RioTinto

# Scope 1, 2 and 3 Emissions Calculation Methodology 2021

# About this document

## This document describes the approach used to prepare our 2021 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 2021 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.

To identify and calculate Scope 1 and 2 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)*. For our 2022 reporting we will align with the *GHG Protocol Scope 2 Guidance*.

**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 WRI and WBCSD 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 2021 Scope 3 emissions inventory has been prepared on an equity basis, taking into account Rio Tinto's relevant interest in all managed and non-managed operations.

The Scope 3 Standard divides Scope 3 emissions into 15 categories covering activities both upstream and downstream of our operations.

Of these categories, Category 10 – *Processing of Sold Products* – accounts for almost 95% 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, salt and copper concentrate using a combination of internal emissions modelling, regional- and industry-level emission factors, and internal production and shipments data.

We engaged an independent external assurance organisation, KPMG, to provide the directors of Rio Tinto with reasonable assurance on Scope 1 and 2 data, and limited assurance on the Scope 3 emissions estimates and other selected subject matter set out in this report.

Building on the work of 2020, we have made some changes and improvements to calculation methodologies that represent a higher level of maturity and accuracy in Scope 3 emissions reporting.

The changes in aluminium value chain, marine transport and purchased and capital goods in particular have taken our emissions accounting to the next level of detail that more precisely represents Rio Tinto Scope 3 emissions sources.

| Scope 3 description | 2020 | **2021** |
|---|---|---|
| Aluminium value chain emissions (Category 10, Processing of Sold Products) | Global emission factors using 2018 CRU Group data<br>Net material balance method | Regional emission factors (using 2020 CRU Group data) and site-specific data where available<br>Regional factors, especially for our customers based in Asia, are higher than global factors<br>Site by site individual purchased and sold materials (increased tonnes) |
| Marine transport upstream and managed (Category 4) | Country-to-country distances<br>Emission factor by ship type (IMO) | Port-to-port distances (first load port and last discharge port)<br>For time chartered vessels (TCV), specific individual emission intensity factor (based on weighted average energy efficiency operational indicator value). Where actual emission values from TCVs were not available, use of standard IMO emission factors. |
| Marine transport downstream (Category 9) | Country-to-country distances | Where possible, the following is used in order of preference and/or availability<br>– Port-to-port distances<br>– City-to-city distances<br>– Country-to-country distances |
| Purchased and capital goods and services (Category 1 & 2) | Approximate groupings (Quantis model) | Specific category-by-category analysis and matching to Quantis emission factors and categories<br>Inclusion of emissions from bauxite and alumina purchases (resulting from new aluminium model)<br>Inclusion of anodes, coke, pitch and cathodes (previously in fuels Category 3) |
| Processing of sold products (Category 10) | Calculation of major sources and estimates of minor products<br>Titanium dioxide 2010 factor from Titanium Dioxide Manufacturers Association (TMDA) | Inclusion of Scope 3 emissions from processing of salt, predominantly into chlor-alkali processes<br>Improved estimates for minor products<br>Titanium dioxide 2016 factor TMDA |

We are still reporting 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 2021 and the Climate Change Report available on our website.

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Cover image | West Angelas iron ore mine in the Pilbara region. Western Australia.

# 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 (GHG) emissions as direct GHG emissions from facilities owned or controlled by an operator, including fuel use, onsite electricity generation, anode and reductant use, process emissions and land management. GHG 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 the electricity supplier or the appropriate regional and subregional factors.

## Consolidating greenhouse gas (GHG) emissions data

Historically, we reported our GHG emissions using the operational control approach. From 2020 we have moved to reporting using an equity approach against a 2018 baseline, also 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 – 2025 and 2030 target calculation methodology

In 2021 we announced new Scope 1 and 2 targets to reduce carbon emissions by 15% by 2025 and 50% by 2030. Our targets apply to our Scope 1 and 2 emissions and are relative to our 2018 equity emissions baseline.

We use the equity share approach for consolidating our total Scope 1 and 2 emissions, to which we would apply the benefit of our use of valid offsets. 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 the Sustainability Fact Book and Climate Change Report.

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) emissions from relevant operations from the baseline.

As an example, in November we announced that Rio Tinto had increased its shareholding in Diavik Diamond Mine from 60% to 100%. A commensurate adjustment will be made to the 2018 baseline data for Diavik Diamond Mine.

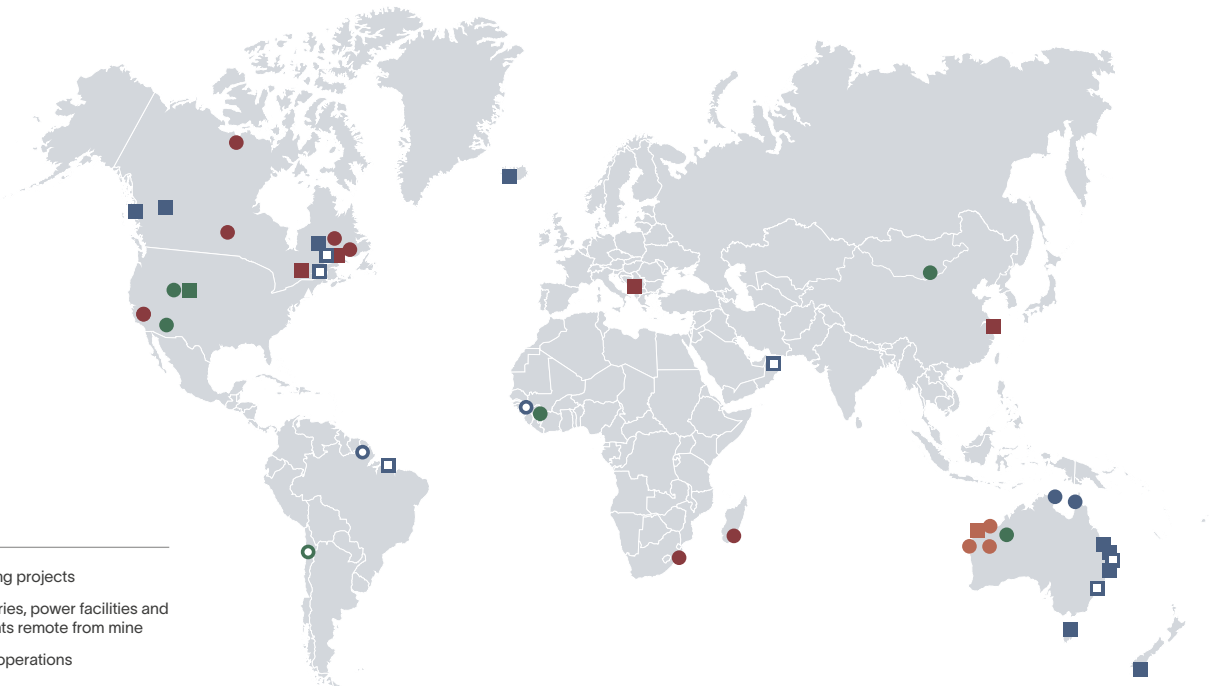
Permanent closure of assets will not result in any adjustment to the baseline. Similarly, we will not adjust the baseline if our global production increases from the expansion of existing operations or new projects. These growth projects are expected to be carbon neutral overall so that we can deliver against our absolute 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

Aluminium
Copper
Minerals
Iron ore



Key

- Mines and mining projects
- Smelters, refineries, power facilities and processing plants remote from mine
- Non-managed operations

# Scope 1 and 2 emissions summary

## Scope 1 and 2 emissions – equity basis

| Equity greenhouse gas emissions - million tonnes carbon dioxide equivalent (Mt $CO_2e$) | 2021 | 2020 | 2019 | 2018 |
|---|---|---|---|---|
| Total Scope 1 and 2 GHG emissions | **31.1** | 31.5 | 31.5 | 34 |
| Scope 1 emissions | **22.7** | 22.8 | 23.1 | 24.7 |
| Scope 2 emissions | **8.4** | 8.7 | 8.3 | 9.3 |

| 2021 equity greenhouse gas emissions by product group & source (Mt $CO_2e$) | Electricity[1] | Anodes & Reductants | Process Heat | Mobile Diesel | Other | 2021 Total emissions (Mt $CO_2e$) |
|---|---|---|---|---|---|---|
| Aluminium | **10.4** | **5.2** | **4.9** | **0.3** | **1.1** | **21.9** |
| Aluminium (Pacific) | **8.1** | **1.7** | **0.2** | **0.0** | **0.2** | **10.2** |
| Aluminium (Atlantic) | **0.6** | **3.5** | **0.5** | **0.0** | **0.6** | **5.2** |
| Bauxite & Alumina | **1.6** | **0.0** | **4.3** | **0.3** | **0.3** | **6.5** |
| Minerals | **1.4** | **1.2** | **0.5** | **0.3** | **0.1** | **3.4** |
| Iron Ore | **0.8** | **0.0** | **0.1** | **2.1** | **0.0** | **3.0** |
| Copper | **1.3** | **0.0** | **0.2** | **0.8** | **0.0** | **2.2** |
| Other (includes Shipping and corporate functions) | **0.1** | **0.0** | **0.0** | **0.5** | **0.0** | **0.6** |
| **Total** | **14.0** | **6.4** | **5.6** | **4.0** | **1.1** | **31.1** |

Note: The sum of the categories may be slightly different to the Rio Tinto total due to rounding.

1. Electricity includes imported power and own generation; process heat includes diesel consumption from stationary sources such as pumps; mobile diesel sources are haul trucks, locomotives and other mining fleet.

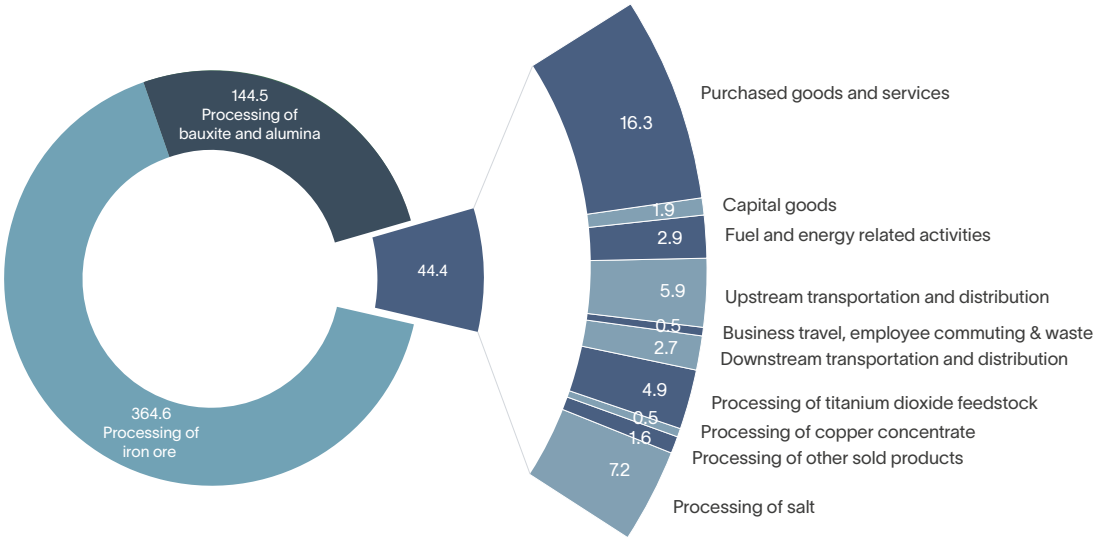
# Scope 3 emissions summary

| Total equity Scope 3 greenhouse gas emissions (million $tCO_2e$) | 2021 | 2020 |
|---|---|---|
| Scope 3 - Upstream | 27.5 | 24[2] |
| Scope 3 - Downstream | 526 | 546[2] |
| Total | **553.5** | **570** |

| | Sources of Scope 3 equity emissions[1] | 2021 | 2020 |
|---|---|---|---|
| **Upstream emissions** | | | |
| **1** | Purchased goods and services | 16.3 | 14.3[2] |
| **2** | Capital goods | 1.9 | 1.4[2] |
| **3** | Fuel and energy related activities | 2.9 | 2.8 |
| **4** | Upstream transportation and distribution | 5.9 | 5.1 |
| **5** | Waste generated in operations | 0.1 | 0 |
| **6&7** | Business travel & employee commuting | 0.4 | 0.14 |
| **8** | Upstream leased assets | Not applicable[3] | Not applicable |
| **Downstream emissions** | | | |
| **9** | Downstream transportation and distribution | 2.7 | 3.0 |
| **10** | Processing of sold products | | |
| | Iron Ore | 364.6 | 376.4 |
| | Bauxite & alumina | 144.5 | 152[2] |
| | Titanium dioxide feedstock | 4.9 | 5.8 |
| | Copper concentrate | 0.5 | 0.6 |
| | Salt | 7.2 | 6.0 |
| | Other[5] | 1.6 | 2.0 |
| **11** | Use of sold products | 0 | 0 |
| **12** | End of life treatment of sold products | Not material | Not material |
| **13** | Downstream leased assets | Not applicable[3] | Not applicable |
| **14** | Franchises | Not applicable[3] | Not applicable |
| **15** | Investments | Not applicable[4] | Not applicable |
| **Total** | | **553.5** | **570** |

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/).
2. Approximate equivalent 2020 figures for purchased goods & services, and capital goods emissions from spend data, bauxite & alumina processing have been re-estimated using the 2021 methodology and provided to allow comparability over time.
3. Not applicable since Rio Tinto does not lease significant upstream and downstream assets or have franchised operations.
4. This category is for reporting emissions from company investments not already reported in Scope 1 and 2. Rio Tinto reports using the equity share approach, so all Scope 1 and 2 emissions from managed and non-managed investments are included in Scope 1 and 2 reporting and Scope 3 emissions within other applicable categories of Scope 3 reporting.
5. Other processing of sold products included an estimate for salt in 2020, in 2021 salt has been reported separated with new methodology.

The bauxite and alumina processing of sold products 2021 equivalent is calculated using 2021 methodology and 2018 CRU factors (as were used in 2020 reporting). 2018 CRU data is higher in average emissions). Where there have been changes in reporting methodology, the 2020 data has been provided for context in an equivalent way using the same vintage of emission factors that were selected for use in the 2020 report.



# Processing of sold products

The majority of our exposure to Scope 3 emissions is from processing of sold products mainly related to our iron ore, bauxite and alumina, titanium dioxide, copper and salt value chains. 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, salt and titanium dioxide value chains.

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 where our products displace similar products with a higher emissions footprint.

Rainbow Bridge. Tokyo, Japan.

# Processing of iron ore

| Iron ore shipments[1] (2021, Mt equity share) | Attributable steel production (2021, Mt steel) | Emissions per tonne of steel (t $CO_2e$ per t attributable steel) | Estimated iron ore value chain emissions (Mt $CO_2e$, equity share) |
|---|---|---|---|
| 273.2 | 168.0 x 2.17 = | | 364.6 |

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 and the electric arc furnace (EAF).

Around 99% of our iron ore is processed in the 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 that process our iron ore products. We have taken a conservative approach to capturing these differences while ensuring our modelling accounts for the different emissions profiles associated with our suite of iron ore products.

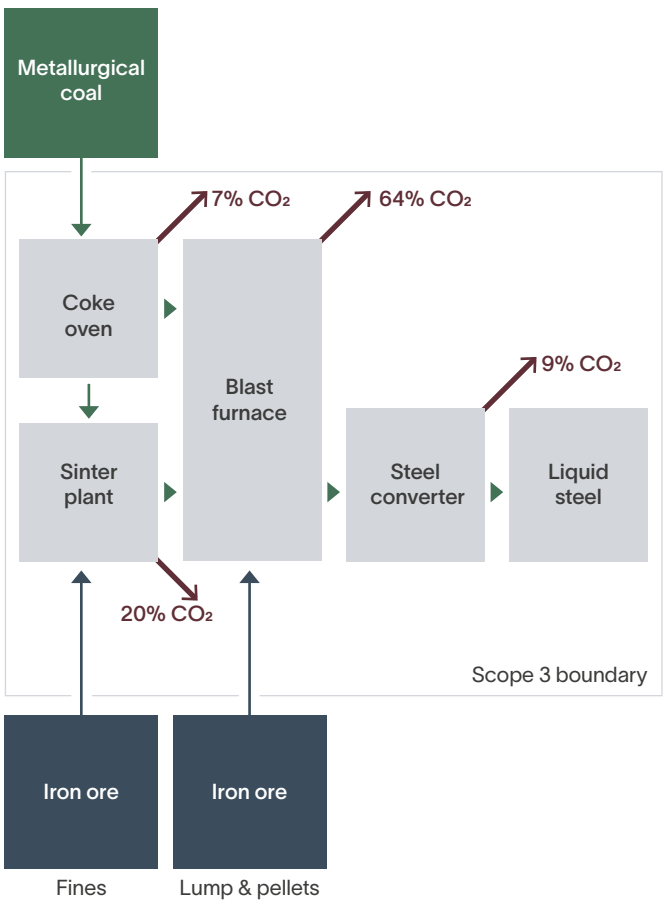
## Calculation boundary

We have developed a steelmaking energy and mass balance model to estimate emissions from processing of iron ore into a liquid steel product by both the BF/BOF and DRI/EAF processes. Each of our 12 iron ore products are analysed within this model based on respective ore grades, mineral chemistry and moisture content.

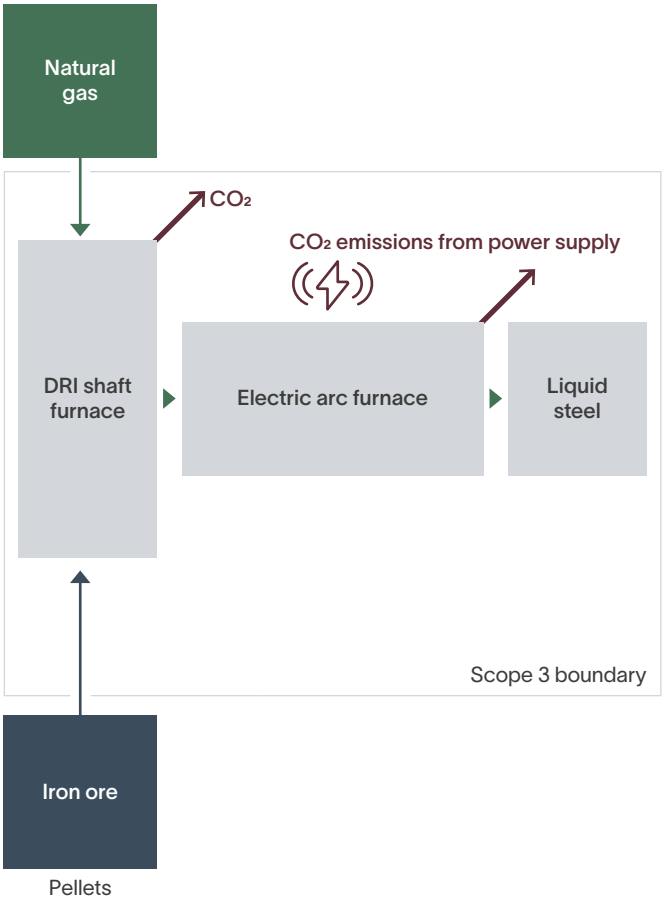
The model captures the activities incorporated at a typical steelmaking facility, recognising that this varies by customer and region. The emissions boundary used to prepare this estimate includes emissions from the four primary sources of BF/ BOF steelmaking: the production of coke, iron ore sintering, 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.

## Integrated blast furnace route (BF/BOF)




## Electric arc furnace route (EAF)




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

## Calculation methodology

We use typical industry parameters when modelling to consider the energy needed in each step of the steelmaking 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 26Mt $CO_2e$), 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 pelletised 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 $Fe_2O_2$) 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 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*

*IEA Emission Factors: Database documentation (2019)*

*Thermochemical Data of Pure Substances, Third Edition – Prof.-Dr. Ing. Ihsan Barin*

*Rio Tinto Fourth Quarter Operations Review 2021*

| Item | Range (by product) | Example (Pilbara Blend™ Fines) | Rio Tinto portfolio | Description |
|---|---|---|---|---|
| **Iron ore production (million tonnes, equity share)** | | | | |
| 2021 iron ore shipments[1] | | 109.6 | 273.2 | We produce a range of iron ore products from our Pilbara and Iron Ore Company of Canada operations.<br><br>Data sourced from Rio Tinto shipments data for the year ended 31 December 2021. |
| **Processing iron ore to steel (million tonnes)** | | | | |
| 2021 attributed steel production | | 67.0 | 168.0 | 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 | 0.16 | Emission are estimated using average global grades of metallurgical coal and typical coke oven efficiencies. |
| Emissions associated with ore sintering | 0.04 – 0.66 | 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 – 1.59 | 1.36 | 1.39 | 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) | 0.20 | 0.20 | 0.20 | Emissions in the steel plant are reasonably consistent across our products. |
| **Emissions per tonne of attributable steel** (tonnes $CO_2e$ per tonne liquid steel) | | 2.26 | 2.17* | Emission factors sourced from our energy and mass balance modelling of iron ore processing.<br>* Includes contribution from DR pellets used in DRI+EAF process |
| **2021 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) | | 168.0 | 364.6 | Total estimated emissions from processing of our iron ore to produce steel.<br><br>Calculated on a product basis by applying the specific product emission factors to the 2021 shipment volumes of each product. |

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

# Processing of bauxite and alumina

| Downstream emissions attributable to bauxite sales (Category 10) Mt $CO_2e$ | Downstream emissions attributable to alumina sales (Category 10) Mt $CO_2e$ | Upstream emissions attributable to bauxite & alumina purchases (Category 1) | Estimated Scope 3 emissions from sales and purchases of bauxite and alumina (Mt $CO_2e$, equity share) |
|---|---|---|---|
| 144.5 | | 1.6 | 146.1 |

The processing of bauxite and alumina into aluminium is the second largest contributor to our Scope 3 emissions. For 2021 reporting we have calculated Scope 3 emissions looking at the value chain of each of our bauxite and alumina operations and accounting for all upstream and downstream emissions. This is a materially different approach to calculating Scope 3 emissions based on consolidated net bauxite and alumina volumes, as reported in 2020.

This new methodology allows full value chain transparency and when Rio Tinto and our customers and suppliers reduce their Scope 1 and 2 emissions it will more clearly demonstrate the improvement over time. It also provides the pathway for greater accuracy of Scope 3 reporting using site-specific emission factors, conversion ratios and regional emission factors instead of global factors and conversions.

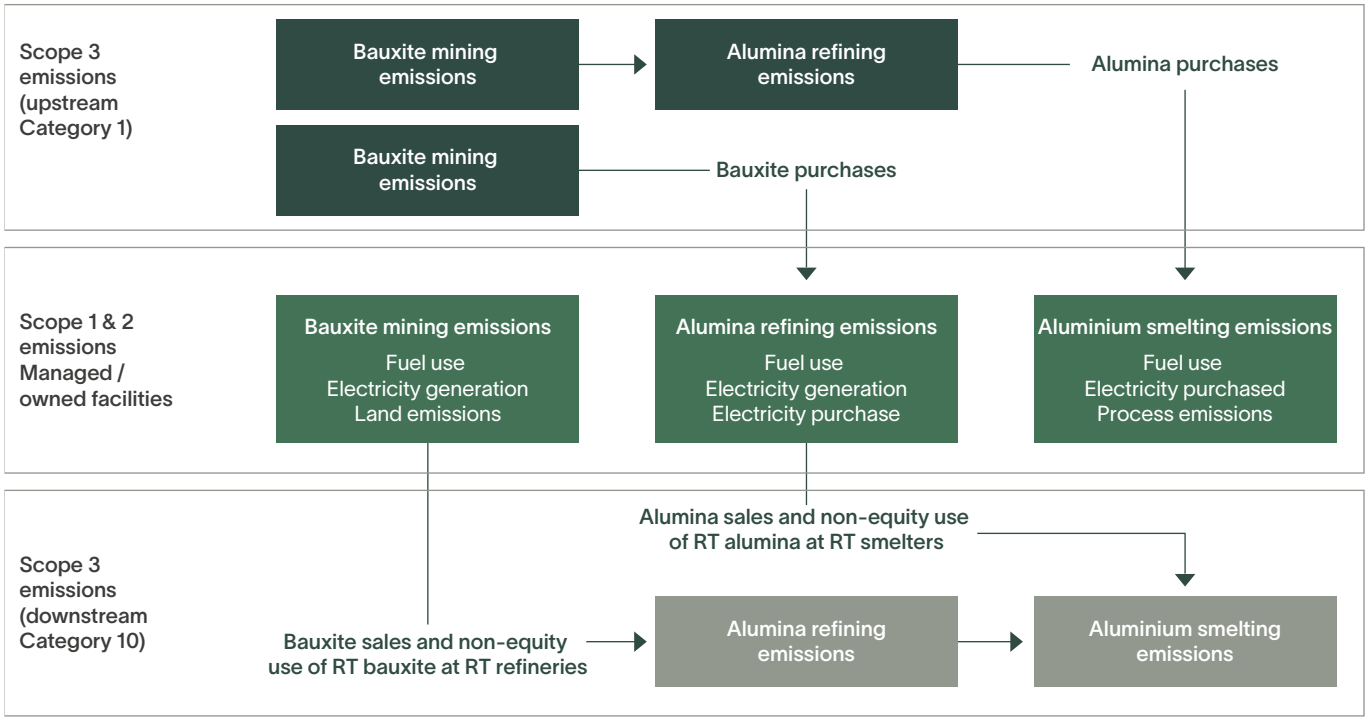
In our global value chain, bauxite is converted to alumina via the Bayer process. The emissions associated with this process are primarily driven by the emission factors associated with the fuel used in steam generation and calcination of alumina, and the electricity supply at our customers' refineries.

Processing alumina into aluminium uses the Hall-Héroult process which is electro-intensive and releases process $CO_2$ emissions from the use of carbon anodes in the electrolytic production of aluminium. From the 2020 CRU Group data, the average emissions to convert alumina to aluminium are around 11.63t $CO_2e$ per tonne of aluminium. This average accounts for both low-carbon hydroelectricity-supplied smelters and smelters that operate in regions with high-carbon-intensity electricity. The majority of the emissions are to do with electricity consumption or generation of electricity consumed by the operations. The remainder are from the baking and consumption of carbon anodes, process emissions and fuel consumption.

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

The calculation of emissions is inclusive of all three processing steps: bauxite mining, alumina refining and aluminium smelting. Where Rio Tinto has equity ownership, the emissions upstream and downstream are reported as Scope 1 and 2. Where Rio Tinto sells or purchases third-party bauxite and alumina, the emissions are reported as Scope 3 emissions.

Our vertically integrated supply chain produces aluminium with a significantly lower carbon footprint than the global average, due primarily to the hydropower electricity used by our Canadian aluminium smelters. We have applied CRU Group data for emissions intensities, using average regional data with emissions from Rio Tinto facilities excluded. This approach more accurately accounts for emissions from third-party suppliers and customers. Regional emission factors for our bauxite and alumina customers located in Asian countries are much higher than the global average. For example, average China smelting emissions according to CRU Group data are approximately 25% higher than the global average t $CO_2e$/t aluminium.




## 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 exposure to Scope 3 emissions in this value chain, we have calculated emissions from both the purchases and the sales of bauxite and alumina across the equity position within our managed and non-managed operations. Where applicable, non-equity share of actual emissions from our joint ventures (not already covered in Scope 1 and 2 emissions reporting) are included. Within the calculations, we have also preferentially used more accurate regional emission factors for calculating downstream processing of sold bauxite and alumina (Category 10), and upstream processing of purchased bauxite and alumina (Category 1).

Outside 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 minimal associated downstream emissions from processing.

## Calculation methodology

The approach is as follows:

| Emissions from | Conversion ratio | Emissions intensity |
|---|---|---|
| Bauxite sales | Bauxite-to-alumina ratio<br>– Facility-specific data, where available from internal Life Cycle Assessment (LCA)<br>– Otherwise, regional International Aluminium Institute (IAI) conversion factor<br>– Otherwise, global IAI conversion factor of 2.847t bauxite/t alumina | Of alumina refining<br>– Facility-specific data, where available<br>– Otherwise, regional 2020 CRU Group data (average excluding Rio Tinto assets)<br>– Otherwise, global 2020 CRU Group data (average excluding Rio Tinto assets 1.24t $CO_2e$/t alumina) |
| | Alumina-to-aluminium ratio<br>– Facility-specific data, where available from internal LCA<br>– Otherwise, regional IAI conversion factor<br>– Otherwise, global IAI conversion factor of 1.928t alumina/t aluminium | Of aluminium smelting<br>– Facility-specific data, where available<br>– Otherwise, regional 2020 CRU Group data (average excluding Rio Tinto assets)<br>– Otherwise, global 2020 CRU Group data (average excluding Rio Tinto assets 11.97t $CO_2e$/t aluminium) |
| Alumina sales | As above for alumina-to-aluminium ratio in bauxite sales | As above for aluminium smelting emissions in bauxite sales |
| Bauxite purchases | | Of bauxite mining<br>– Facility-specific data, where available<br>– Otherwise, regional 2020 CRU Group data (average excluding Rio Tinto assets) |
| Alumina purchases | Alumina-to-bauxite ratio<br>– Facility-specific data, where available from internal LCA<br>– Otherwise, regional IAI conversion factor<br>– Otherwise, global IAI conversion factor of 2.847t bauxite/t alumina | Of alumina refining<br>– Facility-specific data, where available<br>– Otherwise, regional 2020 CRU Group data (average excluding Rio Tinto assets)<br>– Otherwise, global 2020 CRU Group data (average excluding Rio Tinto assets) 1.24t $CO_2e$/t alumina<br>– As above for bauxite mining emissions in bauxite purchases |

The emission factors used in the calculation are taken from CRU Group data on 2020 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 emission factors for converting bauxite through to aluminium, and alumina to aluminium.

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

| Item | Calculation steps | Rio Tinto portfolio | Description |
|---|---|---|---|
| **2021 sales (million tonnes, equity share)** | | | |
| Bauxite sales | A | 38Mt | Sales of bauxite to third parties |
| Alumina sales | B | 3Mt | Sales of alumina to third parties |
| **Conversion factors** | | | |
| Bauxite:Alumina | C | 2.847 | International Aluminium Institute, Life Cycle Inventory (published 2018) |
| Alumina:Aluminium | D | 1.928 | International Aluminium Institute, Life Cycle Inventory (published 2018) |
| **Processing-related emission factors (tonnes $CO_2e$ per tonne of input material)** | | | |
| Bauxite-to-alumina intensity (t $CO_2e$/t alumina) | E | 1.24 | CRU Group dataset (2020), global average (excluding Rio Tinto assets) |
| Alumina-to-aluminium intensity (t $CO_2e$/t aluminium) | F | 11.97 | CRU Group dataset (2020), global average (excluding Rio Tinto assets) |
| **2021 aluminium value chain emissions (million tonnes $CO_2e$)** | | | |
| Emissions from processing of bauxite sales | A ÷ C x E + A ÷ C ÷ D x F | | Emissions associated with processing of bauxite to alumina and then further to aluminium |
| Emissions from processing of alumina sales | B ÷ D x F | | Emissions associated with processing of alumina to aluminium |
| Total Scope 3 GHG emissions from processing of bauxite and alumina (Mt $CO_2e$ equity share) | | 144.5 | Total estimate emissions from processing of bauxite and alumina<br>This is reported in Category 10 |

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

| Item | Calculation steps | Rio Tinto portfolio | Description |
|---|---|---|---|
| **2021 purchases (million tonnes, equity share)** | | | |
| Bauxite purchases | G | 1.7Mt | Purchases of bauxite from third parties |
| Alumina purchases | H | 1.4Mt | Purchases of alumina from third parties |
| **Conversion factors** | | | |
| Bauxite:Alumina | C | 2.847 | International Aluminium Institute, Life Cycle Inventory (published 2018) |
| Alumina:Aluminium | D | 1.928 | International Aluminium Institute, Life Cycle Inventory (published 2018) |
| **Processing-related emission factors (tonnes $CO_2e$ per tonne of input material)** | | | |
| Bauxite mining intensity (t $CO_2e$/t bauxite) | I | 0.0155 | CRU Group dataset (2020), global average (excluding Rio Tinto assets) |
| Bauxite-to-alumina intensity (t $CO_2e$/t alumina) | E | 1.24 | CRU Group dataset (2020), global average (excluding Rio Tinto assets) |
| **2021 aluminium value chain emissions (million tonnes $CO_2e$)** | | | |
| Emissions from processing of purchased bauxite | G x I | | Emissions associated with the mining of purchased bauxite |
| Emissions from processing of purchased alumina | H x E + H x C x I | | Emissions associated with the processing of alumina and mining of the bauxite used to refine that alumina |
| Total Scope 3 GHG gas emissions from purchased bauxite and alumina (Mt $CO_2e$ equity share) | | 1.6 | Total Scope 3 estimate emissions from purchased bauxite and alumina<br>This is reported in Category 1 |

## Data sources

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

## References

*Rio Tinto Fourth Quarter Operations Review 2021*

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

*CRU Group Commodity Market Analysis*

# Processing of titanium dioxide feedstocks

| Titanium dioxide production (2021, Mt tonnes equity share) | Emission factor (tonnes $CO_2e$ per tonne product sold) | Estimated $TiO_2$ value chain emissions (Mt $CO_2e$, equity share) |
|---|---|---|
| 1.0 | x 4.9 = | 4.9 |

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 Lac Tio in Canada, as well as smelters at RBM and Sorel-Tracy in Canada. These operations generate products for the $TiO_2$ pigment industry.

Our $TiO_2$ business provides the main feedstock for the TiO2 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 $TiO_2$ feedstock as Scope 1 and 2 emissions. Our Scope 3 emissions estimate incorporates the emissions associated with the conversion of mineral sands and feedstock to $TiO_2$ pigment. The Scope 3 emissions from processing ilmenite are not included in this calculation.

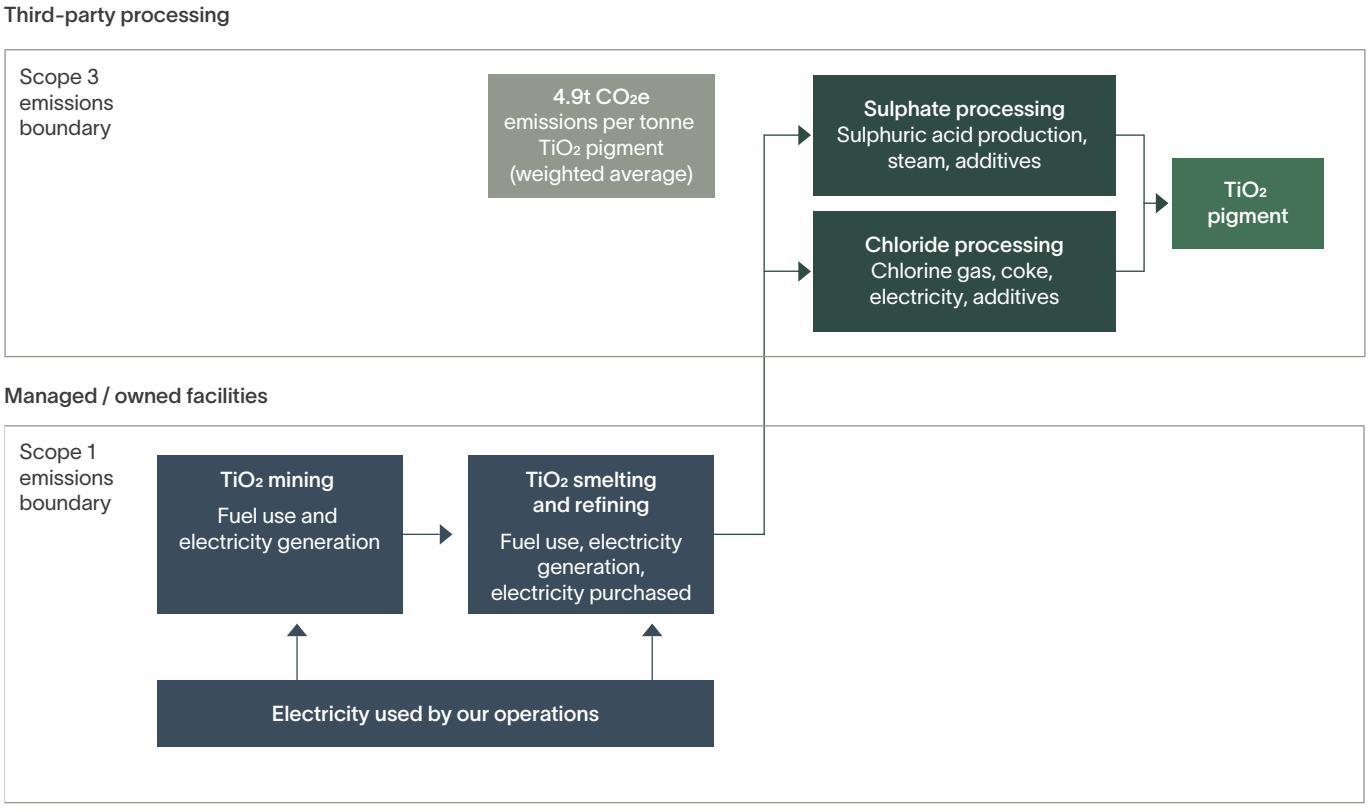
$TiO_2$ pigment is produced through two main processes, sulphate and chloride, using a wide selection of $TiO_2$ feedstocks such as ilmenite, titania slag, and natural rutile.

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 organisation 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. We use this to estimate our customer value chain emissions.

The global average emission factor calculated by the TDMA includes emissions related to processing $TiO_2$ 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 to estimate our Scope 3 emissions. We acknowledge that our Scope 1 and 2 emissions double up somewhat within this Scope 3 calculation. The source factor used in the 2020 inventory was 5.2 t $CO_2e$/t pigment and the updated Life Cycle Inventory is 4.9 t $CO_2e$/ t pigment.



| Item | Calculation steps | Rio Tinto portfolio | Description |
|---|---|---|---|
| **2021 $TiO_2$ feedstock production (million tonnes, equity share)** | | | |
| $TiO_2$ feedstock production (million tonnes, equity share) | A | 1.0 | Weighed production quantities of $TiO_2$ feedstocks from managed and non-managed operations |
| **Processing of $TiO_2$ feedstocks – emission factor (tonnes $CO_2e$)** | | | |
| Emissions associated with processing $TiO_2$ feedstock into pigment (tonnes $CO_2e$ per tonne $TiO_2$ feedstock) | B | 4.9 | Weighted average emission factor sourced from TDMA Titanium Dioxide Industry Average Carbon Footprint (2018 publication, 2016 data) |
| **2021 $TiO_2$ value chain emissions (million tonnes $CO_2e$)** | | | |
| Total emissions from processing $TiO_2$ feedstocks (Mt $CO_2e$, equity share) | A x B | 4.9 | Total estimated emissions from processing of feedstock into refined product |

## Data sources

Equity share production volumes have been obtained from reported production $TiO_2$ feedstocks from managed and non-managed operations.

Our emission factor has been sourced from the $TiO_2$ industry average carbon footprint as published by the Titanium Dioxide Manufacturers Association.

## References

*Rio Tinto Fourth Quarter Operations Review 2021*

*Titanium Dioxide Industry Average Carbon Footprint, TDMA*

# Processing of copper concentrate

| **Net copper concentrate production** (2021, Mt tonnes equity share) | **Emission factor** (tonnes $CO_2e$ per tonne copper) | **Estimated copper value chain emissions** (Mt $CO_2e$, equity share) |
|---|---|---|
| 0.3 | x 1.64 = | 0.5 |

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 processing of our net sales of copper concentrate into refined copper. We do not sell copper ore without first converting it to copper concentrate.

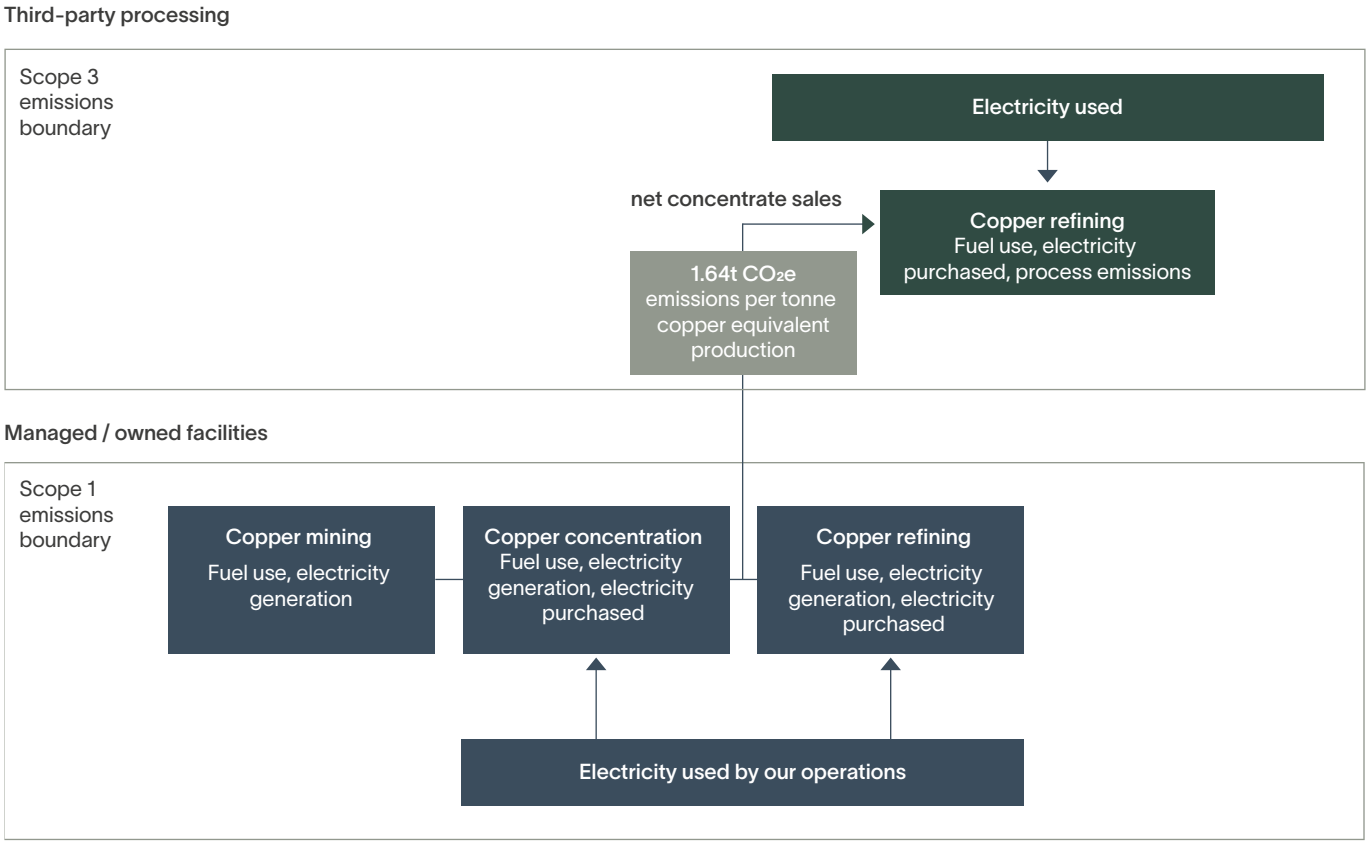
The emissions associated with mining, concentrating and, where applicable, refining copper at our operations are included in our Scope 1 and 2 emissions reporting.

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 the emission 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 5.88t $CO_2e$/t Cu for all processing stages from mining to refining. Using the emissions breakdown in the paper, the emissions associated with processing of copper concentrate into refined copper have been determined to be 1.64t $CO_2e$/t Cu. We have used this emission factor for the copper refining process and applied this to our net copper concentrate sales.



| Item | Calculation steps | Rio Tinto portfolio | Description |
|---|---|---|---|
| **2021 copper production (million tonnes, equity share)** | | | |
| Net copper concentrate | A | 0.3 | Calculated by subtracting refined copper from copper concentrate volumes to determine our net copper concentrate production.<br><br>Data sourced from site production records as reported in the Rio Tinto Annual Report for the year ended 31 December 2021, where refined copper is copper (refined) and copper concentrate is copper (mined) |
| **Processing of copper concentrate – emission factor (tonnes $CO_2e$)** | | | |
| Copper concentrate to refined copper | B | 1.64 | The emission factor utilised to capture typical emissions generated converting copper concentrate to refined copper |
| **2021 copper value chain emissions (million tonnes $CO_2e$)** | | | |
| Total Scope 3 GHG emissions from processing of copper concentrate (Mt $CO_2e$, equity share) | A X B | 0.5 | Estimate calculated by applying the emission factor to the 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.

Because many of our copper concentrate sales are to customers in China, our emission 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*

# Processing of salt

| Salt production (2021, Mt tonnes equity share) | Estimated salt processing emissions (Mt $CO_2e$, equity share) |
|---|---|
| 5.9 | 7.2 |

Dampier Salt operations are located in Western Australia and comprise three salt operations at Dampier, Port Hedland and Lake MacLeod. The majority of our salt production ends up in chlor-alkali processes and the manufacturing of caustic soda and chlorine.

## Calculation boundary

The emissions captured within our Scope 3 estimate include processing of our salt into refined products on an equity basis.

## Calculation methodology

The emission factor applied to the amount of production estimated to have been used in chlor-alkali processes is 2.03t $CO_2e$/t NaOH, sourced from SimaPro V9 Life cycle database. To apply this factor to sodium chloride, the molar mass ratios were used to give an equivalent t $CO_2e$/t NaCl and adjusted for % of moisture. The amount of caustic that our customers would likely produce from our salt is then multiplied by the emission factor.

Manufacturing salt through processes such as those used in the paper and pulp industry is lower in emissions intensity than those used in chlor-alkali processes. We have estimated GHG emissions from salt in these other processing applications.

## Data sources

Production volumes are taken from managed site production quantities of salt. This data is used for compiling the Rio Tinto Annual Report production data.

## References

*SimaPro V9 Life cycle database: Sodium Hydroxide, 50% in H2O, production mix, at plant/RER U/AusSD U (Method: IPCC 2013 HWP 100a V1.03).*

# Calculation methodology – all Scope 3 Standard emissions categories

| Category | Mt $CO_2e$ (equity share) | Calculation boundary | Calculation methodology | Data sources |
|---|---|---|---|---|
| **1. Purchased goods and services** | 16.3 | Includes emissions associated with relevant purchased goods and services.<br><br>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.<br><br>Specific Scope 3 emissions are calculated for use of explosives, lime, anodes, coke, pitch, cathodes and caustic soda.<br><br>Scope 3 emissions from purchases of bauxite and alumina are also included in this category.<br><br>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<br><br>The 2016 conversions from Quantis are used (which were the most recent available at the time of publication) |
| **2. Capital goods** | 1.9 | 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.<br><br>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. |
| **3. Fuel and energy-related activities** | 2.9 | Includes emissions from the production and transportation of purchased fuels, including natural gas, diesel, coal and energy sources not included in Category 1. This includes transmission losses from purchased electricity. | Factors are sourced from the Australian National Greenhouse Accounts (NGA) Scope 3 factors emissions tables for fuels and the Department for Business, Energy and Industrial Strategy (UK) (BEIS), formerly known as DEFRA Scope 3 tables. | Fuel and energy consumption data from Rio Tinto business systems combined with NGA Factors and BEIS (formerly known as DEFRA) factors. |
| **4. Upstream transportation and distribution** | 5.9 | Total Scope 3 GHG emissions from upstream transportation and distribution of iron ore, bauxite, alumina, aluminium, salt, and $TiO_2$ feedstocks, copper concentrates and copper cathodes related products (million tonnes $CO_2e$, equity share).<br><br>Includes all inbound transport, all inter-company transport paid for by Rio Tinto and all outbound product transport paid for by Rio Tinto (eg under cost, insurance and freight (CIF, CRF) or similar terms).<br><br>Bulk marine transportation and distribution of iron ore, bauxite, alumina and salt paid for by Rio Tinto contribute approximately 4.9Mt $CO_2e$ of these emissions.<br><br>The balance of emissions are from shipping of other products, third-party containerised shipping, road and rail of other products.<br><br>Excludes emissions from Rio Tinto owned vessels (this is included in Scope 1 emissions). | Company shipping quantities, vessel types and route data are used in the calculations. For shipped materials, the International Maritime Organization (IMO), Fourth GHG study has been used for emission factors.<br><br>For trucked materials, the Department for Business, Energy and Industrial Strategy (UK) (BEIS) conversion factors are used.<br><br>For time-chartered vessels, specific individual vessel emissions intensity factor (based on weighted average energy efficiency operational indicator value) are used together with the specific port-to-port distances and cargo carried. Where these specific emission factors are not available, standard IMO vessel emission factors are used with the distance and tonnage carried.<br><br>Some transport emissions based on spend data and Quantis emissions factors are also included in this section. | Upstream transport records sourced from Rio Tinto business systems and combined with the IMO, Fourth GHG study for ships. IMO GHG Study 2020 – Final Report Secretariat and BEIS conversion factors<br><br>Distances are estimated using Veson Integrated Marine Operations System (IMOS) Platform port-to-port distances where available.<br><br>For logistics distances, Google maps<br><br>Emissions data of time-chartered vessels from IMOS. Emission factors from fuels are sourced from the 2018 EEDI Guidelines (International Maritime Organization). These factors are consistent with the IMO GHG Study for ships. |

| Category | Mt $CO_2e$ (equity share) | Calculation boundary | Calculation methodology | Data sources |
|---|---|---|---|---|
| **5. Waste generated in operations** | 0.1 | Estimated emissions for third-party landfill, waste processing and waste water.<br><br>Rio Tinto processes do not generate biodegradable waste and the majority of emissions from waste is included in Scope 1 reporting. | Estimates of domestic waste and wastewater sent to third-party facilities multiplied by the BEIS (formerly known as DEFRA) Scope 3 factors. | BEIS Scope 3 emission factors |
| **6 & 7. Business travel and Employee commuting** | 0.4 | Includes domestic and international flights, road and rail travel as well as travel services including hotels, taxis.<br><br>Includes company arranged charter flights.<br><br>Excludes company buses and cars (Scope 1).<br><br>Employee commuting to remote sites is included in Scope 3 business travel including charter flights. Company buses and cars are in Scope 1 and 2 emissions. Remainder of employee commuting to and from work has been estimated. | Air travel for fly in/fly out has been included in business travel.<br><br>Emissions report is from the corporate Rio Tinto travel provider and estimates for the few sites that do not use the provider.<br><br>Business travel and employee commuting emissions using spend data and Quantis emissions factors are also included in this section. | BEIS Scope 3 emission factors |
| **8. Upstream leased assets** | Not applicable | | Rio Tinto does not lease significant upstream assets. | |
| **9. Downstream transportation and distribution** | 2.7 | Total Scope 3 GHG emissions from downstream transportation and distribution of iron ore, bauxite, alumina, aluminium, and $TiO_2$ feedstocks and minerals related products, copper concentrates and copper cathodes (million tonnes $CO_2e$, equity share.<br><br>Includes emissions from the transport and distribution of our products where freight has not been arranged by Rio Tinto (eg under Free on Board (FOB) or similar terms).<br><br>Bulk marine transportation and distribution of iron ore, bauxite, alumina, and salt account for approximately 2.3Mt $CO_2e$ of these emissions.<br><br>The balance of the emissions are from transportation of other products. | Company shipping information (tonnes, vessel, route) is used to calculate emissions with the conversion factors for tonne/km of shipping.<br><br>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, Fourth GHG study for ships. IMO GHG Study 2020 – Final Report Secretariat.<br><br>Distances have been estimated using Sea Distances, Veson Integrated Marine Operations System (IMOS) Platform for port to port distances, and Google Maps for logistics distances. |

## Calculation methodology – all Scope 3 Standard emissions categories *continued*

| Category | Mt $CO_2e$ (equity share) | Calculation boundary | Calculation methodology | Data sources |
|---|---|---|---|---|
| **10. Processing of sold products** | | Includes emissions related to the processing of iron ore, bauxite, alumina, $TiO_2$ feedstocks, copper concentrate and salt. "Other" includes an estimate for processing emissions related to Rio Tinto's other products including molybdenum and minor minerals. High purity products like gold, silver and diamonds, which are low volume and have minimal amounts of further processing, are considered not material. | Emissions calculated as described in this report. | |
| – **Iron ore** | 364.6 | | | |
| – **Bauxite & alumina** | 144.5 | | | |
| – **Titanium dioxide** | 4.9 | | | |
| – **Copper** | 0.5 | | | |
| – **Salt** | 7.2 | | | |
| – **Other** | 1.6 | | | |
| **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 include metals and minerals with minimal emissions at end of life.<br><br>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.<br><br>Investments such as the Rio Tinto Pension Fund UK are managed by third parties. | | |

## Rio Tinto Scope 1, 2, and 3 (value chain) emissions 584.6Mt $CO_2e$ (2021, 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 27.5Mt $CO_2e$

Scope 1 and 2 emissions 31.1Mt $CO_2e$

Downstream emissions 526.0Mt $CO_2e$

| Scope 3 | Mt $CO_2e$ |
|---|---|
| Cat 1 Purchased goods (spend data) | 9.4 |
| Cat 1 Bauxite & alumina purchases | 1.6 |
| Cat 1 Higher emission purchases (eg caustic, lime, explosives coke, pitch, anodes) | 5.3 |
| Cat 2 Capital goods | 1.9 |
| Cat 3 Fuels | 2.9 |
| Cat 4 Transport | 5.9 |
| Cat 5,6,7 Waste, business travel & commuting | 0.5 |

| Scope 1 and 2 | Mt $CO_2e$ |
|---|---|
| Scope 1 | 22.7 |
| Scope 2 | 8.4 |

| Scope 3 | Mt $CO_2e$ |
|---|---|
| Cat 9 Transport | 2.7 |
| Cat 10 Processing | |
| – Iron ore | 364.6 |
| – Bauxite & alumina | 144.5 |
| – $TiO_2$ feedstocks | 4.9 |
| – Copper | 0.5 |
| – Salt | 7.2 |
| – Other | 1.6 |

## Rio Tinto iron ore Scope 1, 2 and 3 (value chain) emissions 380.4Mt $CO_2e$ (2021, equity basis)

This GHG emissions value chain includes direct and indirect emissions on an equity basis from Rio Tinto's Pilbara iron ore operations and Iron Ore Company of Canada (IOC).

Upstream emissions 10.6Mt $CO_2e$

Scope 1 and 2 emissions 3.6Mt $CO_2e$

Downstream emissions 366.2Mt $CO_2e$

| Scope 3 | Mt $CO_2e$ |
|---|---|
| Cat 1 and 2 Purchased & capital goods | 4.7 |
| Cat 1 Higher emission purchases (e.g. explosives) | 0.8 |
| Cat 3 Fuels | 0.9 |
| Cat 4 Transport | 3.8 |
| Cat 5, 6, 7 Waste, business travel & commuting | 0.38 |

| Scope 1 and 2 | Mt $CO_2e$ |
|---|---|
| Scope 1 | 3.6 |
| Scope 2 | 0.02 |

| Scope 3 | Mt $CO_2e$ |
|---|---|
| Cat 9 Transport | 1.6 |
| Cat 10 Processing | 364.6 |

Note: Category 4 Transport is Scope 3 emissions from third-party transport and distribution of iron ore to customers that Rio Tinto has arranged and/or paid for.

## Rio Tinto aluminium Scope 1, 2 and 3 (value chain) emissions 176.9Mt $CO_2e$ (2021, equity basis)

This GHG emissions value chain includes direct and indirect emissions from Rio Tinto bauxite, alumina and aluminium operations on an equity basis. The data includes Scope 1 and 2 emissions from all operating facilities and Scope 3 from upstream and downstream activities.

Upstream emissions 9.8Mt $CO_2e$

Scope 1 and 2 emissions 21.8Mt $CO_2e$

Downstream emissions 145.3Mt $CO_2e$

| Scope 3 | Mt $CO_2e$ |
|---|---|
| Cat 1 and 2 Purchased & capital goods | 2.5 |
| Cat 1 Caustic, lime, coke, pitch, anodes | 3.1 |
| Cat 1 Bauxite & alumina purchases | 1.6 |
| Cat 3 Fuels | 1.4 |
| Cat 4 Transport | 1.1 |
| Cat 5, 6 and 7 Waste, business travel & commuting | 0.07 |

| Scope 1 and 2 | Mt $CO_2e$ |
|---|---|
| Scope 1 | 15.8 |
| Scope 2 | 6.0 |

| Scope 3 | Mt $CO_2e$ |
|---|---|
| Cat 9 Transport | 0.8 |
| Cat 10 Processing | 144.5 |

Note: Category 4 Transport is Scope 3 emissions from third-party transport and distribution of bauxite, alumina and aluminium to customers that Rio Tinto has arranged and/or paid for.

# Independent Reasonable and Limited Assurance Report

of KPMG (KPMG Australia) to the Directors of Rio Tinto plc and Rio Tinto Limited

## CONCLUSION

### a) Scope 1 and 2 GHG Emissions – Reasonable assurance

In our opinion, in all material respects, Rio Tinto's total Greenhouse Gas (GHG) emissions (equity basis) of 31.1 MtCO2-e (Scope 1 and 2) presented in the Scope 1, 2 and 3 emissions calculation methodology 2021 for the year ended 31 December 2021, has been prepared by Rio Tinto plc and Rio Tinto Limited (together, "Rio Tinto") in accordance with the Reporting Criteria.

### b) Scope 3 GHG Emissions – Limited assurance

Based on the evidence we obtained from the procedures performed, we are not aware of any material misstatements in the Scope 3 GHG emissions (equity basis) of 553.5 MtCO2-e presented in the Scope 1, 2 and 3 emissions calculation methodology 2021 for the year ended 31 December 2021, which has been prepared by Rio Tinto in accordance with the Reporting Criteria.

## GHG Emissions data

The information subject to assurance is the following Rio Tinto performance data related to Climate Change disclosed in the Scope 1, 2 and 3 emissions calculation methodology 2021:

- Total Scope 1 and 2 GHG Emissions (equity basis) 31.1 MtCO2e
- Total Scope 3 GHG Emissions (equity basis) 553.5 MtCO2e

Our assurance does not extend to information in respect of earlier periods or to any other information included in the Scope 1, 2 and 3 emissions calculation methodology 2021 for the year ended 31 December 2021.

## Reporting Criteria

The Reporting Criteria used for GHG Emissions data are the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD)'s *Greenhouse Gas (GHG) Protocol: A Corporate Accounting and Reporting Standard (Revised Edition) (2015),* and the appropriateness and alignment of Rio Tinto's approach to calculating the Scope 3 GHG Emissions to the WRI and WBSCD's *GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2013)* and the *Technical Guidance for Calculating Scope 3 Emissions (version 1.0).*

## Basis for Conclusion

We conducted our work in accordance with International Standard on Assurance Engagements ISAE 3000 (Revised) Assurance Engagements other than Audits and Reviews of Historical Financial Information and in respect of greenhouse gas emissions, International Standard on Assurance Engagements ISAE 3410 Assurance Engagements on Greenhouse Gas Statements issued by the International Auditing and Assurance Standards Board (Standards). In gathering evidence for our conclusions, our assurance procedures comprised:

- enquiries with relevant Rio Tinto personnel to understand and evaluate the design and implementation of the key systems, processes and internal controls relevant to the GHG Emissions data;
- analytical procedures over the GHG Emissions data;
- substantively tested the Scope 1 and 2 GHG Emissions data, on a sample basis at corporate and operational level, which included testing a selection of eleven operations including Boyne Smelters Limited, Quebec Operations (Grande Baie, Laterriere, AP40, Avida, AP60 and Strathcona), Gladstone Power Station, Queensland Alumina Limited, Tomago, Yarwun, Bell Bay, Kitimat and Kemano, New Zealand Aluminium Smelters, Escondida, and Richards Bay Minerals;
- interviews and walkthroughs with site personnel at each of the eleven operations listed above to assess the key systems, processes and internal controls to capture, collate, calculate and report Scope 1 and 2 GHG Emissions data at an operational level, and how this information is reported and captured at corporate level;
- sample testing of material Scope 1 and Scope 2 sources of GHG Emissions data back to source documentation;
- interviews and walkthroughs with corporate personnel to assess the key systems, processes and internal controls to capture, collate, calculate and report Scope 3 GHG Emissions;
- evaluating the design and effectiveness of controls implemented by the Rio Tinto Health, Safety and Environment (HSE) Services reporting function over the GHG Emissions data;
- testing the mathematical accuracy of a sample of calculations underlying the GHG Emissions data;
- assessing the appropriateness of a sample of emissions factors applied in calculating the GHG Emissions data;
- testing a sample of transportation and distribution information used in the Scope 3 GHG Emissions calculations to source documentation;
- testing performance data used within the calculations of the Scope 3 GHG emissions data to production results reported by Rio Tinto and on a sample basis, to underlying source documentation;

- evaluating the appropriateness and the alignment of Rio Tinto's approach to calculating the GHG Emissions to the WRI and WBCSD's *Greenhouse Gas (GHG) Protocol: A Corporate Accounting and Reporting Standard (Revised Edition) (2015),* and the appropriateness and alignment of Rio Tinto's approach to calculating the Scope 3 GHG Emissions to the WRI and WBSCD's *GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2013)* and the *Technical Guidance for Calculating Scope 3 Emissions (version 1.0);* and
- reviewing the Scope 1, 2 and 3 emissions calculation methodology 2021 in its entirety to ensure they are consistent with our overall knowledge of Rio Tinto and our observation of its operations.

In accordance with the Standards we have:

- used our professional judgement to plan and perform the engagement to obtain reasonable assurance that we are not aware of any material misstatements in the Scope 1 and 2 Emissions data, whether due to fraud or error;
- used our professional judgement to plan and perform the engagement to obtain limited assurance that we are not aware of any material misstatements in the Scope 3 GHG Emissions data, whether due to fraud or error;
- considered relevant internal controls when designing our assurance procedures, however we do not express a conclusion on their effectiveness; and
- ensured that the engagement team possess the appropriate knowledge, skills and professional competencies.

## How the Standard Defines Reasonable Assurance, Limited Assurance and Material Misstatement

The procedures performed in a limited assurance engagement vary in nature and timing from, and are less in extent than for a reasonable assurance engagement. Consequently, the level of assurance obtained in a limited assurance engagement is substantially lower than the assurance that would have been obtained had a reasonable assurance engagement been performed.

Reasonable assurance is a high level of assurance, but is not a guarantee that it will always detect a material misstatement when it exists.

Misstatements, including omissions, are considered material if, individually or in the aggregate, they could reasonably be expected to influence relevant decisions of the Directors of Rio Tinto.

## Use of this Assurance Report

This report has been prepared for the Directors of Rio Tinto for the purpose of providing an assurance conclusion on the GHG Emissions data and may not be suitable for another purpose. We disclaim any assumption of responsibility for any reliance on this report, to any person other than the Directors of Rio Tinto, or for any other purpose than that for which it was prepared.

## Management's responsibility

Management are responsible for:

- determining that the Reporting Criteria is appropriate to meet their needs;
- preparing and presenting the GHG Emissions data in accordance with the Reporting Criteria;
- establishing internal controls that enable the preparation and presentation of the GHG Emissions data that is free from material misstatement, whether due to fraud or error;
- ensuring the basis of preparation in accordance with which the GHG Emissions data has been determined and compiled is clearly and unambiguously set out in the Scope 1, 2 and 3 emissions calculation methodology 2021; and
- telling us of any known and/or contentious issues relating to the GHG Emissions data.

## Our Responsibility

Our responsibility is to perform a reasonable assurance engagement in respect of the Scope 1 and Scope 2 GHG Emissions data and a limited assurance engagement in relation to the Scope 3 GHG Emissions data for the year ended 31 December 2021, and to issue an assurance report that includes our conclusions.

## Our Independence and Quality Control

We have complied with our independence and other relevant ethical requirements of the Code of Ethics for Professional Accountants (including Independence Standards) issued by the IFAC Ethical Standards Board, and complied with the applicable requirements of International Standard on Quality Control 1 to maintain a comprehensive system of quality control.

KPMG

**KPMG**

23 February 2022

Adrian V. King

**Adrian King**

Partner
Melbourne, Australia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