



Athena

Resources

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BYRO MAGNETITE - MIDWEST GREEN STEEL

Athena Resources Limited (**Athena the Company**) (ASX: **AHN**) is pleased to announce Board approval to develop the 2004 inferred JORC compliant magnetite Mineral Resource Estimate (MRE) to a 2012 JORC compliant Indicated Resource.

- Encryption drilling at the FE1 Resource is booked for 14 May 2022 and will consist of eleven infill diamond drill holes. Once the MRE is in the Indicated classification the Company will be in a position to convert the resource to Probable Mineral Reserve.
- The Company is on a scheduled path to complete the indicated MRE and move forward to development of the Company's Project Feasibility Study, (PFS) within 2022.

Through pilot processing trials Athena can reliably produce bulk concentrate at the FE1 Inferred resource to be divided into two categories, a High Purity magnetite, (**HPFe**), product **71.5%Fe < 72%Fe**, and a Super Purity magnetite, (**SPFe**), product **>72%Fe**. (Announced on 16 April 2018 and 18 September 2018). These iron grades are equaled by few mines in the world and among the highest purity reported in Australia.

The FE1 magnetite resource is a boutique resource identified as Globally unique through comprehensive development including metallurgy, ore characterisation and engineered processing design over the last ten years. The unique nature of the Byro magnetite concentrate puts the product at the forefront of supply to current premium industrial processes and supply to high purity "Green Steel" production of the uppermost grade and purity available.

Engineering design following pilot trials demonstrate supply of magnetite concentrate can be achieved with low capital expenditure using industry standard processing within an economic transport corridor through to the Port of Geraldton, an established iron ore export port, to global markets hungry for **high grade – low impurity** feed stock.

Blast furnaces, with fossil fuel-based energy and coking coal for reduction of the oxide account for 70% of world steel production and produce >7% of total global CO2 emissions. Reduction of iron ore (iron oxide) is responsible for the bulk of CO2 emission in the industry. Steel production is going through a revolutionary shift to low impurity - low CO2 emission production, now commonly known as "Green Steel".

Green Steel production is not a future concept and is currently underway in Europe, Japan, Brazil, Mexico, Saudi Arabia, Portugal, and the United States with many more countries around the world including Australia looking to bring low carbon emission steel-production online. As the demand for Green Steel increases so will the demand for high grade - low impurity ores.

Athena Resources Limited



Key Technological Shifts.

Blast Furnace

Blast furnace steel producers are implementing measures to reduce energy input through **increased proportions of magnetite** in a hematite blend yielding energy saving endothermic reactions. Current technological advances have also reduced CO2 emissions by injection of green hydrogen to the furnace instead of coal dust for reduction, coupled with new technology to improve carbon capture.

Electric Arc Furnace

1. Electric Arc Furnaces (EAF) for the smelting of scrap steel and **high purity magnetite** ores can now be powered by renewable energy sources.
2. Shaft furnaces (MIDREX and HYBRIT) are common reduction furnace forms that can now use green hydrogen for reduction of **magnetite oxides** for zero net CO2 emissions.

When coupled (1 and 2), the shaft furnace output in hot form fed directly to EAFs powered by renewable energy can achieve net zero CO2 emissions.

High grade Magnetite concentrate is usually priced at 68% iron and is rarely greater than 68% in iron content compared to the Byro High Purity magnetite, (**HPFe**), product **71.5%Fe < 72%Fe**, and a Super Purity magnetite, (**SPFe**), product **>72%Fe**.

Every tonne of 68%Fe concentrate contains 680kg of Iron, just under 280kg of Oxygen and just over 40kg of impurities which harbour processing and quality problems. Athena test work shows we can deliver 71.5% Iron with about 280kg Oxygen, and include only 5 kg of impurities, approximately **one eighth of the impurities** or 12.5% of most producers around the world.

Direct furnace supply of the Byro magnetite concentrate or blending to improve high impurity low grade feed stock that incorporate hydrogen reduction will add significant cost saving, environmental and energy benefits to both forms of steel making.

Byro Magnetite Key Development Stages

Development timelines of the Byro project have become aligned with increasing industry action towards low carbon emission steel production. It will take several years, not decades, to upgrade existing furnaces and or increase the number of hydrogen reduction-EAF systems to cater for green steel demand. As these systems come online so too will the demand for suitable feed stock. The Midwest of Western Australia contains significant resources of the primary ingredient, magnetite, few of which compare with the grade and purity discovered and developed by Athena Resources at Byro.

Development of the Byro magnetite resource is at an advanced stage with many key measures completed in careful incremental steps over the last 12 years. The key development steps include grant of mining leases, native title mining agreement, thorough metallurgy repeated in Australia and China, process engineering design, Main Roads WA approved transport corridor, hydrology studies, advanced environmental studies and exploration drilling of supporting satellite ore bodies.



Discovery

The Company has held the Byro Tenements within the Narryer Terrane since grant in 2009. Through exploration and drilling of over 17,000m the Company has identified the ancient Terrene hosts nine unique low impurity magnetite occurrences resulting from intense metamorphism. The Flagship FE1 ore body being identified in 2010.^{1 2 3}

Preliminary Metallurgy

FE1 Head grade and DTR completed by Athena and ALS – Perth, WA, with preliminary coarse grind (P80-120µm) results underlining >70%Fe grades. **(2010)**^{4 5 6}

Detailed Metallurgy / Ore Characterization on FE1 Ore Body

Detailed Metallurgy and Ore Characterization was carried out on **FE1** independently by industry specialists; ALS AMMTEC Laboratories – Perth, WA, and the Changsha University - Institute of Mining and Metallurgy – China. Results from both institutions agreed, identifying exceptional characteristics for simple liberation and recovery of the concentrate at very high grades, carrying extraordinarily low costs in processing, **(2012)**.^{7 8 9 10 11}

MRE

AMC Consultancy, Perth, WA, completed a 2004 JORC compliant inferred Mineral Resource Estimate for a portion of the FE1 ore body, **(2012)**.^{12 13 14}

BYRO FE1 INFERRED CONCENTRATE ESTIMATES									
OXSTATE	Mt	DTR-Fe %	DTR-SiO ₂ %	DTR-Al ₂ O ₃ %	DTR-P %	DTR-S %	DTR-LOI %	DENSITY (t/m ³)	DTR %
Fresh	18.1	70.7	1.16	0.32	0.003	0.014	-3.26	3.5	35.1

Exploration Target Development

The Company completed a magnetite Exploration Target Estimate from surface exploration with a target range of 131 Mt – 481 Mt at 16%Fe – 30%Fe. Follow up drilling confirmed 8 satellite ore bodies in support of the FE1 resource with a further three yet to be confirmed by drilling.

¹ [Commencement of Drilling at Byro Iron Ore](#)

² [Athena Byro Project High Grade Magnetite](#)

³ [Byro Iron Ore Project Growth](#)

⁴ [JORC Iron Ore Resource Drilling Byro](#)

⁵ [Byro Iron Ore Excellent Davis Tube Results](#)

⁶ [Fe1 Excellent Davis Tube Results](#)

⁷ [Grind Size Optimisation Results](#)

⁸ [Excellent Magnetite Chinese Testwork Results](#)

⁹ [Byro Magnetite Metallurgical Results](#)

¹⁰ [Byro Metallurgy - Super Purity Magnetite](#)

¹¹ [Retraction of Production Targets](#)

¹² [Byro Drilling Update](#)

¹³ [Fe1 Infill Drilling Results](#)

¹⁴ [Preliminary JORC Resource for Byro Fe1 Deposit](#)



Satellite Ore Bodies Confirmed from drilling

- Heppinstal ore body
- Whitmarsh Find ore body
- Mt Narryer ore body Bureau Veritas – South Australia, 2012 – 2016
- Byro South ore body
- Whistlejack ore body
- Think Big
- Vanderhum
- Happy Union

Understanding of the satellite ore bodies is at various levels dependent upon individual merits and proximity to the flagship FE1 resource. Following multiple drilling programs Mt Narryer, Byro South and Whistlejack have had DTR and grind optimization work completed. This was followed by more detailed metallurgy. ^{15 16 17 18 19 20 21 22 23}

Detailed Metallurgy / Ore Characterization on Mt Narryer Ore Body

Detailed ore characterisation by Bureau Veritas, Australia, on the Mt Narryer ore body identified exceptional characteristics for low-cost beneficiation, liberation and recovery of the concentrate at extraordinary grades. (2016). Results from ore characterisation at Mt Narryer led to thorough washability studies in China confirming the Mt Narryer ore body can yield consistent concentrate grades of **>70%Fe**. ^{24 25 26 27}

DTR and grind optimization work from the Byro South and Whistlejack ore bodies was followed up with flotation and ore roasting test work also confirming processed concentrate grades **>70%Fe**. ²⁸

¹⁵ [Drilling Update Byro South Iron Ore](#)

¹⁶ [Drilling Whitmarsh and Whistlejack Byro Iron Ore](#)

¹⁷ [Byro Iron Assay Results](#)

¹⁸ [Byro Iron Mt Narryer Magnetite](#)

¹⁹ [Narryer Coarse Grain Magnetite](#)

²⁰ [Mt Narryer DTR Magnetite results](#)

²¹ [Quarterly Activities Report - June 2016](#)

²² [Byro Iron Ore Mt Narryer High Grade Magnetite](#)

²³ [Clarification Statement Presentation](#)

²⁴ [Mt Narryer Metallurgical Results](#)

²⁵ [Byro Metallurgy - Super Purity Magnetite](#)

²⁶ [Retraction of Production Targets](#)

²⁷ [Mt Narryer Metallurgical Results](#)

²⁸ [Completion of further Metallurgical Testwork](#)



Flagship FE1 Engineering Design Stage 1

In October 2011 GR Engineering in Perth, WA, produced a prefeasibility study for 5Mtpa throughput for 2.5Mtpa magnetite concentrate at 67%Fe inclusive of the detailed metallurgy and ore characterisation carried out by ALS AMMTEC. The study included capital expenditure and operating cost with detailed processing plant design. In the proceeding period iron futures fell dramatically leading to a research and development stage undertaken to produce a consistent higher-grade output. ^{29 30}

Mining Lease Grant

Mining lease applications for the FE1 resource and the Mt Narryer ore body were lodged in 2017 followed by successful completion of mining agreements in April 2018 with the Wajarri Yamatji Native Title Group. Lodgment of State Deeds and Grant of mining leases M09/166 (FE1) and M09/168 (Mt Narryer) were completed on 11th of April 2018 and was a major step towards production. ^{31 32}

Flagship FE1 Engineering Design Stage 2

In April 2018 the Company announced the results of processing pilot trials conducted by the Xinhai Mining Development and Design Company in China demonstrating the magnetite concentrate could be reliably processed to produce High Purity magnetite, (**HPFe**), product **71.5%Fe < 72%Fe** from the FE1 resource and the and Mt Narryer ore body. The pilot trials also showed a Super Purity magnetite, (**SPFe**), product of **>72%Fe** could be reliably produced from the FE1 resource.

GR Engineering took a leading role in cooperation with the Xinhai Mining Development and Design Company overseeing the **FE1** engineering design of a full-scale processing plant for a conceptual throughput for magnetite concentrate at 71%Fe, inclusive of detailed metallurgy and ore characterisation carried out by Xinhai. The study included preliminary scope of capital expenditure and operating cost with detailed processing plant design, preliminary pit design, energy requirements and supply, water reclaim and consumption, and mine site layout. The outcomes of this work intended for inclusion in the feasibility study to be published once the FE1 resource is at a JORC 2012 compliant, Indicated MRE. ^{33 34 35 36}

Key Developments Completed Toward Project Feasibility Study

Hydrology

The Company identified a paleo channel associated with the Yarra Yarra Creek within 5 kilometers of the FE1 mining lease. Three drill holes have confirmed significant water volumes of suitable quality to a channel depth of 157m. Geophysical surveys have defined the channel over a linear extent of greater than 50km.

²⁹ [Byro 5M tpa Plant Prefeasibility Study](#)

³⁰ [Quarterly Activities Report - September 2011](#)

³¹ [Mining Leases Granted M09/166 and M09/168](#)

³² [Byro Magnetic Characterisation Results](#)

³³ [Byro Metallurgy - Super Purity Magnetite](#)

³⁴ [Retraction of Production Targets](#)

³⁵ [Byro Project Update](#)

³⁶ [Quarterly Activities Report - June 2019](#)



A desktop study was completed following the discovery of the paleochannel and included water mass balance investigations. The Water Supply Scoping Study was undertaken by Athena Resources in cooperation with Pennington and Scott. The study revised the makeup water requirement for processing and remainder of operations at 2 Gigalitres per annum allowing for the super purity processing to achieve grades of >71%Fe. The desktop study was sufficiently positive to warrant planning for a H3 Hydrogeological Report and H3 Water License application yet to be completed for inclusion in the Feasibility Study. ³⁷

Environment Studies

Flora

Detailed Level 2 flora surveys have been completed at the FE1 and Mt Narryer mining leases. The surveys included government database searches including DPAW data sets with Threatened Ecological Communities (TEC) and Priority Ecological Communities (PEC). The mining lease surveys were completed in accordance with the Guidelines for Mining Proposals in Western Australia. The surveys examined data necessary to assess impacts to flora and vegetation in accordance with Environmental Protection Authority (EPA), Technical Guidance and Flora and Vegetation Surveys, and Environmental Impact Assessment. ³⁸

The surveys included areas proposed for the open pits, waste rock stockpiles, processing facilities, workshops, fuel farm, tailings storage facilities, bore field - water pipeline and power supply corridors, water storage ponds and camp area. The surveys included a linear corridor for the haul roads consistent with guidance requirements including a 500m buffer on either side of the haul road.

No threatened or endangered species were identified. There are several Priority 3 species identified within the mining leases however, substantial populations were mapped in the surrounding region outside the mining leases. Although P3 species are not a game stopper, the Company has been advised on measures and strategies to reduce the impact as a matter of due diligence to be included in the Environmental Impact Assessments.

Fauna

Level 1 Targeted Fauna surveys have been completed to identify if any threatened or endangered species are resident within the mining leases. No threatened or endangered species were identified. There were priority species identified and a detailed Level 2 survey is required to make environmental impact assessments and mitigations.

Climate and Surface Condition

High-definition aerial digital terrane modelling has been completed using a light photometry multi-rotor drone to determine topography sufficient to calculate surface modelling, disturbance volumes, drainage patterns and surface waterflow mitigations. Rainfall data has been acquired from records that date from 1898 – 2022 to be correlated with the detailed surface topography for mine site development. Temperature and solar monitoring data has also been acquired through the period 1990 – 2022.

Environmental Impact Study

Rangeland condition monitoring data has been acquired and will be included with flora, fauna climate and surface data as baseline datasets for in the Environmental Impact Study.

³⁷ [Quarterly Activities Report - March 2019](#)

³⁸ [Quarterly Activities Report - December 2018](#)



Transport Corridor

Road

Assessment of the Byro Project transport corridor has been undertaken with the collective involvement of the Murchison and Geraldton shires and Main Roads WA, (MRWA). In 2019 MRWA completed a survey of the route from mine site to port and in the process added the route to the Random-Access Vehicle (RAV10) Network Corridor within WA, paving the way for the use of concessional loaded quad road trains to deliver product to the port.

Port

The Port of Geraldton is a recognised and experienced port for iron ore handling and shipment with current capacity to cater for the Byro product. The port facilities were deemed suitable for handling the Byro product following a review by the Port Authority and Athena Resources in consultation with GR Engineering, 2016 -2018.

Product and Market Identification

Magnetite concentrate from processing pilot trials, was screened, and set aside to develop industrial products for a variety of markets. Markets identified are: ³⁹ ⁴⁰ ⁴¹ ⁴² ⁴³

- High Grade – low impurity magnetite for supply to Green Steel manufacturing.
- Magnetite catalyst for production of ammonia, and Gas to Liquide synthesis (GLF).
- Magnetite for supply to the 3D Metal Printing and Laser Welding.
- Magnetite for Dense Media Separation (DMS).
- Magnetic property characterisation for product retrieval.
- High Grade – low impurity magnetite for supply to the Powder Metal Industry (PMI).
- Magnetite Counterweight Aggregate.

Consumers of these products have been approached and received samples of the developed products. All companies approached have indicated a high level of interest and are looking forward to the Company's development towards mining and potential offtake opportunities.

Development timelines of the Byro project have become aligned with increasing industry action towards low carbon emission steel production and shifting focus from traditional hematite to magnetite. It is expected demand for suitable high grade low impurity feed stock will increase as Green Steel production increases. The Byro Magnetite Project is a boutique size development of high value that does not carry the exorbitant processing plant costs. It is anticipated following completion of the Company's, Project Feasibility Study, development towards mining approvals could take as little as 12 months followed by an estimated 12-month construction period.

In-house industry initiatives are paralleled by Federal and State Government efforts including the Australian Renewable Energies Agency, (ARENA) and the iron ore-to-steel value chain being investigated by the Minerals Institute of Western Australia (MRIWA), and supported by a \$527,445 contract awarded to GHD Group backing up a government commitment to net zero carbon emissions by 2050.

³⁹ [Byro Magnetic Characterisation Results](#)

⁴⁰ [Byro Magnetite for Dense Media Separation](#)

⁴¹ [Byro Magnetite DMS Marketing](#)

⁴² [Byro Dense Aggregate Magnetite](#)

⁴³ [Byro Project Update](#)



Current work commenced through MRIWA into the viability of sustainably processing Western Australian iron ore to green steel, and the inputs necessary to create green steel. Work is examining regional infrastructure needs, market dynamics and policies needed to ensure the State has a comprehensive understanding on creating green steel. Athena Resources have met with MRIWA to discuss the attributes of the Byro Magnetite Project and favorable timing to fit into the Green Steel shift in the Midwest.

Edmond Edwards Executive Director of Athena Resources has authorised release of this announcement on behalf of the Board to the ASX.

Yours faithfully
Ed Edwards

Executive Director
Athena Resources Limited

Competent Persons Disclosure

Mr Kelly is an employee of Athena Resources and currently holds securities in the company.

Competent Person Statement

The information included in the report was compiled by Mr Liam Kelly, an employee of Athena Resources Limited. Mr Kelly is a Member of the Australasian Institute of Mining and Metallurgy, and has sufficient relevant experience in the styles of mineralisation and deposit styles under consideration to qualify as a Competent Person as defined in "The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code 2012 Edition)". The historical information included is compliant with the relevant JORC Code, 2004 Edition, and new information announced post that version of the JORC Code is compliant with the JORC Code 2012 Edition. Mr Kelly consents to the inclusion of the information in the report in the context and format in which it appears.

Athena Resources Limited