

# CRANE RIDGE LIMITED

Africa's First **GREEN**  
Metals Refinery





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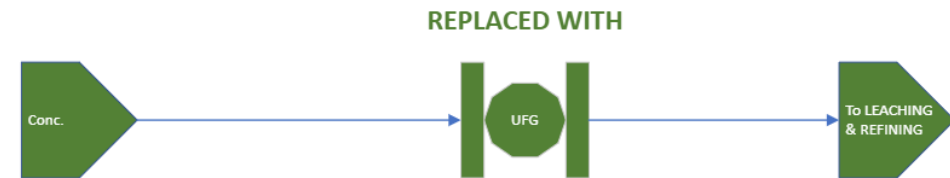
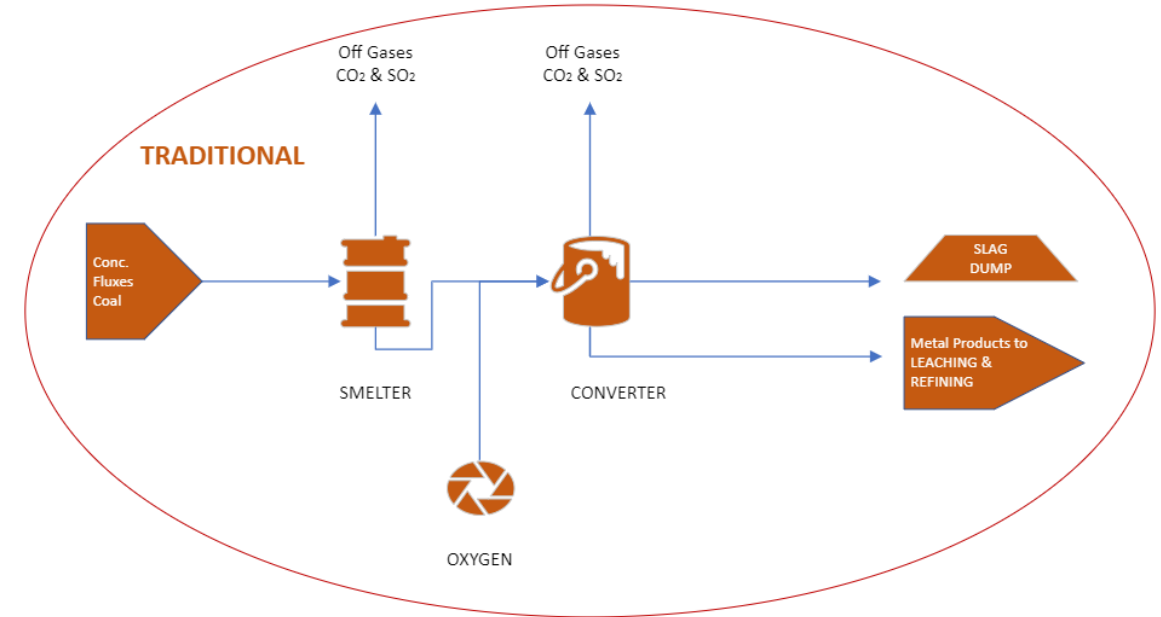
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# THE PROJECT

- A **GREEN** Base & Precious metals refinery to be constructed in Walvis bay.
- Building up to 100,000 tons per annum of refined metal in phase 1
- Business plan is toll treatment, where producer remains owner until refined
- At nameplate scale, will constitute turnover of US\$ 1 bn (15% GDP)
- Will incorporate Recycling capability
- Concentrates sourced from Botswana, DRC, Namibia, RSA, Tanzania, Zambia, & Zimbabwe

# WHAT MAKES CRITICAL MINERALS REFINERIES “GREEN”

- Traditional Smelter/Refineries are environmentally challenging, emit SO<sub>2</sub> and CO<sub>2</sub> gasses, have tailing products that have long term storage risks, and liquids emitted that potentially impact ground water.
- The Crane Ridge solution has:
  - No Smelting Step
  - No Slag Tailings Storage
  - 100% Hydrometallurgical Process
  - Exothermic Reactions – Waste Heat used for Co-Generation
  - 100% Sulphur in liquid form used for leaching of concentrates.
  - Waste Products after Neutralisation include gypsum, iron and silica
  - Waste Liquids after demineralisation will be water
  - 70% less CO<sub>2</sub> emitted
  - 85% less power used, excess power into National grid



# THE MARKET

SADEC Region	Tons Metals Produced					% Conc.	Concentrate
	Cu (t)	Ni (t)	Co (t)	PGE (Oz)	Li (t)	Est.	(t)
Zambia	880,000	32,000	40,000			30%	1,006,000
DRC	2,200,000		95,000		400	45%	3,406,875
Zimbabwe	12,000	30,000		1,500,000	800	100%	345,000
Namibia	25,000	1,400			200	100%	97,333
Botswana	100,000	5,000				45%	172,500
South Africa	40,000	12,000		6,000,000		15%	41,000
<b>TOTALS</b>	<b>3,257,000</b>	<b>80,400</b>	<b>135,000</b>	<b>7,500,000</b>	<b>1,400</b>	<b>42%</b>	<b>5,068,708</b>

- 500,000 t.p.a Concentrates through Walvis Bay from Botswana, DRC & Namibia
- 1<sup>st</sup> Refinery will process approx. 350,000 t.p.a concentrates for 100,000 t.p.a metals
- All Zimbabwe export is intermediate products to South Africa / China
- Zimbabwe producers given until March 2024 for plans to be presented to Government



# SUMMARY INTRODUCTION

- Crane Ridge intends to develop Africa's first "Green" base and precious metals refinery in Walvis Bay, Namibia.
- The refinery will use a hydrometallurgical solution to ensure its environmental impact is neutral.
- The refinery will focus on critical minerals and metals such as copper, nickel, cobalt, lithium, and precious metals including platinum, palladium, gold, and silver.
- Walvis Bay in Namibia was selected as the optimal location for the first project.
- The business plan adopted is that of toll refining, where the concentrates processed into final metals remain the property of the producer.
- The design of the refinery includes the recycling of lithium-ion batteries.
- A blockchain-based metal certification system will be employed, allowing all stakeholders to track the use of the metals produced.
- Several patented hydrometallurgical process routes have been evaluated to design the refinery.
- Final metal recovery will be to highly refined battery metal salts and cathode copper as products.
- Final waste product will include gypsum, iron, and silica.
- Market analysis of the critical metal and mineral future is included.
- Regulatory and governmental support, as well as local and Africa-wide developmental finance investment schemes exist, allowing for cost-effective financing of the project during the construction phase.



# COMPANY OVERVIEW



# COMPANY OVERVIEW

Crane Ridge Limited, registered in the UK, is a management consultancy focused on technical, financial and analytical solutions to industry's challenges.

Crane Ridge has identified the need for refining capacity in Africa in the “critical minerals” envelope as a primary opportunity.

Crane Ridge is committed to lowering the overall environmental impact of mining in Africa, with its refinery design proposal being 70% lower carbon emissions and 85% less energy consumption.

We have a long history of successful project and company management in many commodities throughout Africa.

The toll refining business model provides a “win-win” solution for both producer and refiner – turnover and penalty reductions.

Recycling is almost nonexistent in Africa despite large investment in recent years in new storage capacity.





# CRANE RIDGE LIMITED TEAM



**FOUNDER & MANAGING  
DIRECTOR**

**KEVIN VAN WOUW**

*BSc (Hons) Met, HND & ND Ex  
Met, FSAIMM*

An experienced Executive, Manager and Process Engineer, with strong Team Leadership, Technical Knowledge Diversity and Capability, with KPI oriented Financial and Executive Management skills.

A natural change and turn around manager. Kevin has acquired skills from his discipline as a process design engineer and shown his management and strategic leaning by development through the project management of major capital projects to business management at senior and executive level of listed and unlisted mining, manufacturing and consulting companies.

Kevin has acquired and developed projects, raising funding as required on the capital markets



**DIRECTOR - COMMERCIAL**

**ALANA VAN WOUW**

*BSc (Hons) Management,  
MSc - Global Human  
Resources, FMVA, CBCA, BIDA*

With more than 20 years of experience in the Mining Finance & Project Development Industry, a key player in buy-side and sell-side financial due diligence engagements from both private equity and strategic corporate buyers.

Knowledge and Experience in Analyzing historical financial statements and evaluate operational trends to identify sustainable earnings and upside potential whilst conducting the Valuations.

Well diverse when it comes to managing or aligning with teams and management regarding 'expectations concerning project deliverables, deadlines and risk exposure.

Specialisation in ESG, Financial analysis and modelling as well as PPP projects.



**CFO**

**CAMERON PITCHFORD**

Cameron is the founder and director of Virtual CFO Limited, a financial services company that provides comprehensive accounting, tax solutions, and management reporting. They also specialize in helping clients implement SaaS technology to achieve improved reporting, cost reduction, and staff flexibility. In their role, they've been instrumental in setting the strategic direction of the business and managing remote operations, preparation of financial reports, and devising efficient tax strategies for clients.

Previous roles include Group Financial Accountant at First Rand (Ireland) PLC and Product Controller at Morgan Stanley.

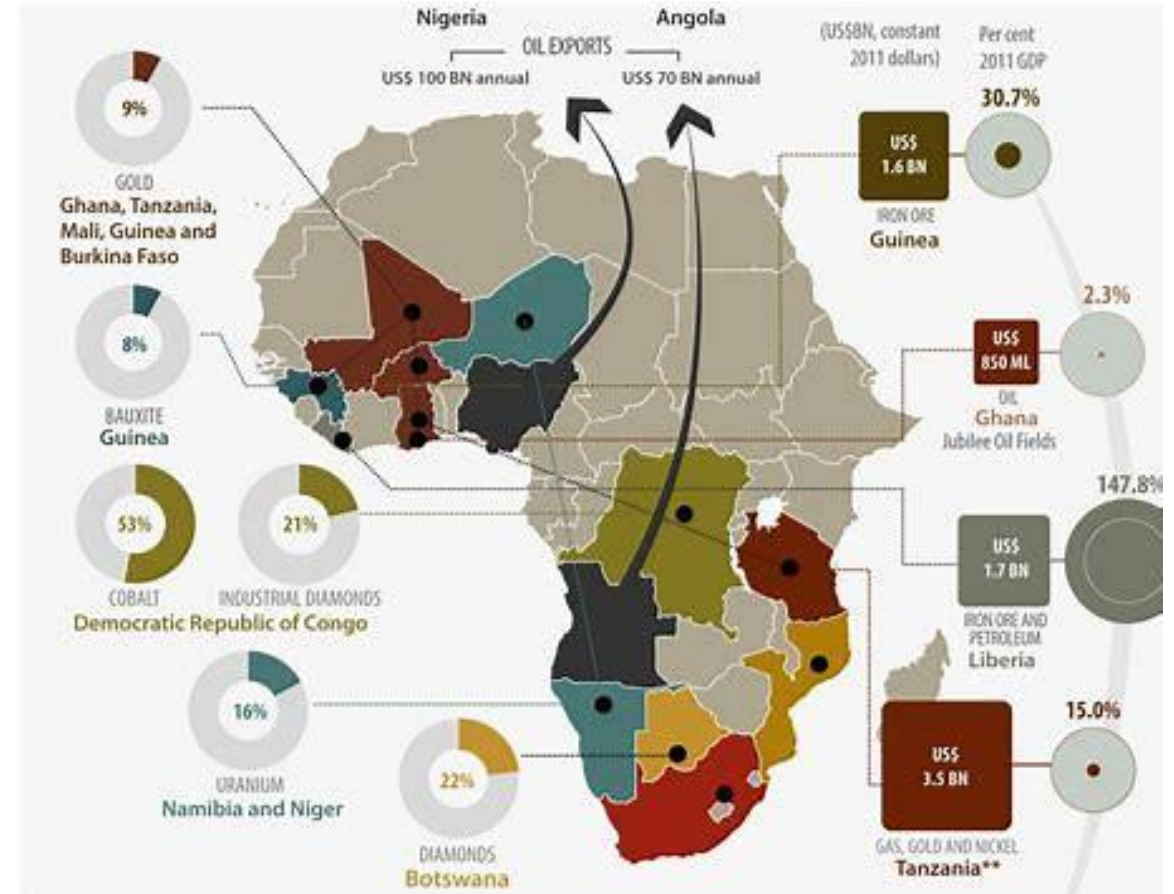
Cameron qualified as a Chartered Accountant and Chartered Management Accountant with Deloitte.



# INDUSTRY OVERVIEW

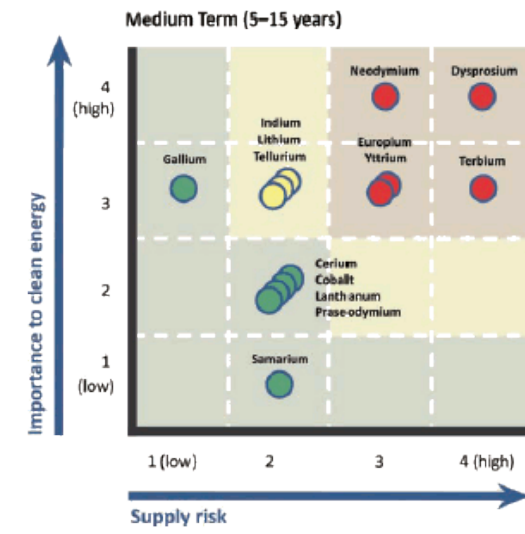
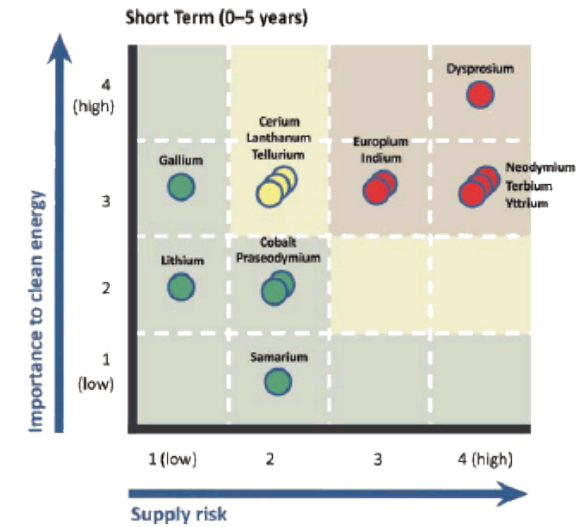
# CRITICAL METALS – MARKET ANALYSIS

- Goal is to unlock more Critical metals, Ni, Cu, Co, Zn, Li, PGE
- Risk has limited capital availability for African projects, resulting in concentrate production & Export
- Lack of Refining capacity in Africa
- Using Cu example, >50% of production exported in unrefined form, usually to Asian destinations
- US, EU & UK has Critical Mineral lists, specifically seeking to secure additional production.
- Increased beneficiation by Toll treatment serves both producers requirement and Namibia's
- Downstream beneficiation opportunities



# CRITICAL METALS – PRICE ANALYSIS

- Demand from end-users is a key factor that influences critical metals prices.
- Pricing of substitute materials is also important.
- Prices of critical metals have been increasing due to demand from renewable energy technologies.
- Limited production and industry-specific regulation and geopolitical uncertainty can cause prices to increase.
- Increased focus on exploration and assessment of African mineral potential
- Several minerals identified as majorly present in African countries
- US-based exploration companies investing in water depths to look for essential metals , looking for stockpiles of essential metals like manganese and nickel.
- Challenges related to governmental regulations and investment laws , For example, the Mining Code in the Democratic Republic of Congo (DRC) has been criticized for lacking clear provisions on environmental protection and beneficial sharing of resources.
- Increasing global demand for resources driving focus on exploration for critical materials in Africa





# CRITICAL MINERAL REFINERIES NAMIBIA – ECONOMIC ANALYSIS

- Purpose of the PIM was to outline that the business case for a toll-refinery is sound.
- Involved a thorough review of the current market conditions – Namibia and Critical Metals
- Examines the cost of running the refinery and potential revenue sources , ref to copper concentrate (PIM)
- The identified income streams from a refinery include:
  - ✓ Treatment and Refining Charges
  - ✓ Metal Participation (efficiencies and margin's)
  - ✓ Co-generation of excess energy to electricity
  - ✓ Byproducts
  - ✓ Waste product risk mitigation strategies
  - ✓ Financing of client opportunities (pre-payment)
  - ✓ Direct subsidiary participation
  - ✓ Battery re-cycling

<b>Model Output</b>						
After Tax NPV With Capex (Unlevered)	000's	USD	452,254			
After Tax IRR With Capex (Unlevered)		%	54%			
Var Cost / ton processed		USD	100			
Var Cost Capex		USD	100%			
Capital Modelled	000's	USD	(219,664)			
			452,254	100%	150%	200%
			100	452,254	381,256	301,253
			150	330,971	250,968	170,966
			200	200,684	120,681	40,679
			250	70,397	(9,606)	(89,609)
						221,250
						90,963
						(39,324)
						(119,327)
						(169,611)
						(249,614)

# CLOSED AND ABANDONED MINES

- 157 abandoned or closed mining opportunities exist in Namibia alone across many commodities
- XRF Sorting technology and a toll refinery model can make these mines and resources economic to recommence operations
- Crane Ridge will assist the local Department of Mines to evaluate the projects and apply the technological advances in the new economic framework
- Expanding across the region provides a significant opportunity to realise additional resource-based income and concomitant development

# SOCIAL & ENVIRONMENTAL BENEFIT

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- Repurposing land of abandoned mines requires environmental cleanup of waste and tailings impoundments
- Metals contained can be economically recovered into intermediate concentrates on small scale to help fund startup and ongoing agricultural conversion
- Crane Ridge will assist the local Department of Mines to evaluate the projects and apply the technological advances in the new economic framework
- The cash flow from the refinery dividend into the Namibian Trust via its shareholding can provide ongoing seed capital for these operations and social projects.
- Each of these projects become employers uplifting socially challenged communities in a sustainable way, both from a rehabilitation perspective as well as from the agricultural conversion.



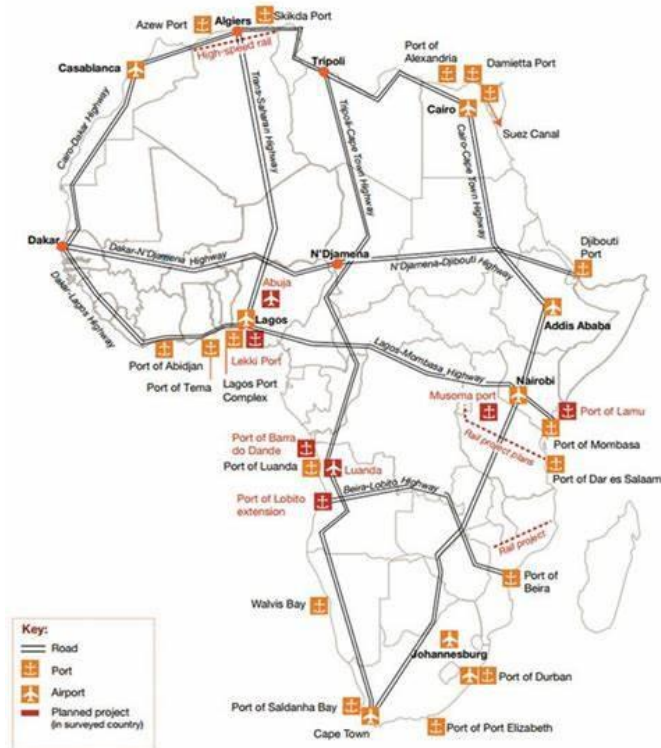


# PROJECT OVERVIEW



# LOCATION

- Evaluated sites in Namibia, Angola, South Africa, and Tanzania in terms of logistics, political stability, labour stability, and energy availability.
- Found that Namibia was the most suitable for developing a manufacturing base due to its strategic geographical positioning, access to energy sources, political stability, and labour stability.



# TECHNOLOGIES

The overall concept for designing and constructing a new refinery in Africa must include the following key aims and objectives:

- The refinery should be designed to accommodate, recover, and ameliorate impurities like Arsenic, Mercury, Lead, and Zinc found in polymetallic concentrates. Traditional off-take agreements often penalize mining companies for such impurities, thereby reducing their net revenue.
- The refinery's design must prioritize green technology and outcomes. As expansion and replacement of traditional smelter refinery pairs occur through this project, the overall objective should be to lower the impact of mining and metals on climate change.
- An integrated polymetallic base and precious metals refinery could include opportunistic refining of other mineral concentrates such as lithium. The free acid and waste heat generated from the processes could be utilized for this purpose.
- The refinery should focus on producing battery-grade and ready products that enable further downstream manufacturing opportunities

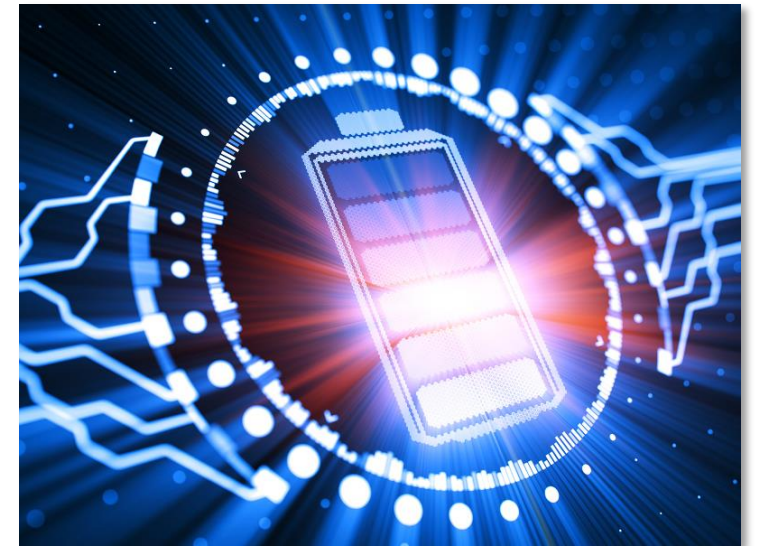
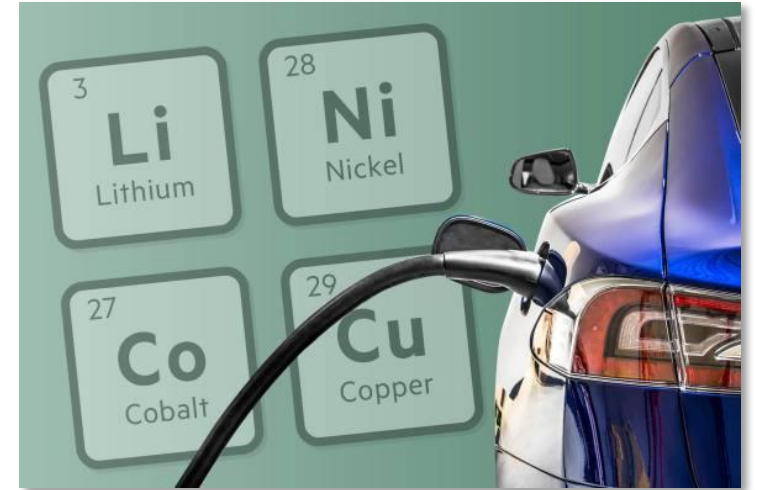


# PROCESS

To achieve these aims and objectives, a hydrometallurgical process solution is proposed, which involves a combination of:

- Pressure Oxidation leaching (POX) with limited UFG
- Sulphurisation of concentrates (baking) for leaching of lithium concentrates (spodumene from pegmatites)
- Neutralisation of acids for precipitation of Carbonate or hydroxyl products and/or refining and electrowinning steps.
- Complete removal of Sulphur in liquid form from the residues prior to precious metal recoveries
- Waste emission designed to be environmentally benign, subsidiary product opportunities
- Small footprint of operations, small impact on environment, large impact of Namibian GDP.
- Exothermic reactions, waste heat co-generation opportunity

**To proceed on the technical aspects of the project, detailed discussions and agreement has been concluded with Worley Parsons , resulting in a binding agreement and proposal for work to be performed.**



# RECYCLING UPSIDE OPPORTUNITIES

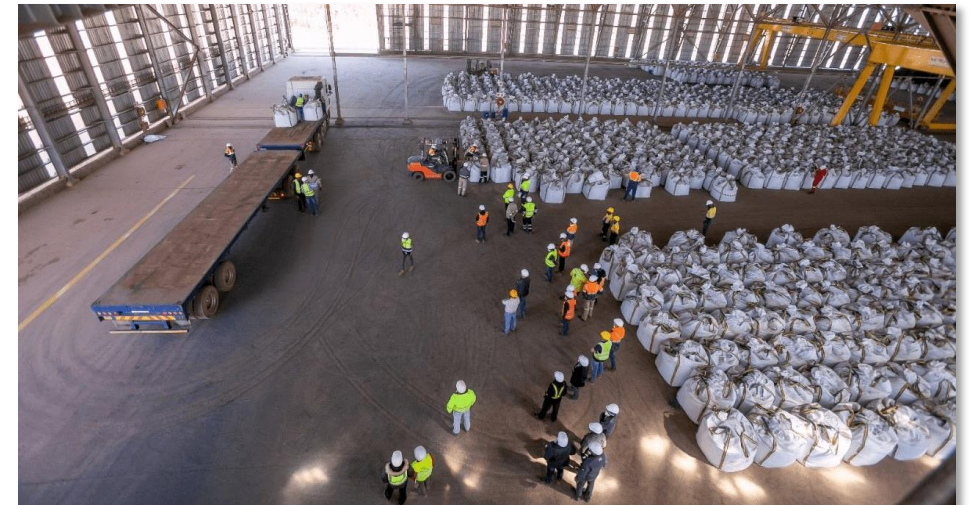
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- Reduce emissions from extraction process
- Improve rate of mineral recovery
- Find new and innovative technologies to create a circular economy for critical minerals
- US Recycling trade statistics for copper in 2020 was \$20.9 billion
- China was the leading importer, accounting for 36% of US copper scrap
- Battery recycling process involves physical dismantling and recovery of graphite and critical battery metals
- Economic justification for introducing a recycle stream into the refinery is sound
- Hydrometallurgical route is preferred for mechanisation and automation of the breakdown process
- Recycling of 10,000 tons per annum of batteries would constitute headline recoverable metals of a value of \$134 million per annum
- Assumed a 30% cost of the current market price for the metals



# CONCENTRATE

- Ownership of metals contained in concentrate remain vested in producer (mine)
- Negotiations required to ensure export duties and taxes are not levied on concentrate
- Concentrate seen as being in bond until sale of final metals produced
- Increased overall revenues applicable to producing mine and host country (+15-20% increase)
- Large pool of concentrates currently being produced in Africa, excess exported to Asian smelter/refiners.
- 43 uneconomic mineral deposits may become economic utilising this model in Namibia alone
- More projects may be started in other source countries of commodities / concentrates



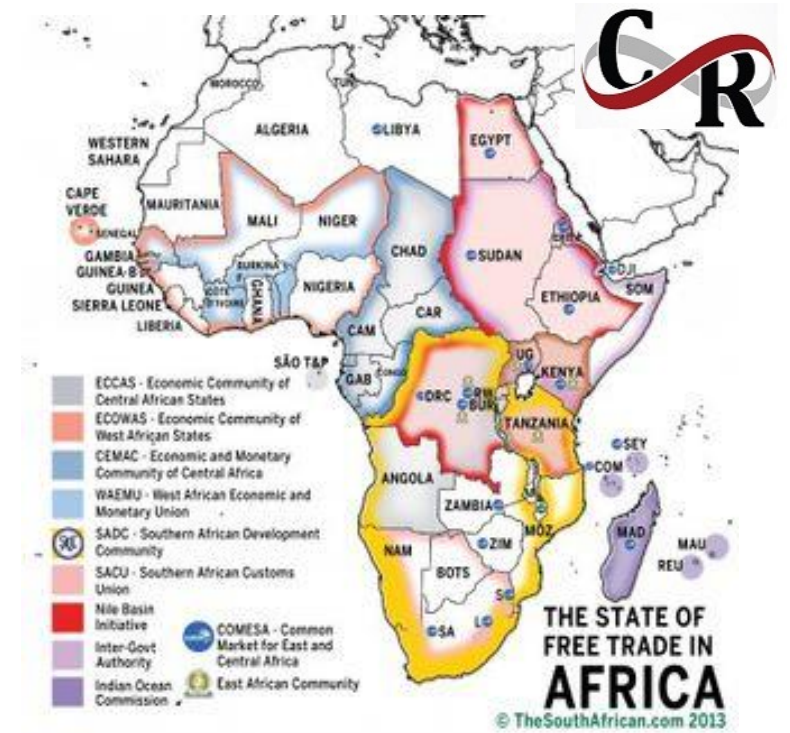
# IMPLEMENTATION OF AI FOR CONTROL AND MANAGEMENT SYSTEMS

- Artificial intelligence (AI) is increasingly being used in refineries to improve control and management systems.
- AI can be used to:
  - ✓ Monitor equipment and predict potential problems.
  - ✓ Optimize the flow of materials and energy, ensuring the correct blend of feed materials to maintain highest quality products.
  - ✓ Develop new products and processes to improve overall recoveries and other cost efficiencies.
  - ✓ AI has the potential to revolutionize the refining industry by making it more efficient, safer, and sustainable than traditional refineries.



# TRADE AGREEMENTS

- Trade Agreements – Namibia The Directorate of International Trade is the focal point and national coordinator of Namibia’s membership to regional and multilateral trade arrangements and economic groupings:
- Southern African Customs Union (SACU),
- Southern African Development Community (SADC),
- Africa, Caribbean, and Pacific (ACP) countries
- World Trade Organisation (WTO)
- SACU-European Free Trade Area (Iceland, Liechtenstein,
- Norway and Switzerland Trade Agreement
- SACU-MERCOSUR (Argentina, Brazil, Chile, Paraguay, and Uruguay) Trade Agreement
- SACU-India Preferential Trade Agreement





# PERMIT AND APPROVALS FOR THE PROJECT

- **NIPDB**

- ✓ Introductory meetings held with Executive of Gvt Departments & SOE's
- ✓ Project and development outlined, and requirements of Namibian State Entities and Government defined
- ✓ Good support found from government, including land, water & power availability

- **BRAVURA NAMIBIA**

- ✓ Advisory, local office presence, legal, accounting, local directorships and advisory services have been negotiated and agreed in principle
- ✓ Registration of the Namibian Corporate entity (Working title: Critical Mineral Refineries Namibia, "CMRN") stand ready to be commenced

Series A Work Streams												
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Company Formation	Orange											
Technical Workshop	Green											
Confirmation Testwork		Orange	Orange	Orange	Orange							
Contractor Works				Green	Green	Green	Green	Green				
ESIA Scoping							Orange	Orange	Orange	Orange		
Licensing & Governmental					Green	Green	Green	Green	Green	Green	Green	
Marketing									Orange	Orange	Orange	Orange





# TRANSACTION OPPORTUNITIES



# INVESTMENT BREAKDOWN

## SERIES A FUNDING (1 YEAR)

Budget Item	Amount
Scoping and R&D for study	\$400,000
Permits and licenses	\$100,000
Consultants and Contractors	\$300,000
Marketing	\$200,000
Total	\$1,000,000

### COMPLETION OF:

- Licensing
- Test work
- Pre-Feasibility

## SERIES B FUNDING (1 YEAR)

Budget Item	Amount
Feasibility, EIA, and Laboratory Confirmation	\$1,050,000
Permits and licenses	\$100,000
Consultants and Contractors	\$550,000
Marketing & contracting	\$300,000
Total	\$2,000,000

### COMPLETION OF:

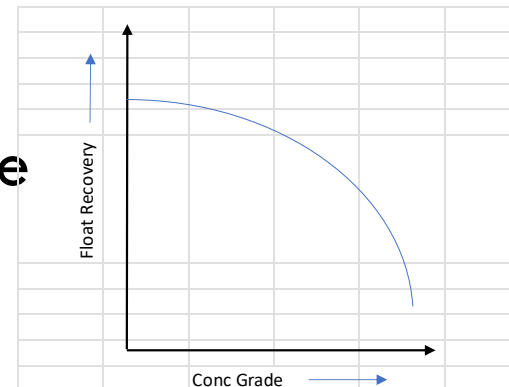
- Environmental
- Test work
- Definitive Feasibility

# PRODUCER ADVANTAGE

- Typically, there is an improvement of recovery where lower grade concentrate is produced. This can lead to additional revenue. See Example Calculation.
- No penalties on As, Hg, Zn and other impurities
- Much cheaper logistics cost.
- Precious metal payabilities not possible in smelting and refining.
- Shorter pipeline to cash flow

## EXAMPLE CALCULATION

Total Contained Copper	100,000
Float Plant Recovery	85%
Conc Grade	26.50%
Conc Tonnage	320,755
Conc Grade New	20%
Additional Tonnage	104,245
Transport Cost	\$ 65.00
Addition Transport Cost	\$ 6,775,943
Treatment Cost	\$ 90.00
Additional TC	\$ 9,382,075
Total Additional Costs	\$ 16,158,019
Spot Cu Price	\$ 8,000
Additional Tons Cu Rqd	2,020
Recovery BE % Rqd	87.02%



### Result

By lowering the conc grade, it is expected that an improved recovery can be achieved in the float plant. In the above example, if the recovery is improved by > 2%, then this has a direct advantage to the producer

Additional Nett Revenue / % above Rec BE	\$ 8,079,009
<b>Increased profit if 5% Gain Total</b>	<b>\$ 24,077,449</b>



A photograph of an industrial refinery at dusk. The sky is a mix of blue and orange, with clouds. Several tall, cylindrical distillation columns are visible, some with lights at their tops. In the foreground, there is a body of water reflecting the lights and the sky. The overall scene is industrial and serene.

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