodology. This methodology also enables a more accurate representation of commercial decisions such as electricity purchase contracts where the rights to the energy attributes and zero emissions sources are secured.

This change has increased our reported 2018 baseline emissions by 1.4Mt CO_2e to 34.5Mt CO_2e. This is predominantly the result of switching to the NEA RMF at ISAL from a hydro-power location-based emissions factor. ISAL continues to use the same electricity sources as in prior years, but the change reflects carbon accounting treatment changes in Europe. Our Australian smelters represent the next largest baseline increases. Previously, the reported Scope 2 emissions (using location-based factors) from these assets were falling due to the increasing penetration of renewable energy in the local markets. This is no longer reflected in the market-based method data used today.

KPMG has assured 2018-2022 Scope 2 location-based and market-based data and emissions factor selection to provide confidence with the restated numbers, and the selected emissions factors that have been applied. The 2023 Scope 1 and 2 data has been assured by KPMG as part of our annual assurance process (the assurance statement can be found in our *2023 Climate Change Report*).

As we progress towards our emissions targets, we exclude reductions achieved by divesting assets and increases associated with acquisitions and so also adjust our 2018 baseline. Following our acquisition of additional equity in the Oyu Tolgoi (OT) mine in late 2022 and the Mineração Rio do Norte (MRN) mine in late 2023, we have also adjusted our 2022 emissions total to compare our actual progress on abatement in 2023 relative to other changes at our operations.

2018 baseline emissions (Scope 1 and 2) Mt CO_2e

Combined basis emissions for 2018 and 2022 are both higher than previously reported in the 2022 Climate Change Report, reflecting portfolio equity changes.

Scope 3 reporting

Category 10 Processing of sold products: Iron Ore

The calculation of emissions for processing of iron ore uses a sophisticated steelmaking energy and mass balance model to estimate emissions from the BF/BOF (Blast furnace/Basic Oxygen Furnace) and DRI/EAF (Direct Reduced Iron in Electric Arc Furnace). This model uses the characteristics and quantities of our sold ore. These are split by our 12 iron ore products and are linked to the steelmaking technology each go into within the emissions calculations. The calculation model used in 2023 is the same as 2022, with updated production, grades, mineral chemistry and moisture content.

Below is the equivalent summary of the emissions factors breakdown provided in the 2022 Methodology Report for 2023 reporting. In 2022, the calculated emissions factor per tonne of attributable steel (tonnes CO_2e per tonne liquid steel) was 2.172 for iron ore shipments totalling 287.9Mt

Item	Range (by product)	Example (Pilbara Blend™ Fines)	Rio Tinto portfolio	Description
Iron ore production (million tonnes, equity share)				
2023 iron ore shipments (of sold product)[1]		**105**	**296.7**	We produce a range of iron ore products from our Pilbara and Iron Ore Company of Canada operations.
				Data sourced from Rio Tinto shipments data for the year ended 31 December 2022.
Processing iron ore to steel (million tonnes)				
2023 attributed steel production		**64.8**	**183.9**	By analysing the different characteristics of our products, including iron grade, minor elements and moisture, we have estimated the steel production attributable to our iron ore.
Processing of iron ore to steel – emission factor (tonnes CO_2e per tonne steel)				
Emissions associated with the production of coke	**0.12 – 0.17**	**0.16**	**0.15**	Emissions are estimated using average global grades of metallurgical coal and typical coke oven efficiencies.
Emissions associated with ore sintering	**0.04 – 0.64**	**0.54**	**0.43**	The sinter plant is primarily used to agglomerate fines ore. Lump and pellets are screened, with much of this product bypassing the sinter plant.
Emissions associated with the blast furnace	**1.31 – 1.54**	**1.36**	**0.21**	The energy required in the reduction of iron ore is the largest emissions contributor. Variations in these emissions are modelled relative to the iron content and gangue components of the ore.
Emissions associated with final processing in steel converter (BOF)	**0.21**	**0.21**	**0.21**	Emissions in the steel plant are reasonably consistent across our products.
Emissions per tonne of attributable steel (tonnes CO_2e per tonne liquid steel)		**2.27**	**2.174***	Emission factors sourced from our energy and mass balance modelling of iron ore processing.
				* Includes a contribution from DR pellets used in DRI+EAF process.
2023 iron ore value chain emissions (million tonnes CO_2e, equity share)				
Total Scope 3 GHG emissions from processing of iron ore (Mt CO_2e equity share)		**147**	**399.9**	Total estimated emissions from processing of our iron ore to produce steel.
				Calculated on a product basis by applying the specific product emission factors to the 2023 shipment volumes of each product.

1. Iron ore shipments are net of unsold product in portside trading facility.

Category 10 Processing of sold products: Aluminium

The calculation methodology for processing of bauxite and alumina used in 2022 incorporated a full value chain calculation of processing emissions from bauxite to alumina to aluminium for all of our assets. This comprehensive model has been used again for 2023 reporting. The changes made in 2023 comprise:

- an update to the 2023 actual emissions data relating to our joint venture assets for which we do not report Scope 1 and 2 emissions; and
- an update to CRU data from 2021 to 2022 factors. There have been no changes to our internal Life Cycle Assessment (LCA) and the published International Aluminium Institute LCA factors we use for the bauxite-to-alumina and alumina-to-aluminium quantity ratios.

Below are the quantities, conversion factors and intensities used for the 2023 reporting in an equivalent disclosure to 2022 Scope 3 reporting. For comparison, in 2022, the bauxite sales to third parties totalled 39Mt with 0.9Mt of bauxite purchased. Alumina sales totalled 4Mt with 1.2Mt purchased.

The table shows the methodology of emissions from bauxite and alumina sales in a simplified form.

Item	Calculation steps	Rio Tinto portfolio	Description
2023 sales (million tonnes, equity share)			
Bauxite sales		**39Mt**	Sales of bauxite to third parties.
Alumina sales		**4Mt**	Sales of alumina to third parties.
Conversion factors			
Bauxite: Alumina		**2.69**	International Aluminium Institute, Life Cycle Inventory (2022).
Alumina: Aluminium		**1.91**	International Aluminium Institute, Life Cycle Inventory (2022).
Processing-related emission factors (tonnes CO_2e per tonne of input material)			
Bauxite-to-alumina intensity (t CO_2e/t alumina)		**1.23**	CRU Group dataset (2022), global average (excluding Rio Tinto assets).
Alumina-to-aluminium intensity (t CO_2e/t aluminium)		**11.1**	CRU Group dataset (2022), global average (excluding Rio Tinto assets).
Total Scope 3 GHG emissions from processing of bauxite and alumina (Mt CO_2e equity share)		**129.8**	Total estimate emissions from processing of bauxite and alumina. This is reported in Category 10.
2023 purchases (million tonnes, equity share)			
Bauxite purchases		**0.08Mt**	Purchases of bauxite from third parties.
Alumina purchases		**0.91Mt**	Purchases of alumina from third parties.
Total Scope 3 GHG gas emissions from purchased bauxite and alumina (Mt CO_2e equity share)		**0.99**	Total Scope 3 estimate emissions from purchased bauxite and alumina. This is reported in Category 1.

Category 10: Processing of other sold products

There have been no changes to the factors and methods used to calculate Scope 3 Category 10 emissions from the remaining sold products. This includes salt, gypsum, molybdenum and other minerals products. Some additional minor minerals processing emissions were added to the inventory in 2023.

Category 1, 2 and 3: Purchased goods, services, capital goods & fuels

Rio Tinto has undergone a business wide taxonomy design update that affected the naming codes and grouping of operating and capital spend. The improvement program also worked to standardise vendor and material classifications against these codes. As a result, all spend-based reporting classifications were re-evaluated and re-mapped against the Quantis groupings and emissions factors.

The approach to calculating Scope 3 emissions for fuels uses quantity-based reporting with emission factors as referenced in the 2022 Methodology Report has not changed. There was a closer review of where transport of high emission purchased goods were categorised and the removal of some duplication of transport emissions in fuels where the transport was already included in the emissions factors used. Improvements in source data have improved accuracy of emissions from high emissions goods including coke, pitch, anodes, caustic, lime, explosives and alloys.

Category 4 and 9: Upstream and downstream transport and distribution

The majority of our Category 4 and 9 emissions comes from the marine shipping of our iron ore, bauxite and alumina products. This year there has been a large focus on extending the current fuel-based reporting of emissions from vessels, automating and improving robustness of the emissions calculations. The hierarchy of emissions calculation selection as described in the 2022 Methodology Report still applies where we use a hybrid approach applying the most accurate calculation method for each product movement.

For transport of purchased goods, these are difficult to separate out when using spend-based method as these are cradle-to-gate factors. For high emission goods we now have more actual information on transport of materials like caustic, coke and pitch. Whilst not large quantities compared to shipping our product, we have re-allocated these from Category 1 to Category 4.

The spend-based part of Category 4 was also re-evaluated as part of the spend taxonomy update and refreshed.

Summary of results

Scope 1, 2 and 3 (value chain) emissions 2023

Rio Tinto Scope 1, 2 and 3 (value chain) emissions 610.7Mt CO_2e (2023, equity basis)

This representation of our emissions shows the Scope 3 upstream emissions, Scope 1 and 2 emissions and the Scope 3 downstream emissions from our overall operations on an equity basis.

Upstream emissions 32.31Mt CO_2e	
Scope 3	**Mt CO_2e**
Cat 1 Purchased goods (spend data)	9.27
Cat 1 Bauxite and alumina purchases	0.99
Cat 1 Higher emission purchases (eg caustic, lime, explosives coke, pitch, anodes, alloys)	7.26
Cat 2 Capital goods	2.49
Cat 3 Fuels	4.72
Cat 4 Transport (includes Rio Tinto chartered vessels)	6.75
Cat 5, 6, 7 Waste, business travel and commuting	0.83

Scope 1 and 2 (market-based) emissions 32.6Mt CO_2e	
Scope 1 and 2	**Mt CO_2e**
Scope 1	23.3
Scope 2*	9.3

* Market-based method

Downstream emissions 545.74Mt CO_2e	
Scope 3	**Mt CO_2e**
Cat 9 Transport (includes customer chartered vessels)	2.44
Cat 10 Processing	
– Iron ore	399.9
– Bauxite and alumina	129.8
– TiO_2 feedstocks	4.9
– Copper	0.5
– Salt	7.0
– Other	1.2

Emissions (indicative) breakdown by Product Group

Product group	Upstream Scope 3 (Cat 1-3, 5-7 & Cat 4 spend) Mt CO_2e	Marine seaborne transport (Scope 3, Cat 4 & 9) Mt CO_2e	Logistics transport (Scope 3, Cat 4 & 9) Mt CO_2e	Scope 1 and 2 emissions Mt CO_2e	Processing of sold products (Scope 3) Mt CO_2e	Total Scope 1, 2 and 3 Mt CO_2e
Total	26.63	7.24	0.88	32.6	543.3	610.7
Iron ore (includes Pilbara Iron Ore and Dampier Salt)	6.0	4.8	0	3.2	395.0	409.0
Aluminium	13.2	1.9	0.4	24.2	129.8	169.5
Copper	3.0	0.02	0.08	1.0	0.5	4.7
Minerals (includes Iron Ore of Canada)	2.7	0.5	0.5	3.7	18.0	25.3
Other (includes shipping and corporate functions)	1.7	0	0	0.5	0	2.3

Data includes some rounding and approximations when apportioning between product groups.

Marine seaborne transport includes bulk marine shipping plus all seaborne vessels. Logistics transport includes all land based transport.