Rio Tinto

Scope 1, 2 and 3 emissions calculation methodology 2020

About this document

This document describes the approach used in the preparation of our 2020 Scope 1, 2 and 3 greenhouse gas (GHG) emissions inventory.

Scope 1 emissions are direct GHG emissions from operations in which we have an equity interest. **Scope 2** emissions are indirect emissions from the generation of purchased energy at these operations. Our 2020 Scope 1 and 2 emissions data is reported and disclosed in detail in our Climate Change Report. Details of how our Scope 1 and 2 emissions inventories were prepared, along with details outlining how our 2030 climate targets are calculated, are included in this report.

Scope 3 emissions are indirect GHG emissions generated as a result of activities undertaken either upstream or downstream of our operations. To identify and calculate Scope 3 emission sources across our operations, we have used the *World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) , Greenhouse Gas (GHG) Protocol: A Corporate Accounting and Reporting Standard (Revised Edition) (2015), GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2013) and the Technical Guidance for Calculating Scope 3 Emissions (version 1.0).* Available at *https://ghgprotocol.org/*

The 2020 Scope 3 emissions inventory has been prepared on an equity basis, taking in to account Rio Tinto's relevant interest in all managed and non-managed operations.

The Scope 3 Standard divides Scope 3 emissions into fifteen categories covering activities both upstream and downstream of our operations.

Of these categories, Category 10 – *Processing of Sold Products* – accounts for almost 97% of the identified emissions across our value chains. Accordingly, this report focuses on the calculation boundary, methodology and data sources used to estimate these emissions.

We estimated emissions from downstream processing of iron ore, bauxite, alumina, titanium dioxide and copper concentrate using a combination of internal emissions modelling, regional and industry level emissions factors and internal production and shipments data. We engaged an independent external assurance organisation PricewaterhouseCoopers to provide the directors of Rio Tinto with assurance on the Scope 3 emissions estimates related to processing of these sold products and other selected subject matter set out in this report.

With the support of EY, we evaluated the remaining categories that make up the balance of our Scope 3 emissions and, where applicable, we have produced estimates for each category using the most appropriate methodologies. Notably, we have reported zero emissions for Category 11 – *Use of Sold Products*, as we do not mine coal or extract oil and gas.

The methodology and inventory presented in this report provide relevant details related to the emissions in our operations and value chains, as published in the Rio Tinto Annual Report 2020, Our Approach to Climate Change 2020, all available at riotinto.com/invest/reports.

Contents

Scope 1 and 2 emissions

Organisational boundary

Rio Tinto plc and Rio Tinto Limited combined (Rio Tinto) use Scope 1 and Scope 2 emissions definitions that are consistent with the *World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) , Greenhouse Gas (GHG) Protocol: A Corporate Accounting and Reporting Standard (Revised Edition) (2015).* Available at *https://ghgprotocol.org/.* This standard defines Scope 1 greenhouse gas emissions as direct greenhouse gas emissions from facilities owned or controlled by an operator, including fuel use, on-site electricity generation, anode and reductant use, process emissions and land management. Greenhouse gas emissions from the generation of electricity, heat or steam brought in from third parties are defined as Scope 2 (indirect emissions).

Scope 1 and 2 emission factors for our Australian operations are consistent with the *Australian National Greenhouse and Energy Reporting (Measurement) Determination 2008.* For non-Australian operations, factors from the *Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (2006)* are used for Scope 1, and where possible factors for Scope 2 are sourced from electricity supplier' or the appropriate regional and sub-regional factors.

Consolidating Greenhouse Gas (GHG) Emissions Data

Up until 2018, we reported our greenhouse gas emissions using the operational control approach. As part of introducing new targets in 2020 we have moved from an equity approach which included re-stating our 2018 baseline on an equity basis.

Where we do not have operational control, we work with the relevant operators to source emissions data. If we are unable to source data for a full-year, we estimate data using the trend in available data and / or observable comparable data at any of our managed operations.

Scope 1 and 2 - 2030 target calculation methodology

In 2019, we looked at our operations in detail to explore emission reduction opportunities for each asset and developed corresponding marginal abatement cost curves. This comprehensive work informed our 2030 targets which are to reduce our emissions intensity by 30% and our absolute emissions by 15%, measured against a baseline of 2018.

We use the equity share approach for consolidating our total Scope 1 and 2 GHG emissions, to which we apply the benefit of our use of valid offsets. This approach applies to both absolute and intensity calculations, where our equity share of production from managed and non-managed operations is used when determining our GHG emissions intensity. In order to account for the different commodities across our business, our production is calculated on a copper equivalent basis.

Each year we will provide details on our performance against these targets by reporting the percentage change for the relevant year compared to our emissions baseline in 2018.

In specific circumstances we may apply appropriate adjustments to the 2018 baseline data. Acquisitions and divestments will result in a commensurate adjustment to the baseline to include (acquisition) or exclude (divestment) the relevant operation from the baseline. Permanent closure of assets will not result in any adjustment to the baseline. Similarly, we will not adjust the baseline if our global production increases from the expansion of existing operations or new projects, such as Winu in Australia or Jadar in Serbia. These growth projects are expected to be carbon neutral overall so that we can deliver against our absolute and intensity targets.

The **control approach** accounts for 100% of GHG emissions from operations where we have operational control (managed operations). GHG emissions from operations that are not controlled by Rio Tinto (non-managed operations) are excluded from the consolidation.

The **equity share approach** accounts for all GHG emissions in accordance with our share of equity in an operation, which includes managed and non-managed operations.

Managed and non-managed emissions

Scope 1 and 2 emissions summary

Scope 1&2 emissions - Equity basis

Total equity greenhouse gas emissions - million tonnes carbon dioxide equivalent (Mt CO_2-e)	2020	2019	2018
Total Emissions	**31.5**	31.5	32.6*
Scope 1 Emissions	**22.8**	23.1	23.8
Scope 2 Emissions	**8.7**	8.3	8.8

2020 equity greenhouse gas emissions by product group (Mt CO_2-e)	Scope 1 emissions (Mt CO_2-e)	Scope 2 emissions (Mt CO_2-e)	Total emissions (Mt CO_2-e)
Aluminium	15.8	6.0	21.8
Aluminium (Pacific)	4.6	5.4	10.1
Aluminium (Canada)	5.2	0.1	5.3
Bauxite & Alumina	6.0	0.5	6.4
Energy & Minerals	2.4	1.2	3.6
Iron Ore	3.0	0.0	3.0
Copper & Diamonds	1.2	1.5	2.7
Other (includes Growth & Innovation and corporate functions)	0.5	0.0	0.5
Rio Tinto	**22.8**	**8.7**	**31.5**

Scope 1&2 emissions & energy - 100% managed basis

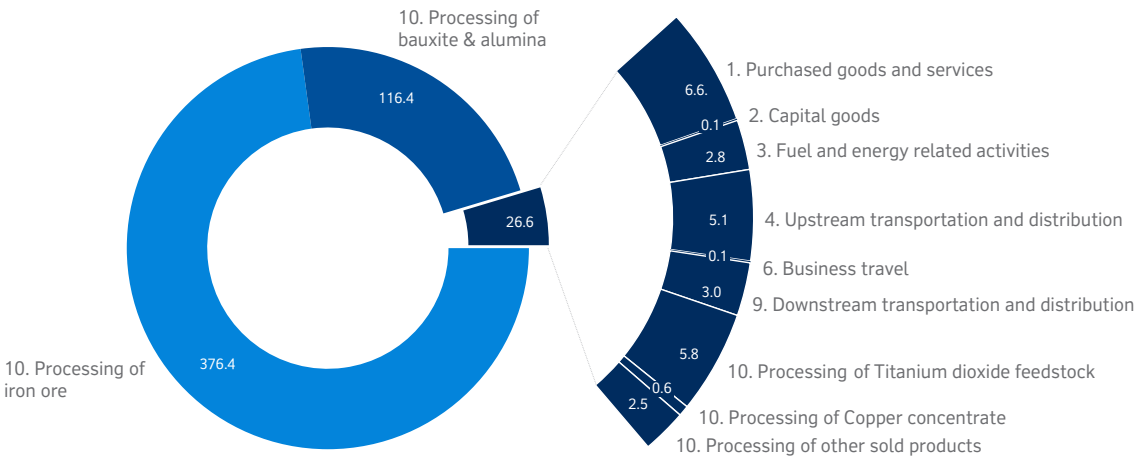
Total managed greenhouse gas emissions (Mt CO_2-e)	2020	2019	2018	2017	2016	2010
Total managed greenhouse gas emissions (Mt CO_2e)	**26.2**	26.4	28.5	30.6	32.0	43.0
Total managed energy (PJ)	**402**	406	425	440	458	

Note: Total managed GHG emissions equal the sum of scope 1 emissions and scope 2 emissions minus the scope 1 emissions resulting from the supply of electricity and steam to third parties minus net carbon credits voluntarily purchased from, or sold to, recognised sources.

* The 2018 figure is the baseline for our 2030 emissions target and has been adjusted to exclude emissions from assets divested in that year. Actual emissions in 2018 were 34.0Mt CO_2e.

Scope 3 emissions summary

	Scope 3 GHG emissions category[1]	2020 Emissions in Rio Tinto's value chain (million tonnes CO_2-e, equity share)
1	Purchased goods and services	6.6
2	Capital goods	0.1
3	Fuel and energy related activities	2.8
4	Upstream transportation and distribution	5.1
5	Waste generated in operations	Not applicable
6	Business travel	0.1
7	Employee commuting	Included in category 6
8	Upstream leased assets	Not applicable
9	Downstream transportation and distribution	3.0
10	Processing of sold products	
	Iron ore	376.4
	Bauxite & alumina	116.4
	Titanium dioxide feedstock	5.8
	Copper concentrate	0.6
	Other	2.5
11	Use of sold products	0.0
12	End of life treatment of sold products	Not material
13	Downstream leased assets	Not applicable
14	Franchises	Not applicable
15	Investments	Not applicable



1. *To identify and calculate Scope 3 emission sources across our operations, we have used the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) , Greenhouse Gas (GHG) Protocol: A Corporate Accounting and Reporting Standard (Revised Edition) (2015), GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2013) and the Technical Guidance for Calculating Scope 3 Emissions (version 1.0). Available at https://ghgprotocol.org/*

Processing of sold products

The majority of our exposure to Scope 3 emissions is from the processing of sold products mainly related to our iron ore, bauxite and alumina, titanium dioxide, and copper value chains. In order to make these emissions easier to understand, we have provided additional information about the estimation of emissions in these value chains.

We have a diverse global customer base with different operating approaches, technology deployment, electricity grid emissions factors and other business inputs that affect the estimation of emissions in our value chains. These complexities, combined with our diverse portfolio of products, require specific emissions calculation methodologies for each of the iron ore, bauxite and alumina, copper and titanium dioxide value chains. The methodologies employed rely on internal carbon modelling and do not incorporate emissions data from any of our customers to date. We will be able to refine our Scope 3 emissions as our customers develop and publish their Scope 1 and 2 emissions inventory.

Our calculation methodology is specific to our products, each impacting the attributable emissions in their value chain according to their characteristics. In calculating these emissions estimates we apply a level of conservatism where specific data is not readily available. We do not account for any emissions credits in the case where our products displace similar products with a higher emissions footprint.

Processing of iron ore

Iron ore shipments (2020, Mt equity share)	Attributable steel production (2020, Mt steel)	Emissions per tonne of steel (t CO_2-e per t attributable steel)	Estimated iron ore value chain emissions (Mt CO_2-e, equity share)
284.0	175.1 x 2.15 =		376.4

The processing of iron ore into steel is the largest contributor to our Scope 3 emissions. The two primary steelmaking routes are the blast furnace (BF/BOF) integrated system or electric arc furnaces (EAF).

Around 99% of our iron ore is processed in the blast furnace (BF/BOF) steelmaking route which uses iron ore, metallurgical coal and other additives to produce steel. The remainder is processed with natural gas to produce direct reduced iron (DRI) for conversion to steel in an EAF. We supply only the iron-based inputs to steelmaking processes which contain no carbon, but due to the consumption of metallurgical coal, natural gas and electricity from local grids (which typically rely on fossil fuel power generation), making steel is carbon intensive.

The BF/BOF steelmaking route is complex and varies at each of our customers' facilities. These complexities contribute to different operating and carbon efficiencies and ultimately varying emissions intensities at the facilities which are used to process our iron ore products. We have taken a conservative approach to capturing these differences whilst ensuring our modelling accounts for the different emissions profiles associated with our suite of iron ore products.

Calculation Boundary

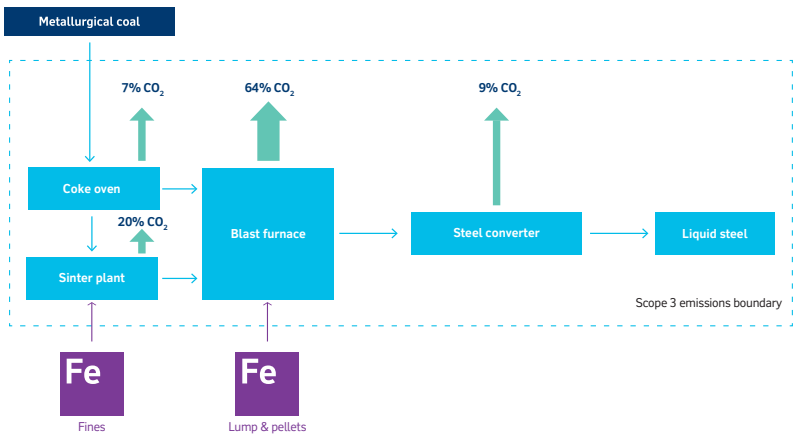
We have developed a steelmaking energy and mass balance model to estimate emissions from the processing of iron ore into a liquid steel product by both the BF/BOF and DRI/EAF processes. Each of our twelve iron ore products are analysed within this model based on respective ore grades, mineral chemistry and moisture content.

The model captures the activities incorporated at a typical steelmaking facility, recognising that this varies by customer and region. The emissions boundary utilised in preparation of this estimate includes emissions from the four primary sources of BF/BOF steelmaking; the production of coke, iron ore sintering, blast furnace operations and final steel conversion.

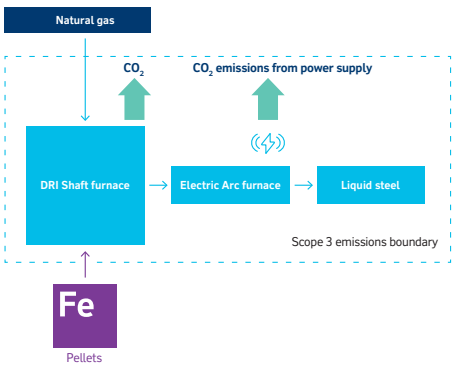
For DRI/EAF processed steel we have included direct emissions and emissions associated with electricity used. For both steelmaking routes, we have employed conservative model assumptions on technology deployment, closed-loop energy efficiency and regional grid factors across the regions in which our customers operate.

Steel Value Chain

Integrated Blast Furnace Route (BF/BOF)



Electric Arc Furnace Route (EAF)



Calculation Methodology

The model employed uses typical industry parameters to consider the energy needed in each step of the steel making process, relative to the grade of iron ore, flux materials and corresponding volume of coke required. Our approach to calculating emissions from steelmaking attributes emissions to four elements of the integrated process; the production of coke, ore sintering, blast furnace operations and final steel conversion.

Within our calculation boundary, the coke plant is the beginning of the process and uses heat energy to convert metallurgical coal to coke used in the steelmaking process. Emissions in this process represent about 7% of our calculated downstream emissions (or approximately 27Mt CO_2-e), despite the absence of our products in this part of the steelmaking process.

The sinter plant is used to prepare fines ores for the blast furnace through a heat-based agglomeration process. Lump ore and pelletized products are screened and largely bypass the sinter plant process, reducing the associated emissions. Emissions attributable to sintering represent about 20% of our calculated downstream emissions.

The blast furnace uses coke to heat and reduce iron ore (typically Fe_2O_3) to liquid iron. This reduction process is completed with carbon-based products in all global blast furnaces and as such results in the emission of CO_2. Around two-thirds of our iron ore downstream emissions are emitted in this process.

The steel converter removes the final impurities from the liquid iron generated in the blast furnace using oxygen and lime flux inputs. Emissions in this process represent about 9% of our calculated downstream emissions.

Integrated steelworks employ a complex variety of processes and energy uses. In our model, the conversion of energy into emissions is based on parameters and typical operating values from relevant published technical papers and International Energy Agency (IEA) global averages as set out in the references below. These calculations are consistent with the approach taken in the *GHG Protocol tool: Calculating Greenhouse Gas from Iron and Steel Production* published by the WRI and WBCSD.

Data sources

Iron ore product grades are determined using laboratory analysis for the ore shipments. Shipment volumes are from site operational data for fines, lump and pellets as used for compiling the Rio Tinto published annual results for managed and non-managed operations.

The energy and mass balance model is an internally produced model using key assumptions representative of typical steelworks operating parameters and typical coke and metallurgical coal specifications.

References

Comparison of Energy Consumption and CO_2 Emissions for Three Steel Production Routes—Integrated Steel Plant Equipped with Blast Furnace, Oxygen Blast Furnace or Corex- Jiayuan Song, Zeyi Jiang, Cheng Bao and Anjun Xu; https://www.mdpi.com/2075-4701/9/3/364

IEA Emission Factors: Database documentation (2019), http://data.iea.org/

Thermochemical Data of Pure Substances, Third Edition – Phof.-Dr. Ing. Ihsan Barin; https://onlinelibrary.wiley.com/doi/book/10.1002/9783527619825

Item	Range (by product)	Example (Pilbara Blend™ Fines)	Rio Tinto portfolio	Description
Iron ore shipments (million tonnes, equity share)				
2020 iron ore shipments		126.6	284.0	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 2020.
Processing iron ore to steel (million tonnes)				
2020 attributed steel production		77.6	175.1	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 – emissions factor (tonnes CO_2-e 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 – 0.65	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	1.37	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)	0.19	0.19	0.19	Emissions in the steel plant are reasonably consistent across our products.
Emissions per tonne of attributable steel *(tonnes CO_2-e per tonne liquid steel)*		2.25	**2.15***	**Emissions factors sourced from our energy and mass balance modelling of iron ore processing.** *** Includes contribution from DR pellets used in DRI+EAF process** ***International Energy Agency IEA and World steel 2020 global average emissions for a typical steel making facility are 2.20 tonnes of CO_2 per tonne of steel.***
2020 iron ore value chain emissions (million tonnes CO_2-e, equity share)				
Total Scope 3 greenhouse gas emissions from processing of iron ore (Mt CO_2-e equity share)		174.8	**376.4**	**Total estimated emissions from processing of our iron ore to produce steel.** **Calculated on a product basis by applying the specific product emissions factors to the 2020 shipment volumes of each product**.

Processing of bauxite and alumina

Downstream emissions attributable to bauxite sales		Downstream emissions attributable to alumina sales		Estimated aluminium value chain emissions (Mt CO_2-e, equity share)
105.6	+	10.8	=	116.4

The processing of bauxite and alumina into aluminium is the second largest contributor to our Scope 3 emissions.

In our global value chain, bauxite is converted to alumina via the Bayer Process. The emissions associated with this process are primarily driven by the emissions factors associated with the fuel used in steam generation and calcination of alumina, and the electricity supply at our customers' refineries.

Processing alumina into aluminium uses the Hall-Heroult process which is electro-intensive and releases process CO_2 emissions from the use of carbon anodes in the electrolytic production of aluminium. Average emissions to convert alumina to aluminium are around 12.4tCO_2e per tonne of aluminium. This average accounts for both low-carbon hydroelectricity supplied smelters and smelters which operate in regions with high carbon intensity electricity. Only approximately 2 tCO_2e per tonne of aluminium are from the carbon anodes with the remainder associated with the electricity used.

We operate production facilities across this value chain from bauxite extraction to alumina refining and aluminium smelting.

The calculation of emissions is based on the net sales of bauxite and alumina to third parties who also operate similar facilities.

Our vertically integrated supply chain produces aluminium with a significantly lower carbon footprint than the global average, due primarily to the hydro-power electricity used by our Canadian aluminium smelters.

Calculation Boundary

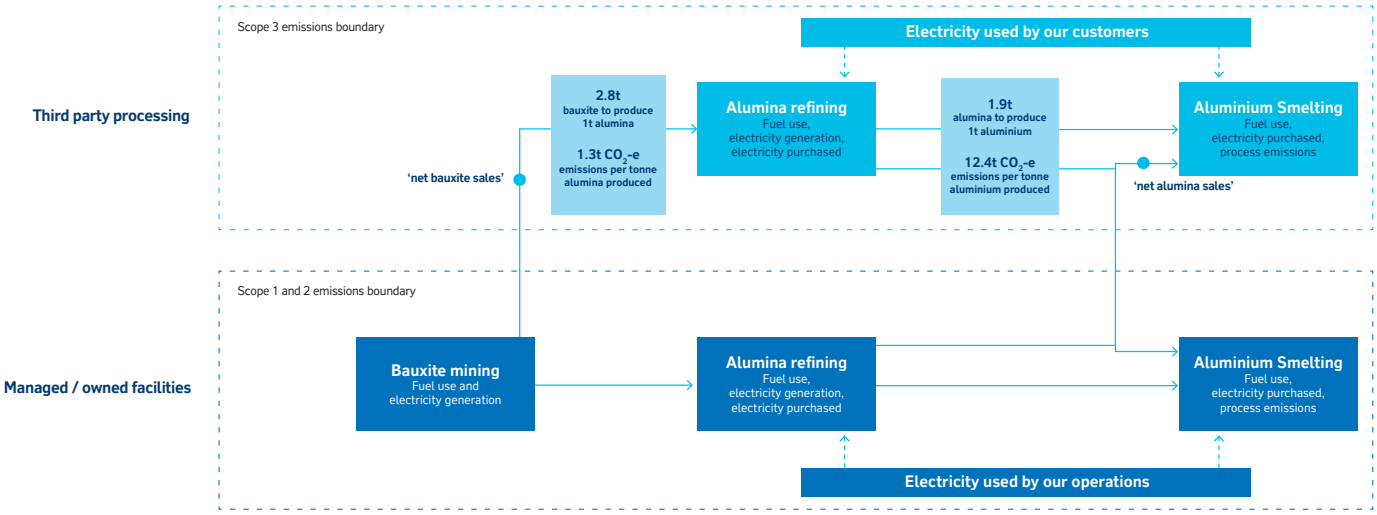
Emissions from the processing of bauxite and alumina include third-party processing of our bauxite into alumina and then into aluminium cast products, as well as third-party processing of our alumina into aluminium cast products.

Due to the various processing routes, and their comparatively low emissions, we have not included the downstream processing of our aluminium into different end-use products in this estimate.

To assess our aggregate exposure to Scope 3 emissions in this value chain, we have calculated the net sales of bauxite and alumina across the equity position within our managed and non-managed operations. This calculation ensures we have adequately accounted for bauxite and alumina used in our vertically integrated business (covered in Scope 1 and 2 emissions reporting).

Outside of this value chain, we also produce specialty alumina products for use in other processes. These are produced in small quantities and considered final products with no associated downstream emissions.

The Aluminium Value Chain



Calculation methodology

The calculated emissions use net bauxite and alumina sales, appropriate product conversion ratios and global average emissions factors for each stage of the process.

Net bauxite and alumina volumes are sourced from sales quantities based on bill of lading records for shipments of bauxite and alumina shipped to/from managed and non-managed operations.

The conversion ratios of bauxite to alumina and into aluminium are published by the International Aluminium Institute and updated annually.

The emissions factors used in the calculation are taken from CRU Group data on 2018 global emissions totals for all non-Rio Tinto global alumina refineries and aluminium smelters. These emissions totals have been divided by the total production from these facilities to determine the production weighted global average emissions factors for converting bauxite through to aluminium, and alumina to aluminium.

Item	Calculation steps	Rio Tinto portfolio	Description
2020 net sales (million tonnes, equity share)			
Net Bauxite sales	[A]	38.6	Net sales of bauxite to third-parties
Net Alumina sales	[B]	1.7	Net sales of alumina to third-parties
Conversion factors			
Bauxite:Alumina	[C]	2.847	International Aluminium Institute, Life cycle inventory (2018)
Alumina:Aluminium	[D]	1.928	International Aluminium Institute, Life cycle inventory (2018)
Processing related emissions factors (tonnes CO_2-e per tonne of input material)			
Bauxite to alumina intensity (t CO_2-e/t alumina)	[E]	1.341	CRU dataset (2018)
Alumina to aluminium intensity (t CO_2-e/t aluminium)	[F]	12.416	CRU dataset (2018)
2020 aluminium value chain emissions (million tonnes CO_2-e)			
Emissions from processing of net bauxite sales	[A] ÷ [C] x [E] + [A] ÷ [C] ÷ [D] x [F]	105.6	Emissions associated with the processing of bauxite to alumina and then further to aluminium
Emissions from processing of net alumina sales	[B] ÷ [D] x [F]	10.8	Emissions associated with the processing of alumina to aluminium
Total Scope 3 greenhouse gas emissions from processing of bauxite and alumina (Mt CO_2-e equity share)		**116.4**	Total estimate emissions from processing of bauxite and alumina

Data sources

Net bauxite and alumina volumes are sourced from sales quantities based on bill of lading records for shipments of bauxite and alumina shipped to/from managed and non-managed operations. These are consistent with published Rio Tinto annual results.

References

Fourth Quarter Operations Review 2020; https://www.riotinto.com/invest/financial-news-performance/results

International Aluminium Institute, Appendix A Life Cycle Inventory (global) to the publication 2015 Life Cycle Inventory Data and Environmental Metrics (2018)

CRU Commodity Market Analysis

Processing of titanium dioxide feedstocks

Net TiO_2 feedstock Production (2020, Mt tonnes equity share)		Emissions factor (tonnes CO_2-e per tonne product sold)		Estimated TiO_2 value chain emissions (Mt CO_2-e, equity share)
1.12	x	5.2	=	5.8

We are involved in the titanium dioxide (TiO_2) supply chain through our interests in QIT Madagascar Minerals (QMM) in Fort Dauphin in Madagascar, Richards Bay Minerals (RBM) in South Africa, and Havre-Saint-Pierre in Canada, as well as smelters at RBM and Sorel-Tracy in Canada. These operations generate products for the TiO_2 pigment industry.

Our titanium dioxide business provides the main feedstock for the TiO_2 pigment industry which is used in a wide range of industrial and consumer products including paints, plastics, cosmetics, paper, rubber, ceramics and textiles.

Calculation Boundary

We treat emissions from mining, mineral processing, smelting and refining of titanium dioxide feedstock as Scope 1 and 2 emissions. Our Scope 3 emissions estimate incorporates the emissions associated with the conversion of this feedstock to titanium dioxide (TiO_2) pigment. The Scope 3 emissions from processing of ilmenite is not included in this calculation.

TiO_2 pigment is produced through two main processes, sulphate and chloride, using a wide selection of TiO_2 feedstocks such as ilmenite, titania slag, and both natural and synthetic rutile.

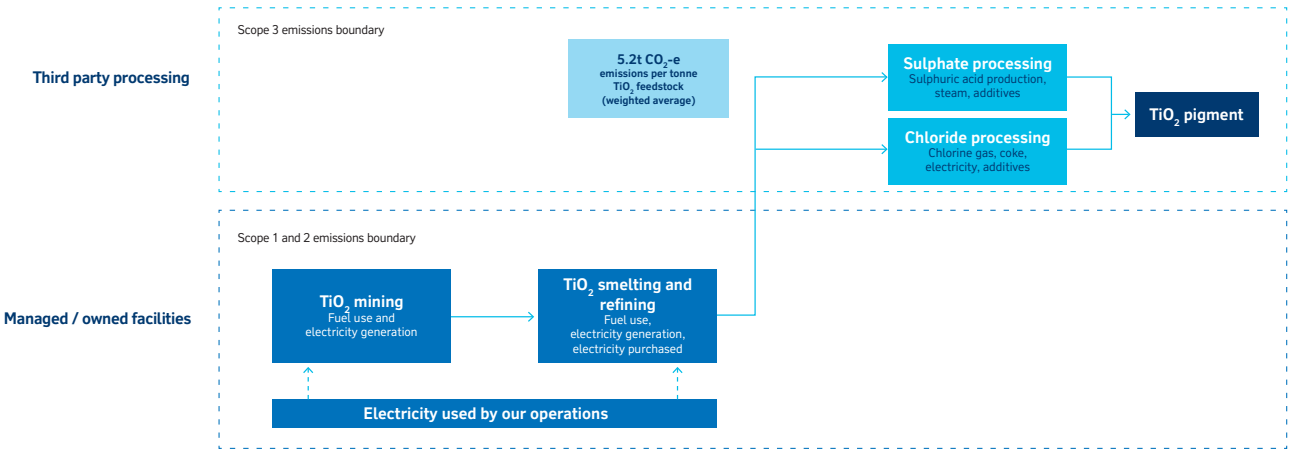
As TiO_2 pigment has a diverse range of downstream applications, we have not included emissions associated with downstream processing of TiO_2 pigment. The conversion process from feedstock to 100% pure TiO_2 refined pigment generates the majority of the value chain emissions and is the downstream boundary of our estimate.

Calculation Methodology

The Titanium Dioxide Manufacturers Association (TDMA), an organization that represents more than half of the annual global production of TiO_2, has calculated the average mine to gate carbon footprint of all their global production facilities and this is used to estimate our customer value chain emissions.

The global average emission factor calculated by the TDMA includes emissions related to the processing of TiO_2 feedstock into TiO_2 pigment considering both typical processing routes, sulphate or chloride. Our total annual production volumes are assessed against the TDMA average emission factor of 5.2 t CO_2-e/t feedstock to provide an estimated of our Scope 3 emissions.

The Titanium Dioxide Value Chain



Item	Calculation steps	Rio Tinto portfolio	Description
2020 Titanium dioxide feedstock production (million tonnes, equity share)			
Titanium dioxide feedstock production (million tonnes, equity share)	[A]	1.12	Weighed production quantities of titanium dioxide feedstocks from managed and non-managed operations
Processing titanium dioxide feedstocks – emissions factor (t CO_2-e)			
Emissions associated with processing titanium dioxide feedstock into pigment (tonnes CO_2-e per tonneTiO_2feedstock)	[B]	5.2	Weighted average emissions factor sourced from TDMA Titanium Dioxide Industry Average Carbon footprint
2020 titanium dioxide value chain emissions (million tonnes (CO_2-e)			
Total emissions from processing of titanium dioxide feedstocks (Mt CO_2-e, equity share)	[A] X [B]	**5.82**	**Total estimated emissions from processing of feedstock into refined product**

Data sources

Equity share production volumes have been obtained from internal sales records of titanium dioxide feedstocks shipped to/from managed and non-managed operations.

Our emissions factor has been sourced from the titanium dioxide industry average carbon footprint as published by the Titanium Dioxide Manufacturers Association.

References

Fourth Quarter Operations Review 2020; https://www.riotinto.com/invest/financial-news-performance/results

Titanium Dioxide Industry Average Carbon Footprint, TDMA

Processing of copper concentrate

Net copper concentrate production (2020, Mt tonnes equity share)		Emissions factor (tonnes CO_2-e per tonne copper)		Estimated copper value chain emissions (Mt CO_2-e, equity share)
0.37	x	1.64	=	0.6

We are involved in the copper value chain through our interests in Kennecott in the US, Oyu Tolgoi in Mongolia and Escondida in Chile. These operations produce copper concentrate and refined copper.

Calculation Boundary

The emissions captured within our Scope 3 estimate include the processing of our net sales of copper concentrate into refined copper. We do not sell copper ore without first converting it to copper concentrate.

The emissions associated with mining, concentrating and, where applicable, refining of copper at our operations are included in our Scope 1 and 2 emissions reporting.

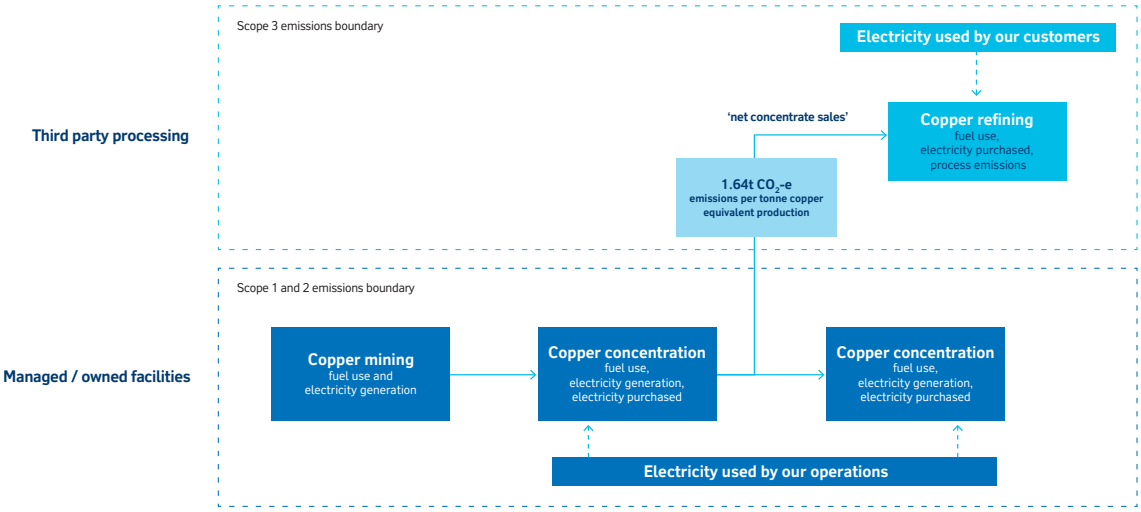
Our calculation boundary concludes with the production of copper cathode ('refined copper'). At this stage, copper can be converted to various products, including wire, tube or sheet. Due to the various processing routes, and their comparatively low emissions, we have not included the downstream processing of our refined copper into different end-use products in this estimate.

Calculation Methodology

The emissions from mining and concentrating copper ore are highly variable due to differences in open cut and underground mines, as well as to the emissions factors of the electricity consumed in the mining and concentrating processes. Life cycle assessments for copper that capture mine-to-gate emissions from copper extraction to final product are subject to these variations and, as such, include large variations in the emission factors proposed in the use of Scope 3 assessment of copper products.

Our calculation uses a regional factor that is representative of the processing of our copper concentrate by our customers. The factor in the paper referenced below is 5.88 t CO_2-e/t Cu for all processing stages from mining to refining Using the emissions breakdown in the paper, the emissions associated with the processing of copper concentrate into refined copper have been determined to be 1.64 t CO_2-e/t Cu. We have used this emissions factor for the copper refining process and applied this to our net copper concentrate sales.

The Copper Value Chain



Item	Calculation steps	Rio Tinto portfolio	Description
2020 Copper production (million tonnes, equity share)			
Net copper concentrate	[A]	0.37	Calculated by subtracting refined copper from copper concentrate volumes to determine our net copper concentrate production. Data sourced from site production records as reported in the Rio Tinto annual report for the year ended 31 December 2020 where refined copper is copper (refined) and copper concentrate is copper (mined)
Processing copper concentrate – emissions factor (t CO_2-e)			
Copper concentrate to refined copper	[B]	1.64	The emissions factor utilized to capture typical emissions generated converting copper concentrate to refined copper
2020 copper value chain emissions (million tonnes CO_2-e)			
Total Scope 3 greenhouse gas emission from processing of copper concentrate (Mt CO_2-e, equity share)	[A] X [B]	**0.6**	**Estimate calculated by applying the emissions factor to the 2020 net copper concentrate volumes**

Data sources

Production volumes are taken from managed and non-managed site production quantities of weighed concentrate and cathodes on a copper equivalent basis. This data is used for compiling the Rio Tinto annual report production data.

As much of our sales of copper concentrate are to customers in China, our emissions factor has been adapted from the technical paper, *Assessing the future environmental impacts of copper production in China: Implications of the energy transition.*

References

Assessing the future environmental impacts of copper production in China: Implications of the energy transition, Di Dong, L van Oers, A Tucker, E van der Voet, 2020, Table 5

Calculation methodology – All Scope 3 Standard emissions categories

Category	Mt CO_2-e (equity share)	Calculation boundary	Calculation methodology	Data sources
1. Purchased goods and services	**6.6**	Includes emissions associated with relevant purchased goods and services. Excludes emissions associated with other Scope 3 categories (capital goods, fuel, energy and transport).	Spend data method using operating business costs for managed sites on equity basis using the Quantis Scope 3 evaluator tool emission factors. Specific Scope 3 emissions are calculated for use of explosives, lime and caustic soda. Non-managed site costs are estimated using costs from similar production facilities.	*Spend data from Rio Tinto business systems paired with GHG Protocol Quantis Scope 3 evaluator tool, https://ghgprotocol.org/scope-3-evaluator*
2. Capital goods	**0.1**	Includes emissions associated with the upstream goods and services purchased or acquired by the business for capital projects.	Spend data method using operating business costs for managed sites on equity basis using the Quantis Scope 3 evaluator tool emission factors. Non-managed site costs are estimated using costs from similar production facilities	*Spend data from Rio Tinto business systems paired with GHG Protocol Quantis Scope 3 evaluator tool, https://ghgprotocol.org/scope-3-evaluator*
3. Fuel and energy related activities	**2.3**	Includes emissions from the production and transportation of purchased fuels, including natural gas, diesel, coal and energy sources including coke, pitch and cathodes. Includes transmission losses from purchased electricity.	Factors are sourced from the Australian National Greenhouse Accounts Scope 3 factors emissions tables for fuels.	*Fuel and energy consumption data from Rio Tinto business systems combined with Australian National Greenhouse Accounts Factors https://www.industry.gov.au/sites/default/files/2020-10/national-greenhouse-accounts-factors-2020.pdf*
4. Upstream transportation and distribution	**5.1**	Total Scope 3 greenhouse gas emissions from upstream transportation and distribution of iron ore, bauxite, alumina, aluminium, and titanium dioxide feedstocks, copper concentrates and copper cathodes related products (million tonnes CO_2-e, equity share). Includes all inbound transport; all inter-company transport paid for by Rio Tinto and all outbound product transport paid for by Rio Tinto (e.g. under cost, insurance and freight (CIF,CRF) or similar terms). Transportation and distribution of iron ore, bauxite, alumina, aluminium, titanium dioxide feedstocks, copper concentrates and copper cathodes paid for by Rio Tinto contribute approximately 4.77Mt CO_2-e of these emissions. The balance of emissions are from third party shipping, road and rail of other products. Excludes emissions from Rio Tinto owned shipping (this is included in Scope 1 & 2 emissions).	Company shipping quantities, vessel types and route data is used in the calculations. For shipped materials, the International maritime organisation, 4th GHG study has been used for emission factors. For trucked materials, the DEFRA conversion factors are used.	*Upstream transport records sourced from Rio Tinto business systems and combined with International MaritimeOrganisation, 4th GHG study for ships. IMO GHG Study 2020 - Final Report Secretariat and DEFRA conversion factors* *https://ghgprotocol.org/Third-Party-Databases/Defra* *Distances estimated using https://sea-distances.org*
5. Waste generated in operations	Not applicable		Any emissions related to the generation of waste at Rio Tinto operations are included in our calculated Scope 1 & 2 emissions.	

Category	Mt CO_2-e (equity share)	Calculation boundary	Calculation methodology	Data sources
6. Business travel	**0.1**	Includes domestic and international flights, road and rail travel as well as travel services including hotels, taxis. Includes company arranged charter flights Excludes company buses and cars (Scope 1)	Air travel for fly in / fly out has been included in business travel. Emissions report is from the corporate Rio Tinto travel provider and estimates for the few sites that do not use the provider.	*2020 DEFRA emission factors*
7. Employee commuting	Not material	Employee commuting to remote sites is included in Scope 3 business travel. Company buses and cars are in Scope 1& 2 emissions. Remainder of employee commuting is not material		
8. Upstream leased assets	Not applicable		Rio Tinto does not lease significant upstream assets.	
9. Downstream transportation and distribution	**3.0**	Total Scope 3 greenhouse gas emissions from downstream transportation and distribution of iron ore, bauxite, alumina, aluminium, and titanium dioxide related products feedstocks, copper concentrates and copper cathodes (million tonnes CO_2-e, equity share. Includes emissions from the transport and distribution of our products where freight has not been arranged by Rio Tinto (e.g. under Free on Board (FOB) or similar terms). Transportation and distribution of iron ore, bauxite, alumina, aluminium, titanium dioxide feedstocks, copper concentrates and copper cathodes contribute approximately 2.45Mt CO_2-e of these emissions. The balance of the emissions are from transportation of fuels	Company shipping information (tonnes, vessel, route) is used to calculate emissions with the conversion factors for tonne.km of shipping. Emissions related to non-managed operations have been used when available and estimated using data from similar operations.	*Rio Tinto internal shipping database for all sold products combined with International Maritime Organisation, 4th GHG study for ships. IMO GHG Study 2020 - Final Report Secretariat.* *Distances estimated using https://sea-distances.org*
10. Processing of sold products **- Iron ore** **- Bauxite & alumina** **- TiO_2** **- Copper** **- Other**	 **376.4** **116.4** **5.8** **0.6** **2.5**	Includes emissions related to the processing of iron ore, bauxite, alumina, titanium dioxide feedstocks and copper concentrate. "Other" includes an estimate for processing emissions related to Rio Tinto's other products.	Emissions calculated as described in this report.	
11. Use of sold products	**0.0**		Rio Tinto does not produce any fossil fuels.	
12. End of life treatment of sold products	Not material, Not calculated		Rio Tinto's products includes metals and minerals with minimal emissions at end of life. Final products related to Rio Tinto's material value chains (steel, aluminium and copper) produce materials with established recycling industries.	
13. Downstream leased assets	Not applicable		Rio Tinto does not lease significant downstream assets.	
14. Franchises	Not applicable		Rio Tinto does not have franchised operations.	
15. Investments	Not applicable	Excludes Rio Tinto's emissions from non-managed assets. These emissions are attributed to the relevant categories of Scope 1,2 and 3 emissions as our emissions are reported on an equity share basis. Investments such as the Rio Tinto Pension Fund UK are managed by third parties.		

Independent Limited Assurance Report to the Directors of Rio Tinto Limited

pwc

What we found

Based on the procedures we have performed and the evidence we have obtained, nothing has been identified that causes us to believe that the Selected subject matter within Rio Tinto Scope 1, 2 and 3 emissions calculation methodology 2020 for the year ended 31 December 2020 has not been prepared, in all material respects, in accordance with the Reporting Criteria.
This conclusion is to be read in the context of what we say in the remainder of our report.

What we did

The Board of Directors of Rio Tinto Limited ("Rio Tinto") engaged us to provide limited assurance on the Selected subject matter within the Rio Tinto Scope 1, 2 and 3 emissions calculation methodology 2020 for the year ended 31 December 2020.

Subject matter

The scope of our work was limited to assurance over the Selected subject matter within the Rio Tinto Scope 1, 2 and 3 emissions calculation methodology 2020 for the year ended 31 December 2020 (the "Selected subject matter").

The Selected subject matter and the Reporting Criteria against which it was assessed are summarised below. Our assurance does not extend to information in respect of earlier periods or to any other information included in the Rio Tinto Scope 1, 2 and 3 emissions calculation methodology 2020.

Subject matter	Mt CO_2-e (equity share)
Total Scope 3 greenhouse gas emissions from processing of iron ore	**376.4**
Total Scope 3 greenhouse gas emissions from processing of bauxite and alumina	**116.4**
Total Scope 3 greenhouse gas emissions from processing of copper concentrate	**0.6**
Total Scope 3 greenhouse gas emissions from processing of titanium dioxide feedstocks	**5.8**
Total upstream transportation and distribution Scope 3 greenhouse gas emissions for iron ore, bauxite, alumina, aluminium, titanium dioxide feedstocks, copper concentrates and copper cathodes	**4.77**
Total downstream transportation and distribution Scope 3 greenhouse gas emissions for iron ore, bauxite, alumina, aluminium titanium dioxide feedstocks, copper concentrates and copper cathodes	**2.45**

Our Independence and Quality Control

We have complied with relevant ethical requirements related to assurance engagements, which are founded on fundamental principles of integrity, objectivity, professional competence and due care, confidentiality and professional behaviour.

The firm applies Auditing Standard ASQC 1 Quality Control for Firms that Perform Audits and Reviews of Financial Reports and Other Financial Information, Other Assurance Engagements and Related Services Engagements and accordingly maintains a comprehensive system of quality control including documented policies and procedures regarding compliance with ethical requirements, professional standards and applicable legal and regulatory requirements.

Reporting Criteria

The Selected subject matter needs to be read and understood together with the Reporting Criteria, being the boundaries, definitions and methodologies disclosed within the Rio Tinto Scope 1,2 and 3 emissions calculation methodology 2020, which Rio Tinto is solely responsible for selecting and applying. The absence of a significant body of established practice on which to draw to evaluate and measure non-financial information allows for different, but acceptable, measurement techniques and can affect comparability between entities and over time.

Responsibilities

PricewaterhouseCoopers

We are responsible for:

- planning and performing the engagement to obtain limited assurance about whether the Selected subject matter is free from material misstatement, whether due to fraud or error;
- forming an independent conclusion, based on the procedures we have performed and the evidence we have obtained; and
- reporting our conclusion to the Directors of Rio Tinto.

Rio Tinto

Rio Tinto management are responsible for:

- preparing the Selected subject matter as well as the Rio Tinto Scope 1, 2 and 3 emissions calculation methodology 2020 in its entirety;
- the prevention and detection of fraud and error in relation to the Selected subject matter;
- the design and operation of controls to ensure the completeness and accuracy of information within the Rio Tinto Scope 1, 2 and 3 emissions calculation methodology 2020, including but not limited to the Selected subject matter; and
- Determining suitable reporting criteria for reporting the Selected subject matter within the Rio Tinto Scope 1, 2 and 3 emissions calculation methodology 2020 and publishing those criteria such that they are available to expected users of the report.

What our work involved

We conducted our work in accordance with the Australian Standard on Assurance Engagements (ASAE) 3410 Assurance Engagements on Greenhouse Gas Statements. This Standard requires that we comply with independence and ethical requirements and plan the engagement so that it will be performed effectively.

Main procedures performed

We are required to plan and perform our work in order to consider the risk of material misstatement of the Selected subject matter. In doing so, we:

- Made enquiries of relevant management of Rio Tinto regarding the processes and controls for capturing, collating, calculating and reporting the Selected subject matter, and evaluating the design and effectiveness of these processes and controls;
- Tested the arithmetic accuracy of a sample of calculations of the Selected subject matter;
- Assessed the appropriateness of the Scope 3 greenhouse gas emission factors and methodologies applied in calculating the Selected subject matter;
- Tested of a sample of transportation and distribution information utilised in the calculations of the Selected subject matter, on a sample basis, to relevant underlying records including bills of lading and certificates of analysis;
- Tested performance data utilised within the calculations of the Selected subject matter to production results publicly reported by Rio Tinto; and
- Undertook analytical procedures over the performance data utilised within the calculations of the Selected subject matter.

We believe that the information we have obtained is sufficient and appropriate to provide a basis for our conclusion.

John Tomac

John Tomac
Partner

12 February 2021

PricewaterhouseCoopers

PricewaterhouseCoopers
Sydney

12 February 2021

Inherent limitations

Inherent limitations exist in all assurance engagements due to the selective testing of the information being examined. Therefore fraud, error or non-compliance may occur and not be detected. Additionally, non-financial data may be subject to more inherent limitations than financial data, given both its nature and the methods used for determining, calculating and sampling or estimating such data.

Restriction on use

This report, including our conclusions, has been prepared solely for the Board of Directors of Rio Tinto in accordance with the agreement between us, to assist the Directors in reporting Rio Tinto's 2020 Scope 3 greenhouse gas emissions performance and activities. To the fullest extent permitted by law, we do not accept or assume responsibility to anyone other than the Board of Directors and Rio Tinto for our work or this report except where terms are expressly agreed between us in writing.

We permit this report to be disclosed in the Rio Tinto Scope 1,2 and 3 emissions calculation methodology 2020 to assist the Directors in responding to their governance responsibilities by obtaining an independent assurance report in connection with the Selected subject matter.

Limited assurance

This engagement is aimed at obtaining limited assurance for our conclusions. As a limited assurance engagement is restricted primarily to enquiries and analytical procedures and the work is substantially less detailed than that undertaken for a reasonable assurance engagement, the level of assurance is lower than would be obtained in a reasonable assurance engagement.

Professional standards require us to use negative wording in the conclusion of a limited assurance report

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RioTinto