POSITIONED FOR EXCEPTIONAL GROWTH

MINERAL COMMODITIES LTD

NOVEMBER 2018

ASX: MRC | www.mineralcommodities.com

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The information in this presentation which relates to Exploration Results, Mineral Resources or Ore Reserves for Xolobeni is based on information compiled by Mr Allen Maynard, who is a Member of the Australian Institute of Geosciences ("AIG"), a Corporate Member of the Australasian Institute of Mining & Metallurgy ("AusIMM") and independent consultant to the Company. Mr Maynard is the Director and Principal Geologist of Al Maynard & Associates Pty Ltd and has over 37 years' of exploration and mining experience in a variety of mineral deposit styles. Mr Maynard has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the 2004 Edition of the Australasian Code for reporting of Exploration Results, Exploration Targets, Mineral Resources and Ore Reserves ("JORC Code (2004)"). This information was prepared and first disclosed under the JORC Code (2004). It has not been updated since to comply with the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves ("JORC Code (2012)") on the basis that the information has not materially changed since it was last reported. Mr Maynard consents to inclusion in the report of the matters based on this information in the form and context in which it appears.

The information in this presentation which relates to Exploration Results, Mineral Resources or Ore Reserves for Tormin is based on information compiled by Mr Adriaan du Toit, who is a Member of the AusIMM and was previously an independent consultant to the Company. Mr du Toit is the Director and Principal Geologist of AEMCO Pty Ltd and has over 26 years' of exploration and mining experience in a variety of mineral deposits and styles. Mr du Toit has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the JORC Code (2012).

The information from Mr du Toit was prepared under the JORC Code (2012). Mr du Toit consents to inclusion in the report of the matters based on this information in the form and context in which it appears.

The information in this presentation which relates to Mineral Resources for Munglinup is based on information compiled by Mr Adriaan du Toit who is a member of the AusIMM and an independent consultant to Gold Terrace Pty Ltd. Mr du Toit is the Director and Principal Geologist of AEMCO Pty Ltd and has over 26 years' of exploration and mining experience in a variety of mineral deposits and styles. Mr du Toit has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity he is undertaking to qualify as a Competent Person as defined by the JORC Code (2012). The information from Mr du Toit was prepared under the JORC Code (2012). Mr du Toit consents to inclusion in the report of the matters based on this information in the form and context in which it appears.

The information in this presentation which relates to the Ore Reserve for Munglinup is based on information compiled by Mr Daniel Hastings, who is a Member of the AusIMM. Mr Hastings is an employee of Hastings Bell Pty Ltd and a consultant to the Company. Mr Hastings has sufficient experience relevant to the type of deposit under consideration to qualify as a Competent Person as defined by the JORC Code (2012). Mr Hastings consents to the inclusion in the report of the matters based on the reviewed information in the form and context in which it appears.

The information in this presentation that relates to metallurgy, the process plant and infrastructure design for Munglinup is based on information compiled and reviewed by Mr David Pass, who is a Member of the AusIMM. Mr Pass is an employee of Battery Limits Pty Ltd. Mr Pass has sufficient experience relevant to process plant and infrastructure design thereof to qualify as a Competent Person as defined by the JORC Code (2012). Mr Pass consents to the inclusion in the report of the matters based on the reviewed information in the form and context in which it appears.

OVERVIEW AND RECENT ACHIEVEMENTS

- **Board & Management team** - proven history of project delivery on time and on budget
- **Diversified** - emerging commodity and jurisdictional
- **Proven Performance** – YoY financial and production improvement
- **Dividend** – peer leading 8% yield*
- **Tormin, South Africa** – 4 years operational history, highest grade mineral sands mine in the world
- **Tormin Expansion** - near-term expansion development project, potential 10 year mine extension
- **Munglinup Graphite Project, Western Australia** - defined near-term pathway to development
- **Western Australian exploration prospects** - portfolio of lithium, gold, copper, iron ore, vanadium
- **Iran mining sector** - first mover advantage
- **Business strategy** – near-term fully funded from existing cashflow

** Based on annual dividends of 1.2 Australian cps and closing price of 15 Australian cps at close of business 14 November 2018*

CORPORATE PROFILE

ASX : MRC

SHARES ON ISSUE
421,091,571

PERFORMANCE RIGHTS
3,800,000

MARKET CAPITALISATION
A$63.2m at A$0.15*

BORROWINGS
US$2.5m at 30 September 2018

CASH BALANCE
US$14.8m at 30 September 2018
(+US$7.1m in trade & other receivables)

INVENTORIES
US$21m at 30 September 2018
(circa US$60m in future revenue and US$20m in future net operating cash flow & profit)

**Share price at close of business 14 November 2018*

SUBSTANTIAL SHAREHOLDERS – Top 20 hold 90.73%

Au Mining Limited	26.7%
Zurich Bay Holdings Pty Ltd	18.6%
Tormin Holdings Limited	14.8%
M&G Investment Management Limited	8.8%
Mr & Mrs Anthony C Lowrie	6.6%

BOARD OF DIRECTORS

Mark Caruso	Executive Chairman/Chief Executive Officer
Joseph Caruso	Non-Executive Director
Peter Torre	Non-Executive Director/Company Secretary
Ross Hastings	Non-Executive Director
Guy Walker	Non-Executive Director

MANAGEMENT TEAM

SURINDER GHAG
TECHNICAL SERVICES MANAGER
21 years mining experience
Atlas Iron | Nautilus Minerals | Ok Tedi
Consolidated Rutile Limited

MARK CARUSO
EXECUTIVE CHAIRMAN/
CHIEF EXECUTIVE OFFICER
37 years mining experience
Allied Gold | FMG

BAHMAN RASHIDI
IRAN MANAGING DIRECTOR
GEOLOGIST
21 years mining experience
RioTinto | Normandy Mining

SAIT UYSAL
MARKETING MANAGER
12 years mining experience
Syrah Resources
Black Mountain Minerals Holding

A PROVEN TECHNICAL AND MANAGEMENT TEAM THAT HAS SUCCESSFULLY DELIVERED PROJECTS ON TIME AND ON BUDGET

TONY SHEARD
CFO
33 years mining & engineering experience
Iluka | WMC Resources

DANIEL HASTINGS
BUSINESS DEVELOPMENT
19 years mining experience
Ok Tedi | Newcrest | Equinox
Allied Gold | Silver Standard

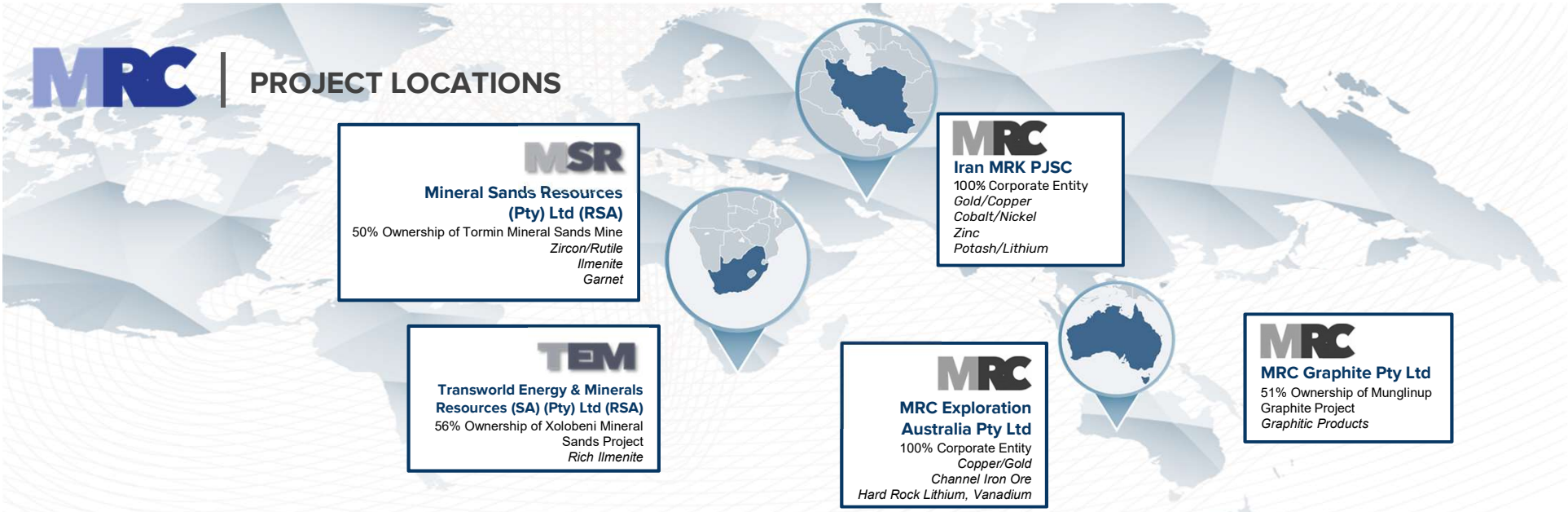
FLETCHER HANCOCK
LEGAL COUNSEL
12 years legal advisory & mining experience
Ashurst | Hancock Prospecting Pty Ltd

2017 FULL YEAR GROUP FINANCIAL & 2018 FULL YEAR FORECAST GUIDANCE

			2017 FY ACTUAL			2018 FY FORECAST
Total Revenue	↑	131%	US$62.6 million 2016: US$27.1 million	↑	2.4%	US$64.1 million
Underlying Group EBITDA	↑	75%	US$19.1 million 2016: US$10.9 million	→		US$19.1 million
Reported Earnings NPAT	↑	161%	US$9.9 million 2016: US$3.8 million	↓	9.1%	US$9.0 million
Cashflow from Operations	↑	409%	US$22.3 million 2016: US$4.4 million	↓	19.78%	US$17.9 million
Capital Expenditure	↓	21.5%	US$5.4 million(1) 2016: US$6.8 million	↑	64.8%	US$8.9 million
Cash Balance	↑	279%	US$11.0 million 2016: US$2.9 million	↑	66.4%	US$18.3 million
Borrowings	↓	43%	US$4.2 million 2016: US$7.4 million	↑	14.3%	US$4.8 million
Earnings per Share	↑	163%	US$2.45 cents 2016: US0.93 cents	↓	13.1%	US$2.13 cents
Dividend	→		A$1.2 cents 2016: AU1.2 cents	↑	8.3%	A$1.3 cents

(1) Excludes US$0.9m capital expenditure associated with the issue of 10m MRC shares relating to a 51% acquisition of the Munglinup Graphite Project

PROJECT LOCATIONS



Projects	Location	Resource	Interest	Status
MSR Tormin	South Africa	Mineral Sands Mine	50%	Commenced operation October 2013, potential extension to mine life identified
TEM Xolobeni	South Africa	Mineral Sands Project	56%	Rich ilmenite mineral sands deposit on the Eastern Cape of South Africa
Munglinup	Australia	Graphite	51% (earn-in to 90%)	Feasibility study in progress, planned commissioning Q4 2019
WA Exploration	Australia	Gold, Copper, Lithium, Channel Iron Ore, Vanadium	100%	Drill program completed at Doolgunna on high grade gold target, results pending
Iran	Iran	Gold, Copper, Potash, Lithium, Cobalt, Nickel, Zinc	100% of corporate entity	Reviewed in excess of 36 mining projects. Four project investments to date including operating gold mine

SOUTH AFRICA | SNAPSHOT

TORMIN MINERAL SANDS OPERATION

- Continued strong safety record with 1 LTI since commencement of operations
- Resource:
  Original 2.7Mt at 49.7% THM
  Mined 8.4Mt at 36.77% THM
  Current Inferred 1.8Mt at 15.9% THM[1]
- Identified potential 10+ years life of mine extension
- Logistics/Power Optimisation via rail and Eskom grid connection
- Permitting continuing with expected resolution in Q1 2019
- New South African Government leadership pro mining development

(1) Refer to ASX release of 28 February 2018

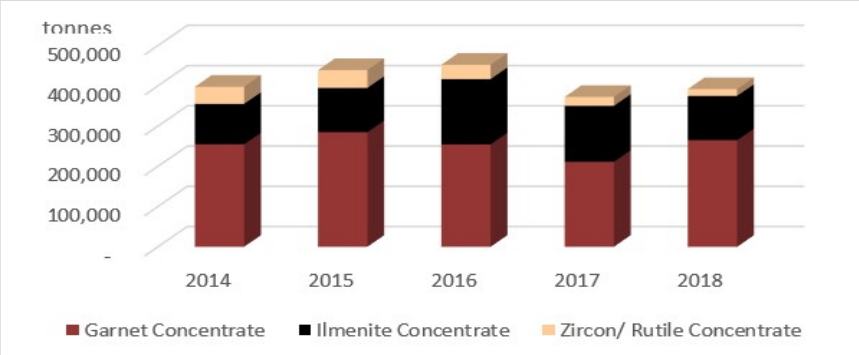
XOLOBENI MINERAL SANDS PROJECT

- World Class mineral sand deposit geographically located near Richards Bay
- JORC Resource of 346Mt at 5% THM
- Mining Right under Application
- Future development and divestment options under consideration
- N2 National Highway under construction
- New South African Government leadership pro mining development

SOUTH AFRICA | TORMIN OPERATION | PRODUCTION

372,418t ▼ 17.72% on prior year

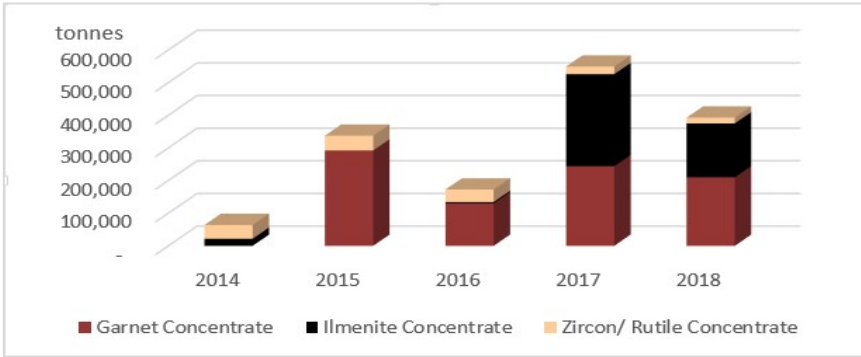
2017 Total Production Tonnes - Net



Production Tonnes - Net	2014	2015	2016	2017	2018[1]
Garnet Concentrate	254,816	284,990	254,693	211,394	265,000
Ilmenite Concentrate	100,437	109,959	162,123	138,913	110,000
Zircon/ Rutile Concentrate	42,668	44,489	35,813	22,111	17,000
Total	**397,921**	**439,438**	**452,629**	**372,418**	**392,000**

549,212t ▲ 217.86% on prior year

2017 Total Sales Tonnes



Sales Tonnes	2014	2015	2016	2017	2018[1]
Garnet Concentrate	-	292,472	130,308	243,962	210,000
Ilmenite Concentrate	21,920	-	4,070	282,098	165,000
Zircon/ Rutile Concentrate	42,042	45,240	38,408	23,152	18,000
Total	**63,962**	**337,712**	**172,786**	**549,212**	**393,000**

(1) Mid point of production and sales guidance as per pending ASX release of 29 October 2018

AUSTRALIA | MUNGLINUP GRAPHITE PROJECT | SNAPSHOT

MUNGLINUP GRAPHITE PROJECT

- High grade natural flake graphite deposit
- Tier 1 jurisdiction
- Ore Reserve of 3.4Mt at 15.9% TGC (JORC Code 2012)[1]
- Mining Lease approved
- Mineralisation open in all directions
- Near term development profile
- Excellent infrastructure available nearby
- Potential downstream value adding processing optionality currently being assessed

(1) Refer to ASX release of 30 May 2018

FINANCIAL - PFS FOR CONCENTRATE ONLY

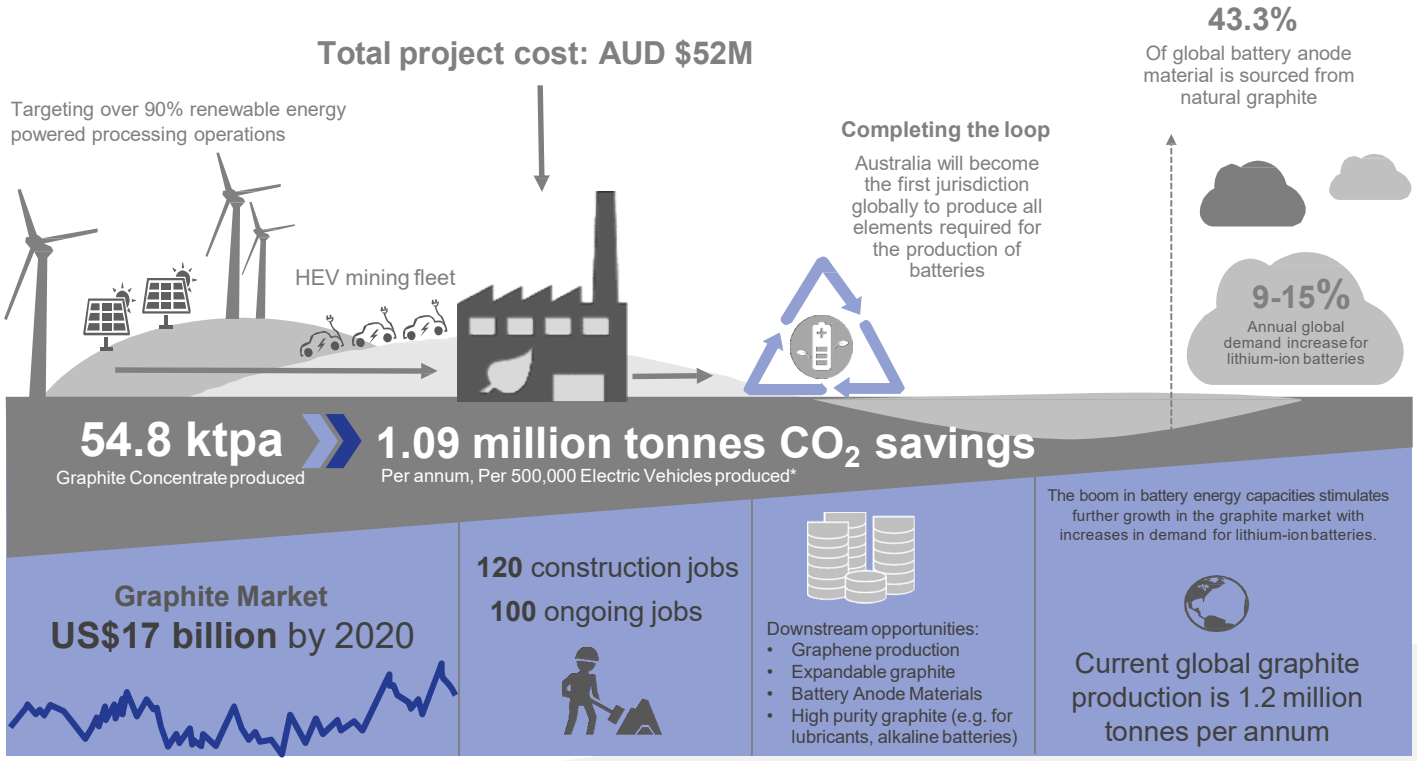
- Capital Budget A$52m[1]
- Lowest quartile operating and capital costs
- Robust economics across pricing and flake distribution scenarios
- Midcase NPV - A$139m

TIMELINE

- Pre-Feasibility Study completed
- Approvals submissions completed
- Approvals and Permits granted Q1 2019[2]
- Begin construction Q1 2019[2]
- Commissioning Q4 2019[2]

(1) Refer to ASX release of 30 May 2018
(2) Subject to final decision to proceed and assumes no EPBC or EPA review requirement

AUSTRALIA | MUNGLINUP GRAPHITE PROJECT



AUSTRALIA | MUNGLINUP GRAPHITE PROJECT | DEPOSIT

LOCATION

- 105km west by sealed road from the port of Esperance
- Mining Lease granted to 2031 on designated Mining Reserve

HIGH GRADE

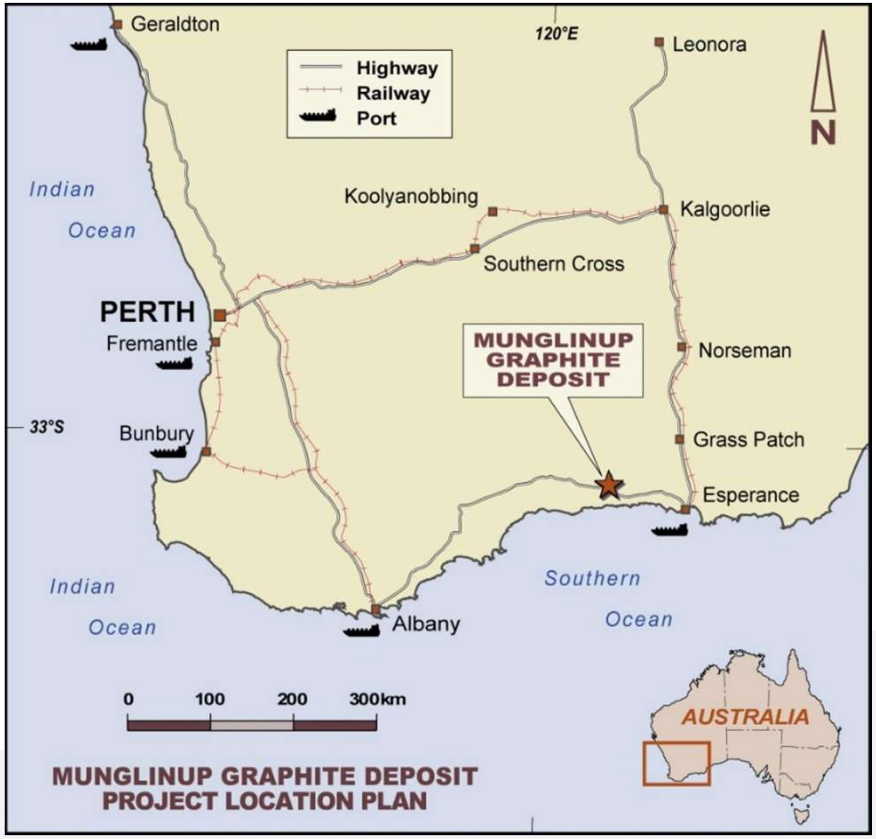
- Significant previous work undertaken including feasibility study and process testing
- Measured & Indicated Resource of 3.6Mt at 15.3% TGC (10% cut-off) with mineralisation open in all directions[1]
- Proved & Probable Reserve of 3.4Mt at 15.9% TGC[2]
- Recent metallurgical test work confirms production of high grade concentrate (>98% TGC)[3]

NEAR TERM PRODUCTION TIMELINE

- High grade, coarse flake graphite production target within 18 months
- Strategically significant state project – Lead Agency Framework Status
- Downstream vertically integrated purification and spheroidisation development strategy

LOW PRODUCTION COSTS

- Open-pit graphite mining operation targeting the lowest operating costs quartile for global flake graphite deposits

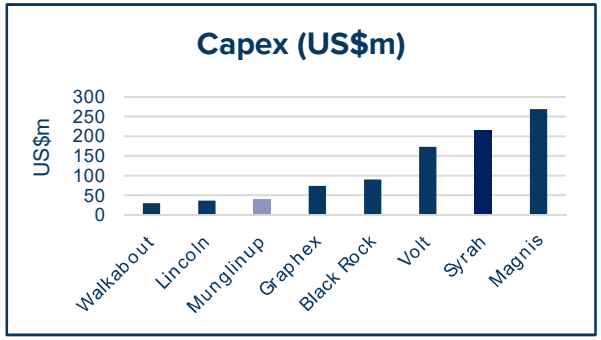


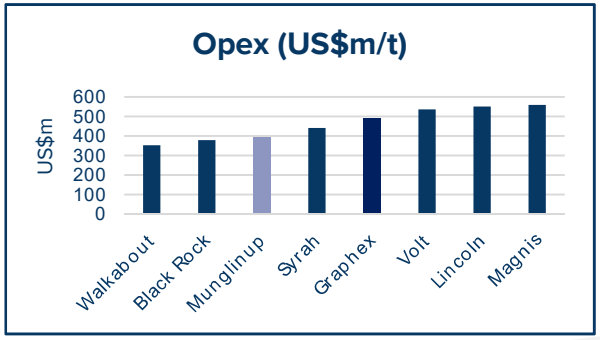
(1) Refer to ASX releases of 11 and 13 September 2017
(2) Refer to ASX release of 30 May 2018
(3) Refer to ASX releases of 8 February 2018 and 15 March 2018

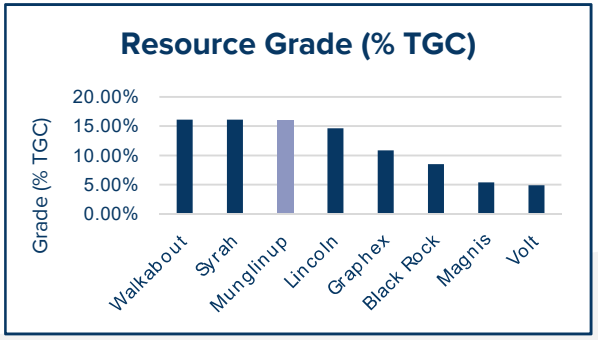
AUSTRALIA | MUNGLINUP GRAPHITE PROJECT | PFS OUTCOMES FOR CONCENTRATE

A$139m	48%	A$52m	2 years	9 years	54,800t	A$47.5m	A$531/t
Post-tax NPV(1)	Post-tax IRR(1)	Total DEV CAPEX(1)	Capital PAYBACK PERIOD(1)	MINE LIFE(1)	Average ANNUAL CONC. PRODUCTION (1)	Average ANNUAL EBITDA	Average OPERATING CASH COST(1)

(1) Refer to ASX release of 30 May 2018
(2) Discount rate of 8% real after tax

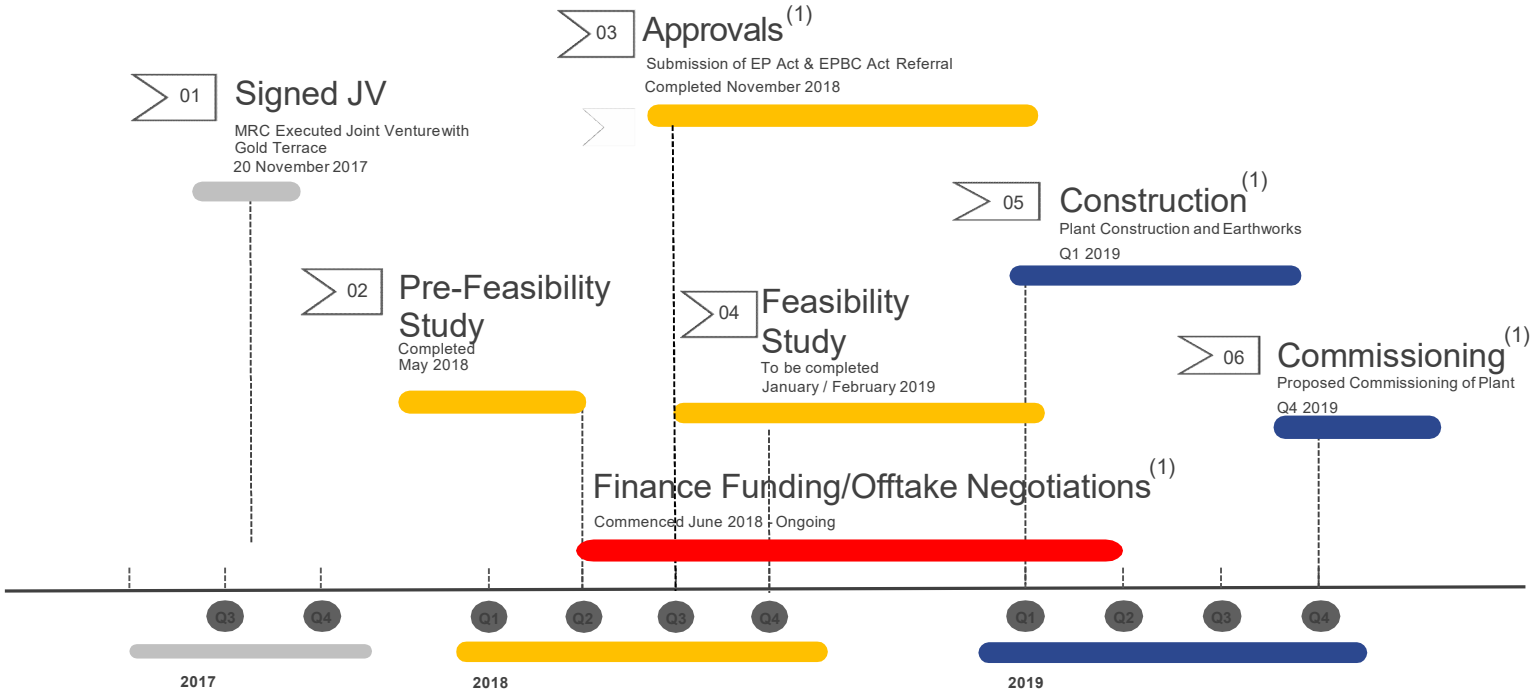






Source: published company data

AUSTRALIA | MUNGLINUP GRAPHITE PROJECT | TIMELINE



(1) Subject to final decision to proceed and assumes no EPBC or EPA review requirement

AUSTRALIA | MUNGLINUP GRAPHITE PROJECT | RESOURCE UPSIDE POTENTIAL

Significant Drill Results

- **7m at 18.7% TGC** including **2m at 26.5% TGC**
- **15m at 19.9% TGC** including **9m at 25.1% TGC**
- **13m at 13.9% TGC** including **2m at 28.2% TGC**

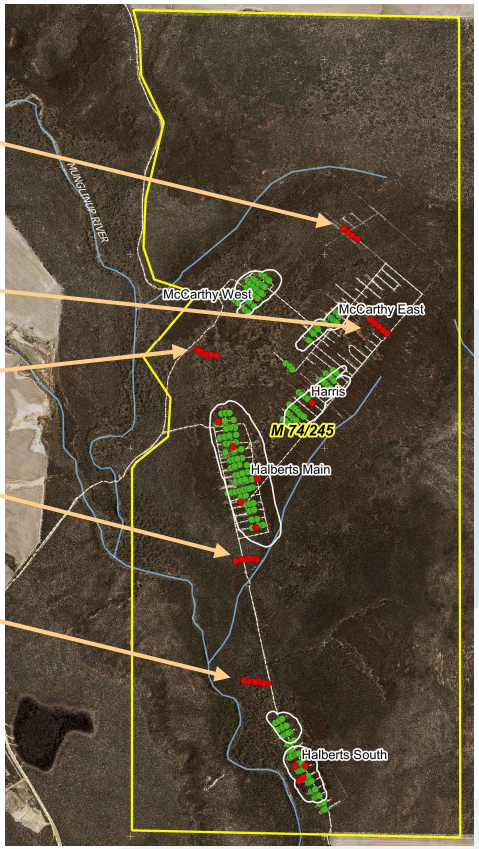
- **3m at 16.7% TGC** including **1m at 36.5% TGC**

- **3m at 16.7% TGC** including **1m at 21.1% TGC**

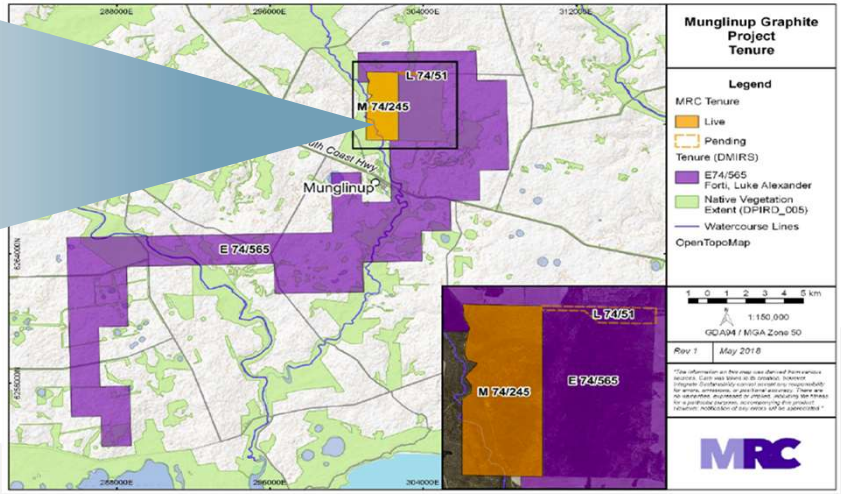
- **13m at 17.2% TGC** including **4m at 25.1% TGC**
- **5m at 18.2% TGC** including **2m at 24.1% TGC**

- **8m at 25.9% TGC** including **5m at 34.9% TGC**

Note: Green holes denote historical drilling, red holes denote recent MRC Phase 1 drilling program, white outlines are proposed pit crests from PFS, yellow line is Mining Lease boundary, refer to ASX release of 5 June 2018



- Recent resource expansion drilling program confirms continuity of mineralisation along strike of known deposits
- Highlights potential to significantly increase Mineral Resource. Update underway
- Potential for other mineralisation including magnesite
- Adjoining tenement (E74/565) acquired



Graphite comes in two forms with **the combined graphite market worth around $13 Billion, and forecasted to reach $17 Billion by 2020.**

The two forms of Graphite include:

► **Synthetic Graphite**

Manufactured product processed by high temperature treatment of amorphous carbon materials in an energy and time intensive process which requires graphitisation of petroleum coke.

Due to Chinese state regulations, synthetic graphite production will be restricted due to its environmental impacts. With this and similar trends likely to continue, the importance and reliance of natural graphite will grow into the future.

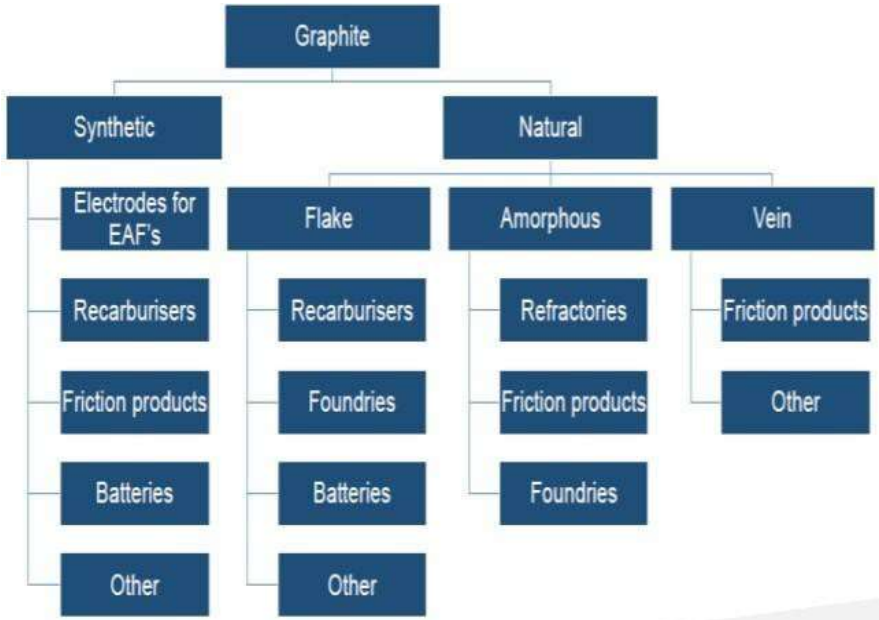
► **Natural Graphite**

Mined resource which is found in three types including Flake, Amorphous and Vein.

They are subsequently processed and treated relevant to their applications.

Consumption areas for graphite include:

- ► Refractories
- ► Foundries
- ► Batteries
- ► Lubricants/metallurgy powders
- ► Building material (flame retardant and temperature regulation)
- ► High energy electronics (temperature regulation and energy efficiency)



Source: Company Reports, Canaccord Genuity

AUSTRALIA | MUNGLINUP GRAPHITE PROJECT | BATTERY COMPOSITIOINS

Essential components within a Li-ion battery

1 Anode

Stores and releases lithium ions from the cathode, enabling currents to pass through an external circuit. The anode is predominantly sourced from **graphite.**

2 Cathode

Provides the source of lithium ions. The cathode can use a number of materials, and is often composed of **Lithium salts** in an organic solvent.

3 Electrolyte

Allows the movement of ions between the cathode and anode. This is made up of different material formulations depending on the required application. Examples include **Cobalt, Manganese, Nickel and Iron.**

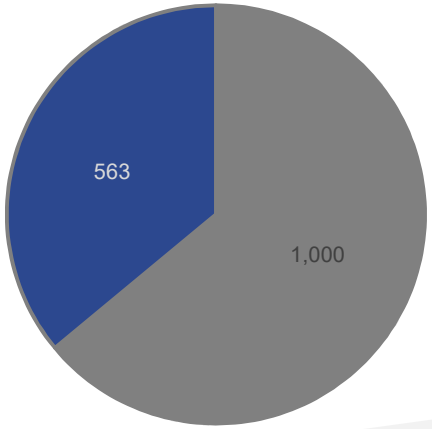
Market share based on battery composition

70% = Market share of Lithium-ion batteries when compared to the wider battery market

Sourcing battery anode material

65%	30%	5%
Natural spherical graphite	Synthetic graphite	Lithium tintate, silicon and tin

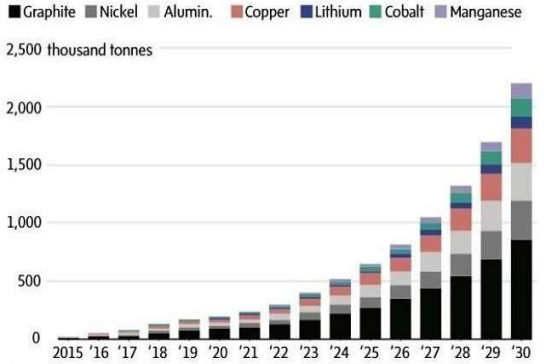
EV battery material consumption



Graphite Lithium Metal

*Quantities represent the total grams of material required to produce each kilowatt/hour of energy in a typical (EV) LiB

"World graphite mine production in 2016 totalled 1.2 million tonnes, with forecasted growth to 4 million tonnes per annum to meeting rising steel and battery sector demands." US Geological Survey, Mineral Commodity Summaries. January2017.



Current and projected demand for electric vehicle lithium-ion batteries. Source: Bloomberg.

Technological advancements and the drive towards electrification of cars will see exponential growth in the current graphite market with respect to extensions in battery technology.

Demand for spherical graphite will experience rapid growth due to required use in lithium-battery anodes.

Furthermore, increasing energy density and reduction of cost will be a significant factor in the future battery market. A rapid growth for graphite demand can lead to supply constraints if supply chain sustainability issues remain unaddressed.

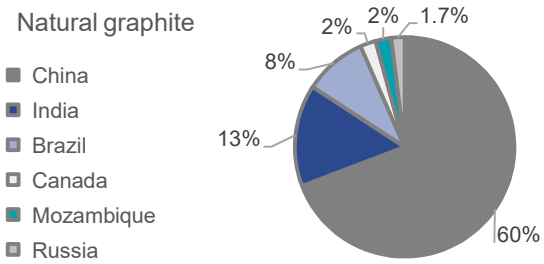
The steel industry currently accounts for 70% of refractory consumptions, correspondingly steel and refractories account for 41% of the graphite market. **Expandable graphite will also contribute to growing graphite demand due to its varied applications in building materials.**

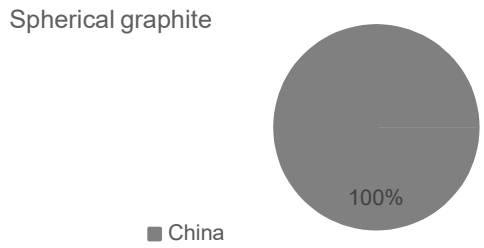
Market Drivers

Currently Germany & the US are the largest importers of graphite, with expected global demand growth driven by national and state policies. Combustion engines will not perform to set targets, meaning a gradual mandatory transition to battery and hybrid vehicles will occur:

- **EU Legislation sets mandatory emission reduction targets which specify CO_2 limits per kilometre for all new cars by 2021. The framework combines CO_2 targets for 2025-2030 with a technology neutral incentive mechanism for zero emission (battery powered vehicles) & low-emission vehicles (hybrids).**
- **California state regulations including the ZEV requirements, GHG Standards, and recent state commitments of 5 million ZEV (Zero Emission Vehicles) by 2030, set a market trajectory to full adoption of battery powered vehicles state wide.**

Country of graphite processing and production





Electric Vehicles

- Estimates predict 19% of all light vehicles in Australia to be electric by 2037.[1]
- The global uptake of electric cars is predicted to increase to 16% by 2025.[2]
- China will account for 57% of the global EV market by 2020.[3]

Battery anode market

Forecasted market potential has been quoted to increase 9-15% annually for lithium, this directly contributes to the increased demand on the combined graphite market. Correspondingly, the global market for graphite is predicted to increase at a CAGR of around 6% annually from 2018-2022.

The growing market for lithium-ion batteries has stimulated growth and demand for graphite, with expectations of higher production of downstream products such as spherical graphite and battery anode materials.

1. '2018 Electricity Forecasting Insights' March 2018. Australian Energy Market Operator (AEMO)
2. 'Global Auto Survey' August 2018. UBS Asset Management
3. Macquarie Group Asia Research – Electric Vehicles

AUSTRALIA | MUNGLINUP DOWNSTREAM VALUE ADD | FUTURE ACTIVITY AREAS

The Munglinup Graphite Project not only poses a great opportunity for the Australian graphite and battery industries, it also enables a number of additional market opportunities. These are summarised in the table below.

	Expandable Graphite	Battery Anode Material (BAM)	Graphene
Summary	MRC have undertaken preliminary investigation into the development of techniques and supporting infrastructure to produce expandable graphite. This has included: - Discussions with University of Adelaide regarding collaboration to develop new processes for high quality expandable graphite; - Collaboration with graphite consultancies, including: • Initial test work demonstrating high expansion volumes of MRC coarse flakes; • Preparation for a PFS, incorporating additional test work (expansion reagents, purification of coarse flakes and scalability processes) and PFS-level cost estimates; and - Discussions with global stakeholders within the expandable graphite logistics supply chain.	Future activity may include: - Development of new purification processing capabilities (R&D) to produce high purity graphite fines; - Development of new plant infrastructure to produce high grade spheroidised graphite; - Test work and PFS on purification, spheronisation and coating; - Partnership with major stakeholders within the battery supply chain (e.g. Panasonic, Samsung).	Preliminary research has indicated the viability of transforming Munglinup graphite concentrate into graphene. Research is continuing on potential end-use applications and assessing the potential to produce functionalised graphene and graphene oxide. MRC will look to develop processes for producing graphene and related products (such as graphene oxide and functionalised graphene) from its graphite concentrates, specifically targeting process routes that can achieve commercial scale production.
Potential outcomes	The development of new infrastructure and capabilities for expandable graphite production will enable MRC to participate in a number of expandable graphite markets. Identified opportunities include: - Application within various building materials, as both a flame retardant and measure for improving temperature regulation and energy efficiency; and - Application within high-energy electronics to improve the regulation of processing temperatures, and hence energy efficiency. - Creation of a new Australian technology manufacturing market segment.	Outcomes may include: - Establishment of MRC within the global supply chain for battery development; and - Penetration of niche market areas such as dry lubrication (e.g. for titanium hips). - Creation of a new Australian technology manufacturing market segment to compete with China and leverage the "Lithium Valley" infrastructure currently being built in WA.	MRC have identified a range of potential downstream applications, including the development of many layer, few layer, pristine and graphene oxide for application within: - Electronics; - Biomedical products; - Energy storage; - Coatings; and - Composites and construction additives (green concrete).

AUSTRALIA | MUNGLINUP VALUE PROPOSITION

- Stage-gated development of downstream graphite processing opportunities
- Actively engaged in PFS and R&D to progress

EXPANDABLES/EXPANDED GRAPHITE

- Positive results from initial testwork
- PFS delivery Q1 2019
- FS Decision Q2 2019
- Priority downstream development

BATTERY ANODE MATERIALS

- Testwork to commence Q4 2018
- PFS Delivery Q1 2019
- Pilot scale testwork & FS thereafter
- Align development with qualification period for BAM

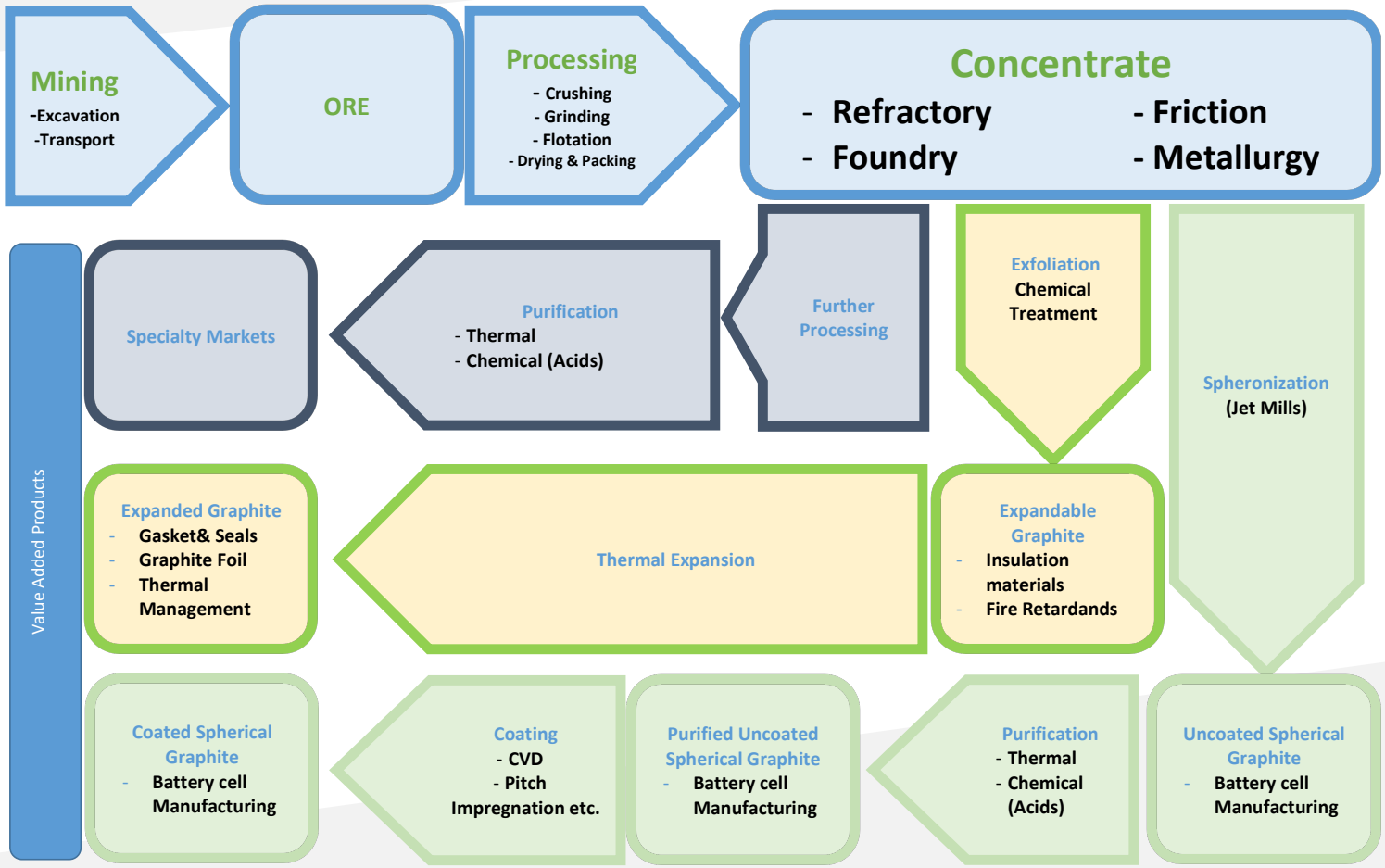
GRAPHENE

- Research Agreement with University of Adelaide
- Proof of concept testwork Q3 2018
- Evaluating a range of methods
- Scale-up testwork in 2019
- FS in ~2020

RECYCLING

- ~A$250,000 investment in low cost, sustainable Li-ion battery recycling technology
- Environmentally-friendly recovery of lithium, cobalt and copper intermediary products
- Pilot program in progress
- Completion by Q1 2019

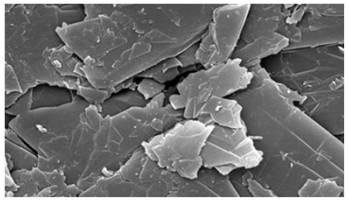
GRAPHITE MARKET | GRAPHITE VALUE CHAIN



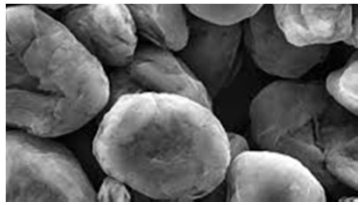
AUSTRALIA | MUNGLINUP DOWNSTREAM VALUE ADD | BATTERY ANODE MATERIAL

VALUE PROPOSITION

- Upgrading of Munglinup high grade concentrate through thermal purification and spheroidisation for battery anode applications
- Uncoated spherical graphite pricing[1] between US$2,800 and US$3,850 depending on size of particles
- Doral[2] facility in Kwinana already fully permitted with easy access to infrastructure and other requirements



Flake graphite



Spherical coated graphite

PRODUCT SALES

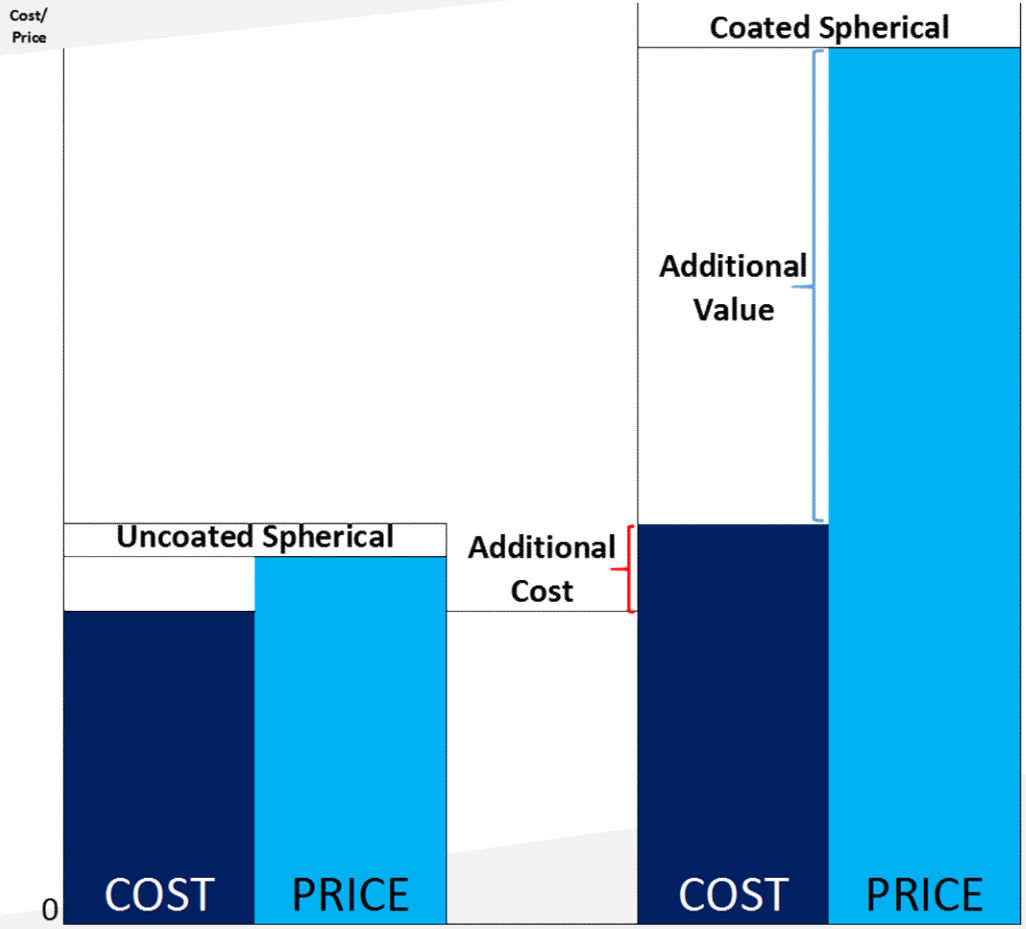
- Discussions with various potential offtake parties commenced
- Product test work underway to determine exact Munglinup product specifications for various markets
- Production of a bulk marketing sample (+200kgs) commenced in Q1 2018
- Dedicated Marketing Manager appointed – highly experienced in the graphite market

THE PROCESS

- Study currently underway to assess the production of battery anode material (BAM) at Kwinana using high grade Munglinup concentrate
- Assessment of both coated and uncoated spherical graphite production
- Results expected within 6 to 12 months due to extensive battery cycle testing requirement

(1) Benchmark Mineral Intelligence Feb 2018
(2) Refer to ASX Release of 13 Dec 2017 – MOU with Doral – Spheroidisation & Purification of Graphite

GRAPHITE MARKET | COST Vs. VALUE



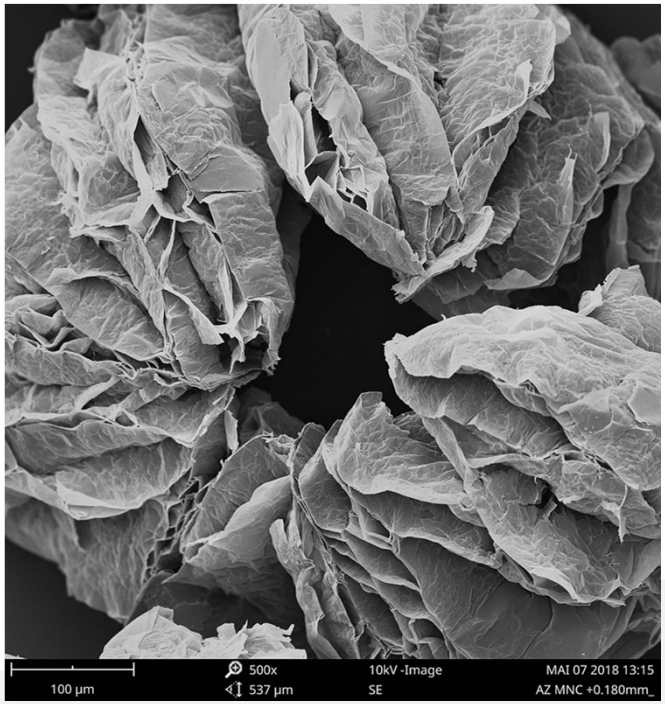
AUSTRALIA | MUNGLINUP DOWNSTREAM VALUE ADD | EXPANDABLES

VALUE PROPOSITION

- Pre-treatment of Munglinup concentrate forcing apart the crystal lattice planes
- The pre-treated graphite undergoes rapid expansion when heated to form expanded graphite
- Large flake (thick) graphite highly desirable and attracts a market premium
- Doral facility in Kwinana already fully permitted with easy access to infrastructure and other requirements to produce pre-treated graphite for expandable markets[1]

EXPANDABLE GRAPHITE

- Test work[2] confirms Munglinup graphite suitable for a broad range of expandable graphite markets, including high-end graphite foil
- Excellent insulative and fire retardant properties
- Rapid expansion on heating releases inert gas that extinguishes fires by suffocation
- Non carcinogenic material
- China recently banned use of traditional brominate flame retardants in all new buildings
- Used in aircraft manufacturing as a light-weight fire retardant

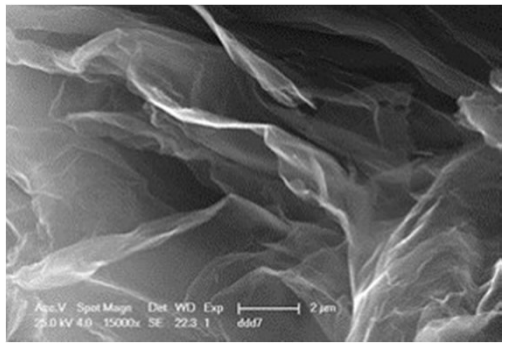


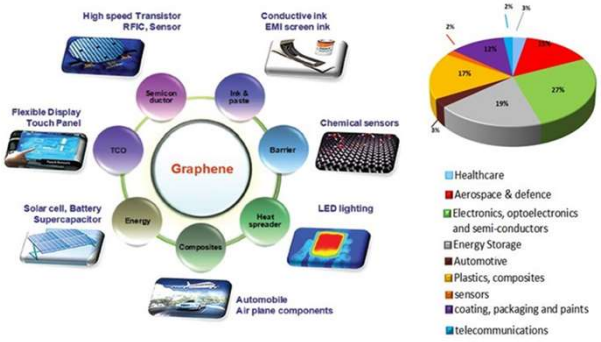
Scanning Electron Microscope photo of expanded Munglinup Graphite

(1) Refer to ASX Release of 13 Dec 2017 – MOU with Doral – Spheroidisation & Purification of Graphite
(2) Refer to ASX Release of 8 May 2018 - Munglinup expandable graphite testwork results positive

VALUE PROPOSITION

- Production of high value graphene from Munglinup concentrate
- Production of graphene oxide and/or functionalized graphene
- Research agreement with University of Adelaide (leader in graphene research in Australia)
- Testing a range of methods to reduce technology risks – initial indications show the concentrate can be used to produce graphene. Report expected Q3 2018
- Target turning lower value (minus 25 microns) fines into high value graphene and related products





A. Ferrari et al, Nanoscale, 2015, 4597-5062

GRAPHENE

- Broad range of uses from electronics, biomedical, energy storage, coatings, composites and construction additives (green concrete)
- Aim is to utilise the unique properties of graphene (high thermal & electrical conductivity, elasticity, transparency), typically in a matrix/composite
- Constrained by inability to cost effectively scale-up graphene production
- Single to few layers of pristine (low defects) graphene targeted

MUNGLINUP GRAPHITE PROJECT | FINANCING OPTIONS

Base Case

- Circa US$55M investment estimate
- Excluding mining fleet and power generation
- Inclusive of infrastructure, fixed plant, commissioning, working capital, $5m free cash float and 15% contingency allowances

Owner Miner and Renewable Energy

- Circa US$70M investment estimate
- Including mining fleet and power generation
- Inclusive of infrastructure, fixed plant, commissioning, working capital, $5m free cash float and 15% contingency allowances

Downstream Graphite Options

- For discussion

Project Sapphire

- For discussion

Tormin Mineral Sands Expansion

- For discussion

Base Case		Facility Amount	
	Total Project Investment Requirement	Debt to Equity 70/30	Debt to Equity 60/40
90% Contribution	US$50m	US$35m	US$30m
100% Contribution	US$55m	US$39m	US$33m

Owner Miner and Renewable Energy		Facility Amount	
	Total Project Investment Requirement	Debt to Equity 70/30	Debt to Equity 60/40
90% Contribution	US$63m	US$44m	US$38m
100% Contribution	US$70m	US$49m	US$42m

- Preference for ring-fenced, limited/non-recourse project debt finance
- Proposed minimum repayment term 5 years

COMPANY STRATEGY

Short Term

- Optimise Tormin cashflow generation to support business development
- Obtain permitting to extend Tormin target LOM to +10 years by defining additional resources and reserves
- Munglinup - complete feasibility & commence construction
- Leverage Iran first mover advantage with correct Corporate Strategy Implementation
- Complete stage 1 of Australian exploration program

Medium Term

- Munglinup project commissioning targeted for 2019
- Graphite downstream value adding – spheroidisation / purification and/or expandable
- Commence construction and complete Tormin expansion
- Leverage first mover advantage in Iran by exploring and developing operating copper / gold asset
- Broaden shareholder base / liquidity

Long Term

- Creation of multi- jurisdictional / commodity mining house with at least 3 operating mines
- Continue shareholder returns through dividend and capital growth
- Disciplined capital management, focused on shareholder returns
- Continue to develop highly capable technical and management team to implement growth strategy

SUPPLEMENTARY INFORMATION – DOWNSTREAM PROCESSING

INTRODUCTION

- **MRC Downstream Activities Completed**
  - Battery Anode Materials (BAM) Concept Study
  - Expandables Graphite Testwork
  - Review of downstream collaboration proposal
  - Proof of Concept Graphene Testwork – Stage 1

- **MRC Downstream Activities Underway**
  - Graphene Production R & D Testwork – Stage 2

- **MRC Downstream Activities to Commence**
  - BAM Testwork
    - Thermo-Halogen Purification PFS
    - Spheronisation PFS (BAM) on purified material
  - Expandables Scale-up testwork and Study

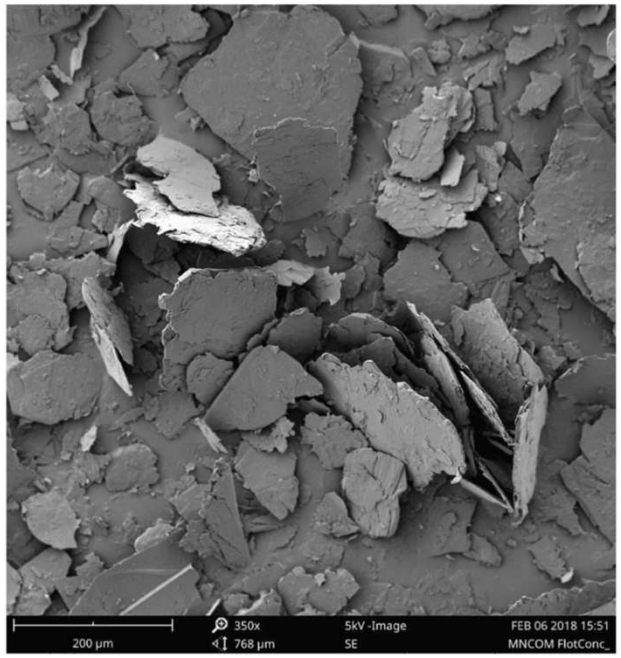
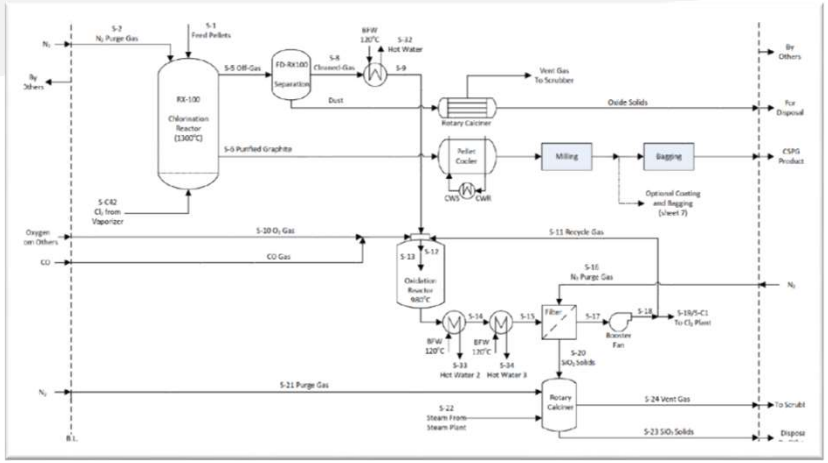


Figure 5: SEM micrograph of flotation concentrate AZ MNC Feed; magnification 350x

BAM CONCEPT STUDY

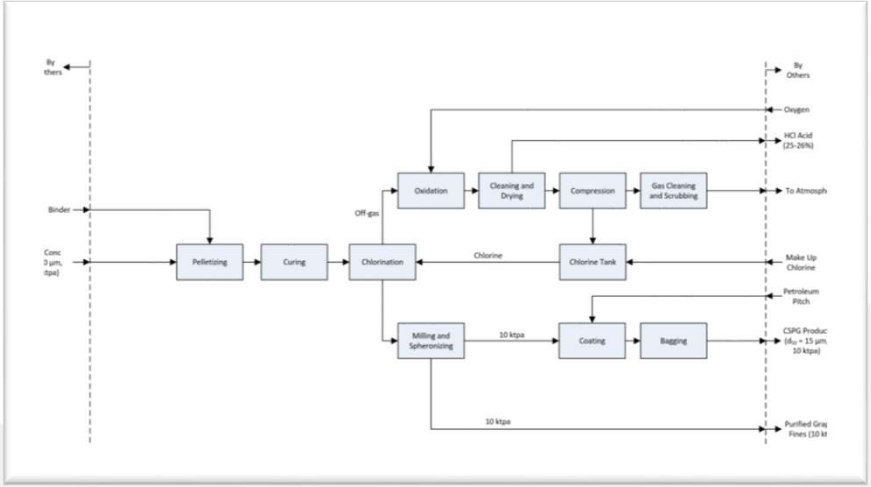
- Concept study undertaken with North American consultancy based on thermo-halogen purification and spheronisation to produce BAM graphite
- **Objectives:**
  - Better define the process flowsheet i.e. whether to spheronised prior to purification or whether to purify first
  - Evaluate the potential to purify concentrate directly versus production of micro-pellets prior to chlorination in a fluid bed reactor – for continuous rather than batch processing
  - Improve understanding of the costs structure (capital and operating),key drivers and financial performance for BAM production scenarios
  - Provide analysis to better define the testwork program and PFS

BAM CONCEPT STUDY



- Study completed in July
- **Key outcomes:**
  - Micro-pelletisation required (~1mm pellets) for fluid-bed reactor (FBR) purification
  - Purification BEFORE spheronisation preferred,
    - Purified fines (~sub-10 micron losses from spheronisation) have a significantly higher value than un-purified fines (~97% C)
  - Spheronisation is a low productivity, energy & capital intensive process
    - Economics of spheronisation relative to selective market penetration for high purity graphite are marginal
      - Potentially requires coating of purified spheronised graphite, which requires customer acceptance of coated spheronised graphite
    - Qualification periods for graphite for BAM is >1 year

- **Financial Evaluation Scenarios**
  - 1. Spheronise & then purify (20ktpa spheronisation, 10ktpa purification)
    - 50% yield to uncoated spherical graphite in spheronisation step. Only spheronised product is purified
  - 2. Purify & then spheronised (20ktpa purification, 20ktpa spheronisation)
  - 3. Purification only (20ktpa purification)
- Capital and Operating costs build-up in the study
- Process Flow Diagrams and equipment list



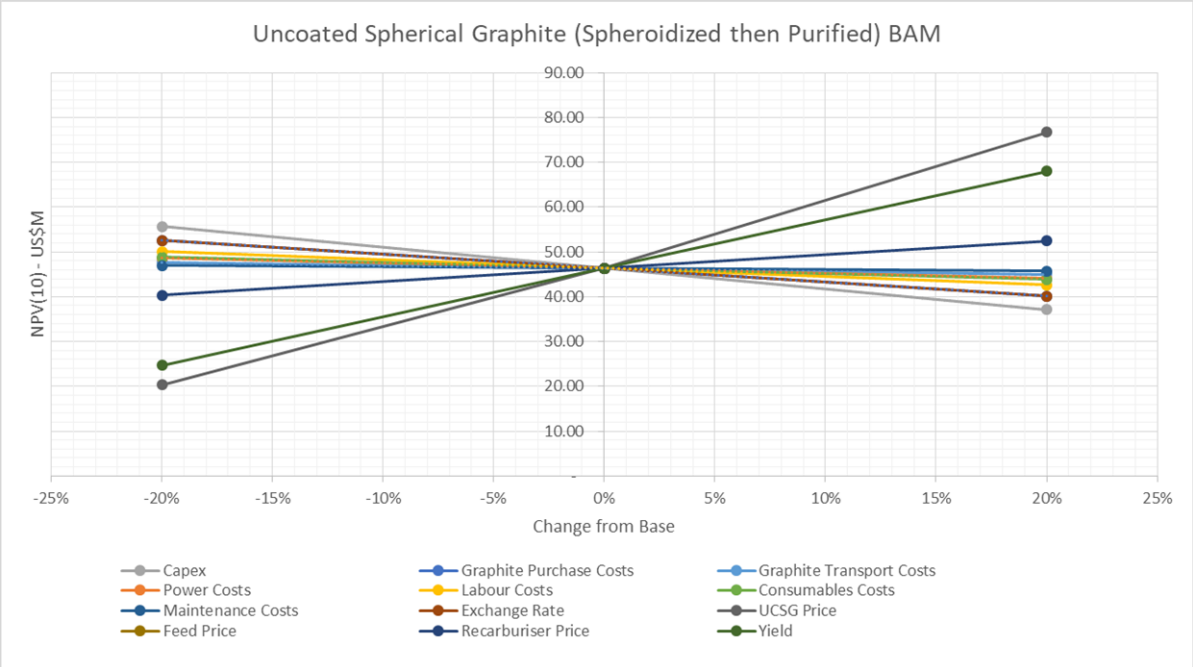
Results for a 20ktpa feed rate plant.*1

Scenario	Capex (US$M)	Opex (US$M/y)	Yield to High Value Product (%)	High-value Product	High Value Product (US$/t)	Low Value Product (US$/t)	NPV@10 %	IRR (%)	Pay-back Period (Yrs)
1. Spheronise then purify	62.6	18.4	50%	UCSPG	3200	700	46.3	25%	3.7
2. Purify then spheronised	87.2	25.3	50%	UCSPG	3200	3000	116	35%	2.8
3. Purification only	61.9	21.7	100% *1	V. High purity pellets/fines	3000	N/A	140	50%	2.0

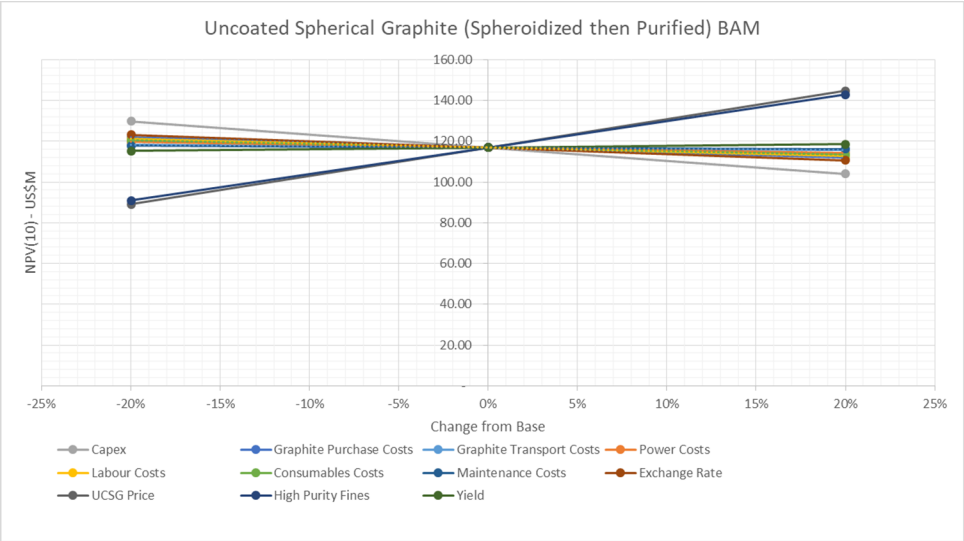
- Spheronisation prior to purification has long paybacks, due to the production of low value fines
- Purification prior to spheronisation increases the capital costs (due to both processes operating at 20ktpa) but improves project returns because both the UCSPG and the fines are high value
- Purification only, producing a high value product and reduces power demand as spheronisation is the key driver for plant power

*1 – based on producting a 99.95% C purified product from a 96% C feed. Higher grade feed and/or lower grade products will reduce capital costs as reactor retention times will reduce. To be evaluated in testwork program

- **1. Spheronised then Purified**
  - Scenario most sensitive to Yield to spheronised graphite, and
  - Price of UCSPG

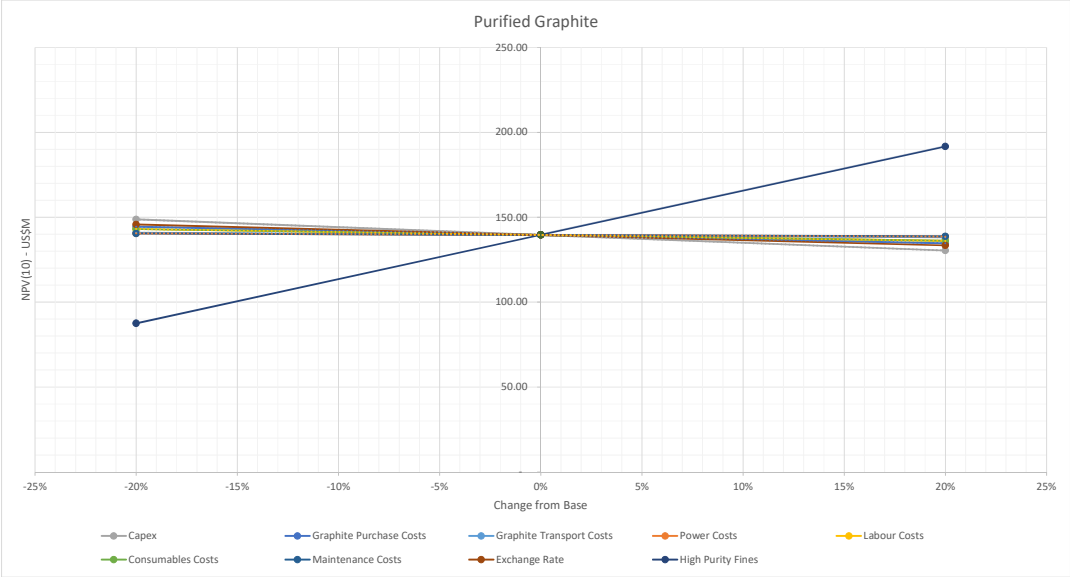


- 2. **Purified then spheronised**
  - More robust alternative, as both the UCSPG and the fines are high value
  - Returns most sensitive to price of UCSPG and the high-purity fines
  - Yield does not have a significant impact on project economics as both products are high value



- 3. **Purification Only**
  - Project insensitive to input prices
  - Sensitivity dominated by product prices

- 20ktpa plant required four FBRs based on concept study results i.e. ~5ktpa per reactor
- Potential to incrementally increase capacity, subject to design of gas handling sub-plant



BAM PATH FORWARD

- Sep 18 – Updated testwork and PFS study proposal
- Oct 18 – Target production of higher grade <150 micron concentrate from flotation circuit*1. Production of bulk sample for marketing & downstream testwork
- **Nov 18 - Mar 19 – Testwork*2 and PFS level report on purification**
- **Apr 19 – Decision on scale-up testing/FS for purification**
- - Aug 19 – Testwork and PFS level report on spheronisation

Overall Approach:

- Focus on purification and sales of high-purity graphite into established markets
  - Target C grades in line with discussions with potential German offtakers (>99% LOI)
- Supplement with smaller scale spheronisation & coating to market test BAM market and customer acceptance i.e. qualify

*1 – Ability to upgrade the concentrate further through flotation decreases the demand on the purification circuit.

*2 – testwork. will evaluate conditions required to produce 99% LOI, 99.8%LOI and 99.95% LOI product. The lower grade products are suitable for a range of markets where 99.95% material is not required. The product grade impacts on chlorine consumption (which is relatively low due to recycling and high quality of concentrate), reactor residence times and throughputs. The concept study determined four reactors required to achieve 20kpta due to heat flux constraints. This will be evaluated further in the next stage of the study.

EXPANDABLE / EXPANDED GRAPHITE

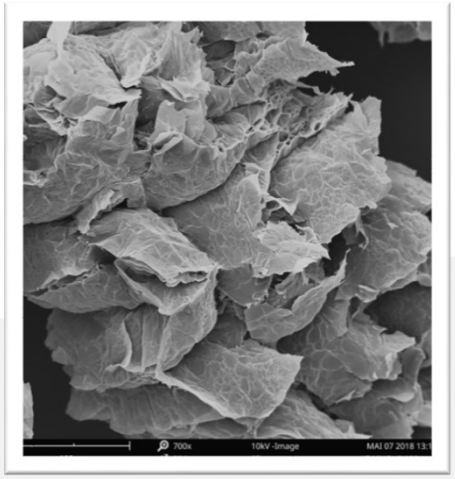
- Laboratory scale testwork on Expandables Completed
- Excellent expansion volumes achieved across size fractions using modified conventional intercalation at room temperature for short durations

Size Fraction	TGC	Expansion Volume @ 800C (cm^3/g)	Expansion Volume @ 1000C (cm^3/g)
>300		**335**	**400**
180-300		**290**	**305**
106-180		205	240
75-106		145	160
<75		100	115

- Marketing assessment targets >180 micron size fraction with >250cm^3/g of expansion – the portion of the market that the Chinese find difficult to supply

EXPANDABLES / EXPANDABLE GRAPHITE

- Figures show expanded graphite 'worms' for +180micron material from Munglinup concentrate,
- Expandable graphite market segments include:
  - High purity graphite foil (>95% TGC)
  - Graphite paper/sheet (>92% TGC)
  - Flame retardants (>85% TGC)



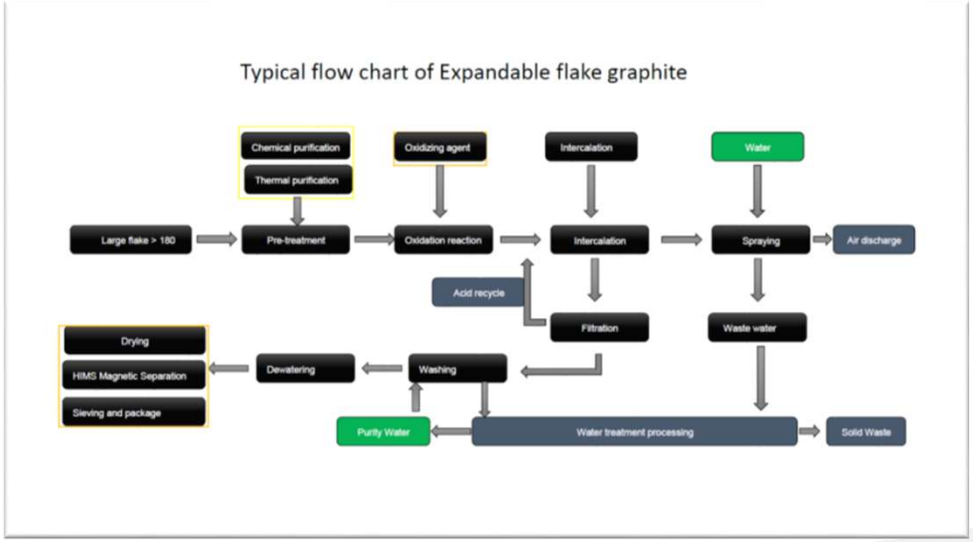
High purity graphite foil is used in electronics such as smartphones, tablets, laptops due to its high thermal and electric conductivity

Graphite paper and sheet used for the production of sealing gaskets, graphite tapes and reinforced graphite sheets

Expandable graphite in flame retardants – increasing market opportunity for graphite

- Flowsheet for Expandable Graphite*1
  - Pre-treatment purification required for low grade concentrates, or targeting high grade expandables
  - Mixing with oxidant and intercalation agent (H2SO4), followed by intercalation reaction
  - Filtration to remove and recover acid (acid recycle impacts economics and is dependent on product quality requirements
  - Washing and drying of expanded graphite
  - Mag sep for pyrite removal (issue with Chinese feed sources)
  - Waste handling

*1 – expanded graphite requires thermal expansion of the expandable graphite followed by pressing and rolling into foil or sheet



EXPANDABLES / EXPANDED GRAPHITE

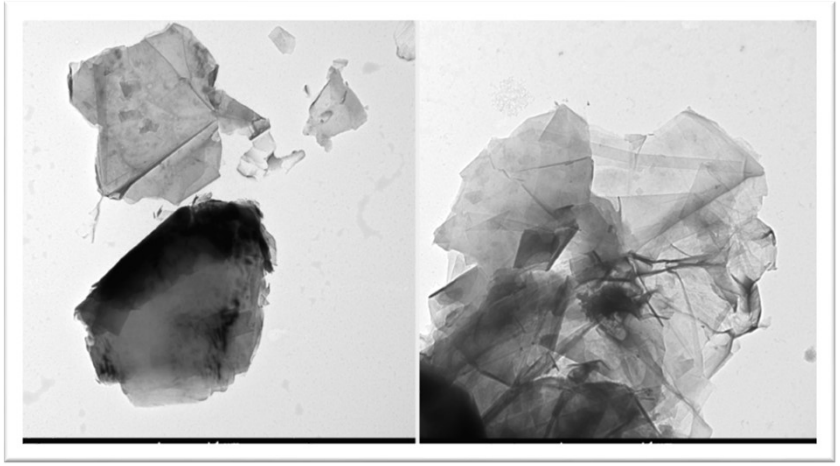
- Financials modelled on conceptual data
- Lower capital cost downstream processing option, with good returns
- Upside potential with respect to increased foil production
- Key drivers:
  - Coarse flake procurement, particularly in case of not having a captive mine
  - H_2SO_4 acid:graphite ratio and acid recycle (function of graphite feed purity and end-use specifications)
  - Additional oxidants required for intercalation

	Expandables (incl. foil)
Feed (tpa)	8,695 of coarse (+180) flake
Production (tpa)	7,600t of expandable graphite 2,000t of graphite foil
Capital Costs (US$M)	26.4
Operating Costs (US$Mpa)	24.3
Product Prices (US$/t)	3,500 – expandables 7,500 – foil
EBITDA (US$M/yr)	18.9
NPV_{10} (US$M)	62.6
IRR (%)	53%

EXPANDABLES / EXPANDED GRAPHITE

- **Summary**
  - Expandable/Expanded Graphite is the preferred approach to downstream processing, due to lower capital costs and higher returns
  - The technology risks are low and the market supply is limited by the limited availability of coarser flakes
  - Demand is expected to increase, in particular in the fire retardant market
- **Path Forward**
  - September – establish consultants to conduct additional testwork and FS
  - October – Generate bulk sample for testwork
  - November/December - expandables testwork on larger sample (10-20kg)
  - Jan - Mar – FS level design, cost estimate and report (China)
  - April/Aug 19 – FS design review and Australian cost-estimate
  - Sep 2019 – Expandables Project decision

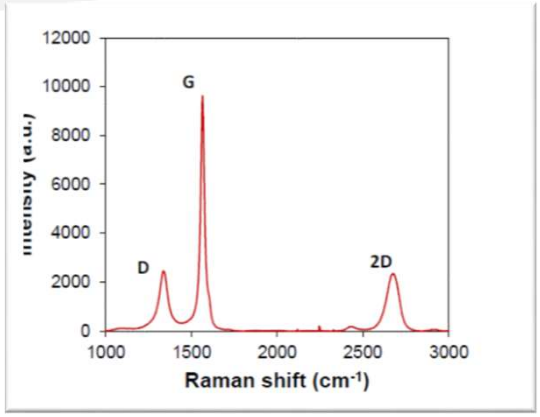
GRAPHENE



- Research Agreement with University of Adelaide
  - Testing of Munglinup concentrate for the production of graphene through a range of different methods
  - Characterisation of the graphene produced
  - Testing for end-use applications
  - Testing of a modified method for producing expandable graphite
  - Production of functionalised graphene/graphene oxide

- **Objective**: Proof of concept to identify at least one, scalable method to take to next stage of development (pilot-scale testing)

GRAPHENE

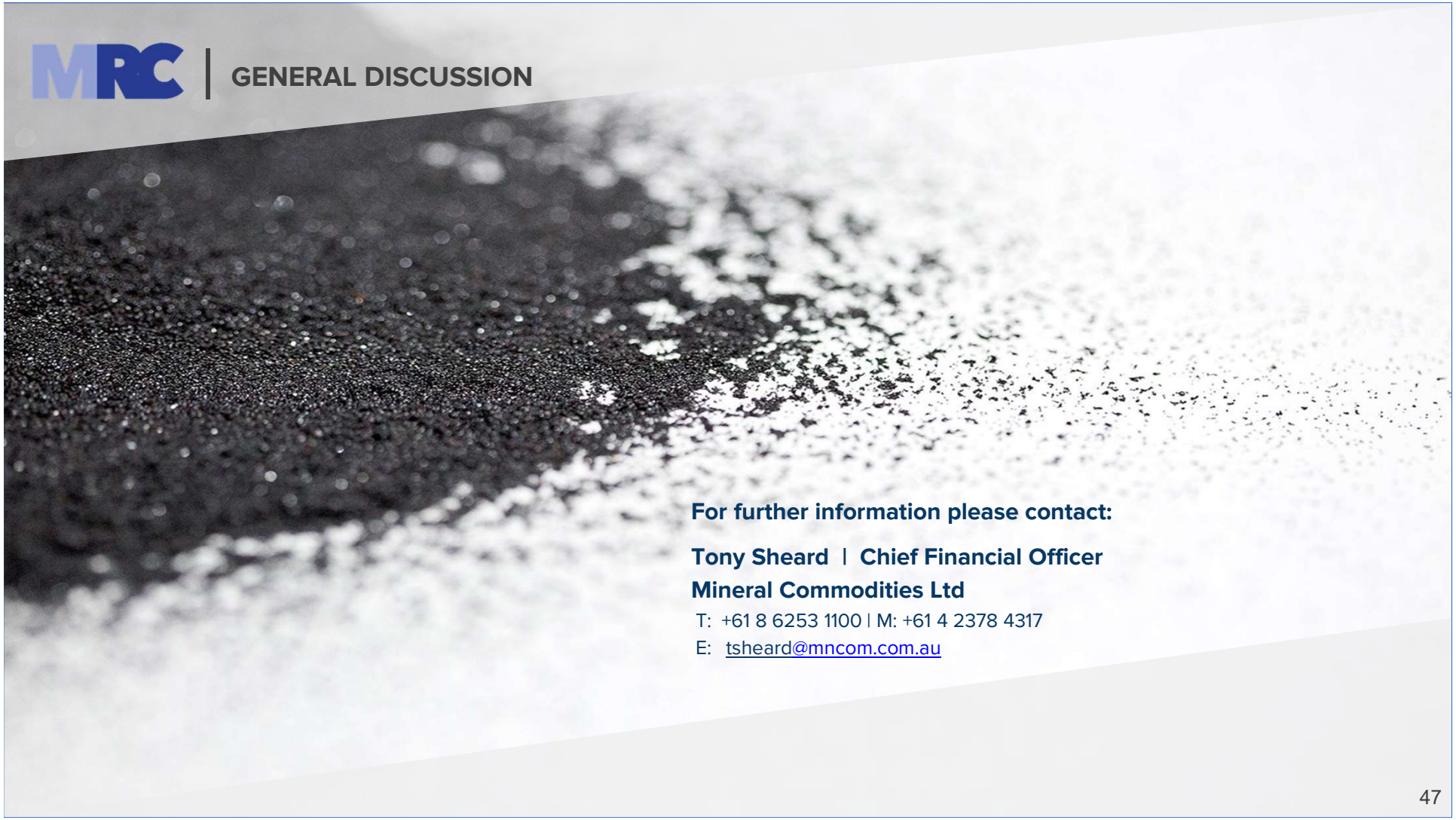


- **Current Status:**
- **Exfoliation of graphene:**
  - One method identified for producing single to multi-layergraphene at high yields (>95%)
    - Has synergies with expandables production
  - Graphene produced shown to be suitable for applications such as conductive inks and paints
- **Graphene Oxide (GO)/Functionalised Graphene**
  - GO produced from MRC concentrate (non-green method) suitable for super-capacitors and protective coatings
  - Production via 'green' method testwork commencing Nov
- **Expandable graphite**
  - method shows the modified chemistry is not as effective as the standard H2SO4/oxidant approach. However, the expansion approach is effective and potentially provides an alternative to high temperature thermal expansion

DOWNSTREAM PROCESSING SUMMARY

Downstream Processing Area	Comments & Status
High purity graphite, uncoated spheronised graphite, coated spheronised graphite	• Concept study & evaluation completed, looking at a range of scenarios • Evaluation shows purification and then spheronisation preferable as the fines are higher value • The rationale for uncoated spheronised graphite (UCSPG) is questionable given market for high purity graphite, the long customer qualification periods for supply of UCSPG, and the additional capital and power required for spheronisation – due to the low productivities of the spheronisation equipment • Approach to be taken is to focus on thermo-halogen purification, with less focus on spheronisation. Initial spheronisation tests to examine coin cell testing on products • In parallel, assess novel (non-HF) chemical purification routes • Testwork and PFS to be completed in 2019 • Pilot scale and FS in 2019/2020
Expandable Graphite/Expanded Graphite	• Testwork shows excellent expansion characteristics for >180 micron flakes • Conceptual evaluation indicates a low capital, high return project • Low technology risk relative to the other options • Additional testwork and FS study to be completed in 2019 • **First target for downstream production**
Graphene & related	• Graphene market potential constrained by inability to scale • Research focused on scalable exfoliation (top-down) methods • Results to date are promising but further work required • Potential market returns warrant continuing to conduct R & D • Potential synergies with Expanded Graphite production – reduce capital costs for future graphene production

GENERAL DISCUSSION



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