



# Rio Tinto Bundoora Technical Development Centre

13 December 2022

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# Agenda

AEDT	Topic	Presenter
10.00 – 10.15	<b>Overview and history of the Bundoora centre</b>	Nigel Steward, Chief Scientist Jared Osborne, General Manager – Technical Development
10.15 – 10.30	<b>Lithium: Fundamentals, our battery materials strategy and an update on Rincon</b>	Travis Baroni, Chief Advisor – Battery Materials
10.30 – 10.40	<b>Q&amp;A session</b>	
10.40 – 10.55	<b>Copper: An update on Nuton</b>	Harald Muller, Technical Director – Nuton Jared Osborne, General Manager – Technical Development
10.55 – 11.05	<b>Q&amp;A session</b>	
11.05 – 11.20	<b>Steel decarbonisation: Biolron and hydrogen based DRI</b>	Nigel Steward, Chief Scientist Michael Buckley, Manager – Steel Decarbonisation
11.20 – 11.30	<b>Q&amp;A session</b>	
11.30 – 12:30	<b>Tour of the facility</b>	
12:30 – 14:00	<b>Lunch and discussion with the Bundoora team</b>	

# Acknowledgement of country



# Induction

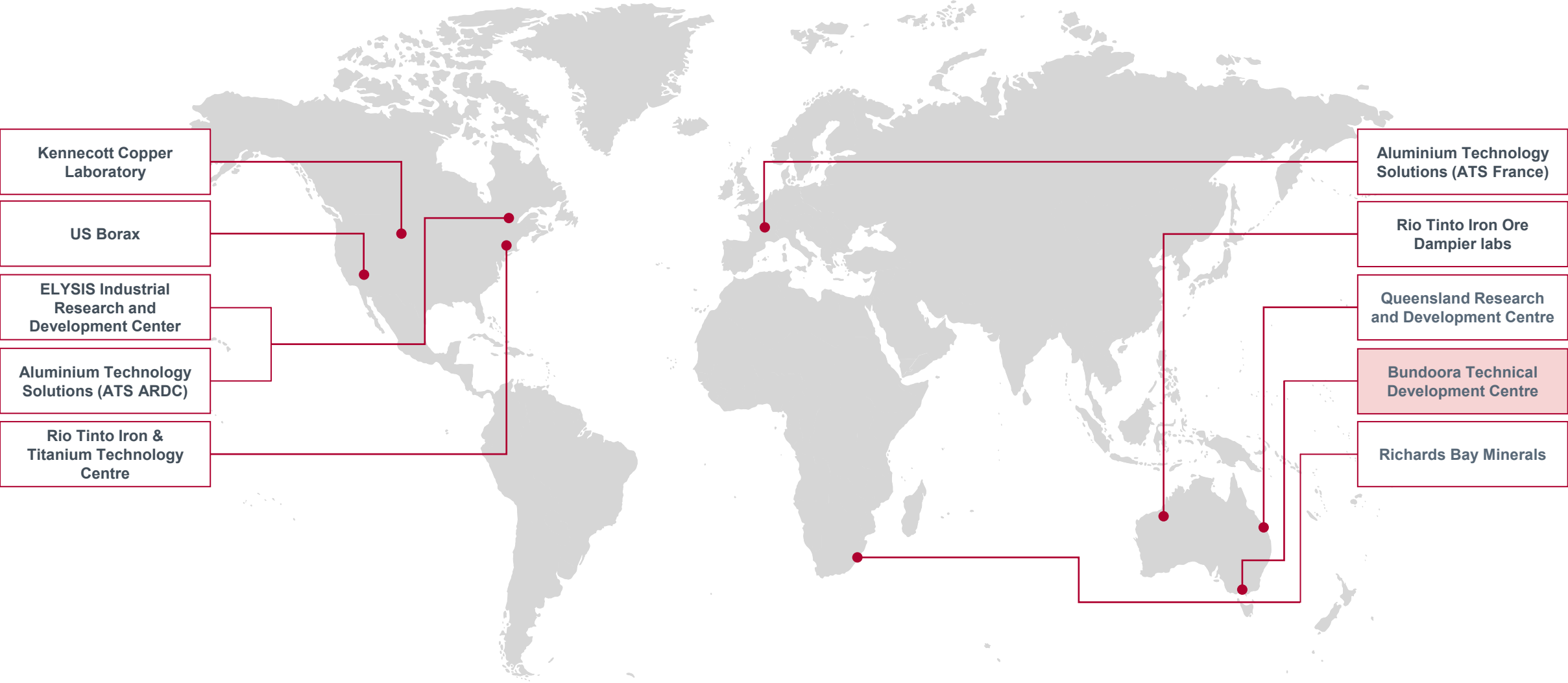


# Overview

Bundoora Technical  
Development Centre



# Our global R&D footprint



# Disciplined technology roadmap

## Health & Safety

9 projects

Reducing frontline exposure to hazards

Managing health and wellbeing of our people

## ESG

19 projects

Reducing water consumption

Improving water treatment

Dry tailings

Dry processing

Closure

## Growth

32 projects

Discovering new orebodies

Reducing capital intensity

⊕ Creating new revenue streams

## Carbon

21 projects

 Green steel and low-carbon products

 Storage options

 Green processing

 Green energy

 Green fleet

## Productivity

54 projects

Maximise value from each ore body

Equipment utilisation

Automation

Energy efficiency

Impeccable ESG credentials

Excel in Development

Best Operator

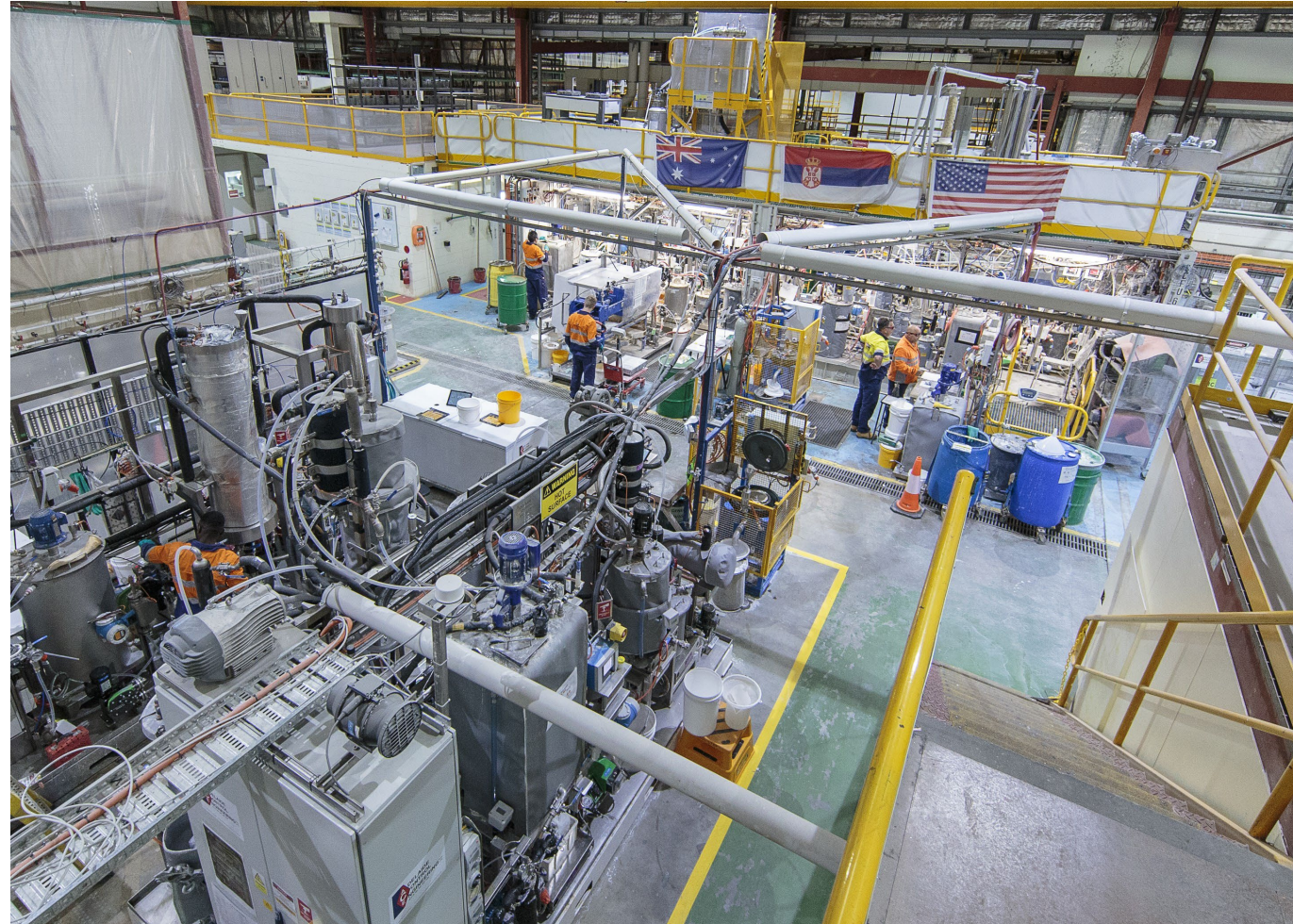
Social Licence



# Bundoora Technical Development Centre

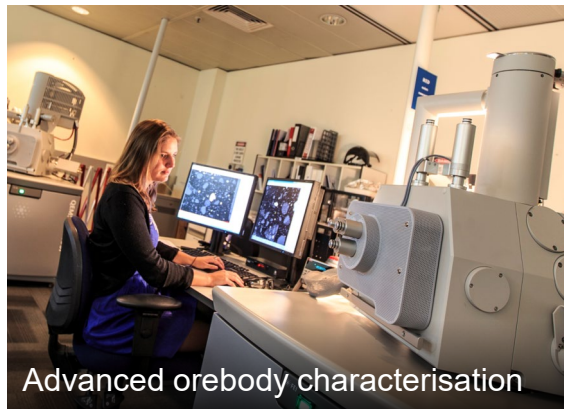
Iconic and unique Rio Tinto facility

Celebrating 30 years of applying technical development to how we find, study, develop, optimise and close our operations



# Technical development with an implementation focus

Only central development laboratory within Rio Tinto for Group-wide, multi-commodity support



# About Bundoora: fast facts

## Combination of factors providing Rio Tinto with a competitive advantage

<p><b>People</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Flexible &amp; Diverse</p> </div> <div style="text-align: center;">  <p>Independent</p> </div> <div style="text-align: center;">  <p>Projects</p> </div> <div style="text-align: center;">  <p>Cross-commodity</p> </div> </div>	<p><b>~7,000m<sup>2</sup></b></p> <p>of Rio Tinto owned office, laboratories, pilot plant, conference rooms, with the ability to hold up to 170 people</p>	<p><b>Partnerships</b> across all business units to unlock value &amp; create new technologies          explore   study   execute   operate</p>	<p><b>~100</b> staff and contractors</p> 	
<p><b>Facilities</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>World class</p> </div> <div style="text-align: center;">  <p>Network partners</p> </div> <div style="text-align: center;">  <p>Unique combination</p> </div> </div>	<p><b>30 years</b></p> <p>pioneering breakthroughs in advanced technical development across all commodities</p>	<p> Study development of Rincon, Jadar, Nuton™</p>	<p> Enhanced <b>Oyu Tolgoi's</b> water conservation</p>	<p><b>17</b> languages</p> 
<p><b>Synergies</b></p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Global reach</p> </div> <div style="text-align: center;">  <p>IP ownership</p> </div> <div style="text-align: center;">  <p>Fully aligned</p> </div> </div>	<p> <b>~10 years</b></p> <p>Injury free</p>	<p> <b>Jadar</b> pilot plant to simulate innovative Li and B recovery process</p>	<p><b>Cu</b> Copper</p> <p>Break-through Cu heap leach recoveries and rates</p>	<p><b>&gt;300,000</b> per annum</p> <p>micro analytical analyses for <b>advanced</b> orebody discovery techniques with <b>RTX*</b></p> <div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> <p><b>6</b> SEMs*</p> </div> <div style="text-align: center;"> <p><b>4</b> Lasers</p> </div> </div>

# Our core capabilities: Linked to our objectives

**Our purpose: Supporting growth and closure studies, orebody discovery and asset related process, water and tailings development**

<b>Excel in Development</b>	<b>Impeccable ESG</b>	<b>Best Operator</b>	<b>Social Licence</b>
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## Process Development

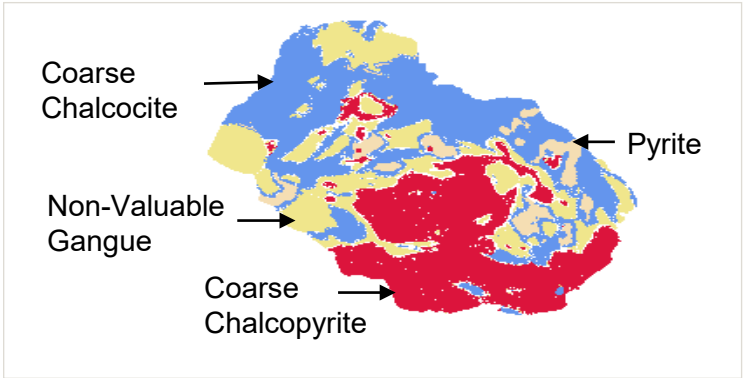
De-risking complex metallurgical processes, cross-commodity insights to process development



Leaching pilot plant (up to 300 tonnes of ore)

## Geometallurgy

Advanced characterisation techniques for orebody discovery and metallurgical insights



OBK\* via quantitative mineralogy

## Water, Waste & Tailings

Innovative approach to water recovery, tailings disposal and dewatering costs, and ultimate environmental impact



IOC\* tailings deposition (lake) before and after initiative

**We maintain our competitive advantage by continuing to develop these core capabilities**

# Our portfolio: Partnering to deliver value via technical breakthroughs

Working across the full breadth of Rio Tinto's commodities and assets



## Jadar Process Development

De-risking process development for Jadar lithium/borate deposit; including waste / residue



## Rincon

Rapid support to process development and implementation



## Nuton™

Primary copper sulphide heap leaching process development



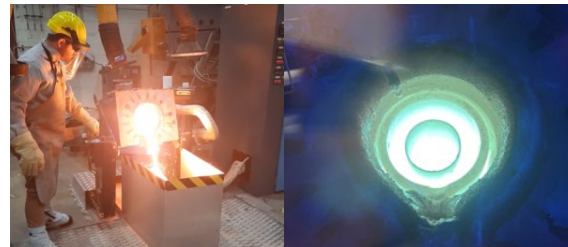
## RIMs and KIMs\*

Unique micro-analytical capability; ongoing development of orebody discovery techniques



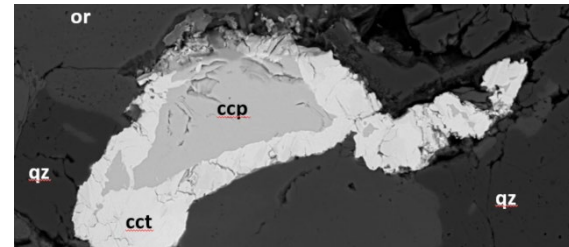
## Closure

Process development input for closure-related activities including water treatment options; regulator interactions



## Steel Decarbonisation

Technical development in use of biomass and hydrogen as reductants; dry processing alternatives



## Winu

Disciplined process development that builds on OBK\* insights



## RTX\*: Opportunity Generation

Early warning metallurgy and process route options

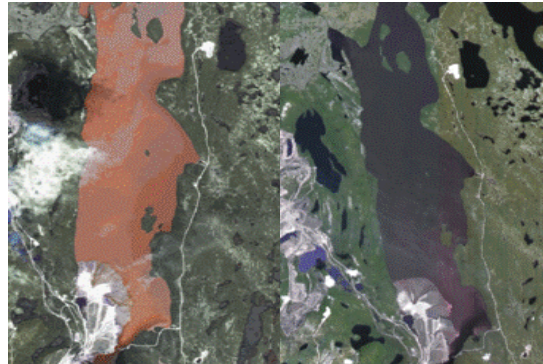
# History of solving complex problems

A longstanding history of adding substantial value to the business



## Century Zinc

Successfully developed alternative process routes for RTX\* discovery that enabled an economically viable project to be created. **\$100m** realised through sale



## IOC\* Red Water

Developed and implemented an in-line flocculation process for cleaning up the “red water” from tailings disposal in Lake Wabush. **>\$200m** saved on dyke costs



## RIMs\*

Leading edge orebody discovery techniques, building on the automated KIMs\* development from early 2000's. World-class micro-analytical capability



## Jadar

Process development for extraction of Lithium and Boron products from RTX orebody discovery. Reduced capital and operating costs significantly through process insights

1995

2004

2012

2017

Lithium



# Lithium market fundamentals

## Strong demand



### 4-7x lithium demand growth by 2030

Lithium will be a fundamental ingredient in EV\* batteries

In a net zero trajectory, over 50% of vehicle sales could be EVs by 2030 (~60 million units)

Additional growth from power network infrastructure required

## Market tightness



### Potential for prices to clear above the cost curve

Supply bottlenecks a challenge for the industry

Cost curve will steepen with growing supply required

Rapid demand growth could see prices clear the cost curve for a long period of time

## Growth opportunities



### Significant portfolio growth opportunities

Forecast demand to require significant investment

Active pursuit of organic and M&A growth opportunities

High-grade brines and Australia hard rock called upon to meet demand in all cases



# Battery Materials Opportunity

Ambition to develop a leading business by 2030, centred on lithium and potentially nickel



<b>Grow the Business</b> Three imperatives: strategic fit, right owner, strong value	<b>Large-scale organic growth – Rincon</b>
	<b>Potential targets – exploration, projects, operations</b>
	<b>Well positioned on cost curve, low-carbon footprint</b>
	<b>Leverage Rio Tinto strengths</b> in mining, processing expertise, commercial knowledge, with global footprint
Develop and implement <b>innovative solutions and technologies</b>	
<b>Build Lasting Partnerships</b>	<b>Best talent</b>
	<b>Host communities</b>
	<b>Leaders in battery technologies</b>
	Organisations across the value chain to <b>maximise market opportunities</b>
<b>Be a Leader of the Green Economy</b>	<b>World-class ESG practices</b>
	<b>Reduced carbon footprint future</b>
<b>Circular economy focus</b>	

\* EVs: Electric Vehicles

# Foundations of a Global Lithium Business

**Boron, USA**

- Ownership: 100%
- Stage: Feasibility Study
- Mine and ore type: Open pit (clay)
- Products: Lithium Carbonate



**Jadar, Serbia\***

- Ownership: 100%
- Stage: Construction ready
- Mine and ore type: Underground (Jadarite)
- Products: Lithium Carbonate, Lithium Hydroxide (potential), Boric Acid, Sodium Sulphate



**Rincon, Argentina**

- Ownership: 100%
- Stage: Pre-feasibility Study
- Mine and ore type: Brine
- Products: Lithium Carbonate, Lithium Hydroxide (potential)



# Rincon Project

**Starter plant construction and studies for larger scale options are progressing well**



## **Starter plant in construction - Market entry in 2024**

Developing strong relationships with local communities, Salta Provincial Government and Argentinian Government

Camp and airstrip construction underway - 3 ktpa LCE\* plant to accelerate market entry in 2024

De-risking of larger scale operation - Confirm technology while refining construction management and operating parameters



## **Larger scale options under evaluation**

Argentina a safe and attractive jurisdiction for lithium

Opportunity for large-scale production

Water usage optimisation

Carbon footprint reduction - Opportunity to become one of the lowest carbon intensity lithium operations through renewable energy from the grid

# Strong linkages to the Bundoora facility

Jadar



Rincon



Boron



**RioTinto**

Nuton™



# What is Nuton™?

## **What is Nuton?**

- Nuton is a technology venture, home to a unique integration of innovative nature-based copper leach technologies, know-how and capabilities.
- Our leading performance is made possible by harnessing the power of microbes and cracking the code on naturally occurring extraction catalysts as an alternative, more ESG-friendly and cost competitive processing route to recover copper

## **Strategic ambition:**

- To support the Rio Tinto Copper strategy and ensure that Nuton is net positive for the world

## **Exploring new ways of working:**

- As we scale up Nuton we will leverage the best of Rio Tinto whilst exploring new approaches to partnerships, commercial models and ways of working

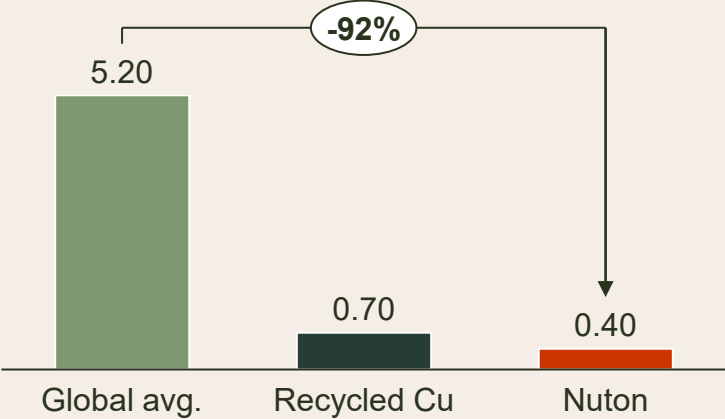
# Nuton™ is seen as a key growth lever for Rio Tinto and an enabler for low-carbon copper

## Nuton's potential

- Worldwide demand for copper is growing rapidly (i.e., transition to a low-carbon economy)
- Increasingly stringent requirements from external stakeholders concerning ESG issues (e.g. carbon footprint in copper production)

## Nuton has the potential to deliver leading ESG performance

Carbon intensity (CO<sub>2</sub>/t)



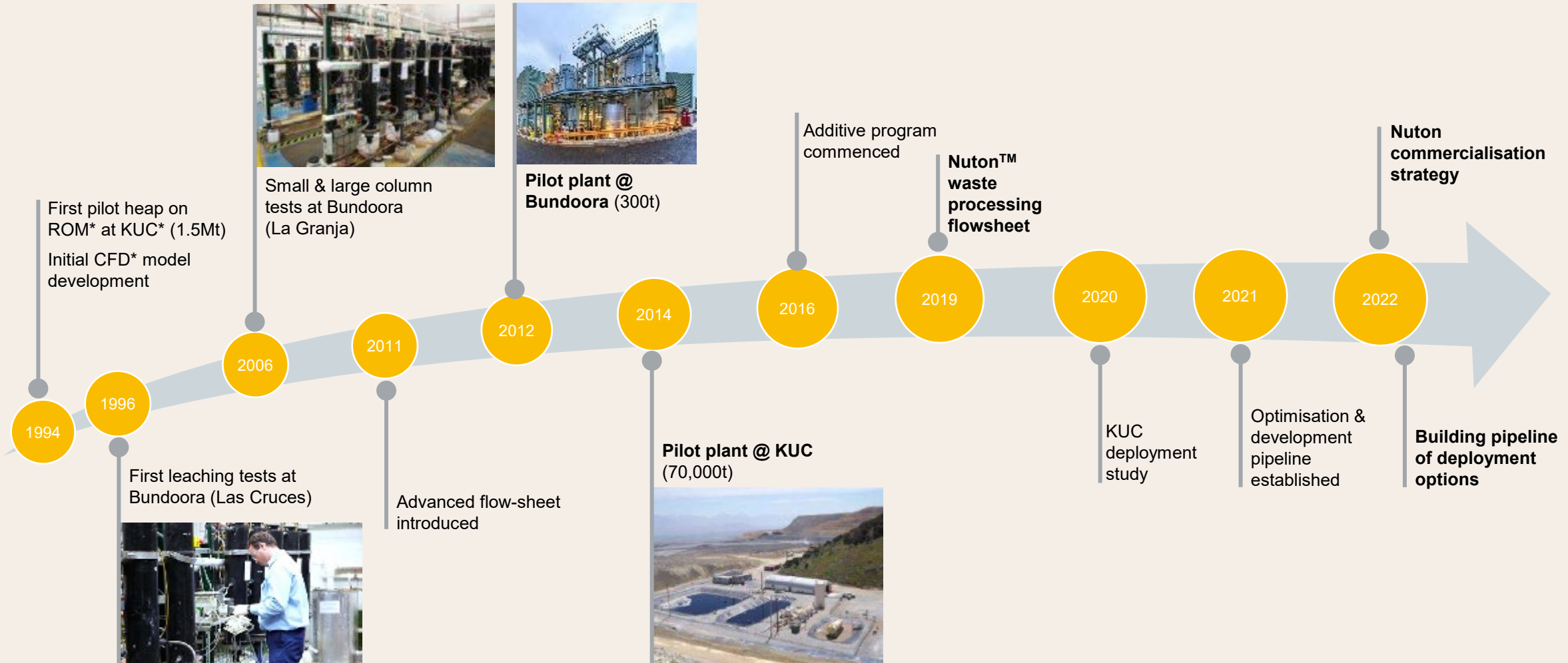
- Reduced CO<sub>2</sub> emissions (CO<sub>2</sub>/t)
- Efficient water consumption
- Ability to restore and reclaim mine sites by reprocessing mine waste

## Current Progress

- In development for +25 years, with first leaching tests taking place at Bundoora in 1996
- Launched Nuton as a corporate start-up 12 months ago
- 3 partnerships announced in 2022
- +10 ongoing collaborative viability studies



# The journey so far



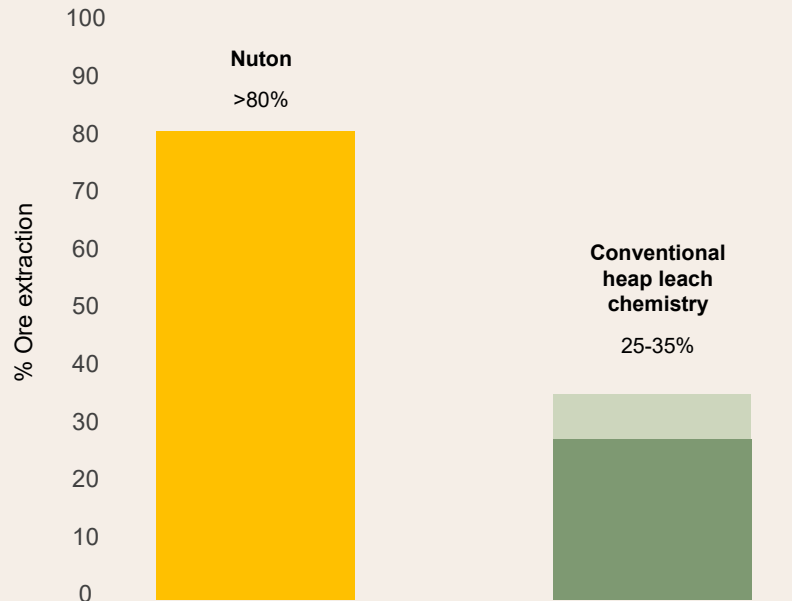
**+25 years of research & development, several patent families granted, substantial know-how accumulated**

# Nuton™ offers exceptional recovery performance **nuton**

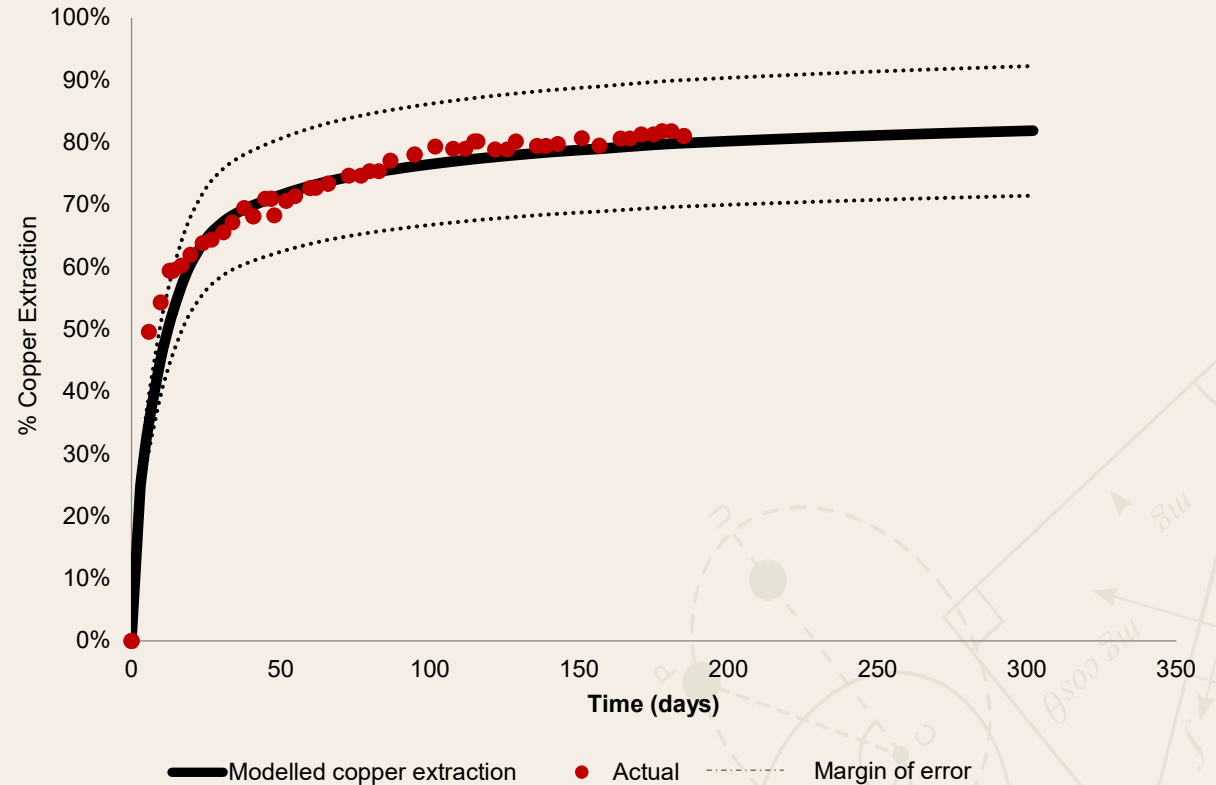
A Rio Tinto venture

Nuton extracts up to >80% of copper from primary copper sulphides compared to 25-35% in tradition heap leach process

Nuton modelling capabilities reduce requirement for extensive test programs



\* Percentage extractions are from primary copper mineralogy



# Nuton™ has numerous applications that expand partnership optionality

nuton

A Rio Tinto venture

## Inactive Mines



## Brownfield Expansions



## Greenfield sites



## Nuton advantages

- Positive community impact
- Economic mine rehabilitation

- Alternative to concentrator
- Lower water & power intensity
- Potential to utilise waste
- Reduces closure liabilities

- Low water & power intensity
- In-country finished product
- Addresses complex ores & high penalty elements

# Building a pipeline of opportunities

## Yerington, Nevada-US (Lion Copper Gold)



### Historic Mine

- Option to earn in
- Stage 1 work in progress

## Cactus, Arizona-US (Arizona Sonoran Copper Company)



### Brownfield

- 7.4% interest in Arizona Sonoran Copper Company
- Nuton collaboration work program underway

## Los Azules, San Juan-Argentina (McEwen Copper)



### Greenfield

- 9.8% interest in McEwen Copper
- Nuton collaboration work program underway

**RioTinto**

# Steel Decarbonisation



# Why does the world need to decarbonise the steel industry?

The steel industry **ranks first** among heavy industries when it comes to CO<sub>2</sub> emissions, accounting for 3 billion tonnes of CO<sub>2</sub> annually or **~8% of global total**

However, steel is a **key material to enable** the transition to a **decarbonised sustainable future**

“

**It is either a Climate Solidarity Pact – or a Collective Suicide Pact**

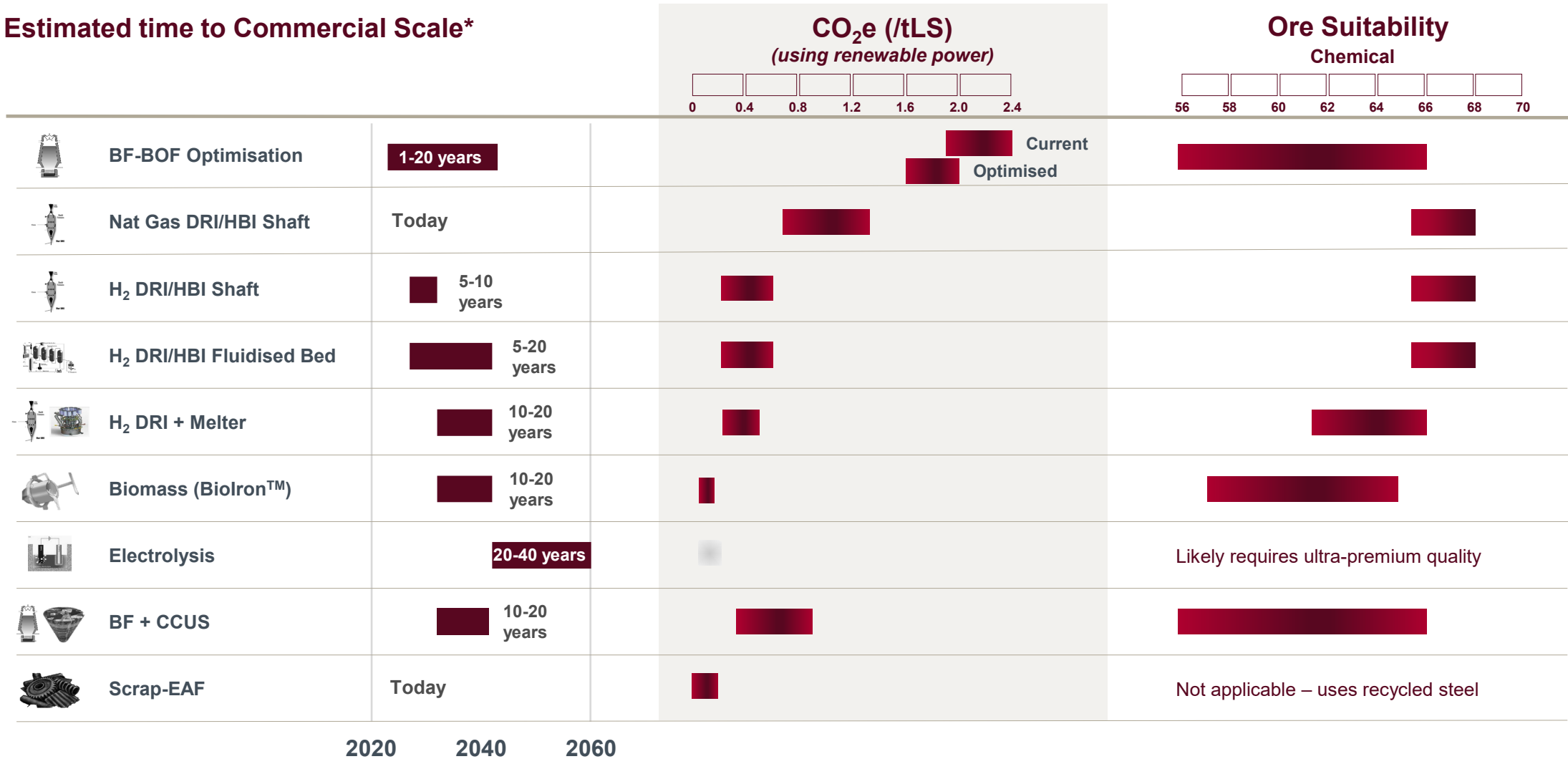
”

*UN Secretary General  
Antonio Guterres  
COP27*



# Green steel pathways: range of potential technology options available

Estimated time to Commercial Scale\*





# Supporting our customers - steel decarbonisation

<p><b>1</b> Blast Furnace Optimisation</p>	<p><b>2</b> Pilbara Beneficiation</p>	<p><b>3</b> Biolron™</p>	<p><b>4</b> H<sub>2</sub> DRI + Melter</p>	<p><b>5</b> High-Grade DRI</p>	<p><b>6</b> Iron Ore Portfolio</p>
<p>Optimising current technology</p> <p>Multiple collaborations with customers</p>	<p>Upgrading our Pilbara ores</p> <p>Finding optimal stage(s) along the steelmaking value chain to remove impurities</p>	<p>Ironmaking with Pilbara ores Pathway 1</p> <p>Developing an alternative steelmaking route to H<sub>2</sub> DRI</p>	<p>Ironmaking with Pilbara ores Pathway 2</p> <p>Developing H<sub>2</sub> DRI with melter for Pilbara ores</p>	<p>Entry to high-grade green iron market</p> <p>Entering H<sub>2</sub> HBI market and demonstrate new tech using RT ores</p>	<p>Bringing high-grade ore to the market</p> <p>e.g. Simandou</p>

## Key Partnerships



# BioIron™ - green alternative pathway for iron & steelmaking

## Simple Raw Material Preparation

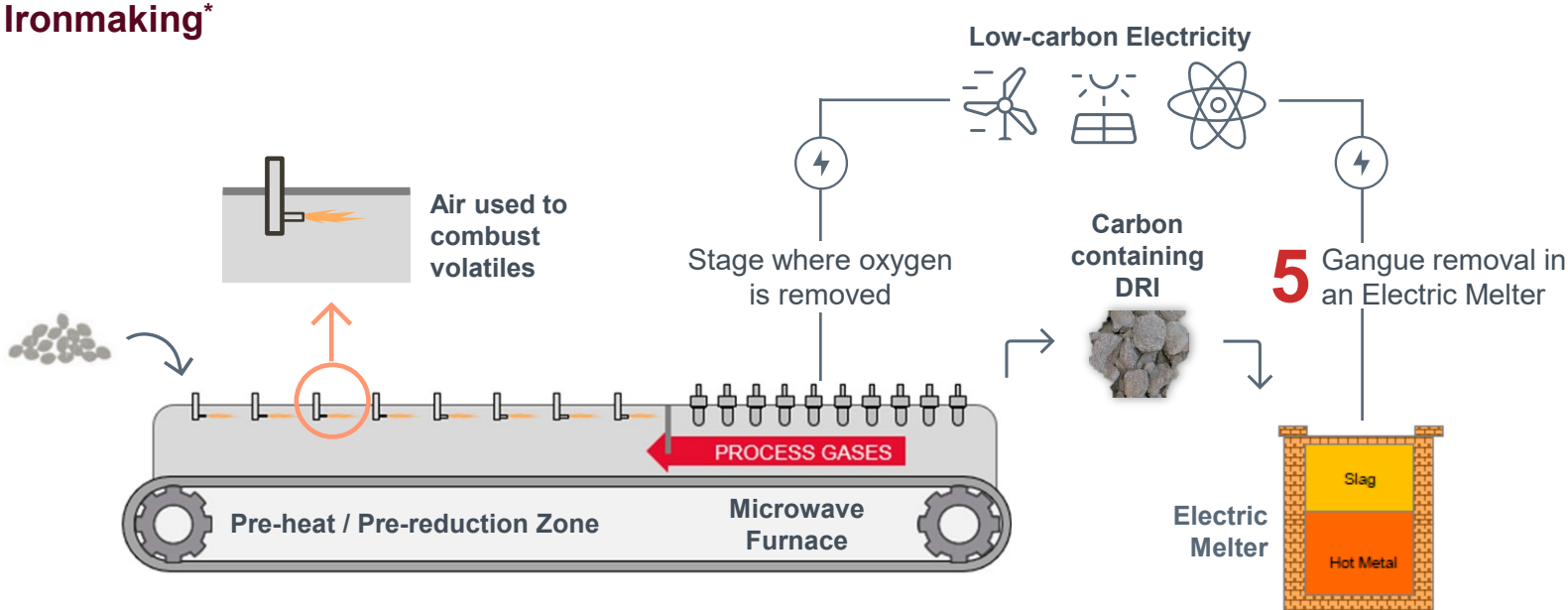
**1** Fine Iron Ore, Fluxes and Biomass are blended together...



**2** ...and compacted into Green Briquettes



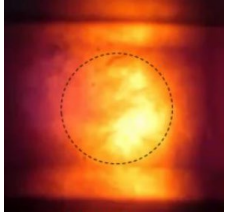
## Ironmaking\*



**3** Combusts volatiles and pre-heats the briquettes to >600°C ahead of microwave section



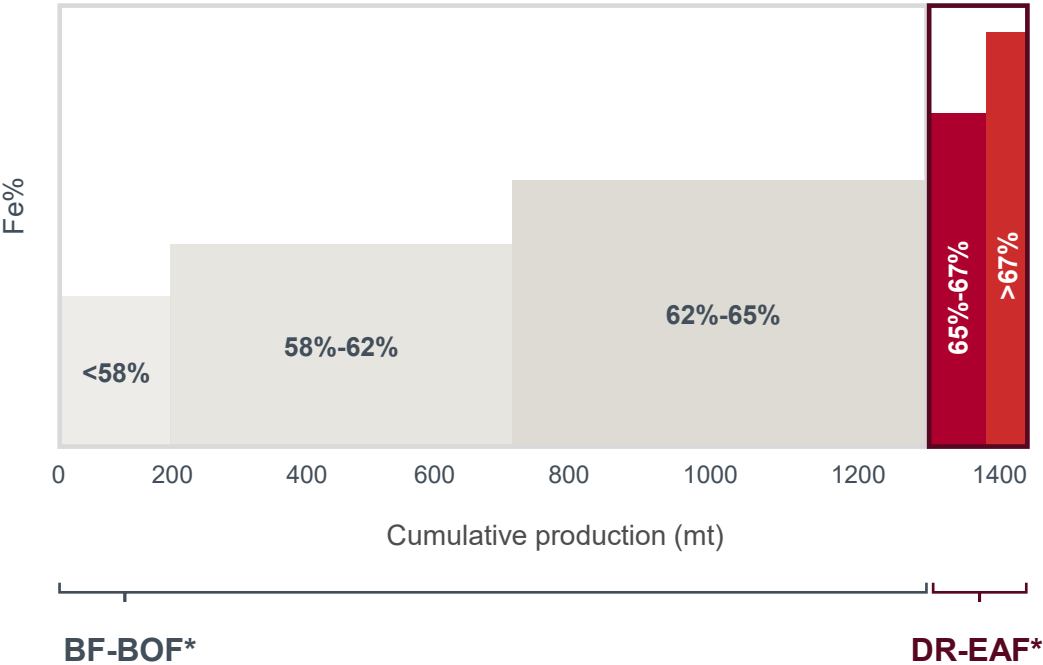
**4** The microwave energy turns the pre-reduced ore into carbon-containing metallic iron\*\*



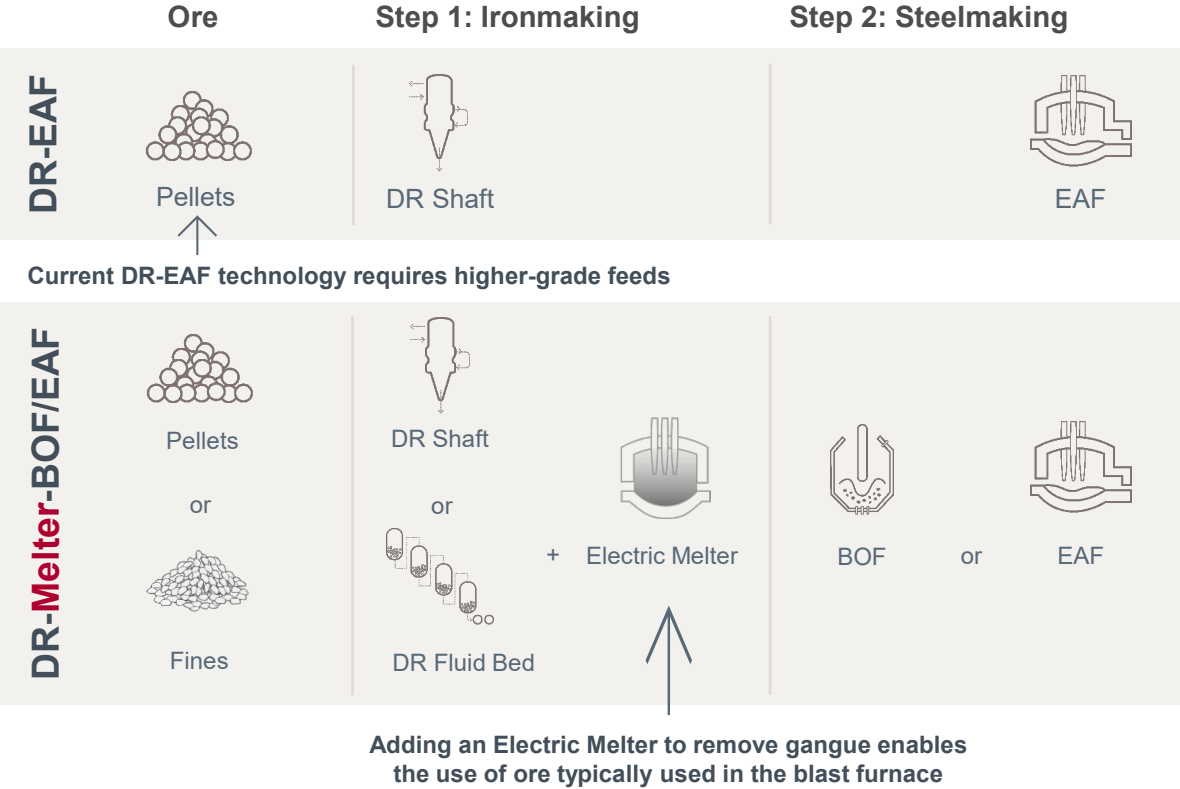
# H<sub>2</sub> DRI + Melter - Processing Pilbara ores with hydrogen

Transition to carbon-neutral: the industry is shifting from BF-BOF\* to H<sub>2</sub> DR-EAF\* steelmaking

Seaborne Iron Ore Product by Grade



Partnership with BlueScope explores adding an Electric Melter into the process



The background features a dark red gradient with faint, wavy, light-colored lines that resemble topographic contour lines or water ripples. The lines are more prominent in the lower half of the image.

**RioTinto**