

Sustainably Sourced Rare Earths for the Green Transition

Mkango Resources Ltd.

Corporate Presentation August 2024



## Strategic REE Projects across the Supply Chain

### Downstream - Near Term 2025 Production



### Rare Earth Magnet Recycling & Manufacturing



- Focus on short-loop recycling in UK
- Commercial production targeted for Q1 2025
- Underpinned by extensive piloting at University of Birmingham
- Initial production 25-30tpa recycled NdFeB scaling up to targeted 100-330tpa



- Collaboration with Envipro in Japan & UK
- Joint marketing of recycling solutions in Japan
- Recycling trials in UK and Japan
- Analysis of scrap feed and offtake opportunities in Japan
- ycled Potential HyProMag recycling technology development in Japan



- Focus on shortloop recycling in Germany
- Commercial production targeted for 2025
- Similar development scope to UK operations
- Targeted production of 100-330tpa recycled NdFeB



- Focus on shortloop recycling in USA
- Commercial production targeted for 2026
- Feasibility study to be completed by end 2024
- Spoke and hub (Texas) operation
- Targeted min. production of 500tpa recycled NdFeB



- Focus on long-loop recycling
- Complementary process to short-loop
- Pilot plant commissioned in UK in July 2024
- Production of Nd/Pr and Dy/Tb carbonates and oxides

### Upstream – Advanced Stage Projects



### Mining

### Songwe Hill Rare Earths Project

#### Malawi



- Definitive Feasibility Study completed in July 2022
  - NPV of U\$\$559m, IRR of 31.5%
- Targeting 5,954tpa TREO in mixed rare earth carbonate (MREC)
- Environmental Assessment (ESHIA) approval received in January 2023
- Mining Development
   Agreement signed with
   Government of Malawi in July
   2024
- Significant opportunities to reduce OPEX

# **香梅**

### Refining

### Pulawy Separation Project

Poland



- Potential for creation of European rare earths hub aligned with CRMA
- Underpinned by sustainablysourced, mixed rare earth carbonate from Songwe and other potential sources
- Site adjacent to Grupa Azoty
   Pulawy fertiliser and chemical
   plant
- Pre-feasibility studies completed (Carester)
- CAPEX US\$120m & OPEX <US\$3/kg</li>
   TREO in MREC

Nd <sub>2</sub> O <sub>3</sub>	805 t/y
Pr <sub>6</sub> O <sub>11</sub>	212 t/y
$Pr_6O_{11} + Nd_2O_3$	1,018 <del>t</del> /y
$(SEGH)_2(CO_3)_3$	930t/y
$LaCe(CO_3)_3$	9,670t/y

Recycling underpinned by patented Hydrogen Processing of Magnet Scrap (HPMS) technology and US\$100m R&D expenditure

# Mkango Board and Management

### Advanced REE project from exploration to DFS

### Implemented early mover REE recycling strategy



#### William Dawes, CEO & Co-founder

- BSc in Geology, MSc in Mineral Exploration, CFA
- 30 years' experience in exploration, mining, metallurgy, recycling, business development and investment banking at Rio Tinto, Robert Fleming, Chase Manhattan and JP Morgan



#### Alexander Lemon, President & Co-founder

- BSc in Geological Sciences, MSc in Mineral Exploration
- 30 years' experience in exploration, business development and operations management at Allied Commercial, Consolidated Contractors Company



#### Robert Sewell, Chief Financial Officer

- B Comm Hons (Accounting) Chartered Accountant (SA)
- 20 years' experience in commercial accounting, debt and equity finance, and cash management at Deloitte and AfriTin Mining

### Track record of growth via partnerships

### Significant rare earth experience

#### Derek Linfield, Non-Executive Chairman

Former Managing Partner of Stikeman Elliott (London) LLP, over 18 years' experience in London with African mining and oil & gas sectors, Former Chairman of Cornish Lithium.

#### Susan Muir, NED

Over 25 years of capital markets experience in senior investor relations roles and equity research with major Canadian banks. Formerly Vice President, IR, at Barrick Gold and Arizona Mining.

#### Shaun Treacy, NED

Strategic and Financial Adviser, 25 years' experience in corporate finance and investment banking. Former MD of J.P. Morgan, Lehman Brothers, Nomura and UBS. Associate of the Institute of Chartered Accountants.

#### Philipa Varris, NED

Head of Sustainability at Horizonte Minerals and NED of EnviroGold Global. Over 25 years' experience in ESG and H&S management globally with an MSc in Natural Resources. AusIMM Chartered Environmental Professional and UK Committee member.

# Mkango Capital Structure

Mkango Resources	AIM/TSXV: MKA
Share Price	GBX6.20 / C\$0.14
Shares Outstanding	268,453,574
Market Cap.	£16.6m / C\$37.6m

Major Shareholders	
Noble / Talaxis	25.87 %
Stewart Newton	4.40 %
Michael Geoghegan	3.60 %
Leo Mining & Exploration	3.18 %
Derek Linfield	3.00 %



## Rare Earth Magnet Recycling and Manufacturing



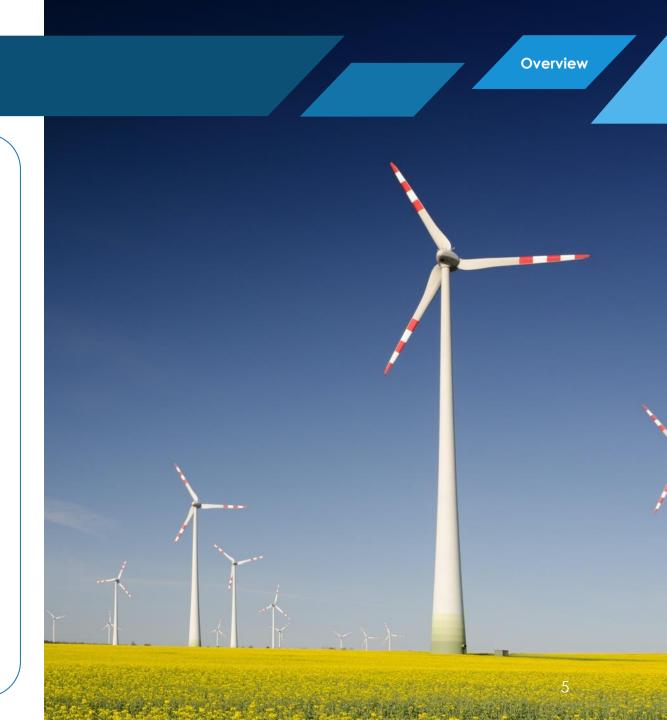






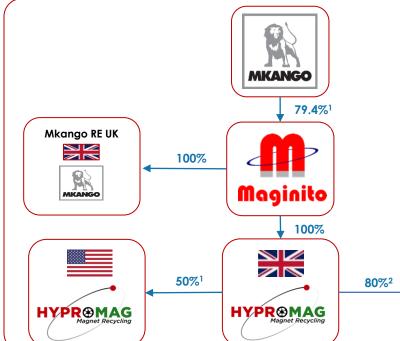


- Major opportunity for growth in recycling less than 5% of rare earth magnets are currently recycled from end-of-life products
- Key challenge is separation how do you liberate embedded NdFeB magnets for recycling in a cost effective and energy efficient way?
- HyProMag has the solution via its patented Hydrogen Processing of Magnet Scrap (HPMS) technology
- The resulting recycled NdFeB can be fed back into multiple points of the supply chain including:
  - short-loop magnet manufacturing to produce magnets with a significantly reduced carbon footprint
  - long-loop chemical processing to produce rare earth carbonates and oxides
- First production runs of recycled NdFeB magnets completed in UK in 2023 with commercial production targeted Q1 2025, Germany in 2025, USA in 2026
- Supported by the Minerals Security Partnership and aligned with the Critical Raw Materials Act



## Recycling – Structure and Team

- Founded in 2018 by leading experts in magnetic materials, recycling and hydrogen technologies
- Highly-experienced team
  - Directors with extensive experience in rare earths, alloys and magnets
- HyProMag GmbH was established in 2021 to commercialise in Germany
- HyProMag USA joint venture formed to commercialise HPMS in USA fully funded by CoTec



- First HyProMag investment 2020, acquired in 2023
- HyProMag focused on Short Loop magnet recycling
- Mkango Rare Earths UK focused on Long Loop magnet recycling
- Initial focus on scale-up of recycling in UK, Germany & United States
- Evaluating opportunities to roll-out recycling into Canada and Japan

<sup>1</sup>Balance held by CoTec Holdings

<sup>2</sup>Maginito's interest in HyProMag GmbH will increase to 90% once convertible loan note is converted



Will Dawes
Director
HyProMag Ltd, Mkango



Prof. Allan Walton Director HyProMag Ltd



Dr. John Speight
Director
HyProMag Ltd



David Kennedy
Director
HyProMag Ltd



**HYPRAMAG** 

Prof. Carlo Burkhardt
Director
HyProMag GmbH



Nick Mann Managing Director HyProMag Ltd



**Nelson Brito** Managing Director HyProMag GmbH

# Magnet Recycling Challenges

### Most end-of-life rare earth magnets are not currently recycled



- Electronic products are not often designed with end-ofuse recycling in mind
- Current recycling processes are not suitable for NdFeB magnets
- Magnets not recovered during shredding process



Hard disk drives



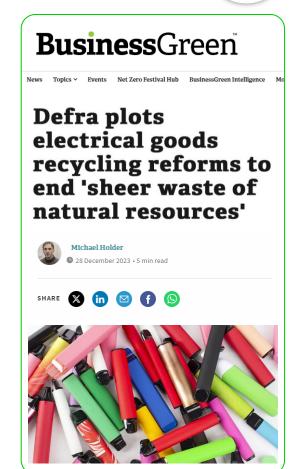
Shredded HDDs



Rotor from an automotive drive motor

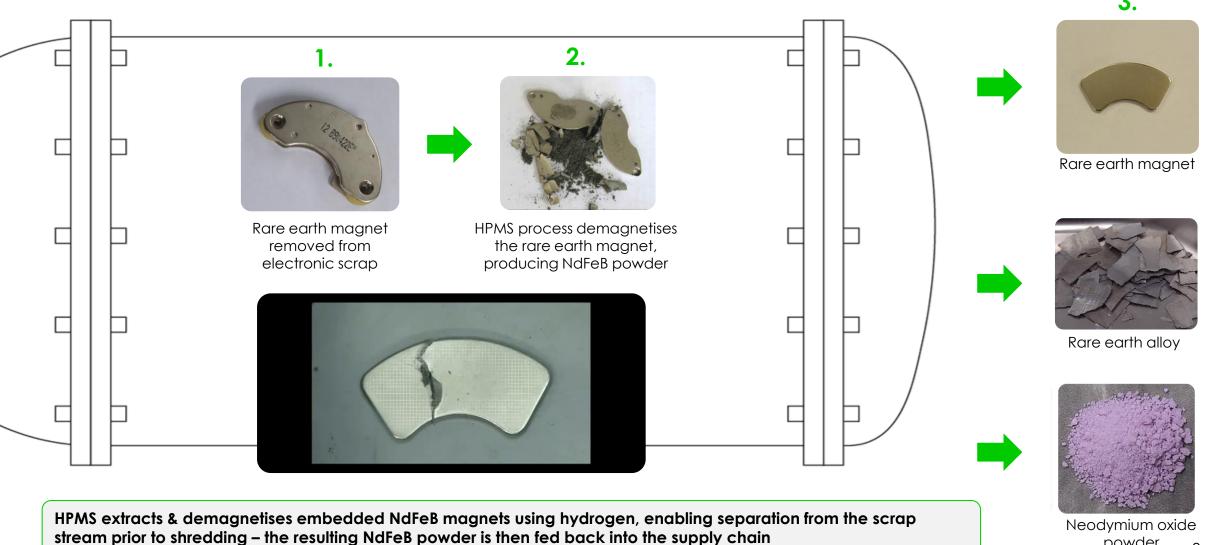


Shredded automotive motor



<sup>&</sup>lt;sup>1</sup>University of Birmingham/HyProMag <sup>2</sup>Axion

# The HPMS Solution Explained



powder

## Short-Loop and Long-Loop Recycling

- **Primary supply:** mixed rare earth carbonate, rare earth oxides
- **Recycled supply:** NdFeB alloys & sintered magnets, rare earth oxides
- NdFeB recovery solutions from EoL products, reduced CO<sub>2</sub> footprint

HPMS process liberates end-of-life magnets in the form of a demagnetised NdFeB powder, which can be fed back into multiple points of the supply chain

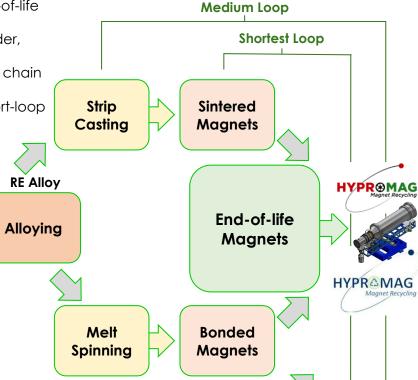
HyProMag is focused on short-loop recycling route.

**RE Metals** 

Metal

Winning

(Reduction)



**Hot Formed** 

Magnets

**Short Loop** 

**Beneficiations** Minina (Crushina & Concentrating)

Mineral **Decomposition** 

**RE Carbonates** 

(Roasting/leaching/ filtration/precipitation)

**RE Oxides** 

**Separation &** 

Purification

(Solvent

extraction)



Long loop NdFeB magnet recycling chemical process being developed by Mkango Rare Earths UK Ltd to complement HPMS and short loop processes



**Longer Loop** 

# **Competitive Advantages**

### Early mover advantage with strong competitive position



- Significant competitive advantages
- HPMS solves the separation issue how to liberate and demagnetise separated magnets
- Short loop recycling more energy efficient and cost effective than recycling via chemical processes
- Underpinned by c.U\$\$100m in research and development funding
- Supported by the Minerals Security Partnership
- Ability to manufacture magnets with a reduced carbon footprint
- Minimal carbon footprint vs. primary mining to separation, to metal alloy, to magnet production

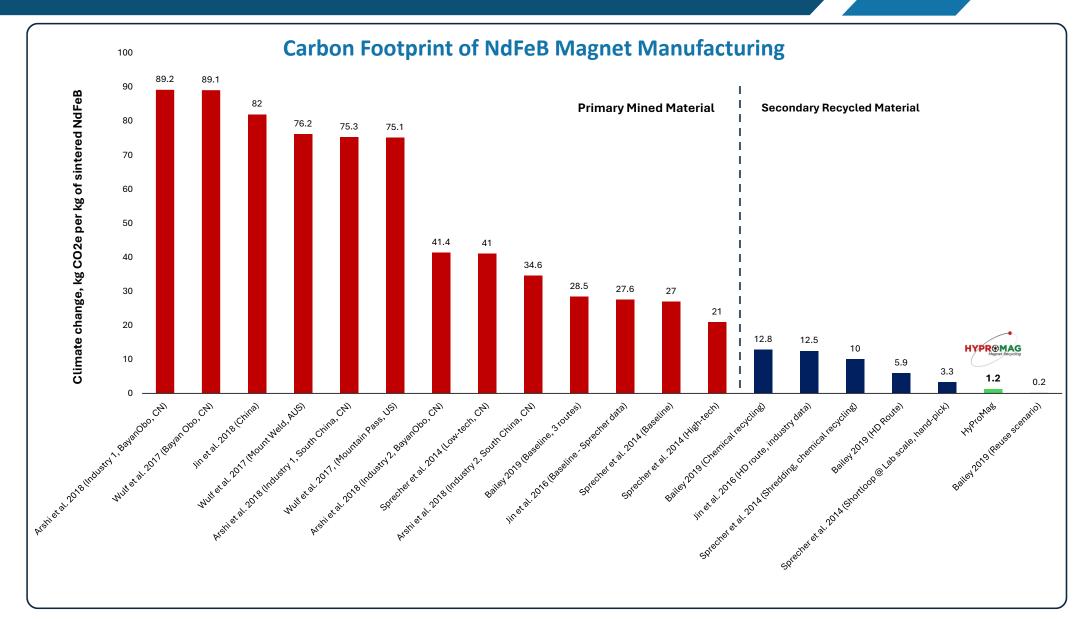


Production of over 10,000 finished recycled magnets targeted by end 2024



Very strong technical expertise and extensive industry experience with broad network of partnerships and excellent reputation – supported by University of Birmingham Magnetic Materials Group and University of Pforzheim, with specialists in magnet processing in UK and Germany

## Significantly Reduced CO2 Footprint



## Commercialisation Underway

### HyProMag – main industrial partner for scale-up and exclusive HPMS licencee

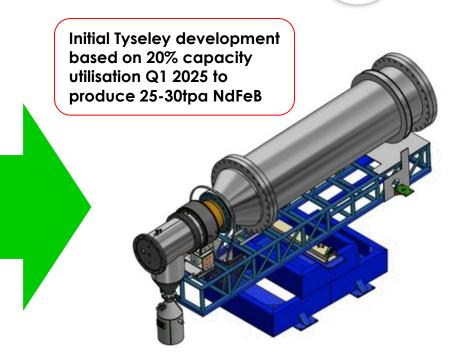


## Proposed equipment at Tyseley Energy park, UK

- HPMS reactor
- Powder processing (sieving, milling, blending)
- Pellet press
- Axial aligning press (commissioned)
- Inert sintering system
- Transverse aligning press (commissioned)
- Analytical equipment
- Chemical processing



- Pilot HPMS vessel at University of Birmingham commissioned in 2022
- 50 100kg per batch
- 10,000 finished recycled magnets targeted for 2024

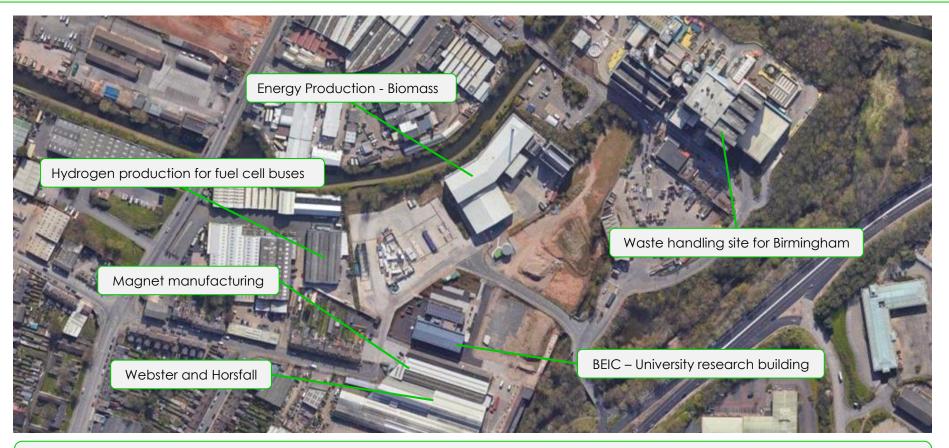


- Scaled-up HPMS vessel targeted for commissioning Q1 2025
- Minimum 350kg per batch
- Presses commissioned at Tyseley with first production runs of magnets completed 12

# New UK Rare Earths Hub at Tyseley

Tyseley Energy Park - delivering low & zero-carbon power, transport, heat, waste and recycling solutions

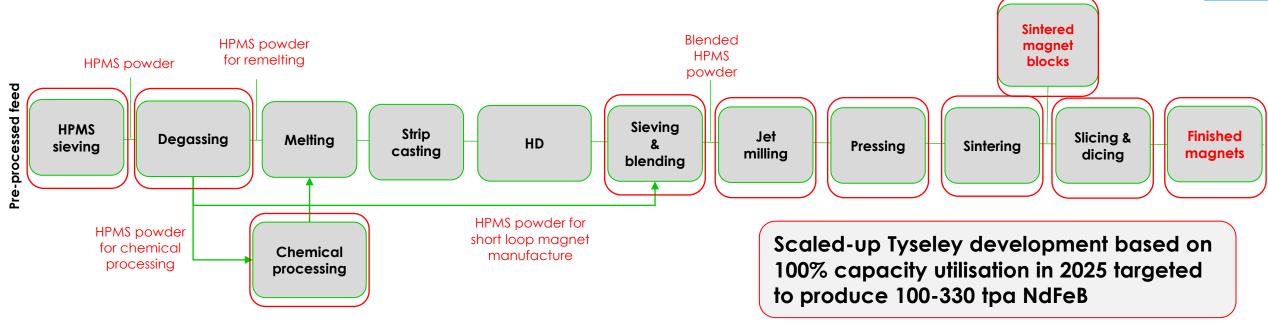


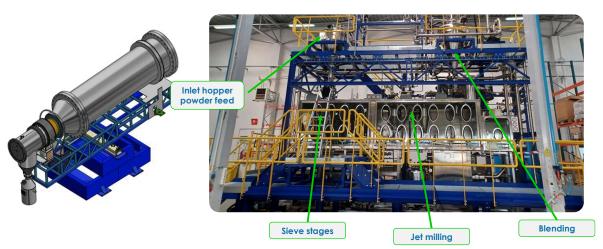


DER (UK) has provided £4.4 million of predominantly capital funding to scale up the HPMS process and magnet manufacturing

#### Recycle

## Tyseley Energy Park Scale-Up



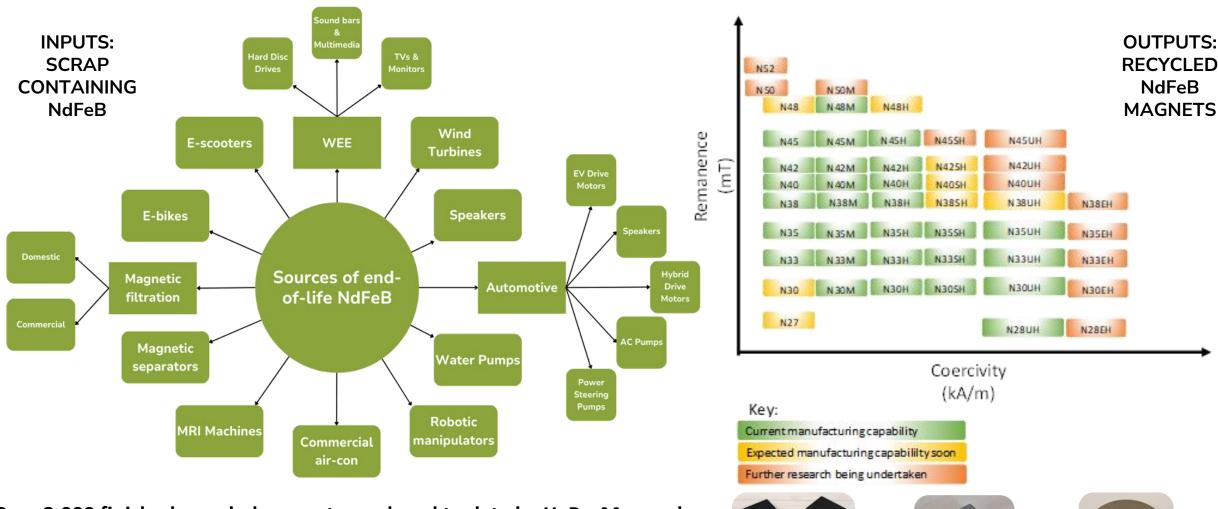








## Recycled Magnets with Low CO<sub>2</sub> Footprint

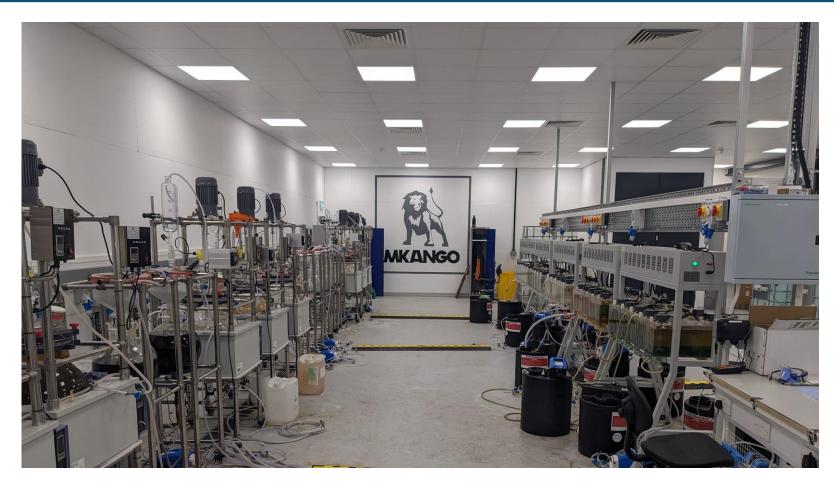


Over 3,000 finished recycled magnets produced to date by HyProMag and University of Birmingham, currently being tested in multiple automotive, aerospace, electronics applications, with other applications planned





## Pilot Plant for Long Loop Chemical Process

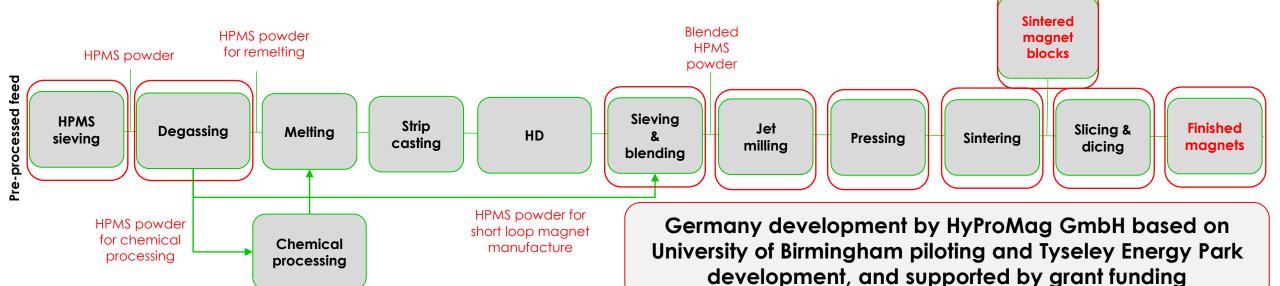


HPMS generates a liberated NdFeB feed for chemical processing to RE carbonates and oxides



Mkango Rare Earths UK has commissioned a pilot plant for long loop chemical processing of swarf and HPMS powder to produce rare earth carbonate and oxides at Tyseley Energy Park - complementary to the HPMS short loop recycling route being commercialised by HyProMag

## Germany Scaled-Up Development







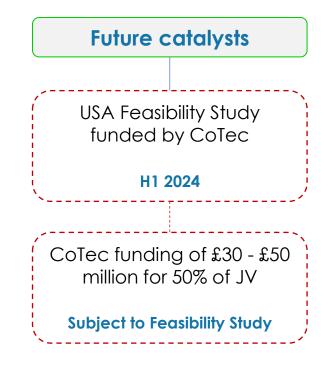
Scaled-up Germany development based on 100% capacity utilisation in 2025 targeted to produce 100-330 tpa NdFeB

US\$2.5m unlocks US\$3.7m of grant funding for full scale development

## Mkango-CoTec Collaboration

### Mkango-CoTec collaboration enhances underlying value





### **CoTec FACT FILE**

- ESG-focused fund led by Julian Treger and Braam Jonker
- Owns **20.6%** stake in Maginito
- Listed on TSX-V and OTCQB as CTH and CTHCF
- Total investment into Maginito of £3.5m
- Co-operation agreement for USA rare earth technologies

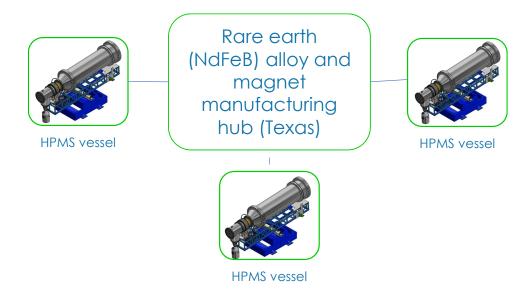
# HyProMag USA Rollout



### USA Feasibility Study Underway based on min. 500tpa NdFeB operation

- HyProMag USA 50/50 joint venture company formed with CoTec to roll-out HPMS and associated magnet manufacturing into the USA
- CoTec funding feasibility study and development costs, subject to feasibility study
- Targeted production capacity min. 500 tpy NdFeB magnets with expansion options to 800 tpy
- BBA USA Inc and Pegasus TSI engaged to complete feasibility study
- Four short-listed 'hub' site options located in Fort Worth, Texas have been identified. Approximate size of the hub site is 90,000 sq. ft, initial 'spoke' facilities in South Carolina and Nevada
- High-level engagement with potential feed supply and product off takers providers has commenced
- Focused discussions with U.S. Federal and State Government bodies to support funding and incentive opportunities underway
- Feasibility Study targeted for completion by end of 2024, with commercial production targeted for 2026

Proposed operating configuration: 'hub and spoke' model



# **Government Support**





## Minerals Security Partnership (MSP)











Press release

UK to host Minerals Security
Partnership for first time to boost
investment in critical minerals

On Tuesday 10 October, the UK hosted the Principals' meeting of the Minerals Security Partnership for the first time, at the London Metals Exchange.



- HyProMag HPMS technology selected as an MSP project
- MSP (est. 2022) consists of 14 governments, including UK and USA
- MSP aims to ensure adequate supplies of minerals, such as rare earths, to meet net zero carbon goals
- MSP regards resilient supply chains to be critically important for an equitable and sustainable energy transition
- MSP aims to catalyse public and private sector investment in responsible critical mineral supply chains globally

# **Government Support**

### Past government grants

SusmagPro Project	Sustainable recovery, reprocessing and reuse of rare earth magnets in a European circular economy	€14m project with 19 partners across the supply chain
RaRE Project	Establishing an end-to-end supply chain to incorporate recycled rare earth magnets into EVs	£2.6m project with Bentley Motors, Unipart, AEMR, ILS
REAP Project	Recycling rare earth magnets from speakers used in automotive and electronics applications	£0.3m project with European Metal Recycling (EMR) – completed Sept 2021

### **Current government grants**

SCREAM Project	UK govt. grant focusing on scrap processing pilot plants, HPMS, remelting, strip casting, chemical processing and magnet production	£3.4m funding shared by Mkango Rare Earths UK, HyProMag UK, B&W, EMR, GKN, Jaguar Land Rover
REEsilience Project	Creating a more robust supply chain integrating primary & secondary RE sources and magnet pilot plants	€14m project with 22 partners including HyProMag GmbH, HyProMag UK and Mkango Polska across the supply chain
Re-RE Wind Project	Establishing UK's first circular supply chain for RE magnets used in wind turbines	£1.5m grant is part funded by Innovate UK's CLIMATES programme
Innovation Centre for Science & Economy Northern Black Forest	Development of HyProMag GmbH operations in Baden- Württemberg State	€6.1m project led by HyProMag GmbH

## **Expected Recycling Development Timeline**

H<sub>2</sub> 2024 2025 2026 2025 Q1 2025 Initial commercial Commercial **Completion of United** Initial commercial Scale up commercial production in production in United States feasibility study production at Tyseley production at Tyseley States Germany **Short Loop recycling Short Loop recycling Short Loop recycling** Short Loop recycling **Short Loop recycling** Sintered magnet blocks Sintered magnet Sintered magnet Sintered magnet blocks NdFeB alloys and and finished magnets and finished magnets blocks, finished blocks, finished sintered magnet blocks magnets and NdFeB magnets and NdFeB alloys alloys Ramping up to initial **Evaluating 500tpa** Initial target of Initial target of 500tpa NdFeB spoke NdFeB spoke and hub target of 25-30tpa approx. 100-330tpa approx. 100-330tpa and hub operation NdFeB operation NdFeB NdFeB Funded by CoTec Funded by CoTec subject to feasibility study

Collaboration with Envipro in Japan announced June 2024



Evaluating options for further development of recycling in Canada

To discuss magnet scrap solutions and purchasing, magnet and other product sales please contact magnets@hypromag.com

To discuss collaboration and consultation please contact **technical@hypromag.com** 









## Rare Earth Mining and Separation Development Projects



# Songwe Hill Rare Earths Deposit

### One of Very Few Independent Rare Earth Projects Globally with a Definitive Feasibility Study





- Initial Mkango drilling programmes carried out in 2011 and 2012
  - First resource report prepared in compliance with NI 43-101
- Pre-Feasibility Study (PFS) completed in 2015
- 2019 in-fill and step-out drilling programme
  - 60% increase in Measured and Indicated Resources
- Definitive Feasibility Study (DFS) completed in July 2022, with lead engineers SENET (a DRA Global Group Company)
- ESHIA completed and approved by Malawi Government in January 2023 (in compliance with IFC Performance Standards)
- Mining Development Agreement (MDA) signed July 2024

# Malawi - A Favourable Jurisdiction

### Longstanding, supportive relationships with government and local communities

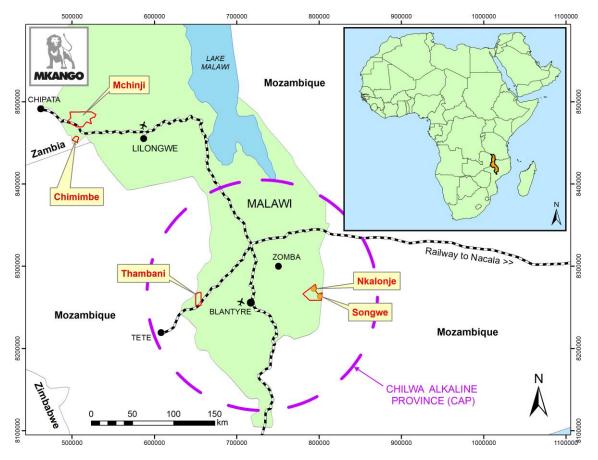
- Premier African rare earths mineral province
- Blantyre, a major commercial centre with rail head and international airport, is located two hours from site by car
- Beneficiation, hydrometallurgical and acid plants to be located in Malawi
- Power co-generated from sulphuric acid plant and supplemented with grid and solar



Minister of Mines visit, 2023



USA/UK govt visit, 2021



# Songwe Hill Feasibility Study

### A new sustainable source of rare earth production

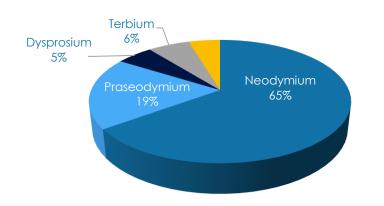


Compelling project economics	
Capital Cost	US\$311M (US\$34M contingency)
IRR	31.5%
NPV	US\$559M*

<sup>\*</sup>Excludes Pulawy Separation project, recycling businesses and Malawi exploration

- One of the few rare earths projects globally to have reached FS stage
- LOM: 18 years producing mixed rare earth carbonate (MREC) grading 55% total rare earth oxides (TREO)
- US\$215M per year EBITDA averaging 5,954 tpa TREO in MREC
  - 1,953 tpa NdPr, and 56 tpa of Dy & Tb oxide

Songwe Hill mixed rare earth carbonate split by value



The recent signing of the Songwe MDA confirms the fiscal terms applicable to the project and enhances the options to create value for shareholders in the context of the ongoing strategic review and engagement with potential strategic investors, development and commercial banks, and offtakers

# Songwe Hill Feasibility Study

### **Extensive Processing Flow Sheet Development and Piloting**



Feasibility study is a culmination of significant mineralogy, bench scale test work and piloting completed since project inception in 2010

CIRCUIT 1 **CAMPAIGN 1A** Flotation Concentrate H<sub>2</sub>SO<sub>4</sub> Gangue Leach CaCl 80°C, pH 4 Ca(OH)<sub>2</sub> HCI Regeneration Neutralisation **Caustic Conversion CAMPAIGN 1B NaOH Liquor** and 2B Dilute (14% NaOH) Na<sub>2</sub>CO<sub>2</sub> / Naf CaCO, CaF, (Waste) **Caustic Conversion** Repulp Wash 2 (Ce Oxid'n)

Flotation piloting completed

- March 2021

Hydrometallurgy piloting completed

- March 2022

Piloting produced a carbonate grading 55% TREO with NdPr oxides comprising 31%

Carester has assessed the carbonate quality for the purposes of separation

Significant opportunities for optimisation of processing flowsheet to reduce OPEX







Hydrometallurgical flow sheet developed and piloted (6 campaigns)

## Mkango in the Community

### Strong Track Record in Corporate Social Responsibility



#### boNGO Worldwide Partnership

- Happy Classroom Project
- Enhancing 3 local primary schools
- 18 classrooms painted with school syllabus

### Scholarships

 Secondary education fees paid for the top 12 students from 3 local primary schools – 58 students to date

### Local community infrastructure projects

- 8 water boreholes & pumps installed. 14 maintained quarterly in the local area
- Bridge construction & extensive road refurbishment









- 1.Before an unhappy classroom
- 2.After a Happy Classroom after renovation
- 3.Water Pump in Mphembezu
- 4.New Bridge Constructed

Refine

### Pulawy Separation Project, Poland

- European rare earths hub underpinned by sustainably sourced, mixed rare earth carbonate from Mkango's project in Malawi
- Site adjacent to a largescale fertiliser and chemicals plant owned by Grupa Azoty Pulawy, the EU's second largest manufacturer of nitrogen fertilisers
- Competitive advantage
  - Established infrastructure
  - o Reagents and utilities on-site
  - Located in Special Economic Zone

Production based on studies to date		
Nd <sub>2</sub> O <sub>3</sub>	805 t/y	
Pr <sub>6</sub> O <sub>11</sub>	212 t/y	
$Pr_6O_{11} + Nd_2O_3$	1,018 t/y	
(SEGH) <sub>2</sub> (CO <sub>3</sub> ) <sub>3</sub>	930t/y	
LaCe(CO <sub>3</sub> ) <sub>3</sub>	9,670t/y	



#### Jun 2020

Initial scoping study completed by Carester

**Jan 2021**Updated scoping study

Jun 2021 Lease option agreement signed

#### Jan 2020

Site visit & initial due diligence

#### Jul 2020

MoU & exclusivity signed with Grupa Azoty Pulawy

#### Mar 2021

Confirmatory due diligence completed

#### Next steps

Completion of Feasibility Study

# Proposed Site for Separation Plant

- 8-hectare site located next to Pulawy Fertiliser and Chemicals Plant with access to road, rail, reagents, by-product customer and utilities
- Subject to Pulawy DFS, targeting capex of US\$120m and opex <US\$3/kg TREO in MREC (based on Songwe Hill production mix)

### Access to infrastructure

- High, medium and low voltage power network, natural gas and process steam network
- Water supply system, sewerage and wastewater treatment plants
- Internal railway of 60km enables fast transportation of raw materials and products
- Electronic weighbridge for trucks and trains
- Easy connections with the national road network



Existing Pulawy Fertiliser and Chemicals Plant

Proposed site

### **THANK YOU**

William Dawes, Chief Executive Officer – will@mkango.ca Alexander Lemon, President – alex@mkango.ca Robert Sewell, Chief Financial Officer – rob@mkango.ca



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Scientific and technical information contained in this Presentation including sampling, analytical, and test data underlying the information has been approved and verified by Dr. Scott Swinden PGeo of Swinden Geoscience Consultants Ltd who is a "Qualified Person" in accordance with National Instrument 43-101- Standards of Disclosure for Mineral Projects ("NI 43-101"). Scientific and technical information contained in this presentation relating to the mineral resource estimate has been approved and verified by Jeremy Witley Pr. Sci Nat of The MSA Group Pty Ltd, who is a "Qualified Person" in accordance with NI 43-101. The Qualified Persons refer red to above are independent of the Company. An NI 43-101 Technical Report supporting the results of the definitive feasibility study for the Songwe Hill Rare Earths Project ("Songwe" or the "Project") in Malawi has been prepared by SENET, a DRA global company, under the guidance of Mr. Nick Dempers, who is a "Qualified Person" in accordance with NI 43-101, and was filed on the Company's profile on SEDAR+ on August 19, 2022.

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