

# Climate Change Report 2022



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**Our operations are located on land and waters that have belonged to Indigenous peoples for thousands of years. We respect their ongoing deep connection to Country and recognise their vast knowledge of the land, water and environment. We pay respects to Elders, both past and present, and acknowledge the important role Indigenous peoples play within our business and our communities.**

[Visit riotinto.com](https://riotinto.com) to find out more

Cover | Employee at IOC tailings in Labrador City, NL Canada

# 2022 highlights

Accelerate the decarbonisation of our assets	Develop products and technologies that help our customers decarbonise	Grow in materials enabling the energy transition
<p><b>Iron Ore</b></p> <ul style="list-style-type: none"> <li>– <b>Pilbara:</b> Planned investment of \$600 million in 230MW of solar power facilities and 200MWh of storage. This is in addition to the 34MW solar facility installed at Gudai-Darri.</li> <li>– <b>Pilbara:</b> Developed partnerships with Scania, Caterpillar, Volvo and Komatsu to deploy more efficient autonomous haulage solutions and battery-powered trucks.</li> <li>– <b>Marine biofuels:</b> Joined a trial with BP.</li> </ul>	<p><b>Green steel</b></p> <ul style="list-style-type: none"> <li>– <b>Blast furnace optimisation:</b> Extended our collaboration with over 20 customers, such as Baowu, POSCO, Nippon Steel Corporation and Shougang, with potential carbon emissions reductions of up to 30%.</li> <li>– <b>Biolron™:</b> Successfully piloted an innovative, low-carbon iron-making process on Pilbara iron ore.</li> <li>– <b>Hydrogen-based DRI<sup>1</sup>:</b> Collaborated with BlueScope and Salzgitter Flachstahl to test direct reduction of our products using green hydrogen and develop cleaner processing options.</li> </ul>	<p><b>High-grade iron ore</b></p> <ul style="list-style-type: none"> <li>– <b>Simandou:</b> Signed a non-binding term sheet with our partners to progress the co-development of infrastructure. The project will deliver high-grade iron ore, suitable for the DRI-EAF<sup>2</sup> steelmaking process.</li> </ul>
<p><b>Aluminium</b></p> <ul style="list-style-type: none"> <li>– <b>Queensland smelter repowering:</b> Commenced evaluation of proposals to repower our aluminium assets with up to 4GW of wind and solar, backed up by energy firming and storage solutions.</li> <li>– <b>Queensland Alumina:</b> Progressed to a pre-feasibility study for a double digestion project to reduce emissions and operational expenditure.</li> </ul>	<ul style="list-style-type: none"> <li>– <b>ELYSIS™:</b> Conducted commercial testing of direct emissions-free smelting technology with 450kA cells under construction.</li> <li>– <b>Low-carbon material:</b> Partnered with organisations including Volvo, Ford and AB InBev (Corona Canada).</li> </ul>	<ul style="list-style-type: none"> <li>– <b>Arvida:</b> Invested in a new aluminium recycling facility and plans to replace our closing smelter with an expansion of the AP60 smelter to produce low-carbon aluminium.</li> <li>– <b>Alma:</b> Committed \$188 million to expand production of higher-value low-carbon billets.</li> <li>– <b>Laterrière Plant:</b> Commissioned a new aluminium remelt furnace.</li> </ul>
<p><b>Copper and Minerals</b></p> <ul style="list-style-type: none"> <li>– <b>Rio Tinto Iron and Titanium (RTIT) Quebec Operations:</b> Committed \$537 million (C\$737 million) in partnership with the Government of Canada to decarbonise RTIT Quebec Operations and boost critical minerals processing.</li> <li>– <b>Richards Bay Minerals:</b> Partnered with Voltaia for solar power (20-year power purchase agreement).</li> <li>– <b>Renewable diesel:</b> Launched a pilot at Boron, with trials also planned for Kennecott.</li> </ul>	<ul style="list-style-type: none"> <li>– <b>Nuton™:</b> Joined strategic partnerships to test leaching technology on legacy copper waste and sulphide orebodies.</li> <li>– <b>Critical minerals from waste:</b> Began extracting tellurium concentrate at Kennecott. Achieved first production of scandium oxide and demonstration of an innovative spodumene (lithium) concentration process at our Critical Minerals and Technology Centre (RTIT Quebec Operations).</li> </ul>	<ul style="list-style-type: none"> <li>– <b>Oyu Tolgoi:</b> Acquired full ownership of Turquoise Hill Resources Ltd (TRQ) for \$3.1 billion, increasing our direct project ownership to 66%.</li> <li>– <b>Rincon:</b> Acquired Rincon for \$825 million and approved funding of \$194 million for early works to develop an accelerated starter plant with planned expansion.</li> </ul>

1. Direct Reduced Iron.  
2. Direct Reduced Iron – Electric Arc Furnace.

# Chief Executive's statement

Over a year ago, we put the low-carbon transition at the heart of our new strategy, setting a clear pathway to deliver long-term value as well as ambitious targets to decarbonise our business.

Our purpose is to find better ways to provide the materials the world needs. Meeting the incremental demand of the energy transition, and ensuring local supplies of critical minerals globally, deepens our relevance to the world and ensures our long-term profitability. We are creating real momentum, and seeing early results gives me conviction that we have the right objectives, the right team, and the right strategy.

Our Scope 1 and 2 emissions targets of 15% reductions by 2025 and 50% by 2030 are aligned with 1.5°C – the stretch goal of the Paris Agreement – and are really challenging. In contrast to many of our peers, about 80% of our emissions are driven by processing and producing metals and minerals, which are high temperature, hard-to-abate activities. The remaining 20% are from our mining operations. The low-carbon transition is complex: developing new technologies and implementing major projects to decarbonise our business will take time.

We estimate that we will invest \$7.5 billion in capital between 2022 and 2030 to deliver our decarbonisation strategy. So we need to be disciplined about our capital investment and make a commercial case for each mitigation project. Our experience shows that we cannot solve this simply by allocating capital. We also need to attract the right talent, deploy new technology at scale, secure approvals from regulators and partner respectfully with local communities and Indigenous peoples. In addition, higher carbon prices and other government incentives are needed to drive the production and consumption of low-carbon metals and minerals.

In 2022, our Scope 1 and 2 emissions were 30.3Mt CO<sub>2</sub>e (31.0Mt in 2021), a reduction of 7% below our 2018 baseline. This is primarily the result of switching to renewable power at Kennecott and Escondida in prior years, as well as lower than planned production from the Kitimat and Boyne aluminium

smelters in 2022. We did not advance the actual implementation of our abatement projects as fast as we would have liked last year, so our capital expenditure on decarbonisation projects was \$94 million, lower than we anticipated when we set our targets. Challenges have included late delivery of equipment, resourcing constraints impacting study progress, construction and commissioning delays, and project readiness.

## 6+1 abatement programmes

In response, we established six abatement programmes, with dedicated people, to focus on the decarbonisation challenges that cut across our product groups: repowering our Pacific Aluminium Operations, renewables, ELYSIS™, alumina process heat, minerals processing and diesel transition. We are building capability and gaining a deeper understanding of our decarbonisation challenge (both constraints and opportunities), and our related operational expenditure increased to approximately \$140 million in 2022. As a result, we are better placed to deliver the complex and large-scale structural changes to our energy system needed to achieve our 2030 target.

Given the long lead times for some of these projects, we established one additional programme to increase our investments in nature-based solutions projects and now expect these to make a more significant contribution to our targets. If done well, these projects can play a substantial role in addressing carbon emissions and biodiversity loss, while also providing benefits to local communities. Our people working on these "6+1" abatement programmes, and our substantial investments in technology, will drive the innovation and transformation needed to accelerate our low carbon transition and ensure the long-term resilience of our business.



## Scope 3 partnerships

Our Scope 3 emissions were 584Mt CO<sub>2</sub>e in 2022 – over 1% of the global total. These are primarily from our customers in Asia, processing our iron ore into steel and bauxite into aluminium, so our level of control is limited. The best way to tackle these emissions is to work in partnerships to develop the technologies needed to produce low-carbon metals and minerals. Last year we increased our engagement with our customers, governments, universities and others. It is encouraging that the initial testing phase of our Biolron™ process showed great promise and demonstrated that using microwave energy and sustainable biomass as a reductant is well suited to Pilbara ores. And we are continuing to scale up the ELYSIS™ technology – the world's first carbon-free aluminium smelting process – towards the demonstration of even larger commercial-size cells.

In the past year, I have spent time engaging with a diverse range of stakeholders on the need to work together and address climate change with urgency. Given the structural changes we must make to our energy system, 2030 is just around the corner. Our success relies on our ability to strengthen our resilience to the physical, societal and economic effects of climate change and the energy transition, while building partnerships and capabilities that enable us to secure new opportunities.

A handwritten signature in black ink, reading 'Jakob Stausholm'.

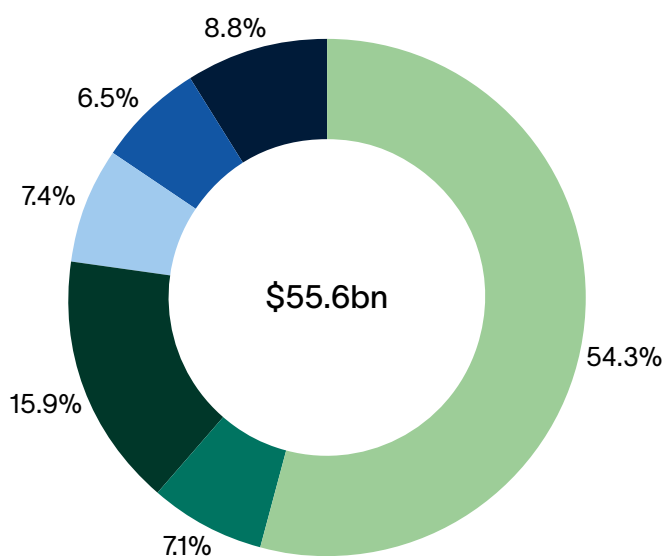
**Jakob Stausholm**  
Chief Executive

**“We will only invest in quality assets which will give robust returns under a range of economic, geopolitical and carbon scenarios, creating a resilient portfolio with significant upside to the energy transition. We are applying similar thinking to our approach to decarbonisation.”**



# Our business at a glance

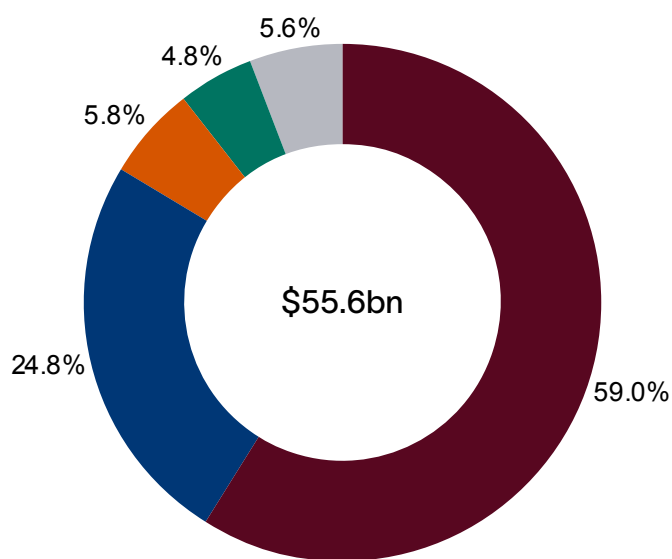
Consolidated sales revenue by destination



Our key assets are located in close proximity to our major markets:



Consolidated sales revenue by product



	Iron ore <sup>3</sup>	Aluminium	Copper	Minerals <sup>3</sup>
Mines	17	4	3	6
Smelters, refineries and processing plants <sup>4</sup>	0	18	1	4
Mt CO <sub>2</sub> Scope 1 and 2 emissions	3.1Mt	21.1Mt	1.5Mt	4.0Mt
Rio Tinto share of production	<b>Iron ore</b> <b>272.9Mt</b> (2021: 266.8Mt)	<b>Bauxite</b> <b>54.6Mt</b> (2021: 54.3Mt)	<b>Mined copper</b> <b>521.1kt</b> (2021: 493.5kt)	<b>Titanium dioxide slag</b> <b>1,200kt</b> (2021: 1,014kt)
Underlying EBITDA	<b>\$18.6bn</b> (2021: \$27.6bn)	<b>\$3.7bn</b> (2021: \$4.4bn)	<b>\$2.4bn</b> (2021: \$4.0bn)	<b>\$2.4bn</b> (2021: \$2.6bn)

1. Excluding Greater China and Japan. Greater China includes China and Taiwan.

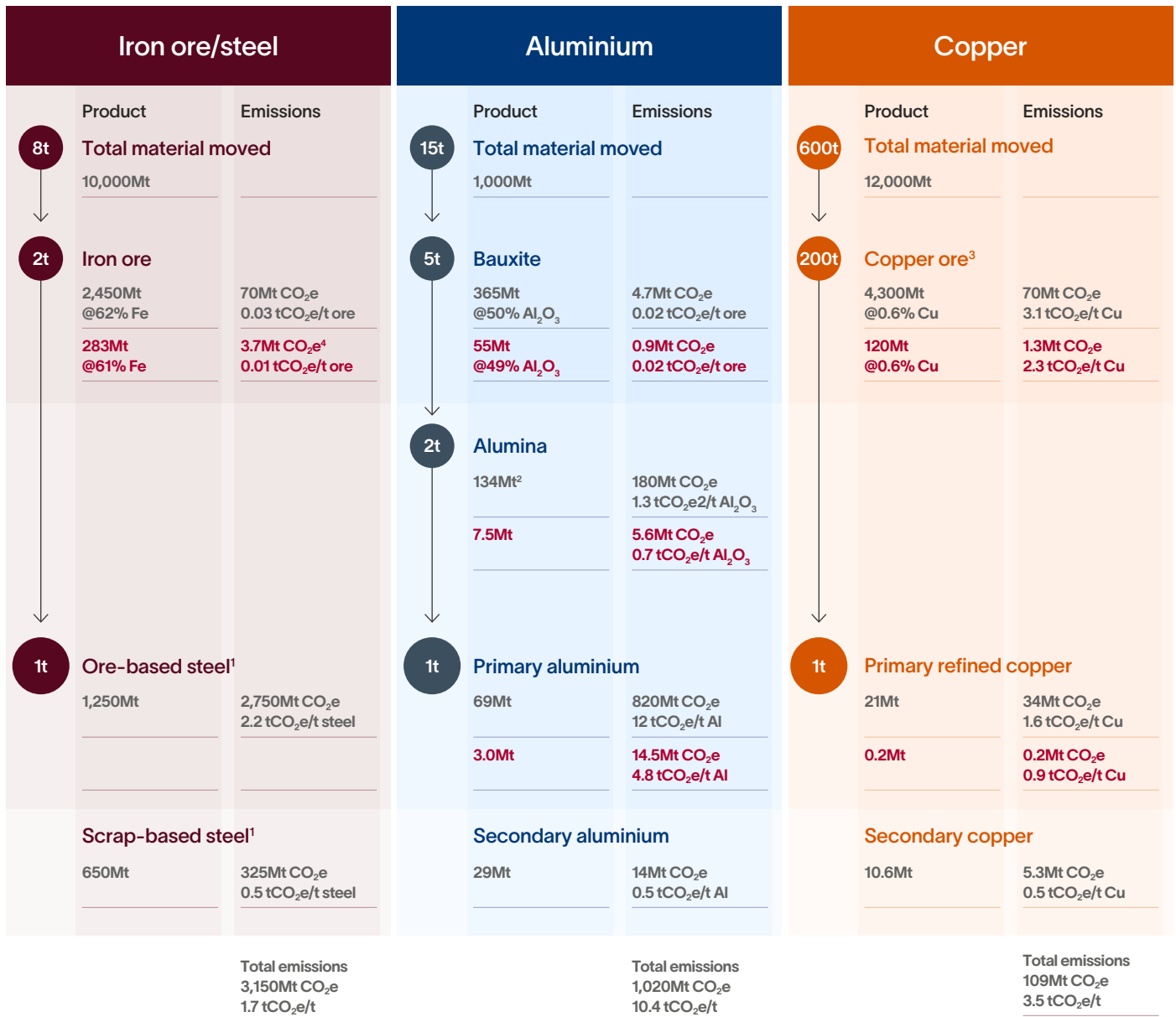
2. Aluminium includes bauxite and alumina.

3. Our Iron Ore product group includes our 17 iron ore mines in the Pilbara and three salt operations (Dampier, Port Hedland and Lake MacLeod). Our Minerals product group includes the Iron Ore Company of Canada (IOC).

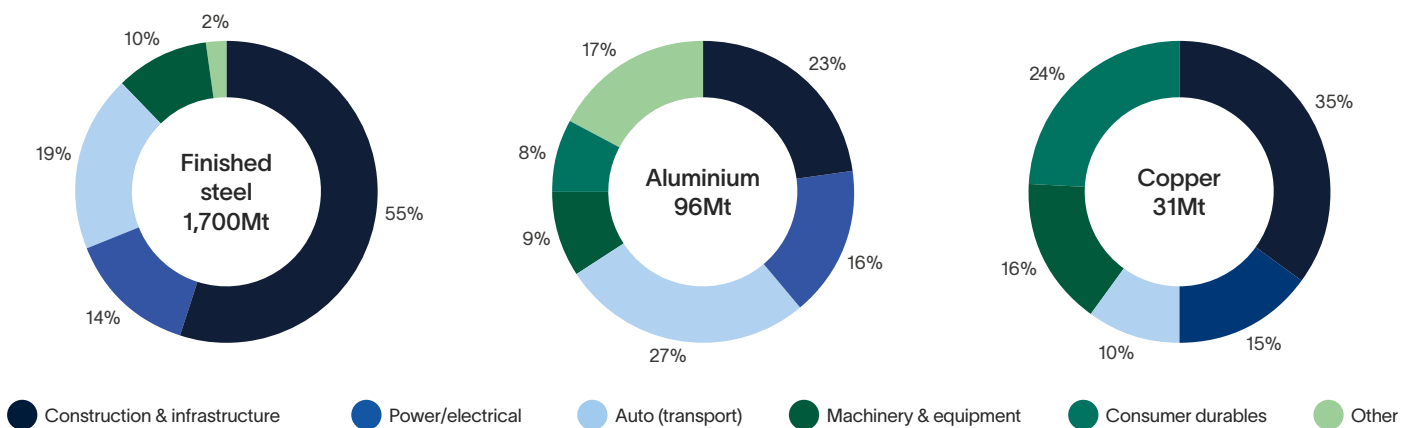
4. Covering processing plants engaged in the material transformation of input products with total Scope 1 and 2 emissions greater than 100,000 tonnes CO<sub>2</sub>. The integrated processing facilities at RTIT Quebec Operations are counted once.

Materials for low-carbon transition

Global data  
Rio Tinto data



Demand by sector



1. Ore- and scrap-based steel are notional categories based on Rio Tinto estimates of raw material inputs for different steel production pathways.  
2. Smelter grade Alumina only.

3. Copper ore product before processing.  
4. Rio Tinto total iron ore emissions include equity-basis emissions from our Pilbara operations and from IOC.

Sources: Rio Tinto analysis and estimates, CRU, Skarn Associates, Wood Mackenzie, International Aluminium Institute.

# Our Climate Action Plan

## – 2022 progress and 2023 update

In 2022, our shareholders supported our Climate Action Plan (CAP) in a non-binding advisory vote on the company's ambitions, emissions targets and actions to achieve them. We will continue to publish our progress on climate change annually in line with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD). The Board is fully aligned with this action plan and believes it will deliver value for our shareholders, our customers and wider society. The table below summarises progress in 2022 and our action plan in 2023.

1. Scope 1 and 2 emissions targets and roadmap	Progress in 2022	Actions in 2023
<p>We have committed to reach net zero by 2050 and have set ambitious interim targets relative to our 2018 equity emissions baseline: to reduce greenhouse gas (GHG) emissions by 15% by 2025 and to reduce GHG emissions by 50% by 2030.<sup>1</sup></p>	<ul style="list-style-type: none"> <li>– <b>Repowering Pacific Aluminium operations:</b> we issued a request for proposal for more than 4GW of wind and solar projects to support repowering of the Boyne smelter. Tomago issued expression of interest seeking renewable projects to support repowering of the smelter (a non-managed joint venture).</li> <li>– <b>Renewables:</b> we installed the first 34MW of solar capacity at Gudai-Darri and announced that we are planning to invest \$600 million for solar, storage and transmission to deliver a further 230MW of solar power and 200MWh storage in the Pilbara from 2023-2026. We started construction for the first phase of our 30MW project at Kennecott and commenced direct market engagement for our US footprint (Boron, Resolution, Kennecott) for around 1GW of renewables. We issued expression of interest for an islanded 35MW microgrid at Amrun and signed a Solar PV 130MW power purchase agreement (PPA) for Richards Bay Minerals (RBM) with Voltaia. Construction of a 20MW hybrid project continued at QIT Madagascar Minerals.</li> <li>– <b>ELYSIS™:</b> production from our pilot cell continued, as did construction of larger commercial scale cells at Alma.</li> <li>– <b>Alumina process heat:</b> we developed our approach to decarbonising our refineries. Order of magnitude studies for electric steam generation and electrical infrastructure requirements are in progress. A feasibility study has been completed for the hydrogen calcination project. An order of magnitude study for double digestion has been completed with approval to proceed with the pre-feasibility study.</li> <li>– <b>Minerals processing:</b> \$537 million (C\$737) partnership with the Government of Canada to decarbonise RTIT Quebec Operations and boost critical minerals processing.</li> <li>– <b>Diesel transition:</b> we have progressed biofuel trials at Boron and Kennecott. We began trialling an underground battery electric loader and haul truck at Kennecott. We delivered our first road-sized haul truck into the Pilbara for testing.</li> <li>– <b>Nature-based solutions (NbS):</b> we completed pre-feasibility studies for NbS projects at five high-potential landscapes.</li> </ul>	<ul style="list-style-type: none"> <li>– <b>Repowering Pacific Aluminium Operations:</b> progress renewable supply options for the Boyne and Tomago aluminium smelters.</li> <li>– <b>Renewables:</b> approve and commence construction of 100MW solar PV for the Pilbara. Progress studies on the next 130MW solar PV for the Pilbara. Sign PPA for Amrun microgrid and start construction in 2023/24. Sign a Wind PPA at RBM. Sign commercial agreements for our US operations (Kennecott, Resolution and Boron).</li> <li>– <b>ELYSIS™:</b> commission 450kA ELYSIS™ cells currently under construction at Alma.</li> <li>– <b>Alumina process heat:</b> develop the decarbonisation energy transition strategy for the Yarwun and Queensland Alumina (QAL) refineries. Complete feasibility studies for electric steam generation and thermal storage options at QAL and Yarwun, and seek approval for electric boilers at Vaudreuil. Advance studies on double digestion, hydrogen and electric calcination. Commence construction of hydrogen calcination industrialisation demonstration at Yarwun.</li> <li>– <b>Minerals processing:</b> commission Blue Smelting demonstration plant at RTIT, Quebec, to test ilmenite pre-reduction process. Commence industrial trials of biochar at RTIT Quebec Operations and RBM, and investigate options to develop a sustainable supply chain. Commission plasma burner pilot at IOC.</li> <li>– <b>Diesel transition:</b> progress plans to convert the entire fleet at Boron to renewable diesel ahead of the requirement to do this in California in 2024. Develop a viable trolley assist option for the existing haul fleet to enable substantial reduction in diesel use while on trolley.</li> <li>– <b>Nature-based solutions:</b> conduct feasibility studies for the development of five carbon offset projects.</li> </ul>

1. Our net zero commitment applies to our Scope 1 and 2 emissions only. For planning purposes, we define short-term as up to two years, medium-term as 2-10 years and long-term as beyond 10 years. For our analysis of physical climate risks, we define short-term as 2030, medium-term as 2050 and long-term as 2100.



## 2. Scope 3 emissions goals and customer engagement

Our approach to addressing Scope 3 emissions is to engage with our customers on climate change and work with them to develop and scale up technologies to decarbonise steel and aluminium production.

### Progress in 2022

#### Steel value chain

- Engaged with nearly all our direct iron ore sales customers (representing two thirds of our total iron-ore related Scope 3 emissions). This has led to decarbonisation collaboration and projects with customers accounting for 59% of our direct iron ore sales.
- Partnerships on track. We advanced 49 projects, together with over 30 partners.

#### Aluminium value chain

- Initiated engagement with customers representing nearly all of our bauxite sales.

#### Shipping

- 30% reduction in emissions intensity achieved (relative to 2008 baseline). On track to exceed target through energy saving initiatives and use of transitional fuels (biofuel/LNG).
- Accelerating development of end-state fuels (green methanol and green ammonia) via partnerships.
- Completed installation of energy savings devices on first vessels capable of 10–12% emissions reductions.

### Actions in 2023

#### Steel value chain

- Progress work on a microwave lump drying pilot plant with Baowu.
- Develop Biolron™ at a larger scale, via a specially designed continuous pilot plant.
- Complete concept studies with BlueScope and determine the next phase of processing Pilbara ores with hydrogen and a melter.

#### Aluminium value chain

- Agreement to hold workshops on decarbonisation confirmed with three major customers representing over half of our sales. Further engagement with other bauxite customers will depend on the level of interest.

#### Shipping

- Review biofuels plan following completion of 12-month trial. Progress partnerships on end-state fuels.
- Advance programme to install energy savings devices on our vessels during dry-docking.
- Incorporate (over 2023–24) nine LNG dual-fuel chartered vessels into our fleet.
- Advance iron ore green corridor development in partnership with the Global Maritime Forum.

## 3. Capital allocation alignment with our 1.5°C decarbonisation strategy

We estimated that we will invest \$7.5 billion in capital between 2022 and 2030 to deliver our decarbonisation strategy (approximately \$1.5 billion over the period 2022 to 2024).

We also expected our incremental operating expenditure to support the CAP to be in the order of \$200 million per year, including research and development initiatives. For example, we planned to spend about \$50 million on our iron and steel decarbonisation initiatives in 2022.

### Progress in 2022

- Our capital expenditure on decarbonisation projects in 2022 was \$94 million compared to an originally estimated spend of \$500 million. Our incremental operational expenditure to support the CAP including spend on steel decarbonisation initiatives, was approximately \$140 million.
- Operational expenditure on steel decarbonisation initiatives was \$24 million in 2022. Resourcing constraints, COVID-19 lockdowns and the need to develop the business case for some technologies has delayed some projects.

### Actions in 2023

- Depending on project planning, approvals and implementation, we estimate that our capital expenditure on decarbonisation will increase over the three years to 2025 and total \$1.5 billion. Our incremental operational expenditure in 2023 is estimated to be \$200 million for the six abatement programmes and offset development.

## 4. Climate policy engagement

We continue to encourage our industry associations to align their advocacy with the goals of the Paris Agreement. We review the climate advocacy of our industry associations each year, and we publish our review on our website and consider it when we decide whether to renew our memberships.

### Progress in 2022

- We published our review of industry associations in February 2022 and conducted an interim and year-end review of their advocacy. We engaged with four industry associations to discuss their climate advocacy.

### Actions in 2023

- In 2023, we will publish our review of industry associations and maintain our engagement with them on climate advocacy.

## 5. Climate governance

In the short-term incentive plan (STIP), safety, environment, social and governance matters, including climate change, are now assigned an explicit performance weighting of 35%, of which 20% relates to safety and 15% to ESG. The “E” component is 5% of the STIP and relates entirely to climate change performance objectives.

### Progress in 2022

- In 2022, the business approved or delivered Scope 1 and 2 abatement projects that would contribute 0.29Mt CO<sub>2</sub> of abatement towards the 2025 target against a target of 0.8Mt.
- Achieved specific milestones relating to steel decarbonisation, zero-carbon aluminium and shipping.

### Actions in 2023

- Climate change performance objectives are assigned an explicit performance weighting of 10% in the STIP in 2023. We will assess progress of moving carbon abatement projects through the various stages of development all the way to execution to meet our decarbonisation ambition.

## 6. Just transition

We are committed to supporting a just transition to a low-carbon economy that is socially inclusive and provides decent work and livelihoods.

### Progress in 2022

- In 2022, we established an Executive Committee-sponsored cross-functional just transition working group, undertook an assessment of our current just transition maturity, and developed a tool to profile risks and opportunities at our assets.

### Actions in 2023

- In 2023, our priorities include assessing just transition-related risks and opportunities across our assets; defining just transition principles; awareness-raising across the business; and continued engagement with civil society organisations, host communities, employees and others.

## 7. TCFD disclosure

We support the TCFD recommendations and are committed to aligning our disclosures with the Climate Action 100+ (CA100+) Net Zero Company Benchmark in 2023 reporting.

### Progress in 2022

- Climate-related disclosures on governance, strategy, risk management, and metrics and targets were integrated into the 2021 Annual Report. Our CAP aligns with the CA100+ Net Zero Company Benchmark.

### Actions in 2023

- We will continue to publish our progress on climate change annually in line with the recommendations of the TCFD.

# Our strategy and approach to climate change

We have positioned the low-carbon transition at the heart of our business strategy to strengthen our long-term resilience and pursue new growth opportunities. In addition to setting ambitious 1.5°C-aligned emissions targets for our operations, our strategy aims to help decarbonise our value chains and provide the materials essential for the energy transition.

## Our approach

Our strategy and approach to climate change are informed by a deep analysis of the interplay of global megatrends, explored through the lens of plausible global scenarios. These set the context for our industry and underpin our commodity price outlooks, portfolio and capital allocation choices, and how we operate as a business. We recognise our success relies on our ability to strengthen our resilience to the

physical, societal and economic effects of climate change and the energy transition while building partnerships and capabilities that enable us to secure new opportunities.

Our strategy has three pillars, each backed by a series of commitments and ambitions. Our approach is supported by strong governance, with a focus on creating streamlined processes and building capabilities, including in green

materials processing, renewable energy deployment and nature-based solutions, which are expected to enable us to reach net zero emissions from our operations by 2050. The three pillars of our strategy inform our Climate Action Plan, which aligns with the CA100+ Net Zero Company Benchmark and was approved by our shareholders at our 2022 AGMs.

Accelerate the decarbonisation of our assets	Develop products and technologies that help our customers decarbonise	Grow production of materials enabling the energy transition
<p>To strengthen our alignment with the Paris Agreement and our long-term ambition of achieving net zero emissions by 2050:</p> <ul style="list-style-type: none"> <li>– We aim to reduce our Scope 1 and 2 emissions by 15% by 2025 and by 50% by 2030.</li> <li>– We expect to invest an estimated \$7.5 billion in decarbonisation projects, predominantly in the second half of the decade.</li> </ul>	<p>To work with our customers to tackle full value chain emissions:</p> <ul style="list-style-type: none"> <li>– We will increase research and development of cleaner products.</li> <li>– We will partner with our customers to help them meet their Scope 1 and 2 emissions goals.</li> </ul>	<p>To capture new growth opportunities in materials with strong low-carbon transition-related demand:</p> <ul style="list-style-type: none"> <li>– Our ambition is to increase disciplined capital growth of up to \$3.0 billion annually by 2024 to 2025.</li> <li>– We will seek to grow further in copper and battery materials and bring additional tonnes of high-grade iron ore and low-carbon aluminium to market.</li> </ul>

Our approach to climate change is intrinsically linked with our four objectives: to be **best operator**, to achieve **impeccable ESG credentials**, to **excel in development** and to strengthen our **social licence**. Delivering on our climate commitments will rely on these capabilities and will also help build our reputation as a partner of choice for new growth opportunities created by the energy transition.

## Global scenarios

Our scenario approach is reviewed every year as part of our Group strategy engagement with the Board. We have recently updated our scenario framework to focus on two prevailing macro-level business concerns: the speed of global economic growth and the trajectory of climate action, each heavily influenced by global geopolitics and governance. Our two core scenarios (Competitive Leadership and Fragmented Leadership) are used to generate a central reference case for commodity forecasts and valuations. Additional scenarios (including our Paris-aligned Aspirational Leadership scenario) are used to further evaluate the positive and negative effects of the energy transition across our portfolio and stress test investment decisions.

We determine the approximate temperature outcome in 2100 by comparing the emissions pathways to 2050 in each of our scenarios with those set out in the Shared Socio-economic Pathways (SSP) by the Intergovernmental Panel on Climate Change (IPCC). We do not undertake climate modelling ourselves, but we are consistent with the estimates for temperature and cumulative temperature between 2020 to

2050 in the SSPs. The emissions pathway of Aspirational Leadership is most closely aligned with the IPCC's shared socio-economic pathway 1 (SSP1-1.9) with emissions reaching net zero by 2050, which limits warming to 1.5°C. Competitive Leadership is most closely aligned with SSP1-2.6 (approximately 2°C of warming) and Fragmented Leadership is aligned with emission scenarios SSP2-4.5 (temperatures exceeding 2.5°C by 2100). We also use the IPCC's highest emissions scenario (SSP5-8.5) when assessing the physical risks of climate change. So, when assessing risks and opportunities to the business we use a 1.5°C-aligned scenario to assess a fast low-carbon transition and we use the highest emissions and high temperature outcome scenario (SSP5-8.5) to assess physical climate risks. While there are many uncertainties about how a changing climate may negatively affect gross domestic product (GDP) growth, physical impacts of climate change are integrated into the GDP growth assumptions in our three scenarios. These are most significant in Fragmented Leadership and least significant in Aspirational Leadership. The steel sector

transition scenarios in the value chain section of this report are presented to highlight the roles and timing of different low-carbon steelmaking technologies and to develop projections of our potential future Scope 3 emissions from processing our iron ore.

At the UN Climate Summit in late 2022 (COP27), there was broad recognition that the pace of decarbonisation across the global economy is too slow to limit warming to 1.5°C and that current climate policies in many countries are not yet aligned with their stated ambitions. Consequently, neither of our two core scenarios are consistent with the expectation of climate policies required to accelerate the global transition to meet the stretch goal of the Paris Agreement. Although our operational emissions reduction targets align with the goals of the Paris Agreement, our two core scenarios do not. Therefore, we also assess our sensitivity and the economic performance of our business against our Aspirational Leadership scenario, which reflects our view of meeting the stretch goal of the Paris Agreement.

**Fragmented Leadership** is characterised by limited progress on policy reform with volatile low growth. The business environment is defined by weak final demand and greater uncertainty, and requires close ties with governments to manage risk. It is a world defined by geopolitical and domestic tensions, spurred by populist agendas that offer leaders little opportunity to build consensus around reform and environmental agendas. Nations eventually achieve their 2030 Nationally Determined Contributions (NDC) as agreed in Paris in 2015 but abandon further progress toward long-term carbon goals as outlined at COP26 in Glasgow. Climate policy is insufficiently ambitious to incentivise significant mitigation in industrial sectors resulting in flat global emissions post-2030; consequently global warming exceeds 2.5°C and the physical impacts of climate change limit GDP growth in this scenario.

**Competitive Leadership** reflects a world of high growth and strong climate action post-2030, with change driven by policy and competitive innovation. A proactive reform environment encourages stronger business innovation, higher investment and improved productivity. This allows global GDP to continue growing at close to recent historical levels with a growing contribution from India and other developing countries. The increasing prevalence of major climate events after 2030, and ongoing pressure from civil society organisations and businesses to provide policy certainty, continue to galvanise national and international climate action. As a result, nations drive against historical precedent toward achieving their Glasgow Climate Pact commitments, resulting in global GHG emissions falling from 54 Gt CO<sub>2</sub>e today to 21 Gt in 2050.

**Aspirational Leadership** reflects a world of high growth, significant social change and accelerated climate action with all countries setting new NDCs that collectively achieve net zero emissions by mid-century. Domestic politics is driven by demands for economic prosperity, social justice and environmental action. Despite geopolitical differences, major economies tend to work together through multilateral frameworks and proactively work towards limiting temperature change to 1.5°C. This results in developed economies and China leading from the front, implementing large increases in carbon pricing, sharply lowering the material intensity of their economies and providing strong financial support to low-income economies. The Aspirational Leadership sensitivity is designed to reach net zero by 2050, and to help us better understand the world on a 1.5°C pathway and what this would mean for our business.

Table 1: Key scenario metrics

	Aspirational Leadership 1.5°C		Competitive Leadership ~2°C		Fragmented Leadership >2.5°C	
	2030 outcome	2021-2050 CAGR	2030 outcome	2021-2050 CAGR	2030 outcome	2021-2050 CAGR
Global average carbon prices <sup>1</sup> in 2030, (2021 US\$/t CO <sub>2</sub> eq)	59	9.3%	42	8.0%	42	2.9%
Global emissions, Gt CO <sub>2</sub> eq	39.5	-11% <sup>2</sup>	49.9	-3.5%	48.3	-0.8%
Global energy demand, mtoe	10,480	0.3%	10,985	0.5%	10,307	0.2%
Global GDP growth (PPP), %	4.4%	3.9%	4.3%	3.8%	2.9%	2.2%
Energy intensity of global GDP, toe/\$ 1000 2015 PPP	0.07	-3.4%	0.08	-3.2%	0.08	-2.3%
Carbon intensity of total energy, gCO <sub>2</sub> /MJ	42.1	-12.7%	46.5	-5.0%	46.4	-1.9%
Global energy from electricity, mtoe	2,880	3.9%	2,936	3.9%	2,668	1.8%
Global wind and solar capacity, GW	9,845	10.6%	7,476	10.0%	5,732	7.1%
Electric vehicle (EV) sales (%) <sup>3</sup>	68.1%	10.6%	63.9%	10.4%	38.8%	9.5%

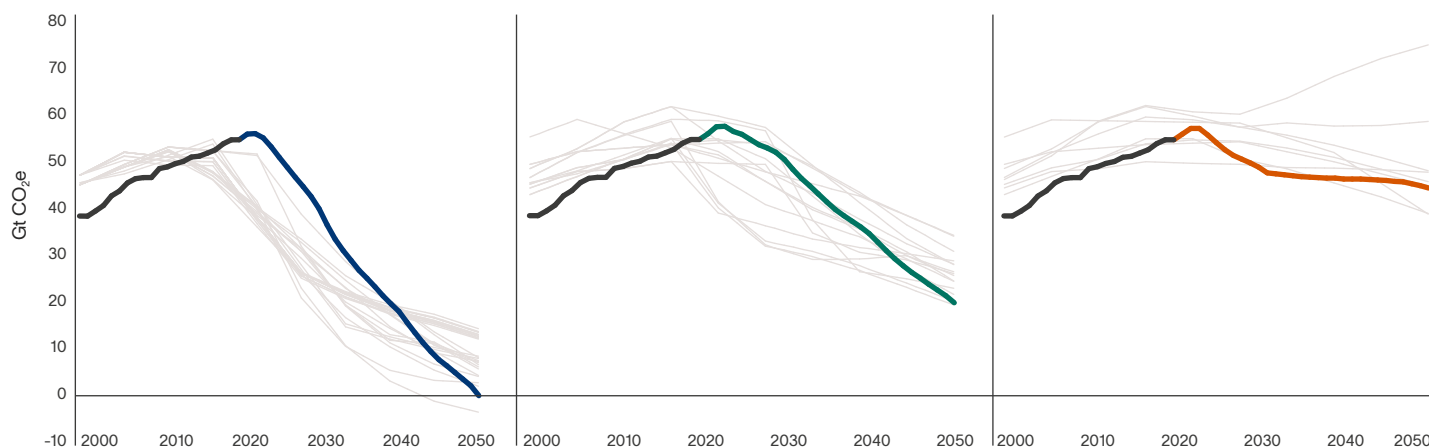
1. Carbon prices are used as a proxy for a broader range of climate policies.  
 2. 11% p.a. decline in CO<sub>2</sub> emissions based on 2021-49 period in net zero pathway (by 2050). Emissions in 2030 are highest in Competitive Leadership due to high GDP growth.  
 3. 2021-50 CAGR based on global electric vehicle sales.

### Group scenario global GHG pathways compared to IPCC scenarios (temperature outcomes in 2100)

#### Aspirational Leadership (1.5°C scenarios)

#### Competitive Leadership (1.9°C to 2.1°C scenarios)

#### Fragmented Leadership (2.6°C to 3.0°C scenarios)



Different IPCC scenarios represented in light grey lines specific to temperature range across different scenarios

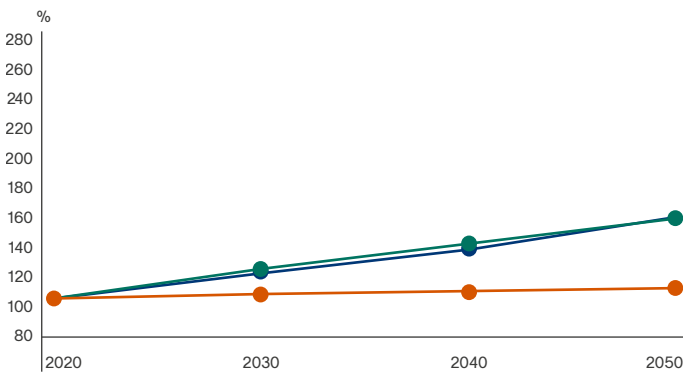
# Producing materials essential for the low-carbon transition

The energy transition is a key driver of commodity demand today and will continue to be so over the next two decades. This will come on top of the demand growth from continued urbanisation and industrialisation (particularly in emerging economies) and it will trigger a new phase of demand growth in developed economies, which have faced saturating demand over the past two decades.

The commodities we produce have a vital role to play in the low-carbon transition. Copper demand will rise with the renewable electrification of energy, and lithium will be a fundamental ingredient in batteries and grid-firming energy storage solutions. Demand for aluminium will grow for uses like energy-efficient lightweight electric vehicles. Steel demand is primarily driven by urbanisation and industrialisation – it correlates with GDP growth and is less exposed to the low-carbon transition than other commodities. It will be essential in a range of applications, from high-speed rail networks to wind and solar support structures, and green hydrogen production facilities. The production of green steel will also bolster demand for high-grade iron ore.

While the low-carbon transition is expected to create additional demand for our commodities, the outlook for demand varies significantly between our scenarios as a function of GDP growth, technology uptake, and scrap supply and use. Different demand trajectories, combined with industry supply responses and global carbon policy evolution, determine the market prices for our three major commodities and implications for our Group-level and asset valuations, as shown below.

## Demand Finished steel

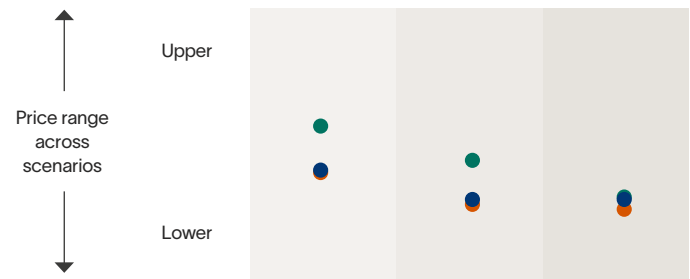


## Price ranges Iron ore: 65% fines



- In all scenarios, China's steel demand growth is forecast to slow as its economy matures. This is offset by construction growth in India and Southeast Asian countries. Steel demand is strongly driven by urbanisation and GDP growth and less exposed to the green energy transition than copper and aluminium. Wind turbines have a higher steel intensity than conventional generation, but the shift to electric vehicles will reduce steel demand in the automotive sector in favour of aluminium. Even by 2050, we expect that more than half of future crude steel production will remain based on iron ore (compared to about two-thirds today).
- In Fragmented Leadership, global iron ore demand remains broadly flat. The absence of challenging carbon targets keeps premiums for high-grade ores around their historical norms. Prices for both 62% Fe fines and high-grade 65% Fe fines are subdued.
- In Aspirational and Competitive Leadership scenarios, stronger underlying GDP and construction demand growth support prices and offset the rising use of scrap materials. In both of these scenarios, the transition to low-carbon steelmaking will be accompanied by an increase in premiums for high-grade iron ores (eg 65% Fe fines) as current low-carbon steelmaking technologies are relatively inefficient at processing unwanted contaminants in iron ore. This is more material in Aspirational Leadership due to the higher carbon penalties imposed. Price differentials for low quality iron ores are also likely to widen.

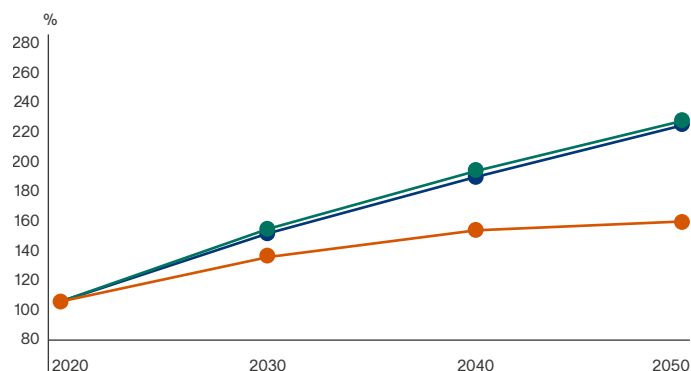
## Iron ore: 62% fines



### Key

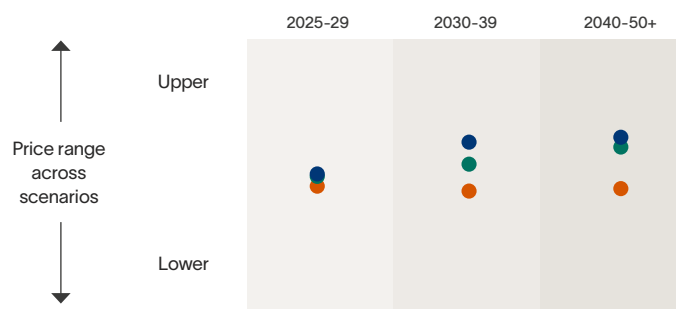
- Aspirational Leadership
- Competitive Leadership
- Fragmented Leadership

## Demand Aluminium



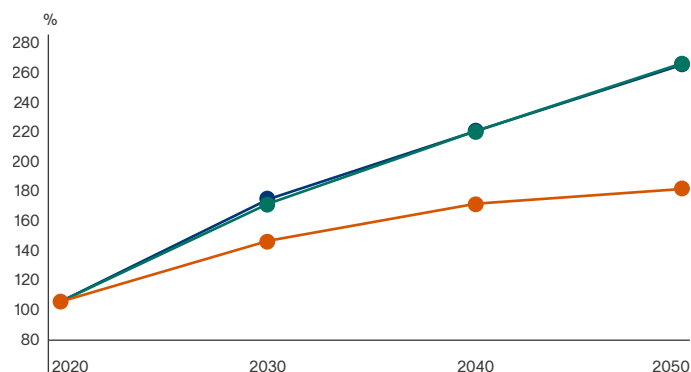
– In Aspirational Leadership and Competitive Leadership, traditional and energy transition demand in the transport and electricity sectors doubles demand for aluminium semi-fabricated products over the next three decades. This supports aluminium prices over all time horizons. As higher global carbon penalties materialise, the overall industry cost structure will move upwards, further supporting prices in these two scenarios.

## Price ranges



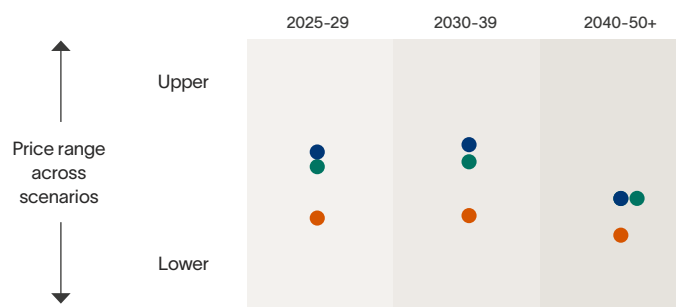
– In Fragmented Leadership, constrained economic growth and limited climate action suppress growth in aluminium demand to more moderate levels.  
– Share of secondary recycled material rises from 28% today to ~45% by 2050.

## Demand Copper



– Copper demand rises by 65-150% by 2050 across the three scenarios. Copper benefits from the rapid adoption of electric vehicles and growth in solar and wind generation, which all have higher copper intensities than conventional technologies. These are key demand drivers in Aspirational and Competitive Leadership scenarios.  
– Copper prices are expected to be higher than historical norms over the next two decades. This is most pronounced in Aspirational and Competitive Leadership scenarios due to higher demand requirements.

## Price ranges



– In the 2040s, prices decline in real terms due to moderating demand growth and greater use of scrap material, which rises from 31% today to ~40% by 2050 across the scenarios.

**Note:** Real 2022 prices. We do not publish our commodity price forecasts as this would weaken our position in commercial negotiations and might give rise to concerns from regulators and market participants.

## Implications for Rio Tinto’s portfolio and operations























We aim to invest in quality assets that give robust returns under our scenarios, creating a resilient portfolio with a significant upside to the energy transition. We have continued to invest in our copper portfolio through traditional assets such as Oyu Tolgoi and Kennecott, as well as early-stage application of our Nuton copper leaching technology. In aluminium, we continue to develop emissions-free smelting technology with ELYSIS™ trials, as well as working to reduce the emissions of our existing capacity (see the section on Scope 1 and 2 below). In iron ore, Simandou will become a major supplier of high-grade iron ore that can

be used in DRI-EAF steel processing and complement our existing product mix. In other commodities, we are evaluating a range of opportunities to produce lithium (including at Rincon and Boron), as well as making demonstrable progress on various critical mineral developments that are essential for the energy transition.

This alignment with the low-carbon transition is reflected in the financial resilience of our portfolio across all scenarios considered. Our estimate for Group value in the Aspirational Leadership scenario lies between those for

Fragmented and Competitive Leadership. This reflects higher estimated valuations for our copper and aluminium businesses in Aspirational Leadership, based on the above price profiles, offset by higher expected carbon penalties across our operating jurisdictions, and lower prices for lower-grade iron ore products. The same pattern holds for EBITDA margins at Group level.

### Our portfolio risks and opportunities in the low-carbon transition

	Aspirational Leadership	Competitive Leadership	Fragmented Leadership
<b>Iron ore</b>	<p> Lower medium-run demand versus Competitive Leadership due to higher scrap-use affecting Pilbara products (recovers post 2040)</p> <p> Large increases in carbon pricing and penalties drive demand for high-grade iron ore supporting Simandou and IOC</p>	<p> Strong global GDP growth and continued urbanisation support iron ore demand including for Pilbara products</p> <p> Stronger customer preference for Simandou and IOC ores for lower-carbon traditional and emerging steelmaking</p>	<p> Slowdown in China and global GDP growth erode demand, creating margin pressure across the portfolio</p> <p> Small and regional increases in carbon prices help preserve longer-term margins for low-cost, Tier 1 Pilbara ores</p>
<b>Aluminium</b>	<p> Strong GDP growth and EV penetration support demand with value upside for hydro-based smelters (more pronounced in Aspirational Leadership)</p>		<p> China slowdown and increasing self-sufficiency reduce demand for seaborne bauxite</p>
	<p> Higher carbon penalties support ELYSIS™, hydro-based smelting assets in Quebec and repowering projects in Australia</p>	<p> Competition to secure large-scale firm renewable electricity to repower coal-based Pacific Aluminium Operations</p>	<p> Slowing demand and low carbon penalties greatly reduce value upside of ELYSIS™ and hydro-based smelters</p>
<b>Copper</b>	<p> Strong GDP growth and accelerated EV penetration and global electrification (backed by renewable electricity) support demand growth and margins across the portfolio</p> <p> Pressure to meet rapid demand growth supports growth projects (and Nuton) if they satisfy environmental and social requirements</p> <p> Environmental and social approval hurdles for new projects including Resolution Copper and La Granja</p>		<p> Lower demand growth and poor carbon policy reduce margins and upside for low-carbon smelting and refining (Kennecott and Escondida)</p> <p> Geopolitical tensions could reduce joint venture partnership opportunities and create potential engineering, procurement and construction (EPC) and logistical issues</p>
<b>Minerals</b>	<p> Accelerated uptake of EVs and battery storage solutions supports growth projects (Rincon and Tamarack joint venture)</p>	<p> Strong outlook for battery materials but international competition for greenfield and mergers and acquisitions opportunities limit growth options</p>	<p> Reduced battery material growth opportunities but resilience from operating high-grade TiO<sub>2</sub> and borates assets</p> <p> Supply disruption risks and volatility bolster demand for precious metal and critical mineral by-products</p>
	<p> Increasing ESG scrutiny of new projects and more stringent regulations</p> <p> Carbon penalties for downstream processing of TiO<sub>2</sub> and battery materials</p>		

**Key: risks & opportunities table**

-  Higher opportunity
-  Moderate opportunity
-  Moderate risk
-  Higher risk

## Classifying our portfolio: revenue, capital expenditure (capex) and operating assets

We classify commodities into five categories based on climate-related transition risks and growth opportunities:

- **Type 1** (highest transition-related demand): lithium, graphite, cobalt, nickel
- **Type 2** (other transition materials): copper, aluminium (including alumina and bauxite), manganese, zinc, other minerals
- **Type 3**: iron ore
- **Type 4**: metallurgical coal
- **Type 5** (highest transition-related risk): thermal coal

Type 1 and Type 2 materials align with a draft classification proposed by the investor coalition Climate Action 100+.

Having divested the last of our coal businesses in 2018, we are orienting our growth capex towards materials that enable the energy transition, including copper, lithium and high-grade iron ore. Our ambition is to increase our growth capital to up to \$3 billion per year in 2024 and 2025, developing new options and finding innovative ways of bringing projects onstream faster.

Growth capex in iron ore relates to higher-grade ore from projects such as Simandou. Capex on mine development at Gudai-Darri and the Western Range is included in total capex.

2022	Production (Mt Cu eq)	Revenue <sup>1</sup> (\$m)	Growth capex (\$m)	Total capex (\$m)	Operating assets (\$m)
<b>Type 1</b> (lithium, graphite, cobalt, nickel)	0	0	15	15	835
<b>Type 2</b> (copper, aluminium, other minerals)	2.46	25,289	482	3,471	34,264
<b>Type 3</b> (iron ore)	2.45	33,115	0	3,265	19,263
<b>Type 4</b> (metallurgical coal)	0	0	0	0	0
<b>Type 5</b> (thermal coal)	0	0	0	0	0

1. Revenue includes share of equity accounted unit sales and intra-subsiary / equity accounted unit sales.

# Reducing the carbon footprint of our operations

We are working to decarbonise our operations to strengthen our alignment with the goals of the Paris Agreement. In 2022, we did not advance our abatement projects as fast as we would have liked; however, our Scope 1 and 2 emissions fell to 30.3Mt CO<sub>2</sub>e, which is 7% below our 2018 equity emissions baseline.

## Ambitious targets aligned with 1.5°C

Our targets are to reduce our Scope 1 and 2 emissions by 15% by 2025 and by 50% by 2030 (relative to 2018 levels), and to reach net zero by 2050. These targets cover more than 95% of our operational emissions and are on an equity basis. We will continue to adjust the 2018 baseline to exclude reductions achieved by divesting assets in the future, and to account for acquisitions. For example, following the acquisition of TRQ in December 2022, we increased our equity in the Oyu Tolgoi copper mine from 33% to 66%, which will result in an increase in our baseline and target trajectory in our 2023 reporting (see data tables for further detail).

In the Glasgow Climate Pact adopted at COP26, governments resolved to pursue efforts to limit the global temperature increase to 1.5°C. The Pact states that this "requires rapid, deep and sustained reductions in global greenhouse gas emissions, including reducing global carbon dioxide emissions by 45% by 2030 relative to the 2010 level and to net zero around mid-century, as well as deep reductions in other greenhouse gases". This is consistent with the IPCC's Special Report on 1.5°C that sets out multiple pathways to limiting warming to 1.5°C, which average around net zero emissions by 2050.

While there is no universal standard for determining the alignment of targets with the Paris Agreement goals, we conclude that our Scope 1 and 2 targets for 2030 are aligned with efforts to limit warming to 1.5°C. In 2021, KPMG provided limited assurance over the alignment of our Scope 1 and 2 targets with efforts to limit warming to 1.5°C. They also provided assurance of the roadmap to delivering those targets (as set out in our *2021 Climate Change Report*). For this 2022 report, KPMG provide limited assurance over our progress reporting against our 2022 Climate Action Plan commitments (in addition to their assurance of our Scope 1, 2 and 3 emissions). Their statement is included at the end of the report.

## Our Scope 1 and 2 emissions in 2022

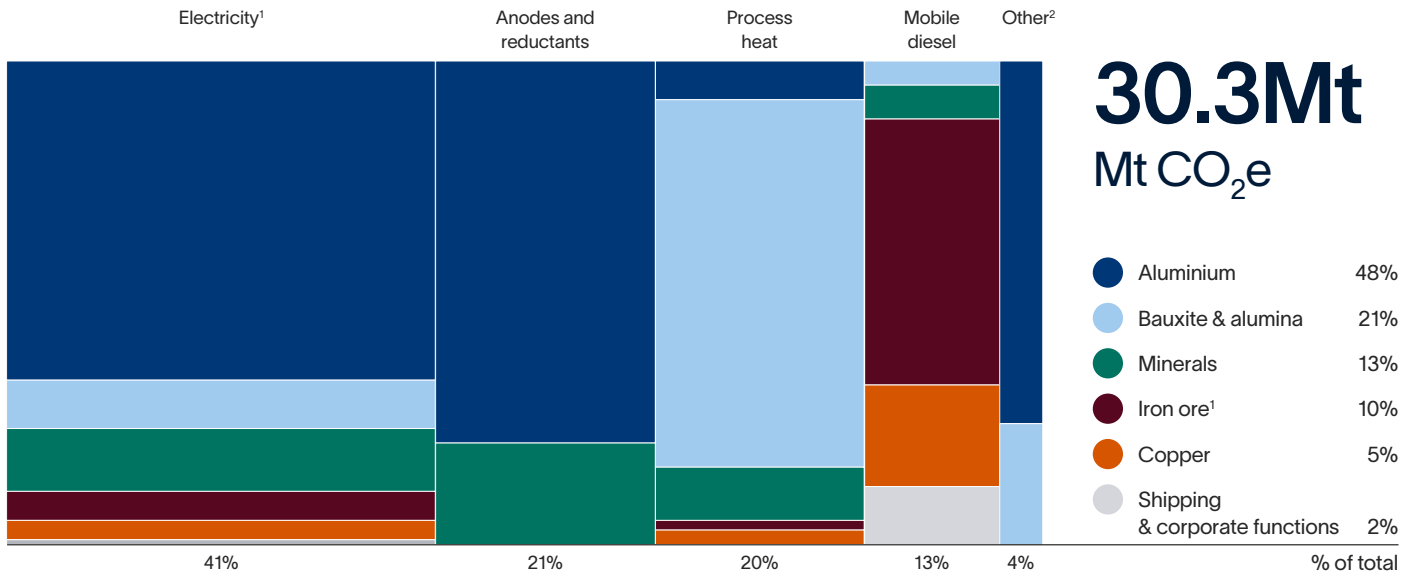
In 2022, our Scope 1 and 2 emissions were 30.3Mt CO<sub>2</sub>e (31.0Mt in 2021), a reduction of 7% below our 2018 baseline. This is primarily the result of switching to renewable power at Kennecott and Escondida in prior years, as well as lower than planned production from the Kitimat and Boyne aluminium smelters in 2022. We purchased renewable electricity certificates at Kennecott in the US and switched to renewable electricity contracts at the Escondida mine in Chile (managed by BHP; Rio Tinto owns 30%).

In contrast to many of our peers, about 80% of our emissions are driven by processing and producing metals and minerals, which are high temperature, hard-to-abate activities. The remaining 20% are from our mining operations. The four most significant sources of our operational emissions are electricity at 41% (purchased and generated), carbon anodes in aluminium - and reductants in titanium dioxide furnaces at 21%, fossil fuels for heat at our processing plants and alumina refineries at 20%, and diesel consumption in our mining equipment and rail fleet at 13%. The carbon intensity of our assets varies widely across our portfolio, and largely reflects the balance between mining and processing activities. Most of our assets already sit at the low end of their respective commodity carbon intensity curves (see charts in appendix). Operations with a predominant mining and logistics focus are less carbon intensive, while refining and smelting operations are high-temperature, energy-intensive processes.

Consequently, approximately 70% of our emissions today are from our aluminium business. Largely because of the high energy intensity of the aluminium business, our Group-wide consumption of electricity is about four times that of other global diversified mining majors. However, our share of renewable electricity consumption is high and we are making investments and supply decisions to increase this. We are reviewing our Scope 2 reporting and moving towards dual location-based (using grid averages) and market-based (using supplier-specific emissions factors) reporting in 2023, at which time the percentage of renewables we consume will also be recalculated using the updated assumptions.



## 2022 Scope 1 and 2 emissions by operations and source (equity basis)



1. Our Iron Ore product group is primarily our operations in the Pilbara and includes some salt production. Our Minerals product group includes the Iron Ore Company of Canada (IOC). Our 2022 equity emissions do not include the additional equity share of the Oyu Tolgoi mine that was purchased in mid-December 2022.  
 2. Other includes perfluorocarbons and land-based emissions. Note the sum of the categories may be slightly different to the total due to rounding.

### Progress towards our 2025 target – slower than planned

We did not advance the actual implementation of our abatement projects as fast as we would have liked last year, so our capital expenditure (capex) on decarbonisation projects was \$94 million, lower than we anticipated when we set our targets. Challenges have included late delivery of equipment, resourcing constraints impacting study progress, construction and commissioning, and project readiness.

So far, we have reduced our Scope 1 and 2 emissions by 7% below our 2018 baseline. We expect carbon emissions increases of 1.5Mt CO<sub>2</sub> as we grow production between 2023 and 2025. Overall, we therefore estimate a need to plan, develop and implement 4.2Mt CO<sub>2</sub> of abatement projects to meet our 15% emissions reduction target by 2025 categorised as follows:

- 0.6Mt CO<sub>2</sub> from projects already approved but not yet executed
- 0.9Mt CO<sub>2</sub> from projects yet to be approved but in advanced planning
- 2.7Mt CO<sub>2</sub> from projects in early stages of design and planning.

There are risks and dependencies to delivering the projects to achieve our 2025 and 2030 targets. Many of the abatement projects identified are at early stages of development and it may be months or years before they reach final investment decision, construction and operation. Others may depend on local approvals or require collaboration with a wide range of stakeholders to achieve the large-scale low-carbon transformation that we are aiming for. The breakdown of our abatement projects above assumes that the full abatement potential is delivered on schedule. However, our experience suggests that there will be delays and that we will require a more significant use of offsets to achieve our 2025 target. We still have much work to do to progress our abatement projects and we continue to aim for our 2025 target to maintain focus within the organisation and drive action across our portfolio.

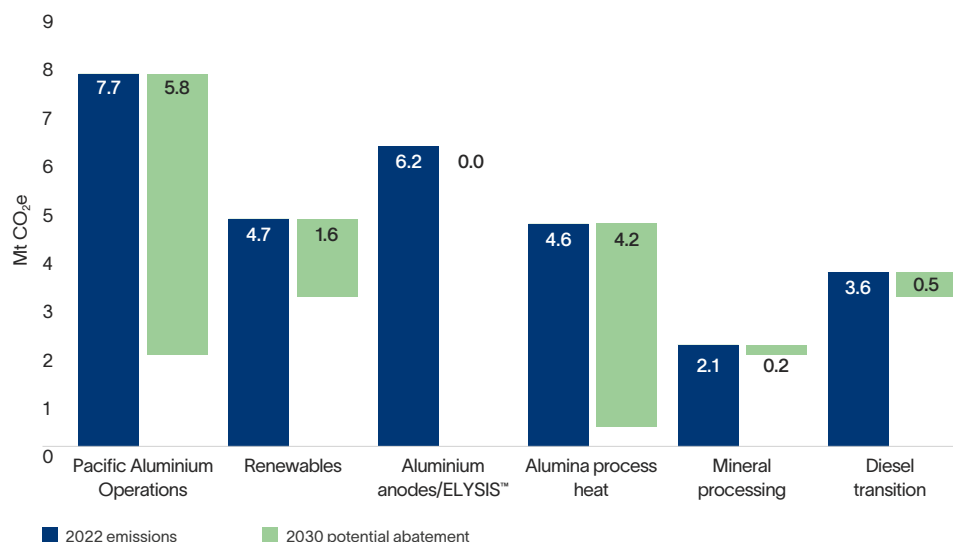
### Our pathway to our 2030 target: 6+1 abatement programmes

Between now and 2030, the two most important decarbonisation levers are firstly, switching the electricity we generate and purchase to renewables, and, secondly, addressing emissions related to process heat at our alumina refineries and minerals processing operations. Beyond 2030, we aim to achieve deeper reductions on the pathway to net zero as we deploy ELYSIS™ and phase out the use of carbon anodes at our aluminium smelters, as well as progressing low emissions trucks and mobile equipment at our mining operations.

We face continuing challenges to improve the commercial returns and overall readiness of many of our abatement projects. The commercial returns of abatement projects will also be influenced by local carbon prices, which currently remain relatively low in many of the countries where we operate.

In 2022, we established six abatement programmes, with dedicated people, to focus on the decarbonisation challenge across our product groups: repowering our Pacific Aluminium Operations, renewables, aluminium anodes – ELYSIS™, alumina process heat, minerals processing and diesel transition. We are also increasing our investment in our Nature Solutions team and now expect high integrity offsets to play a greater role in our decarbonisation strategy. As a result of the six programmes plus our investment in nature-based solutions (NbS), we are now better placed to make complex structural changes to our energy system by 2030, as we work towards our ambitious target that is aligned with the stretch goal of the Paris Agreement.

## 2030 pathway: emissions reduction potential by major abatement programme



<b>2018 emissions baseline</b>	<b>32.5</b>
Emissions reduction to 2022	-2.2
<b>2022 emissions</b>	<b>30.3</b>
Growth to 2030	1.1
Abatement programmes	-12.3
Other required abatement (includes NbS)	2.8

**2030 emissions (50% reduction)** 16.2

New projects will need to be carbon neutral or have emissions mitigated elsewhere in the portfolio.

### Decarbonising electricity: repowering Pacific Aluminium Operations

A continued shift to renewables is central to meeting our 2030 targets and will remain an important area of focus beyond 2030. The Boyne smelter and Gladstone power station in Queensland, and the Tomago smelter in New South Wales, are part of our Pacific Aluminium Operations and all operate in coal-based power grids. These facilities account for 28% of our Scope 1 and 2 emissions and more than half of our emissions from electricity use. Green repowering solutions are essential to the long-term sustainability of these operations. The scale of the smelters' electricity use means that their transition must take into account the impacts on the broader grid and overall system requirements. This requires complex technical, commercial and political negotiations balancing the needs of multiple stakeholders.

Following the signing of a Statement of Cooperation with the Queensland Government in 2021 to work towards establishing more renewable energy in Central Queensland, we began direct market engagement. A formal market request for proposals was undertaken in June 2022 to support the development of large-scale wind and solar power to supply power to the Boyne smelter through the Queensland grid by 2030. This smelter requires 960MW capacity of reliable power to operate, which equates to at least 4GW of quality wind and solar power capacity with firming. We continue to work with the Queensland Government and energy providers to design a renewable energy solution as we approach the end of our supply contract for electricity generation to the smelter. In 2022, we impaired the remaining full value of the Boyne smelter in Queensland, Australia as a result of reduced capacity and the high cost of energy from the coal-fired power station impacting economic performance. (For further detail of the impairment, see note 4 to the Financial Statements).

In September 2022, Tomago Aluminium Company released an expression of interest to develop, invest in or procure long-term traceable renewable energy and dispatchable firm power generation projects or contracts to supply its production assets, and underpin its decarbonisation strategy and net zero ambition.

### Decarbonising electricity: renewables deployment

As we increasingly electrify our processes and mobile fleets, these will need to be supplied by green energy. In the Pilbara, we have one of the world's largest microgrids, underpinned by 480MW of gas-based power capacity and each year we spend approximately \$100-200 million on natural gas to power these operations. We are working towards a plan that will enable 1GW of renewable power capacity in the Pilbara by 2030, which will largely displace gas-fired electricity generation and could support the electrification of our mobile fleet as the technology becomes available.

In 2022, we announced that we are planning to invest \$600 million in the Pilbara to fund construction of two 100MW solar power facilities, one 30MW solar facility<sup>1</sup>, and 200MWh of on-grid battery storage by 2026. This is in addition to the 34MW solar farm installed at the recently commissioned Gudai-Darri iron ore mine. When these solar projects are fully operational, they will displace approximately 30% of our gas usage.

Developing large-scale renewable projects in the Pilbara requires extensive stakeholder engagement to facilitate studies and approvals. We are working collaboratively with regulators, Traditional Owners and other key stakeholders about potential renewable developments. Some Traditional Owners have actively participated in planning activities including site selection for wind monitoring and ecological studies. In December, the Western Australian Government announced a new multi-pronged approach to fast-track green energy approvals.

Planning for 1GW is ongoing, and in late 2022 we signed early agreements to develop a design for a 100MW solar farm suitable for the Pilbara environment and to better understand and plan for potential project risks. Early studies and planning for wind farm developments also commenced in late 2022. Our planning effort is also considering our future energy needs to support further decarbonisation requirements.

It makes sense for us to invest our own capital to develop renewables in the Pilbara as we own much of the infrastructure and operate the grid. In other locations, power purchase agreements may be a better option for us as other investors focused on renewables can develop large capacity solutions at a more attractive cost of capital, offering us savings in operating cost. In 2022, we signed a 130MW solar power purchase agreement for Richards Bay Minerals (RBM). Further projects are being pursued to help us achieve our 100% renewable power ambition in South Africa.

Since we reset our agreement with the Government of Mongolia, we approved an Electricity Supply Agreement to provide Oyu Tolgoi with a long-term source of power from the Mongolian grid. In 2022, we continued our work with the Government to support the development of long-term renewable energy generation options on the Mongolian grid and meet Oyu Tolgoi's commitment to sourcing power domestically.

Long duration (defined as 8-150 hours) energy storage will be required as we decarbonise our businesses through the adoption of renewable power from wind and solar sources, as they become the dominant source of energy. In 2021, we became an anchor member of the newly created Long Duration Energy Storage (LDES) Council that was launched at COP26. In 2022, we supported the publication of the LDES Council report on thermal storage (released at COP27) and started two parallel studies to supply green steam to our operations by integrating thermal energy storage with renewable energy.

1. In our release dated 30<sup>th</sup> November 2022 and Capital Markets Day presentation, we announced plans for the two 100MW solar power facilities and omitted the additional 30MW facility.

### Decarbonising aluminium anodes: ELYSIS™

Emissions from the use of carbon anodes, such as in our aluminium smelters, are 6.3Mt CO<sub>2</sub>e today and a longer-term challenge. We established the ELYSIS partnership in 2018 with Alcoa and with support from Apple and the governments of Canada and Quebec to develop the world's first carbon-free aluminium smelting process, using inert anodes instead of carbon.

With the first industrial scale pilot cell smelting zero-carbon aluminium at the ELYSIS Industrial Research and Development Center, work is now focused on scaling up the ELYSIS™ technology towards the demonstration of even larger commercial-size cells. Construction of these prototype cells is underway at the end of an existing potline at our Alma smelter and we expect this to be commissioned in 2023. The smelting cells will operate on an electrical current of 450kA, which is the commercial scale for many large, modern aluminium smelters. So, between now and 2030, we are deploying ELYSIS™ for growth of new zero carbon aluminium smelting capacity rather than to reduce emissions from carbon anodes at existing smelters. Beyond 2030, we expect to phase out the use of carbon anodes at our smelters.

### Decarbonising alumina process heat

In the alumina refining process, we use coal and gas to generate steam in boilers and gas to generate heat for calcination. In 2022, emissions from these sources were 4.6Mt CO<sub>2</sub>e. Our pathway for decarbonisation is through electrification, including the use of renewable energy to create hydrogen.

In 2021, we formed two partnerships to research using hydrogen to reduce emissions in alumina refining: a study with the Australian Renewable Energy Agency to assess hydrogen use in industry and support a coordinated approach to developing a local supply chain, and a study with Sumitomo Corporation into building a hydrogen pilot plant at our Yarwun alumina refinery in Gladstone, Australia. In 2022, we continued to progress our studies and are working towards approval for an industrial demonstration of the use of hydrogen in the calcination process.

In 2023, we aim to complete studies on options to electrify steam generation at our Australian refineries, while at Vaudreuil in Canada we will progress towards a financial investment decision to produce steam from electric boilers. Thermal storage options studies will be delivered in parallel, as our refineries require a continuous source of heat. Several technologies will be investigated that could allow the use of renewable electricity when available to be stored as heat and used later to generate steam for the refinery. At our Queensland Alumina refinery, our potential double digestion project improves energy efficiency, reducing steam demand for the refinery.

### Decarbonising minerals processing

Our minerals processing programme covers titanium dioxide, iron ore pelletisation, boron and lithium. We use energy for heat and chemical reduction. We developed ilmenite smelting in Sorel-Tracy, Quebec in the 1950s

and we have agreed to invest \$537 million (C\$737 million) to help reduce emissions by up to 70% at the RTIT Quebec Operations. We are working in partnership with the Government of Canada and trialling technological innovations, including BlueSmelting, a new ilmenite smelting technology that, if successful, would allow us to reduce and eventually eliminate the use of coal in the process.

In the shorter term, we are electrifying our sources of heat. We ordered four plasma torches in 2021, and we expect to install these in 2023 to commence a trial at the pelletising plant at IOC in Canada. We are also investigating the use of biochar as an alternative to coal and have trials testing the use and product quality, while we look at options for sourcing sustainably produced biochar.

### Diesel transition

Each year we use approximately 1.3 billion litres of diesel in our trucks, trains and other mobile equipment. In 2022, this contributed emissions of 3.6Mt CO<sub>2</sub>e. We are targeting battery electrification to eliminate these emissions though other technologies will also be important. We expect batteries to develop over time and have been working with heavy mobile equipment suppliers to develop large battery trucks, while working with others in the mining sector to develop charging solutions for them. The Charge On Innovation Challenge, founded by BHP, Rio Tinto and Vale, is complete. This seeks to accelerate commercialisation of effective solutions for charging large electric haul trucks and we are now working with winning vendors to develop low-carbon solutions. We are leading a sector-wide programme linked to the International Council on Mining and Metals's Innovation for Cleaner, Safer Vehicles, to establish an interoperability framework so that battery trucks and charging solutions can develop in parallel and successfully converge. We will trial the first large battery truck in the Pilbara in 2024 and 2025. We are also working with on-road truck and other equipment manufacturers to introduce smaller and more energy-efficient equipment into mine sites, including automated road-sized electric trucks.

As we progress on electrification, which we expect could be mass-deployed from around 2030, we are investigating using biofuels as an interim step to accelerate our progress towards our 2030 target. In 2022, we advanced our biofuels piloting at Boron, and we are working towards transitioning the fleet to 100% biofuels in 2024. A trial of biofuels is also ongoing at Kennecott. However, a scalable global supply chain for biofuels has yet to be fully developed, and we need to use biofuels that are sustainably produced.

### Nature-based solutions (NbS) and offsets

Given the high cost of emissions reductions and lack of feasible production-scale low-carbon technology solutions for parts of our business, our long-term commitment is for our operations to be net zero emissions by 2050, rather than zero emissions. While prioritising emissions reductions at mines and smelters, we are also exploring the role that NbS and offsets can play in our decarbonisation journey. Given the

challenges to reduce emissions at our operations noted above, carbon offsets and removals are expected to form a significant part of our decarbonisation strategy this decade.

Our connection to a large global landholding with unique and varied biodiversity provides us with the opportunity to develop and invest in high-integrity NbS. At scale, high-integrity NbS can play a substantial role in addressing carbon emissions and biodiversity loss, while also providing socio-economic and wellbeing benefits to local communities. We define high-integrity as projects that balance positive outcomes for people, nature and climate and take an integrated landscape perspective. To do this we are working with communities to implement locally appropriate activities that provide a fair share of benefits to all stakeholders, with robust application of human rights and environmental safeguards, and to secure permanent, additional carbon emissions reductions.

This high-integrity definition and associated assessment criteria are based on existing standards for the voluntary market. Together, the definition and criteria guide our two workstreams:

#### a. Developing NbS at, or near, our assets

In 2022, we completed pre-feasibility studies at five high-potential landscapes near our assets in Australia, Madagascar, South Africa and Guinea. These studies covered a diverse set of landscapes including forests, coastal dunes, mangroves and pastoral lands.

The scale of the first-round projects is significant, with the potential for approximately 500,000 hectares of land under conservation, restoration or sustainable management, and generating up to one million tonnes of offsets per year by 2030. Core to this work is putting communities at the centre and empowering them to enhance their livelihoods through the protection, sustainable management, and restoration of nature and biodiversity. This approach helps to reduce social and environmental risks of our operations and is highly complementary to our work in these regions.

We are now progressing the first round of sites through feasibility studies – including stakeholder engagement and partner identification – and completing carbon and biodiversity assessments on the next set of priority sites.

#### b. Securing high-quality carbon credits from the market

Given the long lead times to develop our own NbS projects, in parallel we are ramping up commercial activities to secure high-quality carbon credits focusing on regions where our Scope 1 and 2 emissions are highest. Our preference is to have deeper involvement with a smaller number of projects to ensure that we are retiring high-integrity carbon credits. We anticipate that this will require us to explore a range of upstream partnership models (including long-term offtakes, co-investment and co-development) with high-quality partners and developers.

## Accelerating the creation of high integrity nature-based solutions projects in the regions where we operate

We have developed a set of quality criteria – covering the carbon integrity of the project and the social and ecological safeguards that underpin it – that form the basis of our NbS project quality due-diligence process.

Our ambition

<b>Carbon</b> Build a sustainable and long-term carbon credit portfolio generating approximately 1.7 million tonnes annually by 2030	<b>Nature</b> Originate NbS projects that result in more than 500,000ha being under conservation, restoration or regeneration by 2025	<b>Social and wellbeing</b> Create sustainable jobs and regenerative micro-economies from NbS projects that we have developed or originated
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Workstreams

<b>Develop</b> Develop NbS projects on or near assets	<ul style="list-style-type: none"> <li>– Develop large-scale NbS projects near our assets in Australia, Madagascar, South Africa and Guinea, using local partners and communities to co-design and implement.</li> </ul>
<b>Invest</b> Secure credits in heavy emission regions	<ul style="list-style-type: none"> <li>– Secure long-term quality credits – via commercial deals – in regions with significant Scope 1 and 2 emissions (such as Australia, North America) and explore options to move upstream into co-financing/development for long-term security.</li> </ul>

Integrity criteria

### Beyond the voluntary standards, we further test projects using our development criteria for high-integrity NbS before investment

Ensuring defensible carbon baseline and accounting for real carbon reductions			Ensuring ecological and social benefits		
Permanence	Additionality	Quantification	Ecological safeguards	Social safeguards	
We assess: <ul style="list-style-type: none"> <li>– intervention viability, developer credibility and medium and long-term management plan (beyond credit period)</li> <li>– other funding sources and their impact on additionality claims</li> <li>– threats to permanence (buffer, leakage assumptions) and use in-region benchmarks</li> <li>– baseline credibility and desktop geospatial reviews for NbS projects</li> <li>– impacts of upcoming carbon methodology changes that may adversely affect credits</li> <li>– ability to source recent and future vintage years</li> <li>– monitoring and adaptive management practices for project efficacy and continuous improvement.</li> </ul>			We ensure that: <ul style="list-style-type: none"> <li>– projects meet Rio Tinto’s standards and have Climate, Community and Biodiversity (CCB) certification or equivalent</li> <li>– developer’s community approach is fair. We test for Free, Prior Informed Consent (FPIC) and whether benefits distribution is fair and transparent</li> <li>– projects do not replace intact eco-systems or introduce invasive species</li> <li>– integrated, regenerative landscape stewardship approaches (water, biodiversity, ecosystem services) are prioritised.</li> </ul>		

The recent application of these criteria on the North American carbon offset spot market led to more than 80% of projects failing our internal due diligence, reinforcing the importance of upstream partnerships. We intend to use these criteria in upstream partnership collaborations to either augment existing projects or shape new projects.

In 2022, we worked with a steel producer and bank in China to trial a carbon offset iron ore cargo<sup>1</sup>. We used carbon credits sourced from a Verra-certified forest management project (conversion of logged to protected forest) in Hubei province to offset the emissions associated with Scope 3 upstream activities, as

well as Scope 1 and 2 emissions from mining, rail and marine shipping of the iron ore to a port in China (this represents less than approximately 5% of the emissions associated with producing steel with that cargo).

#### Carbon capture and mineralisation

We continue to explore carbon capture and mineralisation options leveraging our exploration and geological expertise. Together with Carbfix, we are planning to permanently store carbon underground at our ISAL aluminium smelter in Iceland. Carbfix will use our land surrounding the ISAL smelter for onshore CO<sub>2</sub> injection in the world’s first carbon mineral storage hub.

Our goal is to use the Carbfix technology to further decarbonise our operations.

We have also launched a partnership – partly sponsored by the United States Department of Energy – with climate technology and research bodies to assess the potential to store carbon dioxide as rock at the Tamarack nickel project in Minnesota. The geology of the Tamarack site holds the potential to permanently store large amounts of carbon captured from the atmosphere or from hard-to-abate industries by mineralising it through natural chemical reactions.

1. The following Voluntary Carbon Units were retired upon delivery of the cargo:  
 9918-159315717-159318418-VCS-VCU-324-VER-CN-14-1935-01012017-31122017-1  
 9918-159415717-159423014-VCS-VCU-324-VER-CN-14-1935-01012017-31122017-1

## Capital allocation alignment with our decarbonisation strategy

The world will need more aluminium, more copper, more high-grade iron ore and more lithium – and this is where we are focusing our growth investments. However, we will only invest in quality assets that will give robust returns under a range of economic, geopolitical and carbon scenarios, creating a resilient portfolio with significant upside to the energy transition.

We are applying similar thinking to our approach to decarbonisation. This aims to de-risk cash flows for the longer term while remaining very disciplined today. We will also be well positioned to benefit from any carbon incentives if these are rolled out more widely. Our framework guides our decision making. The framework has five key elements – value, materiality of abatement, maturity of technology, competitiveness versus internal and external benchmarks and alignment with the net zero 2050 target. This ensures our investments in abatement projects are phased in the most logical way, prioritising near-term work around energy inputs and where we already see attractive economics. These projects can have very different technical risk profiles – from ‘tried and tested’ to pioneering technology – and trades-offs between transitional and long-term solutions. Many require a carbon price to compete at the challenging internal hurdle rate we set for investment.

Based on our current assumptions, carbon prices below \$100/tCO<sub>2</sub>e may be enough for us to decarbonise power and support our investment in renewable generation and firming infrastructure. Higher carbon prices and other forms of support are necessary to enable us to address harder-to-abate parts of our carbon footprint, such as process heat and carbon anodes, and remain commercially competitive in a global market. We have used a shadow carbon price of \$75 per tonne as part of the investment case for large capital projects; however, we are not using this shadow price to incentivise smaller energy efficiency investments. We will reconsider the merit of using this in evaluations of abatement projects in future.

In 2022, we shifted our focus from multiple projects captured in our marginal abatement costs curve to six abatement programmes that cut across our product groups. We are prioritising investment in decarbonising electricity and process heat this decade, as well as developing the technology such as ELYSIS™ and low carbon vehicles that will deliver reductions in the longer term. Given the long lead times for these projects, we now expect offsets to make a greater contribution towards our ambitious targets.

We are committed to aligning our future capital expenditure with our 2025 and 2030 Scope 1 and 2 emissions targets. We estimate that we will invest \$7.5 billion in capital between 2022 and 2030 to deliver our decarbonisation strategy. Our capital expenditure on decarbonisation is expected to increase over the three years to 2025, reaching an estimated total of \$1.5 billion.

In 2022, our decarbonisation-related capital expenditure was \$94 million compared with an original estimate of \$500 million. Our capex on decarbonisation projects in the years from 2023 to 2025 mainly relates to renewables deployment in the Pilbara. Decarbonisation investment across the rest of the Group will accelerate beyond 2025. This capital expenditure includes further decarbonisation of the Pilbara electricity system and other abatement projects. These projects will deliver a range of economic outcomes but in aggregate are value accretive at a modest carbon price. Most importantly, they safeguard the integrity of our assets over the longer term and reduce the risk profile of our cash flows.

We will also work with third parties through long-term contracts, which are not included in the \$7.5 billion capital expenditure noted above. These decisions will of course go through the same rigorous investment process we have for all our projects, and we will remain open-minded about the right mix of direct investment and third-party contracts. In 2022, our incremental operating expenditure to support our decarbonisation work was approximately \$140 million compared with an original estimate of \$200 million. This includes \$24 million on our steel decarbonisation initiatives. Having divested the last of our coal businesses, we are also phasing out investment in some other carbon-intensive assets.

# Low-carbon technology innovation



**“Technology will bring changes we cannot yet imagine – we need to remain open-minded and that is why we are taking a portfolio approach to R&D and not focusing on one particular technology to the exclusion of others.”**

**Nigel Steward**  
Chief Scientist

Addressing climate change requires us to replace fossil fuels with zero carbon sources of electricity, such as wind, solar, hydropower, geothermal and others. It will also require the electrification of the wider energy system. This transition will increase demand for key minerals and metals that we produce, such as copper, aluminium and iron ore for steelmaking, as well as creating demand for new materials such as lithium. Our strategy is to provide these materials, and we will have to do this with a net zero carbon footprint ourselves. Today, the key materials for the energy transition are not produced without the use of fossil fuels, so we must innovate and create new technology solutions to do so.

We have built an industry-leading Technology and R&D organisation, partnering with universities, governments, companies and start-ups to accelerate technology deployment to support our strategy, and already we have delivered some breakthroughs. We are improving our battery materials capabilities, reducing our carbon footprint through biofuel deployment, and partnering with customers and technology developers to decarbonise steelmaking.

We are disciplined in our approach to R&D, with five components to our technology roadmap, aligned with our strategic priorities: health and safety, lightening our overall

environmental footprint, supporting growth, decarbonising our operations and our products, and improving productivity. On the low-carbon transition we are focused on energy storage; hydrogen; and repowering our vehicles, trains and ships. And we are using new processing technology to create new growth streams.

Our aim is to be the innovation leader in providing materials produced with zero carbon and superior ESG footprint to drive the energy transition. We also strive to be the fastest at translating new ideas into sustained business value. Accessing transformative innovation will require us to take risks, something best done outside the core businesses, which is why we are partnering extensively.

We believe our technology innovation and development will bring competitive advantage. It's also imperative to our future success that we build new capabilities and continue to innovate. There are challenges in achieving net zero across our operations, but also opportunities. There is fierce competition and the pathway to success is uncertain. What is certain is that we won't achieve our net zero aspirations without this innovation in technologies and in our products.

## Energy storage

Over the next 10 years wind and solar deployments will help to address emissions from electricity generation. However, this needs to be firmed to support the 24/7 needs of our operations, especially at our aluminium smelters.

In the short term, we still see the need for conventional power sources to firm renewable electricity generation. However, new zero-carbon firming or long duration energy storage solutions are being developed – this is an active area with many new start up firms innovating in this field.

There are four types of long duration energy storage: thermal, chemical, electrochemical and mechanical. Electro-mechanical storage methods are the only ones capable of storing the large amounts of energy required and then delivering this energy at the power required to our large processing assets and mine sites. Pumped hydropower is such an electro-mechanical storage system that is well known and used today where available. We are also tracking new liquid air and compressed air mechanical storage technologies, and pathways are being pursued to make these technologies more economically viable.



Gudai-Darri solar plant. The Pilbara, Australia

Alternatively, demand will have to be modulated, and we are developing the capability in our aluminium smelters to flex power demand as a function of renewable electricity production.

Lithium-ion battery electrochemical storage is cheaper than the new mechanical storage methods, but still remains expensive, and there is insufficient storage capacity for our sites. The firming of electricity via electrochemical storage still requires development and there are many start ups active in the space.

We expect breakthroughs to be deployable in the 2035-2045 timeframe. The good news is that certain thermal storage technologies can provide firm, low-cost power to our energy-intensive alumina refineries and other hydrometallurgical plants that require steam, and we are actively pursuing these technologies at present.

## Hydrogen

We expect to use hydrogen as a reductant for zero-carbon steelmaking, for ilmenite reduction at Rio Tinto Iron and Titanium Quebec Operations (RTIT) and Richards Bay Minerals, and as a pathway for calcination in our alumina refineries. At the moment, though, hydrogen is very expensive and will require a technological breakthrough to be economically viable.

Hydrogen is a very energetic material to produce – requiring approximately four times more energy per tonne than aluminium – but it can provide a great deal of energy back to decarbonise some hard-to-abate industry sectors. There will be very high-power requirements to generate sufficient hydrogen to meet future demand; however, the electrolyser supply chain to deliver green hydrogen is not yet well established and it will take time before it will be a material contributor to decarbonisation.

While competitive green hydrogen requires very low-cost green electricity at scale, it also needs lower capital costs. We have invested in Electric Hydrogen, a Californian start up that has reduced capital intensity by a factor of three relative to competitor options through better process design and system engineering, as well as a scientific breakthrough.

Where possible we will always seek to electrify our processes as much as we can, for example by using electric boilers to raise steam, rather than using hydrogen as a fuel. This is a far more efficient use of the valuable renewable electricity resource. We lose energy each time we transform an energy from one source to another, and this is what makes direct electrification so compelling and capital-efficient. Therefore, we plan to use hydrogen for its chemical properties where electrification cannot play a role. Furthermore, we will consume it close to its point of generation to avoid supply chain leakage and energy transformation losses.

## Processing innovation

Breakthrough technologies are opening up new revenue streams for Rio Tinto. Customers increasingly want to know the provenance of their metals and minerals. We have the ELYSIS™ zero-carbon aluminium smelting, and at the Alma smelter we've implemented AP4X cell technology, which enables low carbon aluminium production leveraging the highest amperage in its class.

At RTFT, we became the first producer of scandium oxide in North America, using an innovative process we developed to extract high purity scandium oxide from waste streams without the need for any additional mining. Scandium is an essential material in aluminium-scandium (Al-Sc) alloys in automotive and aerospace applications.

We've also produced spodumene, a source of lithium, in a demonstration plant at RTFT. The process used was developed by researchers at our Critical Minerals and Technology Centre, and offers the environmental benefit of not using chemical products and generating only dry, inert residues. At Kennecott, we've started producing tellurium – a critical mineral used in solar panels – from by-product streams generated during the refining process.



Nuton™ technology pilot plant, Bundoora, Australia.

Another technology we've advanced is copper heap leaching, called Nuton™. It offers the potential to economically unlock low-grade copper sulphide resources and copper-bearing waste, and achieve higher recoveries on oxide and transitional material. It also has environmental benefits, including more efficient water usage, lower carbon emissions and the ability to reclaim mine sites by reprocessing waste.

# Partnering to reduce the carbon footprint of our value chains

We need to tackle our Scope 3 emissions, as we fully appreciate that to thrive in the long term we need to be part of net zero value chains. The best way for Rio Tinto to contribute to the low-carbon transition is to partner with our customers and others in our value chain to develop innovative solutions and help shape demand for low carbon metals and minerals.

Our Scope 3 emissions were 584Mt CO<sub>2</sub>e in 2022 – over 1% of the global total. These are primarily from our customers in Asia, processing our iron ore into steel and bauxite into aluminium, so our level of control is limited. Our approach to Scope 3 emissions balances ambition, pragmatism and our level of agency: it is focused on our most significant sources and is grounded in actions where we can have impact. Complex structural changes are needed in hard-to-abate sectors, such as steel, aluminium and shipping, to transition to net zero. While it is clear that we have a key role to play, we do not set an overall Scope 3 emissions target as we have limited ability to directly influence the production processes of our customers or their customers. In addition, reducing our Scope 3 emissions by shifting our portfolio away from fossil fuels or the natural depletion of coal mines is not an option for us.

In 2022, we increased our engagement with nearly all our direct iron ore and bauxite customers and worked with them to optimise their current operations and to develop the low-carbon technologies needed to reduce emissions across our value chains. It is encouraging that this issue remains high on the agenda when we meet our customers. Two things are clear: first, success will require deep collaboration across the value chain, from iron ore producers to steel makers, as well as technology providers, universities, and industry groups; and, secondly, consistent carbon policy is critical to accelerate the transition.

For many of our customers that policy signal is not clear enough.

We have seen a significant increase in the number of our customers that are setting public targets for their Scope 1 and 2 emissions (our Scope 3) and have ambitions to reach net zero by 2050. About 50% of our total iron ore sales are to steel producers that have already set public targets to reach net zero by 2050, up from 28% in 2021. Over 40% of our bauxite sales are to customers that have set net zero emissions targets, though only approximately 5% is to companies that are aiming for net zero by 2050. As these numbers rise, so will our ability to partner through the value chain to achieve our common sustainability objectives.

An inevitable structural shift toward green steel is underway. In the short to medium term, the industry is predominantly focusing on blast furnace optimisation and we are working closely with customers to support their ambitions. In the medium to long term, the industry will move towards cleaner processing routes such as DRI-EAF<sup>1</sup>. Steelmakers will increasingly value higher-grade ores with fewer impurities that are more energy efficient to process. Therefore, we are working in partnerships with customers, technology providers, universities and others to develop low-carbon technologies to process our iron ore into steel. This includes exploring DRI pathways using hydrogen and sustainable biomass. We are also working on options to beneficiate and upgrade our Pilbara ores to be better suited to low-carbon steelmaking technologies.

As we develop new capabilities across a wide variety of fields in steel, aluminium and shipping, we are learning from our experience to channel resources into the most promising areas that can have the greatest impact. The low-carbon technologies we need in these sectors – including Biolron™, hydrogen as a reductant and green methanol – will take years or decades to develop and implement in partnerships between industries and governments. Progress won't be linear; there will be trade-offs, dilemmas and setbacks on the path to net zero. In 2023, we aim to step up our activities and partnerships to accelerate delivery of real-world outcomes. Each of our technology partnerships has individual goals and targets and our progress towards them is detailed below.

## Our Scope 3 emissions in 2022

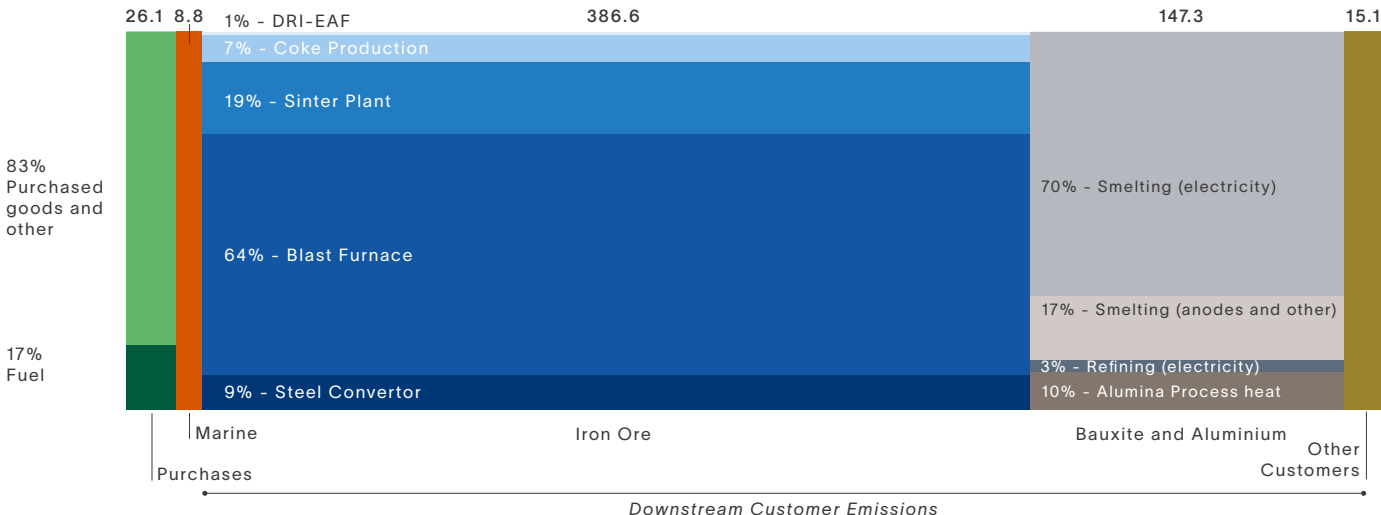
Our Scope 3 emissions were 584Mt CO<sub>2</sub>e in 2022 (558Mt CO<sub>2</sub>e in 2021, restated to be equivalent in methods to 2022). Over 94% of this is from the downstream processing of iron ore, bauxite and other products. Over 76% of these processing emissions arise in China, which has pledged to be carbon neutral by 2060, and another 18% come from Japan, South Korea and other countries that have pledged to be carbon neutral by 2050.

Estimating our Scope 3 emissions remains challenging, but we have made further improvements in accuracy and completeness in 2022, notably the inclusion of voyage-specific emissions data from chartered ships. Customer-specific emissions data from the

1. Direct Reduced Iron.

### 2022 Scope 3 emissions by category and source (equity basis)

# 583.9Mt CO<sub>2</sub>e





processing of our products continue to be limited in availability. We are working with a number of suppliers to understand emission factors for larger purchased goods and fuels with a focus on ensuring an equivalent cradle-to-gate boundary as the current factors. The full details of our updated approach to estimating Scope 3 emissions and our assumptions are available in our separate *2022 Scope 1, 2 and 3 Emissions Calculation Methodology Report* on our website.

Our Scope 3 downstream processing emissions from bauxite and alumina rose from 144Mt CO<sub>2</sub>e in 2021 to 147Mt CO<sub>2</sub>e in 2022. This is due to an increase in sales to customers in countries with a higher than average emissions factor, as well as more accurate bauxite and alumina customer emissions reporting. Scope 3 processing emissions related to our iron ore rose from 365Mt CO<sub>2</sub>e in 2021 to 387Mt CO<sub>2</sub>e in 2022 primarily due to changes in product mix and an increase in iron ore sold.

### The steel value chain

Steel is one of the most cost-efficient construction materials and is essential in low-carbon infrastructure, transportation and buildings. Steel has a similar carbon footprint to hydro-based aluminium today on a per tonne of product basis. However, with close to 2 billion tonnes of crude steel produced globally in 2022, the industry overall emits over 3 billion tonnes of CO<sub>2</sub> annually, equivalent to around 8% of global carbon emissions.

In all our scenarios, we anticipate an increase in the use of steel scrap, especially in China, as the scrap pool rises, although this will depend on quality and quantity. However, even by 2050, we expect that more than half of future crude steel production will remain based on iron ore (compared to about two-thirds today). Meanwhile, blast furnace optimisation will be driven by the use of higher-grade ores, including iron ore lumps and pellets, as well as the replacement of pulverised coal injection with hydrogen and the oxygen enrichment of the blast air enabling gas recycling.

There is no proven process route at an industrial scale to produce primary net zero steel today; however, the industry is developing and scaling a range of new technologies. These include hydrogen-based DRI feeding into an electric arc furnace or into a basic oxygen furnace (BOF) via an intermediary melter step, direct smelting, the use of sustainable biomass, and carbon capture and storage (CCS), as well as more speculative technologies such as electrolysis. The speed and scale of deploying these new technologies will depend on technological breakthroughs, trends in capital intensity to close the cost gap with existing production methods, customer willingness to pay and government policies, including carbon prices.

The low-carbon transition pathway of the steel industry is uncertain today but can be explored and better understood through scenarios. One example is the scenario analysis presented in *Net-Zero Steel Sector Transition Strategy* first published in 2021, and updated in September 2022, by the Net Zero Steel Initiative (NZSI). NZSI is an industry platform, part of the Mission Possible Partnership, that brings together stakeholders across the whole steel supply chain to help put the sector on a path to net zero emissions by mid-century.

The two NZSI net zero-aligned scenarios result in different carbon emission pathways for the steel industry, with reductions ranging from 11% to 33% by 2030, and from 50% to 76% by 2040 (in Tech Moratorium and Carbon Cost respectively, compared to the NZSI 2020 baseline). Assuming that the steel industry follows the NZSI Tech Moratorium scenario, our own analysis indicates that our iron ore-related Scope 3 emissions would fall by 44% by 2035 (24% in our *2021 Climate Change Report*). This projection includes expected production growth at our Pilbara operations in Western Australia and the Iron Ore Company of Canada and assumes the development of our Simandou project in Guinea. The greater forecast reduction in Scope 3 emissions versus the *2021 Climate Change Report* is due to a range of factors.

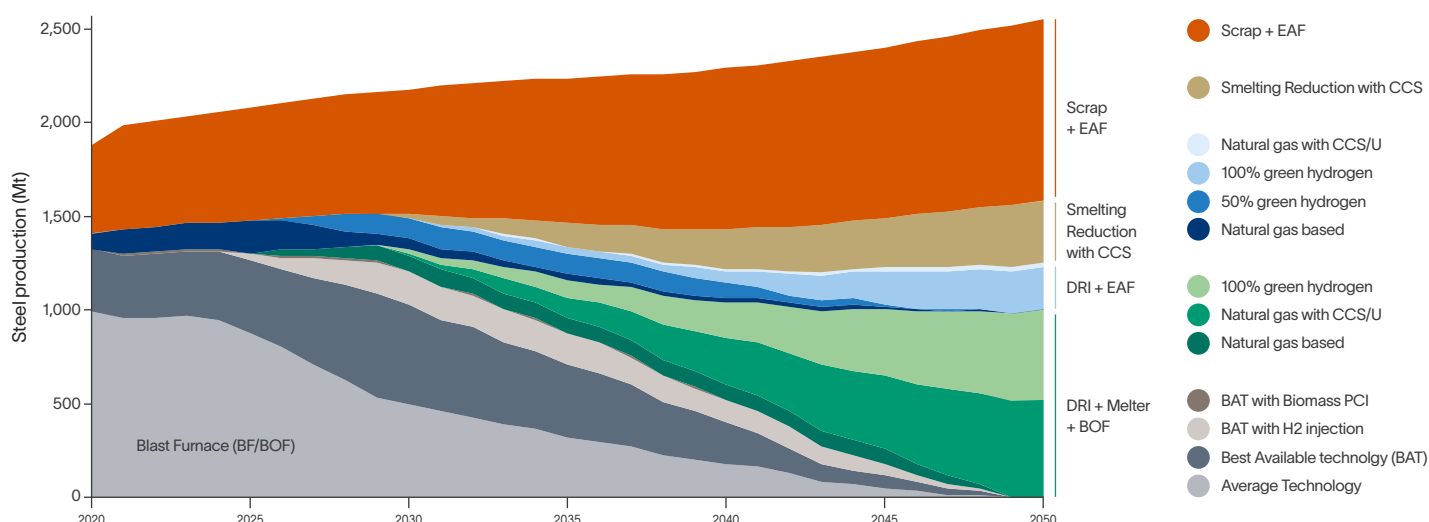
They include, firstly, refinements to the 2022 NZSI model resulting in increased CO<sub>2</sub> reduction via enhanced blast furnace technologies. Secondly, expectation of a faster transition to DRI-based steelmaking via the Melter-BOF route and, thirdly, increased future lump proportion from our Pilbara mines would both have the potential to impact Scope 3 targets. Fourthly, the forecast assumes a greater role for Rhodes Ridge joint venture mines in future production.

### Our focus areas for iron and steel decarbonisation

Our approach is to pursue and support a range of decarbonisation options aligned with the technology pathways highlighted by the NZSI analysis, through partnerships with our customers, suppliers, universities and research institutes. In 2022, we engaged with nearly all our direct steel customers (by sales volume). This represents approximately 70% of our total iron ore sales<sup>1</sup> and two thirds of our related emissions. We have an engagement tracking framework with customer projects covering 59% of our sales volume. We have consolidated these initiatives under six focus areas, with coordination from a dedicated Steel Decarbonisation team<sup>2</sup> within our Commercial team. This includes benefiting our Pilbara ores to be better suited to green steel technologies, optimising the traditional blast furnace route to reduce emissions and innovating green solutions using hydrogen and biomass in a sustainable way.

In 2022, we made progress on 49 projects, together with over 30 partners, building technical and commercial optionality for the future across the steel value chain. In 2022, we spent \$24 million on our iron and steel decarbonisation initiatives, lower than our planned spend of \$50 million. We are aiming to increase our investment in our steel decarbonisation initiatives in 2023 and the level of spend will depend on the speed of success of our research and development initiatives.

### NZSI Tech Moratorium scenario technology pathway



1. The balance includes spot buyers, traders and others procuring from our China portside business.  
 2. Steel Decarbonisation team has 16 people – primarily engineers and research personnel, supported by people from our Iron Ore, Development and Technology, Commercial and Business Development teams, working in all our customer markets.

Goals	2022 progress	2023 objectives
<p><b>1. Blast furnace optimisation</b></p> <p>99% of our iron ore is processed through the blast furnace route today, the optimisation of which could result in potential carbon emission reductions of up to 30%. We will collaborate with over 20 customers, including Baowu, POSCO, Nippon Steel Corporation (NSC) and Shougang, to help them generate those savings as an intermediary decarbonisation step.</p> <p>This includes pilot work on microwave lump drying with Baowu, and progressing our partnership with NSC on test work for lump ores and exploring a new grade of pellets.</p>	<ul style="list-style-type: none"> <li>– We collaborated with China Baowu on low-carbon steelmaking and research projects. The lump drying technology in Baowu’s Meigang subsidiary is one of the signature projects. Through the development and industrial demonstration of green and efficient drying technology for blast furnace lump, the proportion of lump ratio will be increased by 2%. The CO<sub>2</sub> emissions will be reduced by 32,000 tonnes per year in Meigang.</li> <li>– 17 lump collaborations with Chinese customers. Outstanding performance results at some operations, with some mills achieving &gt;5% increase in the proportion of lump in use. This corresponds to about 1% reduction in CO<sub>2</sub> emissions per customer.</li> <li>– We signed an MoU with Shougang Group to explore, develop and demonstrate a low-carbon emission steel value chain. The collaboration consists of four key projects covering all of the blast furnace / basic oxygen furnace (BF/BOF) process optimisation, including low-carbon sintering, blast furnace heat recovery, BOF slag utilisation and carbon capture and utilisation (CCU).</li> </ul>	<ul style="list-style-type: none"> <li>– Commence construction of the pilot plant in March 2023.</li> <li>– Progress work with Nippon Steel Corporation on pelletising and fluidised bed reduction.</li> <li>– Progress collaboration with Shougang. Commence CCU pilot plant construction in 2023.</li> </ul>
<p><b>2. Pilbara beneficiation</b></p> <p>Our Pilbara blend products have been optimised for the blast furnace process route and have impurities that might be more difficult to manage in emerging green steel technologies. These impurities must be removed upfront via beneficiation or during processing. Our goal is to explore how much upgrading of the ore can be done effectively prior to pyrometallurgical processing.</p>	<ul style="list-style-type: none"> <li>– Bulk samples across products and some current and future mines have been collected.</li> <li>– Density measurement of iron ore lumps has explored how density separation can be used to improve grade to match green steel routes for our Gudai-Darri mine. We have also commenced work on liberation, understanding how crushing and grinding can help improve the separation of impurities in the iron ores.</li> <li>– With the Australian National University (ANU), we have been developing 3D characterisation and machine learning techniques to better understand iron ore minerals, where impurities reside and how they can be best processed. 3D scanning and 2D scanning electron microscope work has provided valuable insights into iron ore quality; the relationship between minerals, impurities and porosity; and potential to upgrade ore through processing.</li> <li>– Successful production of pellets from Pilbara Blend at laboratory scale.</li> </ul>	<ul style="list-style-type: none"> <li>– Expand fundamental test programme to include natural fines and an increased number of lump samples from multiple mine sites.</li> <li>– Expand knowledge of density, porosity and liberation to continue to optimise product design and flowsheets for Pilbara ores.</li> <li>– Prepare low impurity beneficiated lump and fines samples and undertake hydrogen-based reduction testwork in conjunction with industry partners.</li> <li>– Produce and evaluate reduction performance of beneficiated, sole sourced and blended ores pellets.</li> <li>– Expand testwork to consider magnetic susceptibility and flotation as options to remove impurities in a range of iron ore types.</li> <li>– Progress fundamental R&amp;D on dry beneficiation and other novel processing techniques led by our Technical Development Centre in Bundoora.</li> <li>– Continue to build on 3D characterisation programme and expand the 3D machine learning data set to include more information on density, porosity, grade, breakage and liberation characteristics.</li> </ul>

Goals	2022 progress	2023 objectives
<p><b>3. Research and development of a low-carbon steel making process – Biolron™</b></p> <p>Over the past decade we have been researching a method of processing Pilbara ores using microwave energy and sustainable biomass as a reductant. The process produces a pig iron type product for either an electric arc furnace or basic oxygen furnace. The overall steelmaking process has the potential to be carbon neutral or even carbon negative with the addition of carbon capture and storage. In 2022, we planned to scale up the technology and develop the design for a continuous pilot plant (CPP) for approval.</p>	<ul style="list-style-type: none"> <li>– In 2022, we planned to scale up the technology and develop the design for a CPP for approval (following laboratory test work, and subsequent third-party review of results).</li> <li>– Over the past 18 months, the Biolron™ process has been tested extensively in Germany by a project team from Rio Tinto, Metso Outotec, and the University of Nottingham’s Microwave Process Engineering Group.</li> <li>– The initial testing phase showed great promise and demonstrated that the Biolron™ process is well suited to Pilbara iron ore fines. The potential was confirmed in a comprehensive and independent technical review by Hatch.</li> <li>– A prefeasibility study for the pilot plant has been completed and the detailed design of the pilot plant is underway. We are considering suitable locations for its construction.</li> </ul>	<ul style="list-style-type: none"> <li>– Develop enhanced microwave energy delivery using pilot models of the CPP plant.</li> <li>– Finalise design and location of CPP and commence fabrication by end 2023.</li> <li>– Complete benchmarking study of sustainable biomass certification processes.</li> </ul>
<p><b>4. Hydrogen DRI and melter</b></p> <p>An alternative to the beneficiation of Pilbara ores is the production of a mid-grade DRI product, with an intermediary electric melter step to remove impurities before processing into steel in an electric arc furnace or basic oxygen furnace. The use of renewable electricity and green hydrogen in the DRI process provides a pathway to net zero iron and steel.</p>	<ul style="list-style-type: none"> <li>– In 2022, we conducted a joint concept study to assess construction of a pilot plant at BlueScope Port Kembla Steelworks in Australia to produce molten iron from our Pilbara ores via a green hydrogen direct reduction and renewable energy electric melter route.</li> </ul>	<ul style="list-style-type: none"> <li>– Concept studies with BlueScope will be completed in the first half of 2023, at which point we will commence a final pilot plant design. As this pathway becomes more understood, we will look into the potential for additional partners.</li> <li>– With our internal Bundoora Technical Development Centre we continue to develop hydrogen reduction processing of iron ores.</li> </ul>
<p><b>5. High-grade DRI</b></p> <p>The direct reduction of high-grade iron ore pellets is already an available technology today using natural gas as a reductant to produce a low-carbon iron product that can be directly processed in an electric arc furnace. Switching from natural gas to green hydrogen would make this a net zero process route.</p>	<ul style="list-style-type: none"> <li>– In 2022, we planned to complete an order of magnitude study and, subject to approvals, commence the next phase of the study including considering partnership options. We are on track with this.</li> <li>– An order of magnitude study for a green hot briquetted iron (HBI) project has been completed. Phase 2 actions are underway including environmental fieldwork studies, economic studies and partnership discussions.</li> <li>– In June this year we signed an MoU with Salzgitter to study using our iron ore in green steelmaking, including the optimisation of pellets, lump, and sintered fines for use in hydrogen direct reduction steelmaking.</li> </ul>	<ul style="list-style-type: none"> <li>– Further evaluate opportunities in North America and the Middle East to produce hot briquetted iron (HBI) with hydro-based green hydrogen and high-grade iron ore from the Iron Ore Company of Canada (IOC).</li> <li>– Ongoing tests of IOC pellets in the SALCOS µDRAL pilot direct reduction plant at Salzgitter.</li> </ul>
<p><b>6. High-grade iron ore portfolio</b></p> <p>The shift to new, green technologies will require more high-quality iron ore and we are pursuing pathways to develop our high-grade Simandou deposit in Guinea. The deposit has an estimated 40% of iron ore resources that are potentially well suited to meet the DRI specification, which could be processed via the lower-carbon DRI-EAF route.</p>	<ul style="list-style-type: none"> <li>– In 2022, we continued to engage with key stakeholders while we carried out early development works.</li> <li>– Extensive metallurgical evaluation of Simandou ore has been done to support the DRI product strategy including tests with MIDREX, COREM and China Central South University.</li> <li>– In December, we signed a non-binding Term Sheet with our partners (including the Government of Guinea) in a significant step towards securing the shareholder agreement, cost estimates and funding necessary to progress the co-development of the infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>– Continue negotiations on the shareholder agreement, cost estimates and the necessary regulatory authority approvals.</li> <li>– Continue sampling and test work, including mineral characterisation of Simandou DR material. This test work is expected to move into pilot plants and industrial trials.</li> </ul>

## The aluminium value chain

Aluminium is a lightweight material essential to the low-carbon transition across a range of end-use sectors including transportation, green energy infrastructure, packaging and buildings. However, the aluminium smelting process is energy intensive and across its full value chain the aluminium industry emits about one billion tonnes of CO<sub>2</sub>e annually. As one of the leading global producers of low-carbon aluminium, our effort to further decarbonise our assets is core to our engagement with the industry and our customers on Scope 3 emissions from the sale of our bauxite and alumina.

Our 147Mt Scope 3 emissions in the aluminium value chain include 19Mt from third-party refining of our bauxite into alumina, and 128Mt from the subsequent aluminium smelting process to produce aluminium from alumina. Note that this is the only area where we consider emissions that are two steps down the value chain in our own Scope 3 emissions, due to materiality of the aluminium smelting emissions (following industry standard).

The most emissions-intensive part of the value chain is aluminium smelting, and the most emissions-intensive input is electricity (over 70% of all bauxite-related Scope 3 emissions). However, since our ability to influence customer power sources is limited, the short- to medium-term focus of our Scope 3 efforts is to improve the alumina refining process to deliver energy efficiency and optimal use of our bauxite.

### Electricity decarbonisation

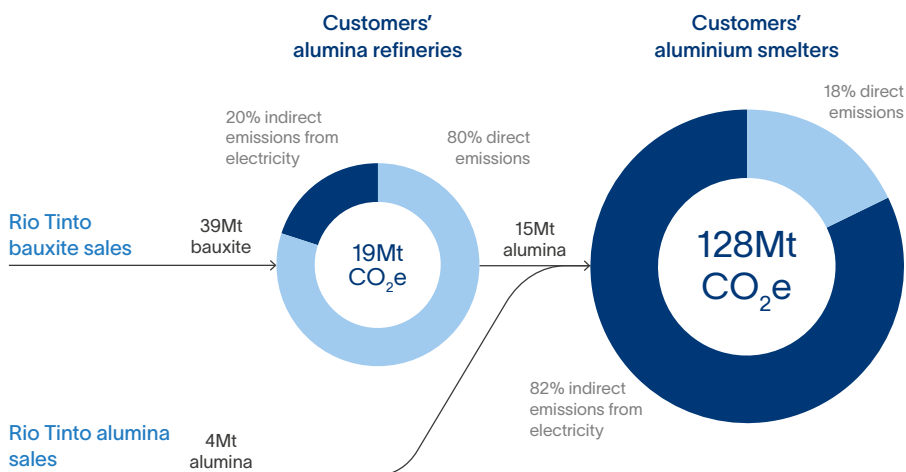
Over 60% of the primary aluminium industry's carbon emissions are related to the use of electricity in the smelting process, of which more than two-thirds originate from China, given the country's share of global production and its predominant reliance on coal-based power. As a large proportion of our bauxite and alumina sales are to customers in China, indirect emissions from the use of electricity account for 74% of our related Scope 3 emissions.

Our ability to influence emissions from these sources is extremely limited, especially regarding the overall decarbonisation process of China's power grid. Some aluminium producers in China currently draw power from captive thermal power stations and have already started to relocate some production capacity to regions such as southwest China that already have hydro-based power options. In addition, as the overall power grid decarbonises, it is possible that some smelters will shift from captive to grid power over time. Renewable power solutions, such as wind and solar, are readily available, although a challenge for the aluminium industry is the sourcing of firmed green power given the limited interruptibility of the aluminium smelting process.

### Direct emissions

Beyond the use of electricity, emissions are mostly related to the combustion of carbon anodes in the aluminium smelting process and the use of energy for process heat in the alumina refining process. These emissions sources account for about 12% and 10% respectively of Scope 3 emissions related to our bauxite and alumina sales.

## Downstream bauxite and alumina Scope 3 emissions



Direct/indirect emissions apportioning indicative using International Aluminium Institute (IAI) primary aluminum life cycle

Our work on inert anode technology through the ELYSIS joint venture is progressing towards industrial scale and is also part of our Scope 1 and 2 decarbonisation roadmap. Construction of large commercial-scale demonstration cells operating on an electric current of 450kA is underway at the end of an existing potline at our Alma aluminium smelter in Quebec, keeping the development pathway on track for the technology to be available for installation from 2024.

Meanwhile, in the context of alumina refining, we lead the way in using renewable electricity at our Vaudreuil refinery in Quebec and are exploring the use of hydrogen at Yarwun, in Australia, in partnerships with Sumitomo Corporation and the Australian Renewable Energy Agency (ARENA). An essential element of our market offering to our bauxite and alumina customers is technical support and knowledge sharing. Our technical teams continuously engage with our customers (our Scope 3 emissions) to share knowledge and expertise, especially from our experience with our own refineries, to support optimal efficiency in processing our products in their facilities.

We continue to engage with our customers via our Technical Service Agreements (TSAs) to help optimise processing of our bauxite, which, in turn, results in energy savings. For example, we have conducted joint studies with three customers to evaluate implementing "sweetening" at refineries, which has the potential to increase productivity while at the same time reducing energy consumption and related emissions. We have received good traction with one customer advancing to a preliminary study to quantify the energy benefits under their specific conditions.

In 2022, we extended our engagement efforts beyond TSAs to include exploring mutual areas of collaboration in line with our customers' broader ESG strategies. We have initiated early-stage ESG engagement with nearly all of our bauxite customers (by sales volume) representing about 13% of our total bauxite and alumina Scope 3 emissions. We have progressed toward deeper engagement with three customers and plan to hold collaboration

sessions. These include both our largest customer, as well as our longest-standing customer relationship in China, together representing 57% of our bauxite sales. Our focus here includes improved extraction of alumina, optimised heat recovery and productivity gains.

Beyond our Scope 3 reported boundary, we are also engaging with our customers' customers further downstream in the value chain. End users in the transport, packaging and electronic sectors are seeking a transparent, sustainable and verifiable supply chain – this is driven by consumer demand and our customers' own commitments towards net zero. In 2021, we launched START, a new standard in transparency and traceability for the aluminium industry, enabling customer demand for low- or zero-carbon products to be supported through verifiable ESG credentials via secure blockchain technology.

### Recycling

Aluminium is infinitely recyclable, without loss of properties, and with a significantly reduced carbon footprint compared to primary production. Although it doesn't directly affect our Scope 3 emissions, recycling of post-consumer scrap today is estimated to avoid about 300 million tonnes of annual CO<sub>2</sub>e emissions.

We are investing \$28 million to build a new aluminium recycling facility at our Arvida Plant in Saguenay-Lac-Saint-Jean, Quebec, to expand our offering of low-carbon aluminium solutions for customers in the automotive, packaging and construction markets.

The facility will make Rio Tinto the first primary aluminium producer in North America to incorporate recycled post-consumer aluminium into aluminium alloys. The recycling centre is expected to be operational in the second quarter of 2024 and will have an initial capacity of 30,000 tons per year.

We are committed to recycled aluminium as an important decarbonisation pathway, while recognising that production of primary aluminium is expected to continue to grow in the coming decades to meet overall demand as recycling rates are already high, more than 90% in some key end-use sectors.

## Shipping

Our total Scope 3 emissions from shipping and logistics are 8.8Mt CO<sub>2</sub>e. Of this 5.1Mt (57%) comes from the approximately 230 vessels we charter, over which we have relatively greater influence, while around 2.2Mt (25%) comes from shipping of our products where freight has been arranged by the purchaser and where our leverage is limited. The remainder comprises other logistics elements such as truck, rail and container movement, accounting for approximately 1.5Mt (17%). As a ship owner of 17 vessels, we emit 0.5Mt in addition to the above – these are included in our Scope 1 totals.

Shipping is a material part of the total CO<sub>2</sub> emissions to produce and deliver products to our customers (for example, shipping emissions are approximately two-thirds of the total emissions to produce and deliver iron ore to China). Across our global fleet of owned and chartered vessels, we aim to realise a 40% reduction in emissions intensity by 2025, five years ahead of the International Maritime Organisation (IMO) targets, to have net zero vessels in our portfolio by 2030 and to be net zero emission by 2050. So far, we have achieved a 30% emissions intensity reduction relative to 2008 levels through technical and operational enhancements. This target we have defined as inclusive of marine shipping of our products and includes emissions relating to ships that we own, operate or manage such as time-chartered vessels.

We have also been exploring the use of transitional fuels. We are conducting a 12-month biofuel trial in one vessel with a 30% blend with very low sulphur fuel oil (VLSFO). This fuel blend reduces CO<sub>2</sub> emissions by 26%. In 2023 to 2024, we will also incorporate nine LNG dual-fuel chartered vessels into our fleet, with each delivering up to 15 to 20% CO<sub>2</sub> emissions reduction.

To achieve our 2030 and 2050 goals, our Marine team's core focus area is on end-state fuels. Although there is no clear, single end-state fuel solution within the shipping industry today, green methanol and green ammonia are viewed currently as the most promising to reach carbon neutrality. Green methanol is significantly more advanced as a maritime fuel with methanol engines already on the water since 2015. It has handling properties that can be supported by existing bunkering infrastructure. Large container operators have

also backed green methanol with at least 37 large dual-fuel container vessels on order<sup>1</sup>. By comparison, green ammonia is a highly toxic and corrosive gas requiring high pressure or low temperature storage, and currently lacks engine design, clear regulation and guidance for safe application in the shipping industry. While green ammonia may play an important role in the long term as these challenges are addressed, green methanol remains the most credible end-state fuel for the foreseeable future and provides the most achievable pathway today to realising our 2030 goal.

Effectively reducing emissions from shipping requires participants across the value chain to share the incremental costs. For example, there are still as yet unresolved questions around the economics of the biofuel blend in the near term, which pose a challenge to scaling up its use. Similarly, the current supply side constraints for end-state fuel solutions such as green methanol<sup>2</sup> and green ammonia also cast uncertainty around the economics of these fuels today. Nonetheless, we remain optimistic and committed to identifying and implementing sustainable solutions across varying time horizons with a clear focus on accelerating end-state compatible solutions in shipping. We will continue to pursue industry partnerships to support access to leading, low-cost net zero fuel projects and to foster green corridors, such as the West Australia to East Asia route being developed with the Global Maritime Forum.

Looking ahead, the main value drivers are:

- The development of low-cost green fuels production through partnerships.
- Regulatory support incentivising green fuel investment and lowering green fuel production cost.
- Carbon prices affecting the use of carbon-intensive fuels.

In 2022, we announced our membership of the First Movers Coalition, through which, with over 60 other major global companies, we can leverage our buying power to help stimulate green technological breakthroughs in hard-to-abate sectors including shipping, trucking and aviation.

We will also continue to develop partnerships to support access to leading, low-cost fuel projects and partner with influential industry bodies (for example, Maersk Mc-Kinney Moller Center for Zero Carbon Shipping).

## Upstream (procurement)

Upstream Scope 3 emissions from procurement were 25.5Mt CO<sub>2</sub>e in 2022, split between purchased fuels, goods and services. The goods and services are further divided between emissions related to operational expenditure purchases (such as third party alumina, caustic, explosives) of 18.9Mt, and capital expenditure purchases (such as machinery, electrical equipment) of 2.1Mt. Due to the nature of our businesses, many of our purchased inputs are from hard-to-abate sectors, such as caustic, coke, pitch and steel.

In 2022, given the impacts of COVID-19, the Procurement team prioritised supply chain resilience. In addition, we requested emissions factors from key suppliers with the aim of integrating them into sourcing criteria for high impact categories.

To complement the discussion with our mobile equipment suppliers on decarbonising our operations, we are also seeking to better understand emissions through their value chains.

In 2023, we will define our approach to upstream Scope 3 in more detail and determine where and how we can drive upstream decarbonisation.

1. A.P. Moller Maersk (the world's largest container liner) has ordered 19 green methanol / dual fuel (GM DF) vessels, while CMA CGM have followed with six GM DF vessels and Cosco in October 2022 with 12 GM DF vessels.

2. Currently, of the total 98 million tonnes of methanol produced globally, only 0.2 million tonnes is classified as green. 50 million tonnes/year of green methanol would be required for 5% of global shipping to be net zero.

# Enhancing our resilience to physical climate risk

From Madagascar’s tropical climate to Canada’s subarctic conditions, we operate in six continents across the globe. Many of our assets, infrastructure, communities and broader value chains are located in areas that are highly exposed to extreme weather events (acute climate risk), including extreme heat and cold, tropical cyclones, drought, extreme rainfall and coastal extremes.

As our climate continues to change, so does the magnitude, intensity and frequency of individual and compound extreme weather events, which will impact our operations for the foreseeable future. From exploration through to closure, quantifying our present and future risk to extreme weather and climate change is critical. Understanding our exposure across the entire value chain and how climate risks are likely to manifest in the future will ensure that we are appropriately placed to respond. The first step is understanding our risk, then we can translate that risk into resilience.

Taking and managing risk responsibly is essential to operating and growing our business safely, effectively and sustainably. Managing our risks effectively ensures we deliver our four objectives to strengthen our social licence, become the best operator, achieve impeccable ESG credentials and excel in development.

Our Group’s strategy, values and risk appetite inform and shape our risk management and internal controls framework. We embed risk management at every level of the organisation to effectively manage threats and opportunities to our business, host communities and our impact on the environment. Our three lines of defence provide assurance that risks are

effectively managed in line with our policies, standards and procedures. While risk management is the accountability of our leaders, all employees are empowered to identify and manage risks at the point that they arise in their business. Our Board and Executive Risk Management Committee provide oversight of our principal risks and the Audit Committee monitors the overall effectiveness of our system of risk management and internal controls. The Principal Risks and Uncertainties section of our 2022 Annual Report considers both physical climate risks and low-carbon transition risks.

Three lines of defence	Responsibilities	Accountability
1 <sup>st</sup> – All operational leaders	Identification, management, verification, and monitoring of risks and controls	Management
2 <sup>nd</sup> – Centre of Excellence, Areas of Expertise and Group functions	Oversight of risks and control effectiveness; design of Group controls; advice on capabilities; and objective assurance of compliance with the Group’s policies, standards and procedures	Management
3 <sup>rd</sup> – Group Internal Audit	Independent objective assurance to evaluate the effectiveness of risk management, internal controls and governance	Board and Board committees

We measure and mature the effectiveness of our risk management practices through our risk management system. This system is built up of six core elements that are continually improved to ensure that we are effectively managing current risks and preparing for emerging risks:

- Risk management framework:** The framework contains Group roles and responsibilities, standards, procedures and guiding principles for effective, consistent and integrated risk management.
- Reporting and insights:** Oversight is supported by proactive and regular reporting to relevant Executive and Board committees. Decision making is supported by connected and insightful risk and control analysis.
- Systems, technology and data analytics:** We leverage systems and data analytics to support risk and control analysis, management and oversight.
- Risk analysis and management:** Risks are measured, monitored and managed, which requires critical controls performance to also be measured, monitored and managed. Risks and their control information are current, transparent and connected. Leaders lead the analysis and management.
- Risk assurance:** We ensure that risks and critical controls are implemented and managed effectively.
- Capability and culture:** Risk capability is built through coaching and training for leaders and teams across our business. A risk culture of actively managing risks is embedded into how we run our business. A risk culture fosters the collective ability to identify, understand, escalate, and then openly discuss and respond to current and future risks.

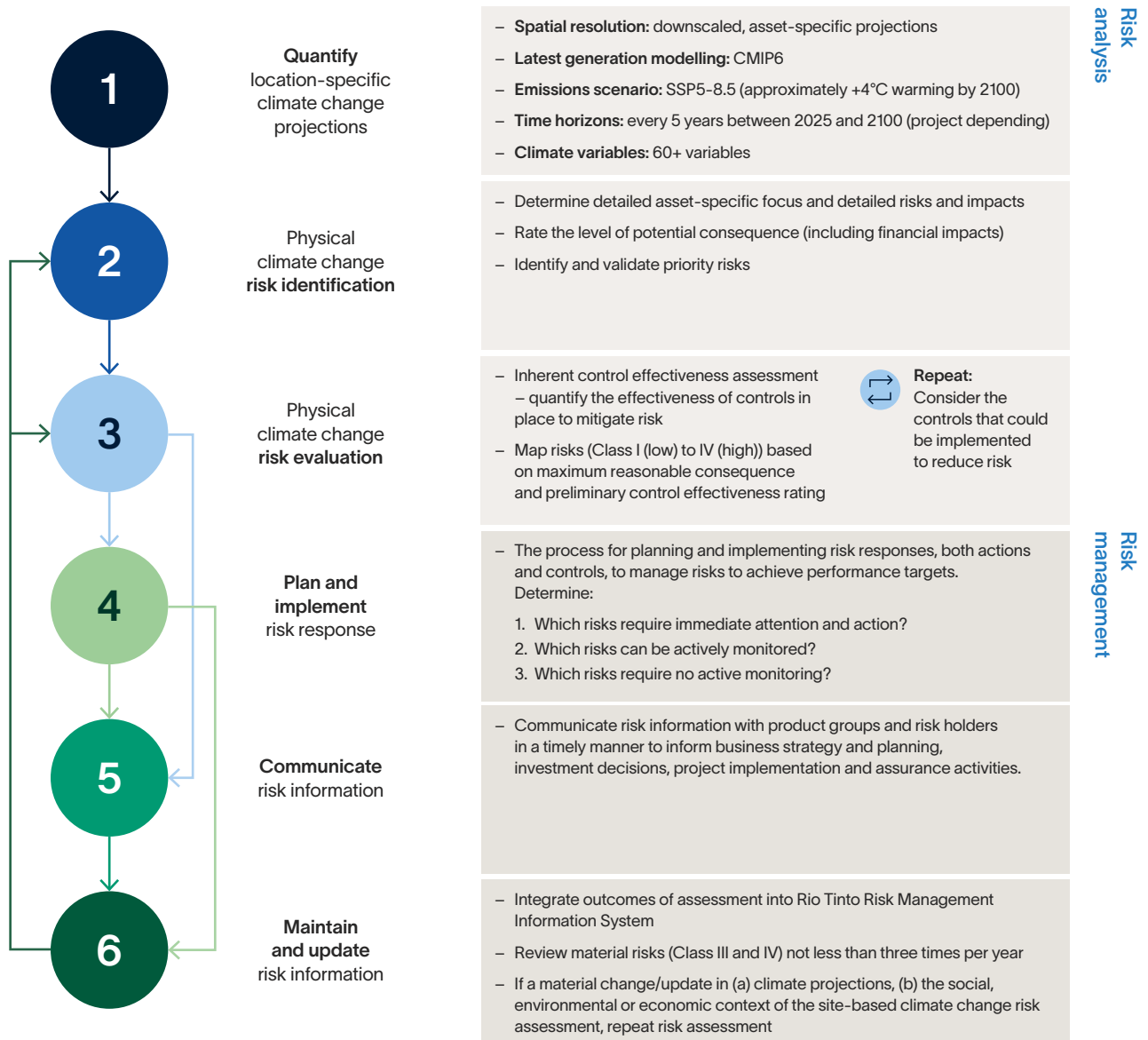
We expect that all our leaders and team members understand their risks, assess them in line with our values and Group policies and procedures, and respond. Where risks are material to the Group, they are escalated to the Risk Management Committee for oversight, and, as appropriate, to the relevant Board committees and the Board. Enhancing our resilience to physical climate risks is an important component of our climate change strategy.

## Our approach to quantifying and managing physical climate risk

In 2022, we launched the Physical Resilience Programme across the business. The Energy and Climate Change Centre of Excellence (E&CC CoE), in collaboration with the Risk team, developed a physical risk and resilience assessment guidance methodology, which provides our assets and product groups with a bottom-up assessment framework to quantify physical climate risk. The guidance methodology provides a systematic framework that focuses on the following:

- **Climate modelling assumptions:** to guide the selection of future emission scenarios and time horizons to support bottom-up risk assessment/analyses.
- **A risk assessment process:** to identify and evaluate climate-related risks and opportunities.
- **A risk management framework:** to plan and implement risk responses, communicate risks with stakeholders, and maintain and update risk information.

Adopting this framework, our Iron Ore business conducted a physical risk and resilience assessment across its entire Pilbara operation in the second half of 2022. Our Aluminium business also conducted a physical climate risk and resilience assessment across its Saguenay operation, focused on climate change risks associated with managing the lake level of Saguenay–Lac-Saint-Jean. Outcomes from each of these assessments are discussed in more detail on the following pages.



## Using the latest generation climate modelling

Our Physical Resilience Programme is underpinned by the latest-generation emission scenarios and climate modelling (Coupled Model Intercomparison Project 6 (CMIP6)) from the IPCC Sixth Assessment Report. We have partnered with a world-leading climate data service provider to provide downscaled (site-specific) climate projections for every asset in our portfolio and wider value chain. Accessing site-specific projections more accurately captures local climatic trends and change, compared to regional-scale projections, which are broader and may overestimate or underestimate the magnitude (and directionality) of expected climate change. Over 30 CMIP6 models (an ensemble or group of climate model simulations) are available for five “tier-one” shared socio-economic pathway (SSP) future emission scenarios.

Climate change projections from the latest generation climate modelling and natural catastrophe modelling are used widely across our business, including:

- **Asset-level physical resilience assessments:** ensuring quantification of physical climate risk across our operations, our assets, our people and communities.
- **Closure planning and optimisation:** making informed decisions to ensure our operational, closing and legacy assets are resilient to a changing climate.
- **Tailings storage facility (TSF) management:** to conform with the Global Industry Standards on Tailings Management (GISTM), each of our tailings storage facilities (TSFs) must undergo a physical risk assessment for extreme and very-high classification facilities by August 2023 and for all other sites by August 2025.
- **Exploration, projects and climate due diligence:** supporting climate due diligence and climate risk assessments for exploration and new projects ensures we quantify our exposure to physical climate risk and adopt risk-informed decision making and planning.
- **Mine water management (water balance, flood estimation):** understanding how rainfall and water availability may change in the future will inform design.
- **Group finance and insurance:** for use in asset-level critical risk assessments and in insurance.

Our physical climate risk and resilience assessments consider a plausible high-emissions future (SSP5-8.5), equivalent to global warming of approximately +4°C by 2100 (compared to pre-industrial levels). Over 60 climate change variables are available for assets in all climate zones, including temperature and extreme heat/cold, rainfall (mean and extreme rainfall) and flooding, drought risk, coastal extremes including sea level rise, tropical cyclone and storm risk, fire danger and extreme wind.

## Assessing the resilience of our Pilbara Iron Ore business

Our Iron Ore business conducted a physical climate change risk assessment across the entire Pilbara operation (Coastal Operations, Mining Operations, Dampier Salt Limited (DSL) operations, and Integrated Rail and Utilities) in 2022. Climate projections and risks were considered across multiple time horizons, including 2030 (near-term), 2050 (mid-term) and 2100 (long-term), using site-specific climate change projections assuming a high-emissions scenario (Shared Socio-economic Pathway SSP5-8.5). Projections were considered for rainfall (mean and extreme), temperature (mean and maximum daily air temperatures), extreme heat days (number of days >35°C and >40°C), tropical cyclone frequency, intensity and location, sea level rise and extreme still high water levels, extreme wind and fire risk. Impacts associated with these changes (such as changes in flooding incidence) were also considered.

Currently, our Pilbara operation is exposed to the impacts associated with tropical cyclone activity, including extreme wind, rainfall, flooding and storm surge. Impacts related to projected changes in tropical cyclone activity were associated with 42% of all Class IV risks (the most serious) identified by 2050. Changes in tropical cyclone activity could result in damage to critical coastal infrastructure (for example, ship loader and/or conveyor systems), an inability and/or interruption in exporting ore, increased vulnerability of our people and communities. Potential consequences include health and safety implications, production and financial loss, and shipping and schedule delays. Although our Iron Ore operation is well-versed in managing risks associated with current tropical cyclones, changes in their characteristics, particularly in intensity, will likely impact future operations. Other risks associated with changes in extreme precipitation, flooding, extreme heat and sea level rise were also captured.

Of all climate-related risks identified by 2050, 45% were identified as material to the business (Class III and IV), reduced to 18% with the implementation of proposed additional adaptation and control measures to manage the risk. The assessment produced a valuable baseline of our current risks that will now be utilised to guide the focus of the Iron Ore Physical Resilience Programme for 2023 and beyond. Material risks have been prioritised for further quantification and evaluation and will be regularly reviewed as per our risk assessment process.

## Progress in managing acute physical risk in the Pilbara

The Dampier Resilience project is progressing through implementation with construction workfronts at Yurrayli Maya Power Station (YMPS) 220kV substation extension, transmission line pole erection from YMPS to the new Kangaroo Hill bulk supply substation, and at the Kangaroo Hill bulk substation itself. The scope of the project is to upgrade the 220kV transmission line between the YMPS and our Port at Dampier, and to develop a new bulk supply substation at Kangaroo Hill and 33kV distribution connections to Dampier and a third party network operator. This critical project replaces existing assets with fit-for-purpose and climate-resilient infrastructure to ensure power network stability, reliability and security.

In 2022, we completed our work to enhance asset resilience of the Cape Lambert A jetty and wharf. These works included replacing berthing and mooring dolphins, longitudinal strengthening of the jetty and protective coating remediation of the jetty piles. These controls have significantly improved the structural integrity and asset life associated with our operations in the Cape Lambert marine port environment.



## Saguenay–Lac-Saint-Jean Climate Risk Assessment

Phase I of the Saguenay–Lac-Saint-Jean Climate Risk Assessment was conducted in 2022 with a focus on quantifying and understanding how climate change might impact the management of the water level of Lac-Saint-Jean.

Climate projections and risks were identified for a number of time horizons, including 2030 and 2050, considering a high-emissions (SSP5-8.5) scenario. Risks identified vary according to season. There are many risks associated with projected climate changes in winter (particularly snowfall, snowmelt and ice), including:

- Projected changes in winter precipitation and increased temperatures could result in more frequent floodgate operations (gate for controlling the flow of water over spillways), causing damage to critical dam infrastructure.
- Projected changes in freezing rain events could result in cascading breakage of electricity transmission lines, causing a major power shortage at one or more aluminium smelters.

On the other hand, many other risks are associated with summer, including but not limited to:

- Projected changes in precipitation combined with an increase in temperature during summer could increase forest fires, limiting access to our hydropower plants for extended periods of time and causing power shortages at our smelters.
- Projected increases in temperature and evaporation could result in a lower water level in the reservoir (Lac-Saint-Jean) causing low water flows through our hydropower plants and a reduction in output, potentially causing production losses at our smelters.

In 2023, further work will consider risks related to our production sites (refinery and smelters), energy generation sites (hydropower plants), and transport (rail network and port) across our entire Saguenay operation. The outcomes of this work will inform priority areas for focus and guide the implementation of adaptation strategies to improve our resilience to the risks associated with climate change.

## Global Industry Standards on Tailings Management

In August 2020, alongside other members of the International Council on Mining and Metals, we committed to implementing the Global Industry Standard on Tailings Management (GISTM) across all managed and non-managed TSFs. In total, we manage 95 active, inactive and closed TSFs across our global assets with a further 43 non-managed TSFs. For facilities classified Very High and Extreme GISTM consequence, conformance to GISTM requirements must be achieved by August 2023. For all remaining facilities, conformance must be achieved by August 2025.

To achieve conformance to the GISTM requirements relating to climate change, we developed a Group-wide climate change resilience assessment methodology, which is now being implemented across our Very High and Extreme consequence facilities. Leaning on the risk analysis and assessment process as outlined above, and using site-specific climate projection data, guidance is specifically tailored to compare design specifications with relevant climate change variables to identify and quantify credible failure modes (such as an exceedance of inflow design flood, resulting in an overtopping of the embankment crest) and impacts associated with non-failure modes (such as changes in rainfall and drought incidence causing vegetation stress).

The climate resilience knowledge base is expected to be regularly updated, at least every three years, or if there is a material change to:

- the tailings storage facility
- the social, environmental or local economic context
- climate projections, brought about by a significant advance in climate modelling capabilities.

## Testing the resilience of our closure plans

Closure planning considers future climate change projections along every step of the process to support safe and appropriate final landform design. Doing so enables us to meet our host communities' and long-term stewards' expectations and supports our goal of leaving a positive legacy for future generations.

In 2022, the design assumptions of the Diavik Diamond Mine closure plan were evaluated considering the latest-generation climate modelling and assuming a high-emissions climate change scenario (SSP5-8.5) for future time horizons, including 2050 and 2080. Closure designs were found to be robust and climate-resilient while being fit-for-purpose. A small number of recommendations were made, including installing additional buttressing for the Processed Kimberlite Containment (PKC) facility.

## Physical risk and resilience implementation in 2023

We will continue to quantify our physical risks and opportunities arising from climate change in 2023. We are planning a comprehensive programme of product group-led physical resilience assessments starting in 2023, including our Iron Ore Canada (IOC) operation, and the Simandou iron ore project in Guinea. This is in addition to our GISTM physical resilience assessments for Very High and Extreme consequence TSFs and our ongoing physical risk and resilience programmes currently underway in the Pilbara and Saguenay.

In 2023, we will progress a Group-wide, top-down assessment to quantify the financial impacts associated with physical climate change, including Group-wide risks and opportunities. This is in addition to the bottom-up climate risk and resilience assessments that are conducted at individual sites.

# Climate policy engagement

In 2015, we supported the adoption of the Paris Agreement and the long-term goal to limit global average temperature rise to well below 2°C and to pursue efforts to limit warming to 1.5°C. Government policy that creates the right framework for change is critical, coupled with real business action and societal shifts. A challenge as serious as climate change requires transparency, collaboration and a shared contribution to the solution. To achieve our decarbonisation goals and to support global goals, we need policy that promotes the production and consumption of low-carbon metals and minerals.

## Summary of our positions on climate change policy

- 1 We agree with the mainstream climate science published by the Intergovernmental Panel on Climate Change. We support the Glasgow Climate Pact, in which governments resolved to pursue efforts to limit the global temperature increase to 1.5°C that “requires rapid, deep and sustained reductions in global greenhouse gas emissions, including reducing global carbon dioxide emissions by 45% by 2030 relative to the 2010 level and to net zero around mid-century, as well as deep reductions in other greenhouse gases”. Consequently, we do not advocate for policies that undermine the Paris Agreement or discount Nationally Determined Contributions (NDCs).
- 2 Business has a vital role in addressing and managing the risks and uncertainties of climate change and driving emissions to net zero. A range of policy measures is necessary to support the early movers in our sector that innovate and deploy low-carbon technology. Our policy principles provide a common architecture for the positions we take in different jurisdictions – policy should be effective, fair, pragmatic, market-based and support free trade.
- 3 A market-based price on carbon is the most effective way to incentivise the private sector to make low-carbon investments and drive down emissions. Based on our current assumptions, carbon prices below \$100/tCO<sub>2</sub>e may be enough for us to decarbonise power and support our investment in renewable generation and firming infrastructure. Higher carbon prices and other forms of support are necessary to address harder-to-abate parts of our carbon footprint, such as process heat and carbon anodes, and remain commercially competitive in a global market.
- 4 Minerals and metals are globally traded, so effective climate policy should incentivise the private sector to invest in low-carbon technology without undermining the competitiveness of trade-exposed industries and shifting production, jobs and supply chains to countries with lower emissions standards (carbon leakage). If there is significant regional variation in carbon prices, carbon border adjustment mechanisms (CBAM), or alternative policies, are necessary to limit leakage, provided they are pragmatic, effective and equitable.
- 5 Carbon pricing, on its own, might not be sufficient to transform the metals sector. Other policy tools are necessary to tackle emissions and simultaneously achieve objectives related to industrial policy. These can include:
  - grant funding, tax incentives and investment incentives to support research and development, innovation and first-of-a-kind projects
  - product standards and procurement obligations (such as minimum and rising requirements for low or zero carbon metal) that drive deployment of pre-commercial technology.

## Working with our industry associations

Industry associations play an important role in policy development, sharing best practice and developing standards. The Rio Tinto Board approves our positions on climate change policy, our approach to engaging with industry associations and our annual review of their advocacy. Responsibility for comparing our positions with those of individual industry associations is delegated to management on a “comply or explain” basis.

Recognising that industry associations’ views will not always be the same as ours, we monitor the advocacy of all our industry associations and periodically review our memberships. This assessment includes:

- the purpose of the association and the value that membership may provide to us and our investors
- the adequacy of governance structures within the industry association
- policy positions and advocacy.

Our annual review of all our industry association memberships supplements this report and can be found on our website.

## Industry association policy and advocacy alignment

Where our membership is significant, we will work in partnership with industry associations to ensure that their policy positions and advocacy are consistent with our own public position and the Paris Agreement. In accordance with our principles, which govern how we monitor our industry association memberships, we may suspend our support and membership of industry associations where they do not align with our own public position and the Paris Agreement. In 2022, we decided not to renew our membership of the Queensland Resources Council.

# Climate governance

Climate change is a material and strategic topic for Rio Tinto and is therefore part of ongoing discussion and analysis at the most senior levels of management and the Board. It is also a key topic when the Board and Executive Committee engage with investors and civil society organisations.

The Board approves our overall strategy, our policy positions and the *Climate Change Report*. It sets the 2025, 2030 and 2050 emissions targets and monitors performance against the targets and operational resilience. The Chair of the Board is responsible for our overall approach to climate change.

**“We have taken a fresh look at our governance arrangements to ensure that the Board and our committees are focusing our time on supporting the delivery of the Group’s strategic objectives.”**

**Dominic Barton,**  
Chair

The Sustainability Committee has oversight of key sustainability areas that may be impacted by climate change, such as biodiversity and water, including the effectiveness of associated controls. The Sustainability Committee also reviews industry association engagement. Other Board committees also address particular climate issues such as how we consider climate change and our scenarios in our Financial Statements (Audit Committee) or the integration of climate-related performance metrics into short-term incentive plans (Remuneration Committee).

We base our appointments to the Board on merit, and on objective selection criteria, with the aim of bringing a range of skills, knowledge and experience to the business. We aim to appoint people who will help us address the operational and strategic challenges and opportunities facing the company, and we strive to ensure that our Board is diverse in terms of gender, nationality, social background and cognitive style. The key skills and experience of our Board are set out in the *2022 Annual Report*. This explicitly assesses the Board’s climate-related knowledge, understanding and competency in the following areas: climate science, technology development, low-carbon and energy transition and climate-related public policy. Five directors meet one or more of the criteria above.

The Chief Executive is responsible for delivering the Climate Action Plan approved by the Board. Risk management, portfolio reviews, capital investments, annual financial planning and our approach to government engagement integrate our approach to climate change and target execution considerations. The Annual Planning Review focuses on our

short-term (up to two years) and medium-term (2-10 years) plans and integrates the new growth and decarbonisation strategy into the financial planning process. The Chief Executive leads the strategy process with the Executive Committee each year and in 2022, reaffirmed the decision to put the low-carbon transition at the heart of our business strategy.

Accountability for delivering the goals, targets and objectives in the Climate Action Plan is delegated to the following members of the Executive Committee: Chief Financial Officer (capital allocation alignment, disclosure); Chief Legal Officer, Governance and Corporate Affairs (climate policy engagement, governance); Chief Technical Officer (Scope 1 and 2 emissions targets and just transition); and Chief Commercial Officer (Scope 3 goals). The Chief Technical Officer works closely with the product group Chief Executives to implement the mitigation projects and also oversees the Energy and Climate Change Centre of Excellence, the Energy Development team (which focuses on developing large-scale renewable power options), the Nature Solutions team, and the low-carbon research and development work led by the Chief Scientist.

To support decarbonisation across our operations, we established six abatement programmes in 2022 that focus on the cross-cutting issues of repowering our Pacific Aluminium Operations, renewables, ELYSIS™, alumina process heat, minerals processing and diesel transition. These six programmes cover 95% of Scope 1 and 2 emissions from across the Group.

Progress reports on operational emissions and abatement projects are provided to relevant Executive Committee members every month. Interim progress reports on actions set out in the Climate Action Plan are provided at the start the third and 4<sup>th</sup> quarters.

## Strengthening the link between executive remuneration and our climate performance

Since 2018, our Chief Executive’s performance objectives in the short-term incentive plan (STIP) have included delivery of the Group’s strategy on climate change. These are cascaded down into the annual objectives of relevant members of the Executive Committee, including the product group Chief Executives and other members of senior management. In 2022, the STIP focused on progress on abatement projects that directly contribute

## Board engagement on climate change in 2022

Climate change and the low-carbon transition are routinely on the Board’s agenda, including as part of strategy discussions, risk management, financial reporting and executive remuneration. In addition, in 2022, the Board:

- Held dedicated meetings to focus on decarbonisation including on large-scale renewable projects, repowering the Boyne Smelters, nature-based solutions and climate change policy.
- Reaffirmed our strategy that puts the low-carbon transition at the heart of our business.
- Engaged with investors and civil society organisations following the publication of our Climate Action Plan, as well as in November and December.
- Approved the *2021 Climate Change Report* and approach to industry associations.
- Approved the *2022 Climate Action Plan* and the advisory Say on Climate resolution in the 2022 AGMs.
- Reviewed our revised climate change policy positions.
- Approved revisions to the way climate change is integrated into executive incentives (Remuneration Committee).
- Approved the climate-related disclosures in the notes to the financial statements (Audit Committee).

towards the achievement of our 2025 and 2030 Scope 1 and 2 emissions targets as well as our Scope 3 goals. In 2022, we approved or delivered abatement projects that should contribute 0.29Mt CO<sub>2</sub> of abatement towards the 2025 target against a target of 0.8Mt. Challenges have included late delivery of equipment, resourcing constraints impacting study progress, construction and commissioning delays, and project readiness. Approval of a solar PV wheeling arrangement for Richards Bay Minerals was a material contributor to performance. We also delivered all four Scope 3 goals relating to steel decarbonisation partnerships, our aluminium value chain and shipping.

We have revised our approach to the STIP in 2023. Climate change performance objectives are assigned an explicit performance weighting of 10% in the STIP (up from 5% in 2022) and we will assess progress of moving carbon abatement projects through the various stages of development all the way to execution to meet our decarbonisation ambition.

Further detail is available in the remuneration section of our *2022 Annual Report*.

# Just transition – managing impacts on people and society

Our climate targets are ambitious and demand swift action. Achieving them relies on integrating social and human rights risks and opportunities associated with our decarbonisation strategy into our planning, in the same way we do for our other business activities. It means taking a holistic approach to manage this complex process, considering the full spectrum of environmental, social and governance issues.

This is why we commit to listen to, partner with, and respect the rights of employees, host communities and others with whom we interact. It is also central to our human rights due diligence process and broader commitment to implement business and human rights standards into our decarbonisation plans and actions – including the UN Guiding Principles on Business and Human Rights, the International Labour Organisation Declaration on Fundamental Principles and Rights at Work, and the UN Declaration on the Rights of Indigenous Peoples. We have codified these commitments – and our commitment to an energy transition that is socially inclusive and just – in our recently updated Human Rights policy. In this way, we are aligned with the 2015 Paris Agreement on climate change that emphasises an energy transition that does not leave people behind.

Our four business objectives help guide how we operate and progress towards our climate targets in a way that is fair and maximises outcomes for our employees and affected communities – a ‘just transition’, in the words of many of our stakeholders.

## Excel in development

The quantum of minerals required to realise the global energy transition will require new mines, many of which will be located on Indigenous land. Respectful and ongoing engagement is critical as we develop and scale up wind and solar projects that may occupy large areas of land.

We are changing the way we engage with Indigenous communities. We are progressively working more closely in partnership with Indigenous peoples across our operations to preserve and protect cultural heritage. We are moving to a model of co-management to ensure Indigenous voices are heard as part of our decision making.

We recognise that unless managed carefully, the low-carbon transition may negatively

impact host communities and people. We take care in understanding – and to avoid or mitigate – potentially adverse impacts, with a particular focus on disadvantaged and vulnerable groups. Our communities and site teams are also starting to work with Indigenous and host communities to explore opportunities for them to participate in and benefit from our climate initiatives.

## Best operator

Our approach to closure provides useful experience as we seek to reduce our carbon emissions while also enabling social and economic benefits. For example, as the closure of the Shawinigan smelter in Quebec, Canada approached in 2015, we worked with the local community and government officials to help remediate and transfer the smelter lands to the City of Shawinigan and assist with the economic transition. This included supporting the creation of a hub for new technology to leverage the digital economy. Most affected employees secured other work either outside or within the company. As our decarbonisation strategy continues to evolve, we will seek to support affected employees to transition to other opportunities either within our business, with other resource companies in different locations or to new industries altogether.

## Impeccable ESG

We are exploring nature-based solutions projects that create opportunities for communities while also helping offset emissions and improve biodiversity. Our experience with our abatement projects suggests that there will be delays and that we will require a more significant use of offsets to achieve our 2025 target. We intend to invest in high-quality projects that implement internationally accepted social and environmental safeguards. We will partner with host communities and other local stakeholders to learn from them and jointly find ways to improve the resilience and protect the biodiversity of land in and around our operations.

## Social licence

Like any disruptive change, the low-carbon transition brings both opportunities and risks. The introduction of the ELYSIS™ technology in Canada or battery electric haul trucks at our mines will create an ecosystem of new opportunities and jobs. We will work closely with our employees and host communities to plan for these changes.

We have an important role to play in driving the development of competitive renewable energy sources for our assets and also working with governments to support their renewable energy targets. We have plans to develop large-scale wind and solar power in Central and Southern Queensland to power our aluminium assets, help meet climate change ambitions, and further encourage renewable development and industry in the region. These activities will help support ongoing economic development in the region, but may also bring challenges, so we will engage and listen to the perspectives of our stakeholders in civil society, government and the communities where we operate.

## Governance and external engagement

In line with our business strategy to contribute to and thrive in a low-carbon future, we established an Executive Committee-sponsored cross-functional energy transition working group in 2022, with participation from Closure, Communities and Social Performance, Human Resources, Strategy and other teams. Working with an external expert, this working group is investigating the development of a tool to profile transition risks and opportunities at our assets.

Knowing that we do not have all the answers, we made external engagement a priority in 2022. This included listening to civil society organisations, investor groups and others to understand good practice and expectations on companies like ours as we transition to a low-carbon future. We participated in an industry working group, convened by sustainability business networks, BSR and the B Team, that is developing guidance and tools to enable a more worker- and community-centred transition.

Our priorities include assessing transition-related risks and opportunities across our assets; defining transition principles; awareness-raising across the business; and continued engagement with civil society organisations, host communities and employees.

### Best operator

Expand capability and leadership

### Impeccable ESG credentials

Strengthen track record and transparency

### Excel in development

Deliver organic and inorganic growth, on time, on budget

## Social licence

Earn trust by building meaningful relationships and partnerships

# TCFD disclosure

We support the recommendations from the Task Force on Climate-related Financial Disclosures (TCFD) and also welcomed the Climate Action 100+ Net Zero Company Benchmark when it was published in 2020. We are committed to continue to align our climate change disclosures with both of these frameworks. We are also engaging with CA100+ as it develops its Net Zero Standard for evaluating action on climate change by diversified mining companies.

During the year, we received a letter from the Financial Reporting Council's (FRC) Corporate Reporting Review team advising their intention to include extracts from our *2021 Annual Report* and accounts as examples of good practice in their thematic reviews of "TCFD disclosures and climate in the financial statements" and "Judgements and estimates". They also made recommendations for improvements to our disclosures, which we have incorporated into our *2022 Annual Report*. The scope of the review by the FRC and correspondence with management was limited to the *2021 Annual Report* and it did not provide assurance that the report and accounts are correct in all material respects.

The CA100+ calls on companies to reduce emissions by 45% relative to 2010 levels by 2030, which aligns with the emissions pathway described in the Intergovernmental Panel on Climate Change report on 1.5°C. Our target to reduce Scope 1 and 2 emissions by 50% compared with 2018 levels by 2030 exceeds this objective.

## Climate change-related financial reporting

The Directors have considered the relevance of the risks of climate change and transition risks associated with achieving the goals of the Paris Agreement when preparing and signing off the company's accounts. The narrative reporting on climate-related matters is consistent with the accounting assumptions and judgments made in this report. The Audit Committee reviews and approves all material accounting estimates and judgments relating to financial reporting, including those where climate issues are relevant. The Group's approach to climate change is supported by strong governance, processes and capabilities.

## Notes to the financial statements

*Given increasing interest in how companies integrate climate change considerations into their financial statements, the following is an abridged version of note h (and is not an exact copy). Readers should refer to the 2022 Annual Report for the complete notes in the financial statements.*

As part of our annual strategy process, we replaced our three scenarios described in the *2021 Annual Report* and now focus on two core scenarios. These are used to generate a central reference case for use in commodity forecasts, valuation models, and reserves and resources determination, as was the case in the prior year. These changes in scenarios represent an evolution of our interpretation and estimations in the current year, not a change in accounting policy and as such we have not restated comparative information. There are many plausible scenarios for global energy transition, all with different impacts on future commodity price outcomes.

At the UN Climate Summit in late 2022 (COP27), there was broad recognition that the pace of decarbonisation across the global economy is too slow to limit warming to 1.5°C and that current climate policies in many countries are not yet aligned with their stated ambitions. Consequently, neither of our two core scenarios are consistent with the expectation of climate policies required to accelerate the global transition to meet the stretch goal of the Paris Agreement. Although our operational emissions reduction targets align with the goals of the Paris Agreement, our two core scenarios do not. Consequently, we also assess our sensitivity and test the economic performance of our business against a scenario we have developed (Aspirational Leadership) to reflect our view of the global actions required to meet the stretch goal of the Paris Agreement. Importantly none of our three scenarios are considered a definitive representation for our assessment of the future impact of climate change on the Group. Scenario modelling has inherent limitations and by its nature allows a range of possible outcomes to be considered where it is impossible to predict which outcome is likely.

We do not publish the commodity price forecasts associated with these scenarios as to do so would weaken our position in commercial negotiations and might give rise to concerns from other market participants.

## Accounting judgments and estimates

### Impacts from executing our climate change strategy - accounting for capital expenditure and operating costs underpinning our Climate Action Plan

Given the significant investment we are making to abate our carbon emissions, we have considered the potential for asset obsolescence, with a particular focus on our Pilbara operations where we are prioritising investment in renewables to switch away from natural gas power generation. No material changes to accounting estimates to useful economic lives have been necessary due to the anticipated use of these assets for firming support in the transition. As the renewable projects progress, it is possible that such adjustments may be identified in the future. The renewable assets in the Pilbara are our own built and operated arrangements and follow normal rules on capitalisation of directly attributable costs. The solar power purchase agreement for RBM is accounted for on an accrual basis as energy is produced.

There are no accounting impacts to date from the programme to develop renewable energy solutions for our Queensland aluminium assets as the work has not been completed and commercial terms have not been agreed. Large scale renewable power off-take arrangements may, in the future, require complex derivative measurement or lease accounting depending on contractual terms.

No adjustments to useful lives of the existing fleet have been identified to date as a result of planned fleet electrification in the Pilbara and the purchase of battery-powered locomotives. The solutions are still in development or pilot stages and the gradual fleet replacement is intended to be part of the normal lifecycle renewal of trucks. Depending on technological development, which is highly uncertain, this could lead to accelerated depreciation in the future. Similarly, our target to have net zero vessels in our portfolio by 2030 has not given rise to accounting adjustments to date, as the replacement is planned as part of the lifecycle renewal. The energy efficiency digestion project at Queensland Alumina refinery does not reduce the economic lives of the underlying alumina assets but could lower operating costs and improve margins.

In general, the expenditure on our own carbon abatement projects and technology advancements follows existing accounting policies on cost capitalisation, research and development costs.

#### Use of sensitivities to Paris-aligned accounting

The forecast commodity prices (including carbon prices) informed by a blend of our two core scenarios are used pervasively in our financial processes from budgeting, forecasting, capital allocation and project evaluation to the determination of ore reserves. In turn, these prices are used to derive critical accounting estimates included as inputs to impairment testing, estimation of remaining economic life for units of production, depreciation and discounting, closure and rehabilitation provisions. These prices represent our best estimate of actual market outcomes based on the range of future economic conditions regarding matters largely outside our control, as required by the International Financial Reporting Standards. As neither of our core scenarios represents the Group's view of the goals of the Paris Agreement, our commodity price assumptions used in accounting estimates are not consistent with the expectation of climate policies required to accelerate the global transition to meet the goals of the Paris Agreement. As described above, we use our Aspirational Leadership scenario to understand the sensitivity of these estimates to Paris-aligned assumptions. The Aspirational Leadership scenario is a commodity sales price and carbon tax sensitivity, with all other inputs remaining equal compared to the two core scenarios and is built by design to reach net-zero emissions globally by 2050 and help us better understand the pathways to meet the Paris Agreement goal, and what this could mean for our business. It is used for strategy and risk discussions, including analysis of sensitivity to our view of a Paris-aligned pathway and comparison of relative economic performance to our core scenarios.

Through our strategy process we compare the economic performance of our portfolio under our two core scenarios and the Aspirational Leadership scenario and this indicates that overall the economic performance of our portfolio would be stronger in scenarios with proactive climate action, particularly in relation to aluminium, copper and higher-grade iron ore. It is possible therefore, under the right conditions, that historical impairments associated with these assets could reverse. We recognised an impairment of US\$202 million during the year for the Boyne smelter cash-generating unit, triggered by economic and operating performance of the smelter (refer to Note 4). When measuring the recoverable amount for this cash-generating unit we used net present value of cash flows to the end of the existing joint venture agreements in 2029, which also coincides with the Group's targeted carbon emission reductions by 2030. The Group continues to evaluate lower emission power solutions for the smelter that could extend its life to at least 2040. In such circumstances, the net present value of forecast future cash flows may support the reversal of past impairments. Both the recorded outcome and the sensitivity represent a reduction in emissions that we consider to be Paris-aligned.

We anticipate the economic performance associated with our assets that produce lower-grade iron ore to be lower under forward pricing curves consistent with the Paris Agreement. In the Aspirational Leadership scenario we expect the prices for lower-grade iron ore to be supported in the medium term by an assumed increase in GDP-driven demand. However, in the longer term we expect pricing for lower-grade iron ore to be weaker. This will depend on the development of low-emissions steel technology, the pace of which is uncertain. We expect this to be offset by higher prices for higher-grade iron ore. This is highly unlikely to give rise to impairment triggers today or in the foreseeable future due to the high returns on capital employed in the Pilbara.

We completed the divestment of our coal businesses in 2018 and no longer mine coal, but retained a contingent royalty from these divestments. Recent favourable coal prices exceeded contractual benchmark levels and resulted in the cash royalty receipt of US\$36 million during 2022. We also carry royalty receivables of US\$209 million on our balance sheet at 31 December 2022, measured at fair value (refer to Note 24). The fair value of this balance may be adversely impacted in the future by a faster pace of transition to a low-carbon economy, but this impact is not expected to be material.

Closure dates and cost of closure are also sensitive to climate assumptions, but no material changes have been identified in the year, specific to climate change, that would require a material revision to the provisions in 2022. For those commodities with higher forward price curves under the Aspirational Leadership scenario, it may be economical to mine lower mineral grades, which could result in the conversion of additional Mineral Resources to Ore Reserves and therefore longer dated closure.

Overall, based on the Aspirational Leadership scenario pricing outcomes, and with all other assumptions remaining consistent with those applied in our 2022 financial statements, we do not currently expect a material adverse impact of the 1.5°C Paris-aligned sensitivity on asset carrying values, remaining useful life, or closure and rehabilitation provisions for the Group. It is possible that other factors may arise in the future, which are not known today, that may impact this assessment.

The impact of climate change on our business is further described in the following notes to the financial statements:

Financial reporting considerations and sensitivities related to climate change	Annual Report page
Recoverable value of our assets, asset obsolescence, impairment and use of sensitivities (Note 4)	168
Operating expenditure spent on decarbonisation (Note 7 - footnote (h))	171
Water rights - climate impact on indefinite life (Note 12)	177
Estimation of asset lives (Note 13)	179
Additions to property, plant and equipment with a primary purpose of reducing carbon emissions (Note 13 - footnote (d))	181
Useful economic lives of power generating assets (Note 13)	181
Close-down, restoration and environmental cost (Note 14)	185
Coal royalty receivable (Note 24)	200

# Emissions data

## Scope 1, 2 and 3 greenhouse gas emissions – equity basis

Equity greenhouse gas emissions – million tonnes carbon dioxide equivalent (Mt CO <sub>2</sub> e)	2022	2021	2020	2019	2018
Scope 1 emissions	22.8	22.8	22.9	23	24.4
Scope 2 emissions	7.5	8.2	8.8	8.4	9.3
Total Scope 1 and 2 emissions	30.3	31.0	31.7	31.4	33.7
Carbon offsets retired	0.0 <sup>2</sup>				
Scope 3 emissions	583.9	558.3	576.2	-	-
Operational emissions intensity (tCO <sub>2</sub> e / t Cu-eq)(equity) <sup>1</sup>	6.2	6.3	6.2	6.1	6.1

Our 2030 greenhouse gas emissions targets are to reduce our absolute Scope 1 and 2 emissions by 15% by 2025 and 50% by 2030 compared with our 2018 equity baseline. Please see our Greenhouse Gas Emissions Methodology for details of our approach to reporting Scope 1, 2 and 3 emissions. Note that our 2022 equity emissions and our 2018 baseline do not include the additional equity share of the Oyu Tolgoi mine that was purchased in mid-December 2022. Queensland Alumina Limited (QAL) is 80% owned by Rio Tinto and 20% owned by Rusal. However, as a result of QAL's activation of a step-in process following the Australian Government's sanction measures, Rio Tinto is currently entitled to utilise 100% of the capacity at QAL, but paying 100% of the costs for as long as that step-in continues. Our 2022 equity emissions and our 2018 baseline include QAL emissions on the basis of Rio Tinto's 80% ownership. In 2022, the additional emissions associated with the step-in were 0.53Mt. Rusal has commenced proceedings challenging the validity of the step-in and the sanctions regime may change over time, such that the duration of the step-in remains uncertain. Historical Scope 1, 2 and 3 emissions have been restated to reflect improvements in data quality.

- Historical information for copper equivalent intensity has been restated in line with the 2021 review of commodity pricing to allow comparability over time.
- We retired 10,000 offsets in 2022 as part of a trial to carbon offset iron ore cargo with a steel producer in China. Further information on this transaction is provided on page 18.

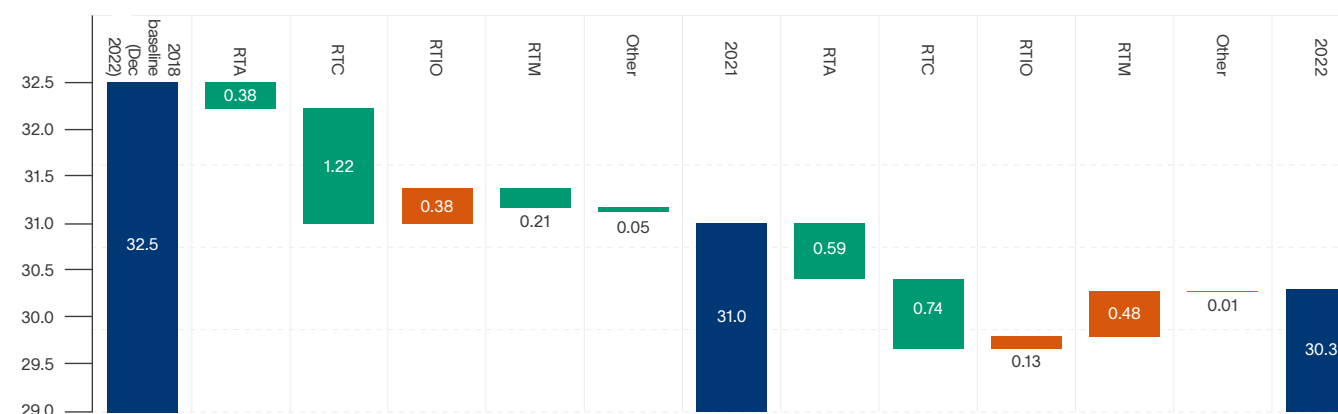
2022 equity greenhouse gas emissions by product group and source (Mt CO <sub>2</sub> e)	Electricity <sup>1</sup>	Anodes and reductants	Process heat	Mobile diesel	Other	2022 total emissions (Mt CO <sub>2</sub> e)
Aluminium	9.5	5.0	5.2	0.3	1.2	21.1
Aluminium (Pacific)	7.7	1.7	0.2	0.0	0.2	9.7
Aluminium (Atlantic)	0.5	3.3	0.3	0.0	0.7	4.8
Bauxite and alumina	1.2	0.0	4.7	0.2	0.3	6.5
Minerals (includes IOC)	1.6	1.4	0.7	0.3	0.0	4.0
Iron Ore (includes Dampier Salt)	0.8	0.0	0.1	2.2	0.0	3.1
Copper	0.5	0.0	0.2	0.8	0.0	1.5
Other (includes shipping and corporate functions)	0.1	0.0	0.0	0.5	0.0	0.6
<b>Total</b>	<b>12.5</b>	<b>6.3</b>	<b>6.2</b>	<b>4.1</b>	<b>1.2</b>	<b>30.3</b>

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

- 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.

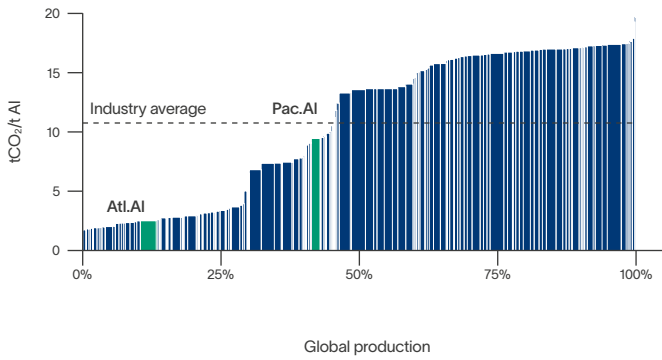
2022 equity greenhouse gas emissions by location (Mt CO <sub>2</sub> e)	Scope 1 emissions (Mt CO <sub>2</sub> e)	Scope 2 emissions (Mt CO <sub>2</sub> e)	Total emissions (Mt CO <sub>2</sub> e)
Australia	13	5.6	18.2
Canada	6.1	0	6.1
South Africa	0.4	1.3	1.7
US	1	0	1
Other: rest of Africa	0.3	0	0.3
Other: Europe	0.3	0	0.3
Other: Asia, New Zealand, Central America, South America	1.7	0.6	2.7
<b>Total</b>	<b>22.8</b>	<b>7.5</b>	<b>30.3</b>

## 2018 emissions baseline and progress towards our 2030 targets

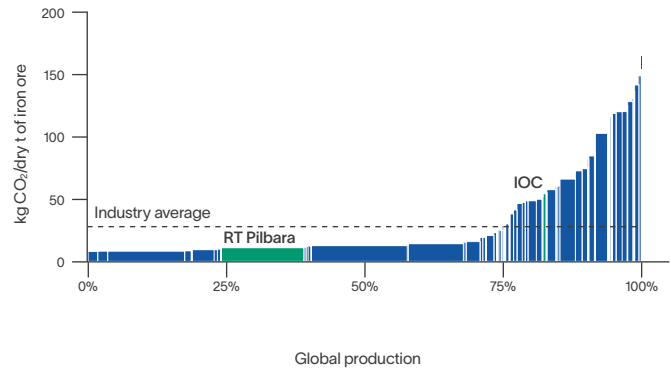


## Carbon intensity curves of global commodity producers by sector

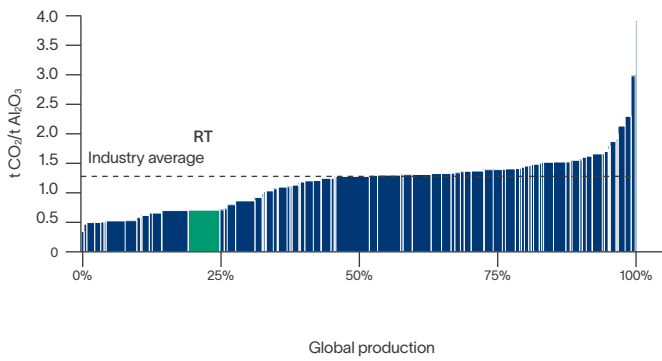
### Aluminium



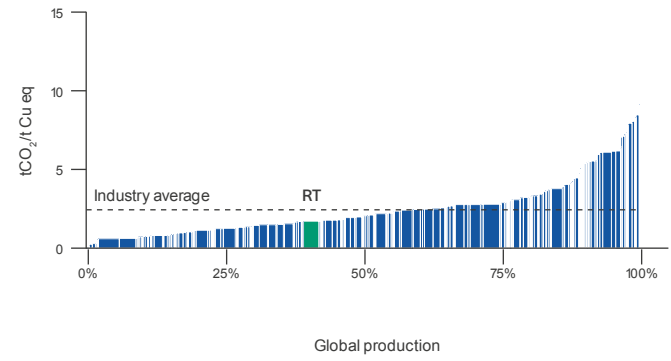
### Iron Ore



### Alumina



### Copper



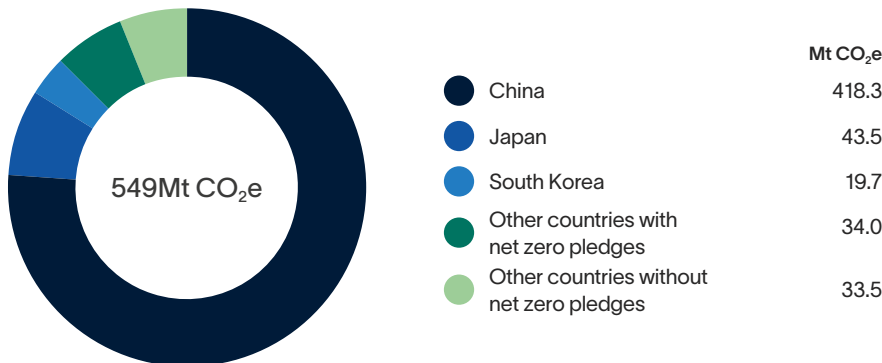
Source: CRU, Rio Tinto analysis, 2021 data

## Scope 3 greenhouse gas emissions - equity basis

Total equity Scope 3 greenhouse gas emissions (Mt CO <sub>2</sub> e)	2022	2021 restated	2020 restated
Upstream emissions	32.6	32.3*	30.4*
Downstream emissions	551.3	526	545.8*
<b>Total emissions</b>	<b>583.9</b>	<b>558.3</b>	<b>576.2</b>

\* Numbers restated from those originally published to ensure comparability over time.

## 2022 Scope 3 emissions from product processing by country





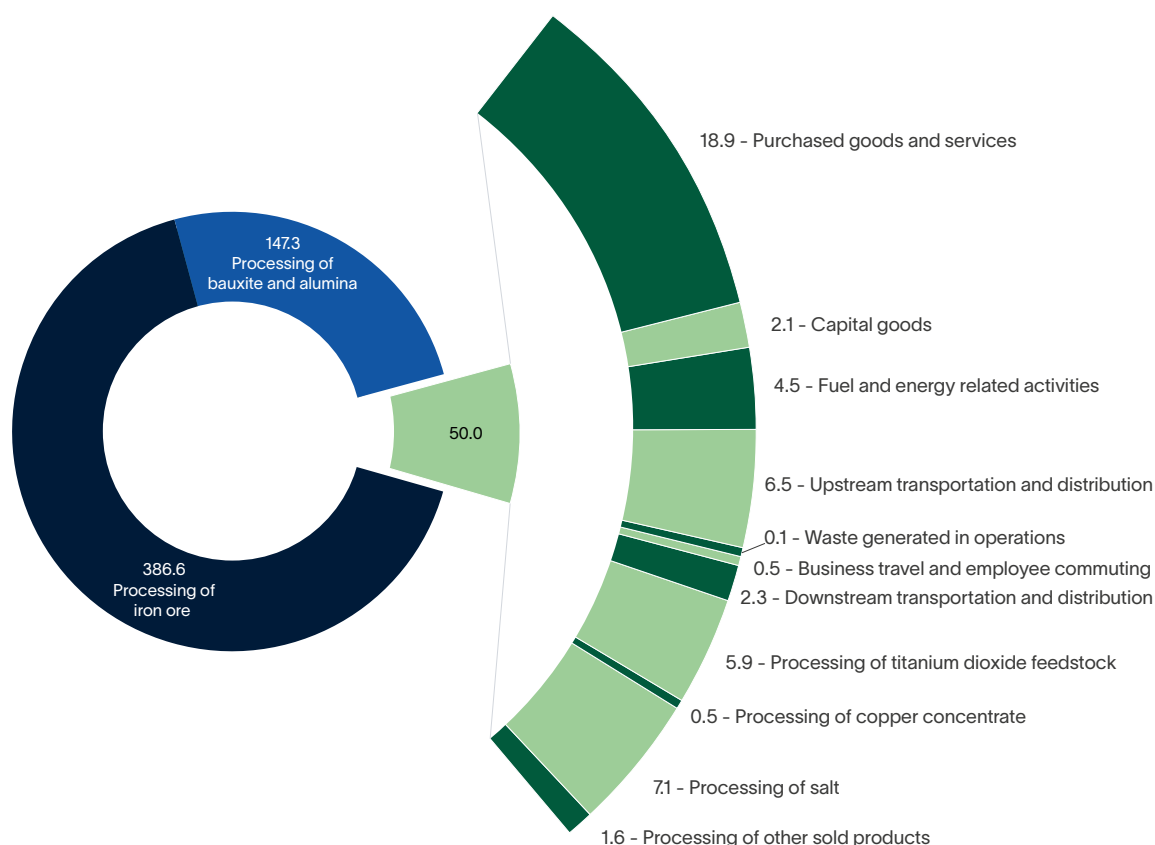
## Scope 3 emissions summary

Sources of Scope 3 equity greenhouse gas emissions (Mt CO <sub>2</sub> e)		2022	2021 restated	2020 restated
<b>Upstream emissions</b>				
1	Purchased goods and services	18.9	19.5 <sup>1</sup>	19.3 <sup>1</sup>
2	Capital goods	2.1	1.9	1.4
3	Fuel and energy related activities	4.5	4.5 <sup>2</sup>	4.5 <sup>2</sup>
4	Upstream transportation and distribution	6.5	5.9	5.1
5	Waste generated in operations	0.1	0.1	0
6 & 7	Business travel and employee commuting	0.5	0.4	0.14
8	Upstream leased assets	Not applicable <sup>3</sup>	Not applicable	Not applicable
<b>Downstream emissions</b>				
9	Downstream transportation and distribution	2.3	2.7	3.0
10	Processing of sold products			
	Iron Ore	386.6	364.6	376.4
	Bauxite and alumina	147.3	144.5	152
	Titanium dioxide feedstock	5.9	4.9	5.8
	Copper concentrate	0.5	0.5	0.6
	Salt	7.1	7.2	6
	Other	1.6	1.6	2
11	Use of sold products	Not applicable <sup>3</sup>	Not applicable	Not applicable
12	End-of-life treatment of sold products	Not applicable <sup>4</sup>	Not applicable	Not applicable
13	Downstream leased assets	Not applicable <sup>4</sup>	Not applicable	Not applicable
14	Franchises	Not applicable <sup>4</sup>	Not applicable	Not applicable
15	Investments	Not applicable <sup>5</sup>	Not applicable	Not applicable
<b>Total</b>		<b>583.9</b>	<b>558.3</b>	<b>576.2</b>

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

- Approximate equivalent 2020 and 2021 figures for purchased goods and services for high emission goods including alloys, coke and pitch used in aluminium smelting have been re-estimated using the 2022 methodology and provided to allow comparability over time. These re-estimates have greater uncertainty than the 2022 reported data.
- Fuels updated to include bunker fuel for time chartered vessels and more complete non-managed site data. Re-estimated for 2020, 2021 based on 2022 assumptions. These re-estimates have greater uncertainty than the 2022 reported data.

- Not applicable since Rio Tinto does not produce fossil fuels or manufacture products applicable to this category.
- Not applicable since Rio Tinto does not lease significant upstream and downstream assets or have franchised operations. In relation to end-of-life treatment, our products – and end-use materials from our products – are predominantly recycled.
- 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.





# Independent Assurance Report

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

## CONCLUSION

### Climate Action Plan Progress – Limited assurance

Based on the evidence we have obtained from the procedures performed, we are not aware of any material misstatements in the reporting of Rio Tinto's progress against its Climate Action Plan commitments (CAP Progress) presented in the Rio Tinto Climate Change Report 2022 for the year ended 31 December 2022, which has been prepared by Rio Tinto plc and Rio Tinto Limited (together, Rio Tinto) in accordance with the Reporting Criteria.

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

In our opinion, in all material respects, Rio Tinto's total Scope 1 and 2 Greenhouse Gas (GHG) emissions (equity basis) of 30.3 Mt CO<sub>2</sub>e (Scope 1 and 2 GHG Emissions) presented in the Scope 1, 2 and 3 Emissions Calculation Methodology 2022 for the year ended 31 December 2022, has been prepared by Rio Tinto in accordance with the Reporting Criteria.

### 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 583.9 Mt CO<sub>2</sub>e (Scope 3 GHG Emissions) presented in the Scope 1, 2 and 3 Emissions Calculation Methodology 2022 for the year ended 31 December 2022, which has been prepared by Rio Tinto in accordance with the Reporting Criteria.

## Information Subject to Assurance

The Information Subject to Assurance comprised the following data and information for the year ended 31 December 2022:

- The CAP Progress, as disclosed in "Our Climate Action Plan – 2022 progress & 2023 update: Progress in 2022" and the disclosures directly related to each "Progress in 2022" update within the body of the report
- Total Scope 1 and 2 GHG Emissions (equity basis) 30.3 Mt CO<sub>2</sub>e
- Total Scope 3 GHG Emissions (equity basis) 583.9 Mt CO<sub>2</sub>e

in the Rio Tinto Climate Change Report 2022 available on Rio Tinto's website at <https://www.riotinto.com/en/sustainability/climate-change>.

## Reporting Criteria

The Reporting Criteria used as the basis of reporting are:

- For the CAP Progress, the Basis of Preparation as described and presented within the Climate Action Plan and the Rio Tinto Climate Change Report 2022;
- For the Scope 1 and 2 GHG Emissions, the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD)'s *GHG Protocol: A Corporate Accounting and Reporting Standard (Revised Edition) (2015)*, and the Basis of Preparation as described and presented within the Scope 1, 2 and 3 Emissions Calculation Methodology 2022; and
- For the Scope 3 GHG Emissions, the WRI and WBCSD's *GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2013) and Technical Guidance for Calculating Scope 3 Emissions (version 1.0)*, and the Basis of Preparation as described and presented within the Scope 1, 2 and 3 Emissions Calculation Methodology 2022.

## Basis for Conclusion

We conducted our work in accordance with International Standard on Assurance Engagements ISAE 3000 and International Standard on Assurance Engagements ISAE 3410 (Standards). In accordance with the Standards we have:

- 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 CAP Progress and the Scope 3 GHG Emissions, whether due to fraud or error;
- Used our professional judgement to assess the risk of material misstatement and plan and perform the engagement to obtain reasonable assurance that the Scope 1 and 2 GHG Emissions are free from material misstatement, 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.

## Summary of Procedures Performed

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 to capture, collate, calculate and report the Information Subject to Assurance;
- Assessment of the suitability and application of the Reporting Criteria in respect of the Information Subject to Assurance;
- Corroborative enquiries with relevant management to understand progress against the Climate Action Plan commitments;
- Testing the disclosed information on CAP Progress to source documentation on a sample basis;
- Analytical procedures over the Scope 1, 2 and 3 GHG Emissions;

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## Independent Assurance Report

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- Substantively tested the Scope 1 and 2 GHG Emissions, on a sample basis at corporate and operational level, which included testing a selection of 15 operations being Weipa, Winu, Gladstone Power Station, Pilbara Rail Operations, Brockman, Yandicoogina, Marandoo, Boyne Smelters Limited, Tomago, Alouette, IOC Processing Plant, Queensland Alumina Limited, RTFT Smelting, Yarwun and Sohar;
- Interviews and walkthroughs with site personnel at each of the 15 operations listed above to assess the key systems, processes and internal controls to capture, collate, calculate and report Scope 1 and 2 GHG Emissions at an operational level, and how this information is reported and captured at corporate level;
- Testing the Scope 3 GHG Emissions to source documentation on a sample basis;
- Testing the mathematical accuracy of a sample of calculations underlying the Scope 1, 2 and 3 GHG Emissions;
- Assessing the appropriateness of a sample of emissions factors applied in calculating the Scope 1, 2 and 3 GHG Emissions;
- Reviewing the Scope 1, 2 and 3 Emissions Calculation Methodology 2022 and the Rio Tinto Climate Change Report 2022 in their entirety to ensure they are consistent with our overall knowledge of Rio Tinto and our observation of its operations.

### How the Standard Defines Limited Assurance, Reasonable 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 assurance conclusions on the Information Subject to Assurance 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 Information Subject to Assurance in accordance with the Reporting Criteria;
- Establishing internal controls that enable the preparation and presentation of the Information Subject to Assurance that is free from material misstatement, whether due to fraud or error;
- Ensuring the Basis of Preparation in accordance with which the Information Subject to Assurance has been determined and compiled is clearly and unambiguously set out in the Climate Action Plan and the Rio Tinto Climate Change Report 2022;
- Telling us of any known and/or contentious issues relating to the Information Subject to Assurance; and
- Maintaining integrity of the website.

### Our Responsibility

Our responsibility is to perform a limited assurance engagement in relation to the CAP Progress and total Scope 3 GHG Emissions and a reasonable assurance engagement in relation to the Total Scope 1 and 2 GHG Emissions for the year ended 31 December 2022, 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

22 February 2023

Adrian King

Partner  
Melbourne, Australia

# Forward-looking statements

This report includes “forward-looking statements” within the meaning of the Private Securities Litigation Reform Act of 1995. All statements other than statements of historical facts included in this report, including, without limitation, those regarding Rio Tinto’s financial position, business strategy, plans and objectives of management for future operations (including development plans and objectives relating to Rio Tinto’s products, production forecasts and reserve and resource positions), are forward-looking statements. The words “intend”, “aim”, “project”, “anticipate”, “estimate”, “plan”, “believes”, “expects”, “may”, “should”, “will”, “target”, “set to” or similar expressions, commonly identify such forward-looking statements.

Such forward-looking statements involve known and unknown risks, uncertainties and other factors which may cause the actual results, performance or achievements of Rio Tinto, or industry results, to be materially different from any future results, performance or achievements expressed or implied by such forward-looking statements. Such forward-looking statements are based on numerous assumptions regarding Rio Tinto’s present and future business strategies and the environment in which Rio Tinto will operate in the future. The important factors that could cause Rio Tinto’s actual results, performance or achievements to differ materially from those in the forward-looking statements include, but are not limited to: an inability to live up to Rio Tinto’s values and any resultant damage to its reputation; the impacts of geopolitics on trade and investment; the impacts of climate change and the transition to a low-carbon future; an inability to successfully execute and/or realise value from acquisitions and divestments; the level of new ore resources, including the results of exploration programmes and/or acquisitions; disruption to strategic partnerships that play a material role in delivering growth, production, cash or market positioning; damage to Rio Tinto’s relationships with communities and governments; an inability to attract and retain

requisite skilled people; declines in commodity prices and adverse exchange rate movements; an inability to raise sufficient funds for capital investment; inadequate estimates of ore resources and reserves; delays or overruns of large and complex projects; changes in tax regulation; safety incidents or major hazard events; cyber breaches; physical impacts from climate change; the impacts of water scarcity; natural disasters; an inability to successfully manage the closure, reclamation and rehabilitation of sites; the impacts of civil unrest; the impacts of the COVID-19 pandemic; breaches of Rio Tinto’s policies, standard and procedures, laws or regulations; trade tensions between the world’s major economies; increasing societal and investor expectations, in particular with regard to environmental, social and governance considerations; the impacts of technological advancements; and such other risks identified in Rio Tinto’s most recent Annual Report and Accounts in Australia and the United Kingdom and the most recent Annual Report on Form 20-F filed with the SEC or Form 6-Ks furnished to, or filed with, the SEC. Forward-looking statements should, therefore, be construed in light of such risk factors and undue reliance should not be placed on forward-looking statements. These forward-looking statements speak only as of the date of this report. Rio Tinto expressly disclaims any obligation or undertaking (except as required by applicable law, the UK Listing Rules, the Disclosure Guidance and Transparency Rules of the Financial Conduct Authority and the Listing Rules of the Australian Securities Exchange) to release publicly any updates or revisions to any forward-looking statement contained herein to reflect any change in Rio Tinto’s expectations with regard thereto or any change in events, conditions or circumstances on which any such statement is based.

Nothing in this report should be interpreted to mean that future earnings per share of Rio Tinto plc or Rio Tinto Limited will necessarily match or exceed its historical published earnings per share.

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# RioTinto

Rio Tinto plc  
6 St James's Square  
London SW1Y 4AD  
United Kingdom

Rio Tinto Limited  
Level 43, 120 Collins Street  
Melbourne VIC 3000  
Australia

