

## Dysprosium still key in delivering optimal performance and efficiency

### Highlights

- Dysprosium remains a key component in the manufacture of NdDyFeB permanent magnets which power high performance, clean energy applications.
- Opportunity to deliver an expanded range of heavy rare earth products to market.
- Offtake Memorandum of Understanding signed with Jien Mining.
- Increased revenue opportunity from sale of lutetium.
- Processing cost improvements identified through removal of yttrium.

Northern Minerals Limited (ASX: NTU; Northern Minerals) is pleased to provide an update on its marketing activities since delivery of the Browns Range Project's Definitive Feasibility Study (DFS) on 2 March 2015.

The marketing team has undertaken a number of activities which include visits to potential customers, rare earth end users and potential toll separators and metal makers, several marketing workshops with specialised market and industry experts, and appointment of an industry expert to assist in guiding the sales and marketing strategy.

This work has enabled Northern Minerals to expand the Browns Range Project's (the Project) marketing strategy to offer a range of specialised, heavy rare earth products. It has also identified an opportunity for increased revenue through the sale of lutetium and confirmed that dysprosium remains a critical element in the production of permanent magnets that power high performance, clean energy applications. Understanding the product offerings has enabled Northern Minerals to segment the market based on product needs and specifically target each potential customer with specific requirements. This work, plus visits to potential toll separators and metal markers, has allowed for the development of cost pricing for each discrete product which will assist Northern Minerals in the negotiation of sales contracts.

Northern Minerals' Managing Director, George Bauk, said the significant amount of work undertaken in relation to marketing this year has guided Northern Minerals' marketing efforts, including expansion of its product portfolio.

"Following the completion of the DFS, our focus has been on marketing, finance and project approvals. To support our marketing efforts we have expanded the marketing team to include technical, communication and finance specialists to drive our strategy forward."



### Powering Technology.

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“Since the DFS, we have extended our product offerings to include the sale of individual oxides and metals, as well as a mixed rare earth carbonate. This has opened doors to a new range of possibilities and allows us to diversify our potential customer base. Of major significance is the potential for additional revenue through the sale of lutetium.”

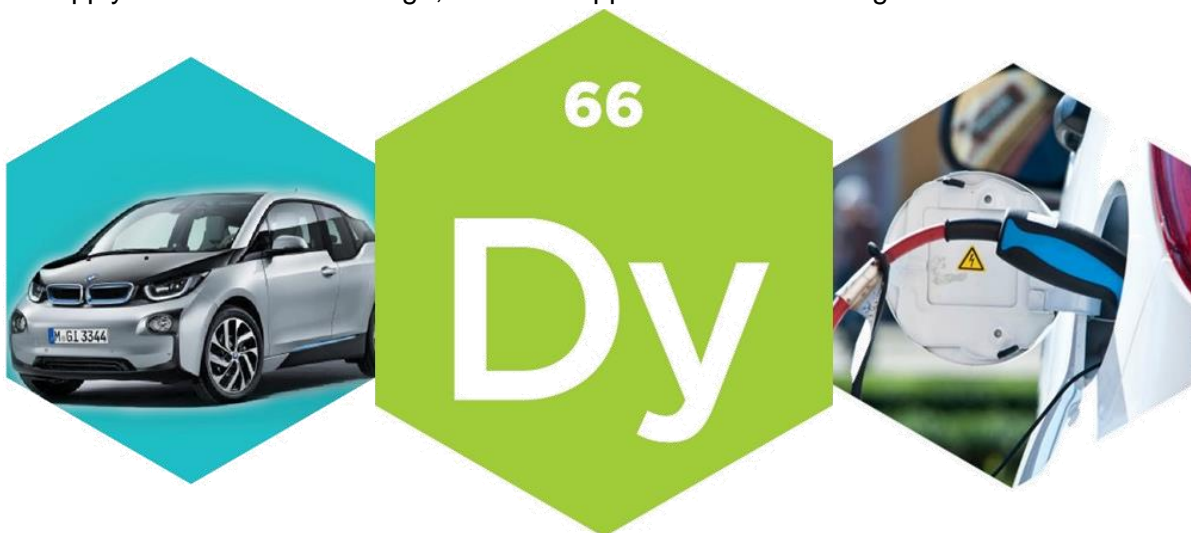
### Dysprosium market update

Discussions with potential offtake partners during recent marketing trips confirms that dysprosium remains an essential ingredient in the manufacture of neodymium-dysprosium-iron-boron permanent magnets (permanent magnets) that power high performance applications. This is because of the positive effect dysprosium has on the magnet's coercivity at higher temperatures. Its addition means that permanent magnets can be smaller, lighter, quieter and more efficient, which are essential attributes for many of today's clean energy applications such as hybrid vehicles, wind turbines, and electric bikes and motors.

While there has been research and development undertaken to find more readily available substitutes for the use of dysprosium in permanent magnets, Northern Minerals' market research, which includes discussions with magnet makers and industry experts, indicates that dysprosium remains a key element in the production of permanent magnets that power certain applications. It is understood that while substitutions may be possible for some applications, this is limited and has not been proven commercially for many other applications that are reliant on dysprosium to achieve optimal efficiency.

While current dysprosium oxide prices are low, Northern Minerals remains confident in the long term market fundamentals. Price forecasting suggests by the time the Project comes online in 2018, dysprosium prices will be firmer as global demand for these applications grows, and illegal supply is reduced. In June 2015, an update from Adamas Intelligence, forecasted that the permanent magnet sector is expected to increase at a cumulated annual growth rate (CAGR) of 7.3 per cent to 2020, driven by strong demand for these clean energy applications.

A key contributor to this growth is the increasing global concern for the depletion of natural resources and climate change. This, coupled with the significant economic and environmental savings, has increased investment in the research and development of clean and renewable energy applications. The increased availability of dysprosium, through new and secure sources of supply such as Browns Range, will also support further technological innovations.

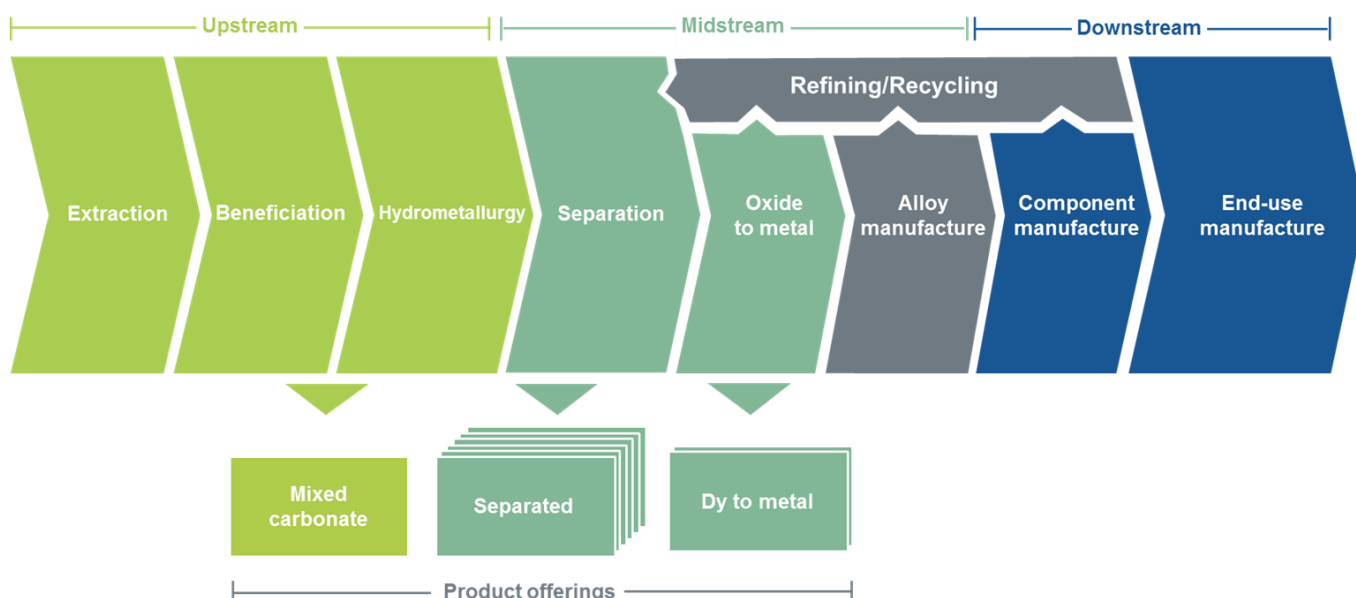


## Enhanced marketing strategy

Following meetings held with potential offtake partners during 2015, Northern Minerals has refined its market strategy, with the opportunity to offer a range of products from the Project, including mixed rare earth carbonate, individual rare earth oxides and DyFe metal. Northern Minerals will enhance its product range through entering into toll treating agreements with separators and metal makers.

Figure 1 below outlines the marketing approach, with the light green (extraction, beneficiation and hydrometallurgy) representing the processes directly under control of Northern Minerals, while the “separation” and “oxide to metal” processes are those that Northern Minerals plans to contract out to toll treating partners.

**Figure 1: Enhanced marketing strategy**



## Offtake MOU signed with Jien Mining

Northern Minerals recently signed a Memorandum of Understanding (MOU) with Jien Mining Pty Ltd (Jien Mining) in relation to product offtake from the Project. The MOU is conditional upon completion of the proposed placement to Jien Mining, first announced on 18 February 2015.

Under the MOU, Northern Minerals agrees to sell and Jien Mining agrees to purchase 50 per cent of the Project's offtake on terms, including price and product specification, to be finalised in a definitive offtake agreement.

This undertaking includes an exclusivity period over this 50 per cent interest ending at the earliest 30 June 2017. As part of the MOU Northern Minerals and Jien Mining will commence discussions, in good faith, to agree on the joint marketing of their respective shares of product under a commercial structure.

This is a significant step forward in Northern Minerals' product offtake strategy and reconfirms Jien Mining's ongoing commitment to realising the Project's potential.

## Lutetium to contribute to project revenue

Northern Minerals has received specific market interest in securing supply of lutetium for use in medical imaging applications such as positron emission tomography (PET) scanners. With limited supply globally, manufacturers are using less optimal alternatives in the production of these technologies. Lutetium, a heavy rare earth element, was not considered a revenue attributing element in the DFS and this new interest provides a significant opportunity for additional revenue. As per the DFS, the Project is forecast to produce approximately 21,000kg of lutetium per annum and with a current market price of US\$836/kg (Asian Metals, 24 August 2015), lutetium has the potential to be an important revenue contributor to the Project.

The marketing team has developed a strategy to engage with potential customers and begin discussions for potential offtake of lutetium.

### Why lutetium?

Research indicates using lutetium in the detectors of PET scanners can provide significant advantages. PET scanners are a medical imaging procedure used in the fields of neurology, oncology and cardiology.

Scintillator crystals are used to detect the gamma-rays emitted by a radiotracer, and to date, only a few scintillator crystal combinations have been widely used. A recent study has found that the combination of cerium-doped lutetium oxyorthosilicate (LSO) scintillators outperform all previously used combinations.

LSO use in PET scanners provides 3D imaging capability and results in shorter scan times which reduces the patient's exposure to radiation with good gamma-ray detection efficiency.



## Removal of yttrium during hydrometallurgical process

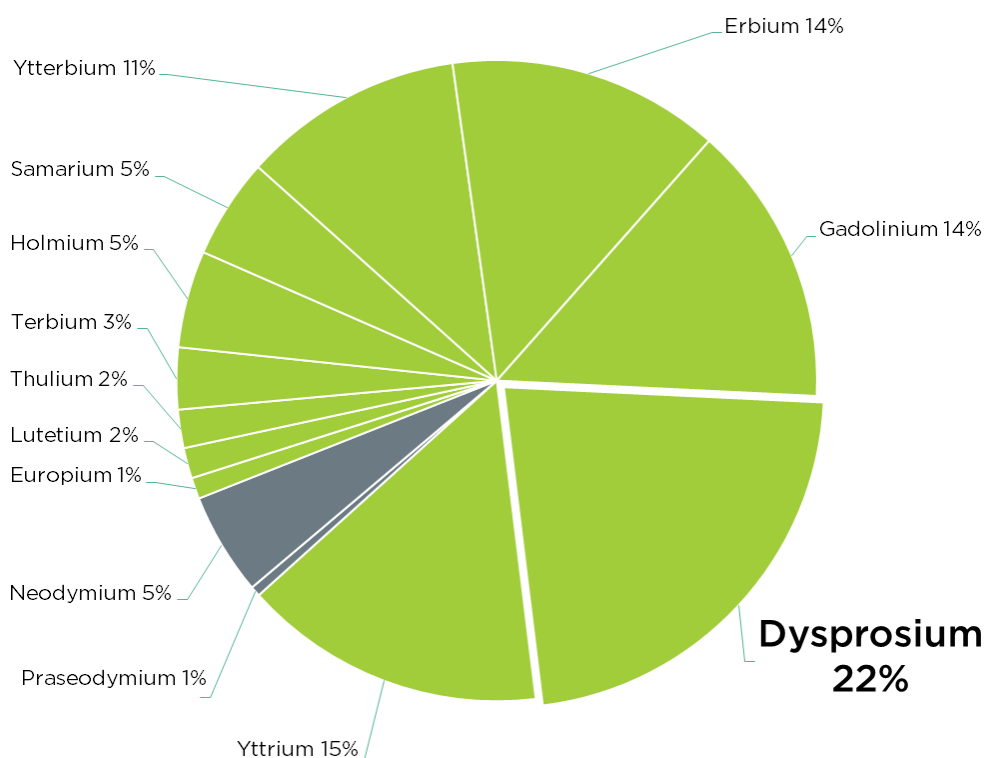
Northern Minerals believes there is significant opportunity to reduce downstream solvent extraction (SX) separation costs, by separating yttrium in the hydrometallurgical process. Removing approximately 90 per cent of the yttrium, which represents 62 per cent of the total TREO distribution, results in less mixed rare earth carbonate being produced. With less material required to be processed through the downstream SX separation process, this delivers a reduction in cost.

Completion of initial testwork at ANTISO Minerals has indicated that removal of yttrium, lanthanum and cerium can be achieved through a relatively simple addition to the hydrometallurgical process prior to mixed rare earth carbonate precipitation. Following these promising results, Northern Minerals has commenced a scoping level study, which includes bench scale testwork, to further test this concept.

With the current market signals indicating that sale of the yttrium oxide is likely to be limited for the foreseeable future, the yttrium removal step will increase the percentage of the dysprosium in the mixed rare earth carbonate product from 9 per cent Dy/TREO to 22 per cent Dy/TREO, see Figure 2, while still retaining a portion of yttrium for sale to potential customers.

Bench scale testwork at ANTISO Minerals is scheduled to finish mid-September, with the scoping study expected to be complete in the third quarter of this year. Northern Minerals plans to upscale this process to pilot plant level for a definitive feasibility study to be completed in the first quarter of 2016.

Figure 2: Mixed rare earth carbonate distribution after yttrium removal





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### About Northern Minerals:

Northern Minerals Limited (ASX: NTU; Northern Minerals) is focussed on the delivery of the heavy rare earth (HRE) element, dysprosium. Northern Minerals has a large landholding in Western Australia and the Northern Territory that is highly prospective for this element. Through the development of its flagship project, the Browns Range Project (the Project), Northern Minerals aims to be the first significant world producer of dysprosium outside of China.

The Project is 100% owned by Northern Minerals and has a number of deposits and prospects containing high value dysprosium and other HREs, hosted in xenotime mineralisation. Dysprosium is an essential ingredient in the production of NdDyFeB (neodymium-dysprosium-iron-boron) magnets used in clean energy and high technology solutions. As a result of increasing global demand for these applications dysprosium supply is critical. The Project's xenotime mineralisation facilitates the use of a relatively simple and cost effective processing flowsheet to produce a high value, high purity dysprosium rich product.

Completion of the Definitive Feasibility Study in February 2015 confirms the Project is economically and technically viable. Construction is targeted to commence at the Project in 2016, followed by production in 2018 to produce a high purity mixed rare earth (RE) carbonate for export.

Exploration continues at Browns Range (WA and NT), and is also underway at the geologically similar John Galt and Boulder Ridge projects. For more information [northernminerals.com.au](http://northernminerals.com.au).

