“Tens of thousands of South Australians work in the mining industry and the supply chain companies and fabricators that ship our resources to the world to build the structures of the future.

Our ambition is to build on this strong foundation and make South Australian magnetite the world’s choice for steelmaking.”

**Tom Koutsantonis MP**  
Minister for Mineral Resources and Energy
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The goals of the Magnetite Strategy are to secure $10 billion of committed investment in major magnetite projects to enable production to begin by 2021; and for the industry to ramp up to 50 million tonnes of annual production by 2030.

These objectives will drive community benefits such as new jobs, significant investment in infrastructure, increased royalties to fund Government services and economic opportunities for regional communities, including Aboriginal stakeholders.

The South Australian Government’s key role is to create a business environment that attracts the tens of billions of dollars of investment required to plan, commission and deliver high quality magnetite projects.

This document outlines key findings to date from the research undertaken and provides broad direction for further development of the South Australian Magnetite Strategy.

We are seeking your input to the Magnetite Strategy so that your ideas can help shape the final document.

You can provide feedback through the Magnetite Strategy website: 
minerals.statedevelopment.sa.gov.au/magnetite_strategy

or contact the Department of State Development on +61 8 8303 2298 or DSD.MagnetiteStrategy@sa.gov.au by the end of March 2017.

“Your feedback will play an important role in shaping the final strategy and so I urge all South Australians interested in unlocking the full potential of our resources sector to add their input into this nation-building vision for our State.”

Tom Koutsantonis MP
Minister for Mineral Resources and Energy
Making South Australian magnetite the world’s choice for steelmaking

Iron ore sourced from South Australia’s Middleback Ranges has been the foundation of the nation’s steelmaking industry.

Magnetite mined in South Australia is fed into the steelworks at Whyalla to create structural steel used on major projects across Australia.

South Australian steel manufactured in Whyalla from South Australian magnetite has been used to upgrade the rail track between Adelaide and Tarcoola and has supported major developments such as the Adelaide Oval redevelopment and the Northern Connector.

Experience has shown that iron ore mining and steelmaking underpin regional jobs and support nationwide investment.

Tens of thousands of South Australians work in the mining industry and the supply chain companies and fabricators that ship our resources to the world to build the structures of the future.

Our ambition is to build on this strong foundation and make South Australian magnetite the world’s choice for steelmaking.

South Australia’s magnetite resources are located throughout the State from just south of Coober Pedy to the Eyre Peninsula and right through the Mid North to our border with New South Wales.

The South Australian Government has set an ambitious target to deliver $10 billion of committed investment to unlock the potential of our magnetite resource.

By planning now for the expected uptake in demand we can put South Australia on a pathway toward producing 50 million tonnes of magnetite a year by 2030.

Investment in long-life mines creates job opportunities at the mine site as well as in the construction of the rails, roads, ports and pipelines that will carry our product to the world’s steelmakers.

These projects create high-paying, highly-skilled jobs in regional areas of the state and open up economic opportunities for local stakeholders including Aboriginal communities.

Securing the future for Whyalla as a steelmaker and exporter is only one element of the Magnetite Strategy. The Magnetite Strategy will help prospective exporters to identify and secure markets for South Australian processed products.

This Directions Paper is an opportunity to have your voice heard on the development of this long-term, comprehensive Magnetite Strategy.

Your feedback will play an important role in shaping the final strategy and so I urge all South Australians interested in unlocking the full potential of our resources sector to add their input into this nation-building vision for our State.

Tom Koutsantonis MP
Minister for Mineral Resources and Energy
For half a century, South Australia was the main source of ore for Australia’s iron and steel industry.

Today Australia is a major exporter of iron ore from the direct shipping ore (DSO)-rich Hamersley Range in Western Australia’s Pilbara region, overshadowing the nation-building accomplishments of South Australia’s recent past. Dormant as an exporter since the 1960s, South Australia re-emerged as a supplier of iron ore on the back of demand from Asia, which in turn sparked a resurgence in exploration activity. Increased exploration led to the discovery of a number of new iron ore deposits beyond the Middleback Ranges to include the Gawler Craton and the Braemar province. More than 90 per cent of South Australia’s iron ore is magnetite and collectively represent an estimated 14 billion tonnes of untapped wealth for all South Australians.

Unlike haematite, which can be direct shipped to steelmakers, magnetite ore needs to undergo a process to improve its economic value and make it suitable for use in blast furnaces and direct reduction steelmaking plants. This beneficiation process creates a concentrate that adds value to the ore and transforms the magnetite into a high-quality feedstock for the production of low-impurity, premium-quality steel. South Australia now has an opportunity to harness its creativity and innovation to develop a premium magnetite product. Identifying and securing new markets for this valuable magnetite resource will also encourage investment in developing our abundant supply of ore.

By unlocking the inherent value of our magnetite wealth, South Australia’s goal is to double our current 2 per cent share of our national export tonnage to 4 per cent. The doubling of export share equates to an increase in annual iron ore production rate from 11.5 million tonnes in 2014 to 50 million tonnes by 2030. The value added to our product before export, and its status as a premium product by global steelmakers, will be our comparative advantage. The South Australian Government is now seeking to engage with all stakeholders in the development of our South Australian Magnetite Strategy. The Strategy will provide a road map that can be used to steer our way to success. We look forward to your contribution.

Dr Ted Tyne
Executive Director, Mineral Resources Division, Department of State Development
Iron ore going through Arrium Mining's crushing and screening plant at its South Middleback Range operations. Photograph by Sean Kelly, courtesy of Arrium Mining
Global demands for steel and iron ore are expected to continue to grow with steelmakers looking to magnetite product as an alternative feedstock to complement direct shipping ore.

With future demand for magnetite concentrated within China, India and South East Asia, South Australia’s Magnetite Strategy aligns to the South Australian Government’s international engagement strategies within these regions.

**OUR VISION**
South Australia – the foremost global source of quality magnetite product for steel making.

**OUR PURPOSE**
To work with investors, explorers, research institutes, supply companies, landowners and remote and regional communities to identify international markets and potential buyer demand and develop a comprehensive Magnetite Strategy to maximise economic opportunities for South Australia.

South Australia’s Magnetite Strategy

**Goals**

**AMBITIOUS TARGET TO DELIVER**

**$10 BILLION**
OF COMMITTED INVESTMENT TO UNLOCK THE POTENTIAL OF THIS RESOURCE

**PRODUCING**

**50 MILLION TONNES**
OF MAGNETITE A YEAR BY 2030

We must plan now to take advantage of the opportunity.
Australia has a well established reputation as a supplier of quality iron ore and is the second largest iron ore producer behind China.

High-grade haematite ore, also known as direct shipping ore (DSO), is mined, crushed and screened in Western Australia’s Pilbara region and South Australia’s Middleback Ranges and then transported to a port for export to steelmakers. DSO grades from the Pilbara region are generally 56 per cent to 62 per cent iron.

Magnetite ores also require initial crushing and screening, but then undergo a second stage of processing to produce a concentrate. Further processing of the concentrate produces pellets and sinter that can be fed directly into blast furnaces and electric arc furnaces including direct reduction steelmaking plants.

Pellets produced from magnetite contain 65 per cent to 70 per cent Fe, an iron grade significantly higher than DSO exported from Western Australia. Magnetite pellets contain lower levels of impurities, such as phosphorous, sulphur and aluminium compared to DSO. Magnetite pellets are premium products which attract higher prices from steelmakers which can offset the higher costs of production.

Strong global demand for steel in recent years has sparked renewed exploration which has led to an increase in Australia’s Economic Demonstrated Resources (EDR) of iron ore. Magnetite now represents nearly half of the nation’s total EDR and South Australia accounts for around 26 per cent of that total. Industry trends point toward an opportunity to expand the role of South Australian magnetite in the global iron ore trade.

Furthermore, as the grade of haematite gradually declines in the medium to long-term, magnetite offers a viable alternative to DSO that could cement South Australia as major global supplier of premium magnetite products. A Magnetite Strategy will assist South Australia to achieve that ambition.

**Magnetite production flow chart**

Image courtesy of the Magnetite Network (MagNet)
Environmental advantages of magnetite in steelmaking

In 1950, about two-thirds of the world’s population lived in rural areas. By 2050, this will have reversed with the majority of people residing in cities as a result of the vast urbanisation occurring in Asia and Africa. The projected urban migration of 2.5 billion people in the next few decades will bring a concomitant demand for steel and iron ore to provide city dwellers with housing, transport and power.

The unparalleled majority of this urbanisation is occurring on our doorstep in China, India and Southeast Asia. However, unlike the urbanisation in the West during the 1800s, environmental concerns are now paramount in urban planning and design. South Australia, with our abundant magnetite resources, can play a role in addressing these concerns.

As the largest consumer of coking (or metallurgical) coal, global steel production accounts for 6.5% of all CO₂ emissions (IEA 2010).

Magnetite concentrate can significantly reduce energy consumption during steelmaking as it releases heat during the smelting phase. The net environmental benefits of using magnetite concentrate rather than DSO throughout the production cycle from mine to steel products is 108kg of CO₂ emissions prevented for each tonne used in place of haematite fines.¹

Magnetite concentrate is already used in South Australia as a feedstock for the Whyalla steelworks.

With only two operating magnetite mines in South Australia, unlocking the state’s vast, soft, shallow magnetite ore bodies represents an untapped opportunity for this State to assist in the worldwide reduction in greenhouse gas emissions required as nations work toward delivering their commitments under the COP21 Agreement signed in Paris.

South Australia is blessed with vast iron ore resources with superior characteristics such as being comparatively softer with a larger grind size and placement of mineral deposits. More than 90 per cent of South Australia’s iron ore is magnetite. With only two operating magnetite-producing mines and up to 15 projects in development, South Australia’s 14 billion tonnes or more of magnetite assets remains largely untapped.

There are multiple highly prospective areas of the State containing significant, large tonnage magnetite resources comprising Eyre Peninsula, the Braemar province and the Far North. A significant amount of confirmed magnetite deposits have already been identified under project development proposals which together could sustain production for decades.

Adopting a strategy that positions magnetite projects to take advantage of an anticipated turn in the world iron ore pricing cycle will enable South Australia to be in prime position to benefit from the upswing in the market. Such a strategy also requires identifying and securing potential markets for magnetite premium product from South Australia.

### Developing South Australia’s magnetite production capacity

#### Operational mines and major projects in the pipeline

<table>
<thead>
<tr>
<th>Owner</th>
<th>Arrium Ltd</th>
<th>Cu-River Mining Australia P/L</th>
<th>Iron Road Ltd</th>
<th>Magnetite Mines Ltd</th>
<th>Havilah Resources Ltd</th>
<th>Carpentaria Exploration Ltd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Middleback Ranges (operating mine)</td>
<td>Mt Woods Magnetite Project (operating mine)</td>
<td>Central Eyre Iron Project (major project)</td>
<td>Mawson Iron Project (major project)</td>
<td>Maldorky</td>
<td>Hawsons Project</td>
</tr>
<tr>
<td>Region</td>
<td>Eyre Peninsula</td>
<td>Far North</td>
<td>Eyre Peninsula</td>
<td>Braemar</td>
<td>Braemar</td>
<td>Western NSW</td>
</tr>
<tr>
<td>Total resource</td>
<td>179 million tonnes</td>
<td>569 million tonnes</td>
<td>4.5 billion tonnes</td>
<td>2.7 billion tonnes</td>
<td>147 million tonnes</td>
<td>1.8 billion tonnes</td>
</tr>
<tr>
<td>In-situ Fe Grade (%)</td>
<td>35</td>
<td>27.1</td>
<td>15.5</td>
<td>18.2</td>
<td>30.1</td>
<td>15</td>
</tr>
<tr>
<td>Projected Concentrate Fe Grade – DTR (%)</td>
<td>67</td>
<td>68.5</td>
<td>67</td>
<td>67</td>
<td>67</td>
<td>70</td>
</tr>
<tr>
<td>Projected Production Rate (million tonnes per annum)</td>
<td>1.8 (current)</td>
<td>0.9 (current) +4.5 (projected)</td>
<td>21.5</td>
<td>25</td>
<td>2.4</td>
<td>10</td>
</tr>
<tr>
<td>Life of mine (years)</td>
<td>10</td>
<td>20</td>
<td>25</td>
<td>25</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Major infrastructure required</td>
<td>Existing</td>
<td>Existing</td>
<td>Railway, deep sea port</td>
<td>Slurry pipeline, floating port</td>
<td>Haul road to rail line Port</td>
<td>Slurry pipeline to rail line Port Development</td>
</tr>
</tbody>
</table>
South Australia’s iron ore deposits
(source SARIG)

Above map indicates haematite and magnetite resources
South Australia is the birth place of Australia’s steel industry and has an opportunity to secure a place in the world’s iron and steel supply chain.

Minister for Mineral Resources and Energy Tom Koutsantonis convened the first Magnetite Strategy workshop in May 2016 to gauge support for the Government’s vision for the industry.

Attended by 61 participants comprising representatives from industry, the supply chain, local government and various sectors of State Government, the workshop sought to identify the opportunities and obstacles to developing a long-term, comprehensive strategy.

For the first time, representatives from a range of mineral resources and services sectors gathered to begin discussions on the actions to be taken to maximise the economic benefits of the State’s abundant magnetite resource.

South Australia only produces about 2 million tonnes of magnetite a year and the consensus at the workshop was that the State could attract significant investment, build valuable infrastructure and create jobs and economic opportunities for service suppliers by working together to boost production to 50 million tonnes. Such an ambition required a strategy that targets global investment and finance companies, global traders and steelmakers and persuasively sets out the wider benefits to the South Australian community.

The workshop identified the challenges and opportunities across three key areas:

- Comparative advantages of mining and processing magnetite in South Australia
- Market considerations to meet future global demand
- Stakeholder involvement – who needs to be involved.

The Department of State Development collated the feedback gained from these discussions to identify the further actions required to better inform a coherent and collaborative strategy.

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MORE THAN 90% OF SOUTH AUSTRALIA’S IRON ORE IS MAGNETITE LOCATED IN SEVERAL PROSPECTIVE AREAS OF THE STATE STRETCHING FROM THE EYRE PENINSULA TO THE BRAEMAR PROVINCE.

ONLY ABOUT 2 MILLION TONNES OF MAGNETITE IS MINED EACH YEAR FROM SOUTH AUSTRALIA FOR DOMESTIC USE AND EXPORT WHILE THERE ARE 15 MAGNETITE PROJECTS IN VARIOUS STAGES OF DEVELOPMENT.
What we learned

The workshop highlighted several key challenges and opportunities facing the development of a long-term, sustainable magnetite industry in South Australia.

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Challenges</th>
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<tr>
<td>• A marketing strategy – Brand South Australia</td>
<td>• Power – supply and price</td>
</tr>
<tr>
<td>• Abundant, good quality soft magnetite resources</td>
<td>• Gas – supply and price</td>
</tr>
<tr>
<td>• Supportive government – regulatory environment / case management / knowledge transfer</td>
<td>• Water – state supply</td>
</tr>
<tr>
<td>• Existing infrastructure – currently under-utilised capacity</td>
<td>• Community engagement / social licence to operate</td>
</tr>
<tr>
<td>• Further development of the Whyalla Port</td>
<td>• Infrastructure enhancement – rail / port / pipelines</td>
</tr>
<tr>
<td>• Low geopolitical risk – easier to do business</td>
<td>• Land access – in particular infrastructure corridors</td>
</tr>
<tr>
<td>• Research – comparative advantage, supply (other markets) and demand</td>
<td>• Competitiveness with DSO producers in Western Australia and the world</td>
</tr>
<tr>
<td>• Industry collaboration – research and development</td>
<td>• Tailings management in the environment</td>
</tr>
</tbody>
</table>

“South Australia now has an opportunity to harness its creativity and innovation to develop a premium magnetite product. Identifying and securing new markets for this valuable magnetite resource will also encourage investment in developing our abundant supply of ore.”

Dr Ted Tyne
Executive Director, Mineral Resources Division,
Department of State Development
Three key themes were identified at the Magnetite workshop as providing a solid basis for positioning South Australia in the global magnetite product supply chain.

- Supporting independent research to assess and identify South Australia’s magnetite resources and its comparative advantages to global suppliers – against our potential competitors in Australia and global players
- Identifying international market demand and trends to determine potential export destinations for South Australian magnetite
- Marketing South Australia’s comparative advantages across the global supply chain for magnetite product to attract investment and become the global source of quality magnetite product.

In response, the Department of State Development commissioned Professor Bill Skinner, Research Leader - Minerals and Resource Engineering, Futures Industries Institute at the University of South Australia to explore the first theme. International market analysts, CRU then provided expert insight on the second theme.

Together the independent analyses and the feedback to this issues paper will inform the approach taken to developing the third theme as well as the overall strategy.
Theme 1 - Findings of research

Working in partnership with the University of South Australia, Theme 1 examined the comparative attributes of South Australia’s magnetite resources against Australian and global competitors with the aim of identifying comparative advantages. The research spanned the value chain from the resource deposit to the customer steel mills.

The findings will better position our producers to:
• Exploit identified advantages whilst assisting investment attraction as the industry matures
• Assist projects to accelerate through the prefeasibility and development cycle as they progress towards production.

The research also produced base layer mapping of the State’s geological provinces to incorporate comparative and competitive attributes from the resource deposit to the steel mill.

Research methodology

The assessment across the value chain included assessment for:
• Characteristics of resource deposits and magnetite products
• Cost breakdowns from mining, processing and export supply chains to the steel mill
• Cost curve comparisons for South Australia, Australia and other global projects
• Gaps and attributes impacting on comparative advantage in South Australia.

Key outcomes

South Australian deposits of magnetite are generally softer, with low overburden depths providing potential advantages in efficiencies for mining ore and processing, given the lower energy requirements to produce a product.

The magnetite product is able to be produced in benefaction processes at advantageous grades and with lower impurities – a quality product adding value in steel mill efficiencies. The South Australian products can supply emerging global markets for pellet and pelletised feed into steel mills.

South Australia’s geographical location is closer to the major emerging markets with shorter shipping distances.

South Australia also has milder weather in comparison with Western Australia and is not affected by the annual monsoon season resulting in more reliable shipping schedules.

South Australia is in the top 10 Fraser Institute rating as a mining friendly jurisdiction with an efficient mining assessment and approval process.

Magnetite production already exists at Arrium’s Whyalla operations, including processing facilities and a pellet plant, providing expertise in South Australian processing, with internationally-accredited quality analysis facilities. The existing industry has developed close relationships with the tertiary sector and CSIRO for research and development across processing technologies. This relationship between industry and the university sector has contributed to extensive and significant processing innovation from ore blending to pelletisation and an enhanced ability to fast track technology change to adapt to shifts in market demand.

The research also identified innovations in processing under development at the University of New South Wales, which aims to use recycled plastics to produce magnetite products that may improve the energy efficiency of blast furnaces.

Theme 2 - Findings market analysis

A review of the international market demand trends was sought to determine potential markets for South Australian magnetite products. The review included the identification of key global markets, potential customers including steelmakers and potential domestic and international competitors. The report provided intelligence on forecast demand volumes and product types.
Changing product demands

There are two basic methods of steel production; blast furnace (BF) and electric arc furnace (EAF). On a global scale, the preferred steelmaking technology is overwhelmingly BF (~66 per cent of global steel production). However, the imminent and unprecedented increase in scrap metal supply within China may result in significant market changes in the years ahead.

Higher pellet rate usage is expected in blast furnaces within China as productivity and profits become a focus of its steel sector. Environmental constraints on sintering have led to increased operating costs and the closure or modernisation of smaller sinter plants, which has benefited the pellet feed markets.

China’s “scrap age” and the changing landscape

The biggest shock to the global iron ore and steel sector is expected to come from an unprecedented increase in scrap supply driven by the demolition of buildings and infrastructure constructed in China during the late-1980s and early-1990s.

Scrap steel is generally recycled using EAFs and pellets are often used to supplement feedstock. A rapid surge in coke and coking coal prices in 2016 has seen a surge in pellet demand and prices. A shift to pellet feed by China may present some opportunities for pellet and pellet feed producers in Australia capable of producing a premium product.

Direct Reduction Iron (DRI) in India

Direct Reduction Iron (DRI) production is common in the Middle East, South America, India and Mexico. DRI offers an attractive option due to its small scalability and low capital requirements coupled with its ability to be customized to suit local feed material.

India is the largest producer of DRI in the world and is forecast to be the single largest driver of global steel demand growth in the next 20 years. There are a large number of DRI producers in India, and their numbers are continuously increasing.

The environmental benefits of DRI are well established with 90 per cent of the global DRI plants using natural gas which leads to lower CO2 emissions. In India, DRI production is primarily coal based and small scale operations are a barrier to more energy efficiency investments.

The environmental benefits of customised magnetite products as the primary feedstock for DRI steel production in India represents an opportunity that warrants further investigation.

Theme 3 - Market approach concepts

Despite the age and longevity of the iron ore and steel industry in South Australia, we lost the iron ore crown to Western Australia more than 50 years ago. Our competitive advantage is the quantity and quality of our magnetite resources. In order to capitalise on our natural endowment we must be more innovative in our market approach.

We will seek out potential customers and tailor our market approach to meet their specific needs. South Australia will be known globally as the pre-eminent producer of a superior magnetite product.

The market approach will be further refined during the development of the Magnetite Strategy.

Market Approach Concepts could include:

• Targeted approach to Investment Attraction South Australia
• Identification of niche markets
• Trade missions to key jurisdictions
• Media and marketing plan implementation.
How the strategy will be measured

The Magnetite Strategy will incorporate milestones to measure the success of progress toward the 2030 objectives.

These key milestones will also gauge the extent to which the South Australian community has benefited from the investment in the strategy such as:

• The achievement of committed investment into development of magnetite mining operations
• Approvals for mine development and supporting infrastructure
• Extent of local industry participation in construction and supply chain
• Export tonnages targets
• Total royalties paid to the South Australian Government.

The strategy will also include a mechanism to review its performance against these milestones and suggest any necessary changes to ensure flexibility in its implementation. This adaptive approach will ensure the strategy can respond to and adapt to global trends including advances in technology and will still deliver on its objective.

Next steps

Feedback > Due Friday 31 March 2017
Feedback is sought from stakeholders. You can provide feedback either through the Magnetite Strategy website at minerals.statedevelopment.sa.gov.au/magnetite_strategy or via email DSD.MagnetiteStrategy@sa.gov.au

Stage 1 > February 2017
Further workshops and targeted feedback from key stakeholders to identify actions and refine the Magnetite Strategy.

Stage 2 > April 2017
Marketing and communications plan developed and Magnetite Strategy released.

Stage 3 > May 2017
Implementation of Magnetite Strategy.
Investment into South Australia for long-life mining and export operations will be essential in producing significant volumes of high grade, quality magnetite product with low impurities. Processed magnetite is a high grade, clean and concentrated product that requires less energy for the steelmaking processes.

South Australia’s Magnetite Strategy will identify market opportunities for South Australian-processed products.