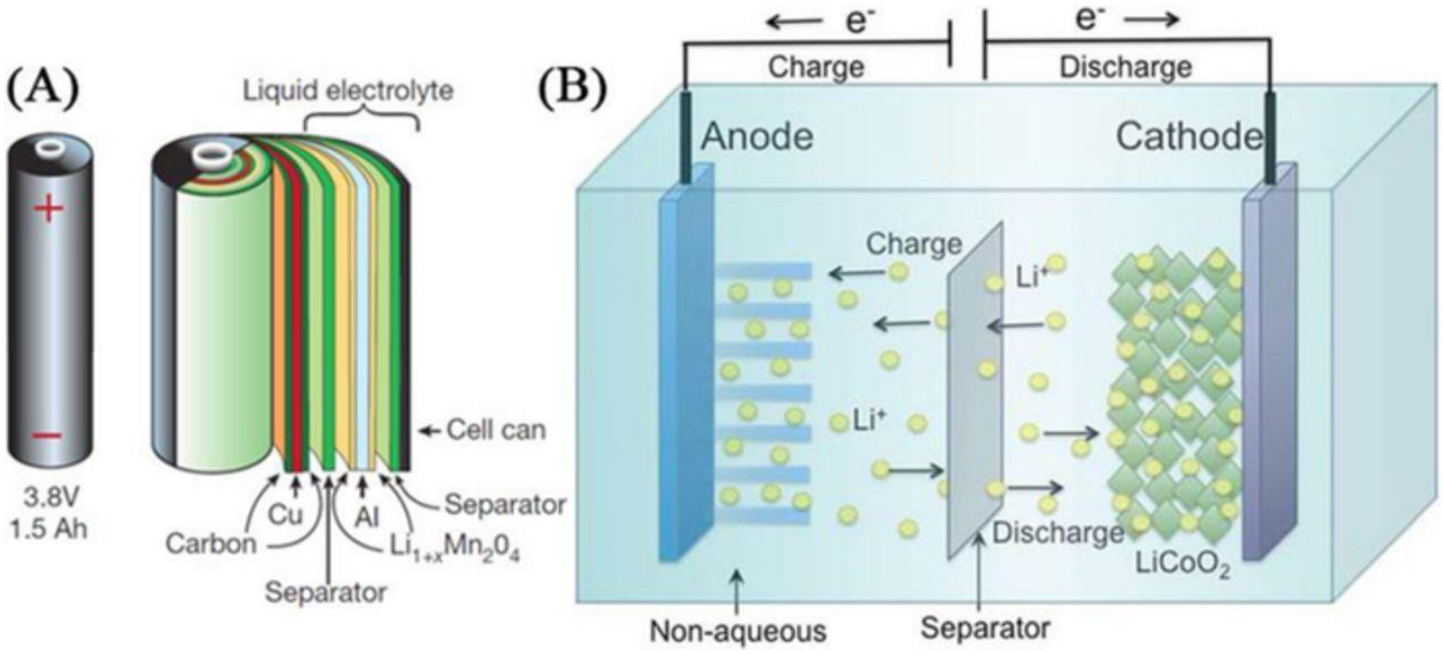
# Metals and Mining

## Renascor Resources Ltd*

December 2019

**John Meyer**
**Sergey Raevskiy**
**Simon Beardsmore**



Front page photograph

Schematic view illustrating operating principle of Li-ion secondary battery | NIKKEI XTECH

A Japanese institute succeeded in visualizing the lithium (Li) ions coming in and going out of the positive electrode of a Li-ion secondary battery.

Non-Independent Research
*SP Angel acts as Broker

MiFID II Exempt

# Mining Note

## Renascor Resources Ltd*

**RNU LN** **BUY**

**TP A$0.09/s**

## Siviour graphite DFS demonstrates value

Renascor are developing the Siviour graphite project in South Australia

One of the world's largest graphite Resources

DFS indicates low operating costs of US$355/t over the Life of Mine

Low capital start-up cost of US$82m including mining pre-strip

**17 December 2019**

### Stock Data

| | |
|---|---|
| Ticker (ASX) | RNU AU |
| Share Price | A$0.012 |
| Market Cap | A$15.0m |

### Price Chart



**Research**

**John Meyer**
+44 20 3470 0490
john.meyer@spangel.co.uk

**Simon Beardsmore**
+44 20 3470 0484
simon.beardsmore@spangel.co.uk

**Sergey Raevskiy**
+44 20 3470 0474
sergey.raevskiy @spangel.co.uk

**Sales**

**Richard Parlons**
+44 20 3470 0472
richard.parlons@spangel.co.uk

**Abagail Wayne**
+44 20 3470 0534
abagail.wayne@spangel.co.uk

**Rob Rees**
+44 20 3470 0535
rob.rees@spangel.co.uk


- Renascor are looking to develop one of the world's largest and lowest cost graphite deposits in South Australia.
- The deposit is close to flat lying with a significant proportion of the Resource running from 5m below surface with a 1.5:1 strip ratio over the first 10 years. This favourable geometry lowers the cost of mining resulting in a relatively low-cost operation overall.
- Metallurgical test work indicates the project is capable of producing graphite products ranging from jumbo flake through to small flake and fine graphite with an average sales price of US$780-944/t as the market for battery anodes matures.
- The large and jumbo flake represents >10% of the product and should sell for >US$1,000/t into the market for non-toxic fire-retardant material. This is a specialist market for around 60,000tpa in 2019 is expected to expand to 120,000tpa based on forecasts by Benchmark Minerals.
- Medium flake should sell for US$800/t to US$1,000/t and represents some 7% of the product.
- Small and fine graphite material represents 72.4% of the material and is expected to sell for US$700/t to US$900/t as the market for spherical graphite for battery anodes expands to feed the new electric vehicle revolution. We have reduced this to US$475/t in our modelling based on our own base-case assumptions.
- The graphite market needs new supply to support the expected growth in demand for battery anodes over the next 10 years. Producers will need to gear up on consistent quality small & fine flake to meet rapid expected growth in the market.
- **Production: Stage 1:** 80,000tpa. **Stage 2:** 144,000tpa
- **Capex: Stage 1** US$82m first 4 years. **Stage 2 Expansion** US$54m
- **Reserve:** 45.2Mt grading 7.9% Total Graphitic Content. **Resource:** 87.4Mt of 7.5%

| Year | | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|
| Stockpile | kt | 3,434 | 5,130 | 4,928 | 5,969 | 7,563 |
| Grade TGC | % | 8.3% | 9.8% | 7.6% | 8.2% | 8.3% |
| Milled ore | kt | 640 | 825 | 825 | 857 | 1,602 |
| Production | kt | 68 | 97 | 76 | 78 | 146 |
| Sales | US$m | 41 | 58 | 45 | 46 | 87 |
| Cash Cost/t | US$/t | 427 | 299 | 336 | 367 | 296 |
| Op Profit | US$m | 12 | 22 | 17 | 15 | 35 |
| Pre-Tax Profit | US$m | 13 | 23 | 18 | 19 | 39 |
| Tax | US$m | -19 | 6 | 2 | -8 | 10 |
| Post-Tax Profit | US$m | 31 | 17 | 15 | 27 | 29 |

*Source: (Renascor own 100% of Siviour Graphite Project). SP Angel figures simplified from the DFS.*

**Renascor optimised Definitive Feasibility Study results**

Renascor's Siviour Definitive Feasibility Study results demonstrate value at the Siviour Graphite Project in South Australia.

**Key figures, assumptions and estimates:**

**Capex (including Mining Pre-Strip):**

- Stage 1 (Yrs 1-4): US$82m for the first 4 years – includes a 10% contingency on plant
- Stage 2 Expansion: US$54m

**Throughput**

- Stage 1: 825,000tpa
- Yrs 5-40: 1,650,000tpa

**Grade**

- Stage 1: 10.7%
- Stage 2 (Yrs 5-10): 9.1%
- Life of Mine: 7.4%

**Production of 94-96% Graphite Concentrate:**

- Stage 1: 80,000tpa
- Stage 2: 144,000tpa
- Life of Mine: 105,000tpa

**Flake distribution:**

- Jumbo Flake – 4%
- Large Flake – 17%
- Medium Flake – 7%
- Small Flake – 37%
- Fine – 35%

**Pricing: Basket price US$804/t** – over first 5 years to 2025 and US$925/t over Life of Mine

- Jumbo Flake - US$1,254-1,450/t
- Large Flake - US$877-1,047/t
- Medium Flake - US$839-999/t
- Small Flake - US$716-898/t – SP Angel assumption US$475/t

**Costs: cash cost:**

- Stage 1: US$345/t
- Stage 2 (Yrs 5-10): US$325/t
- LOM: US$355/t

**Valuation:**

**DFS estimates for Siviour**

- NPV10% - US$271m post tax
- IRR 33%
- EBITDA US$58m average LoM
- EBITDA margin 57%

**Life of Mine** est. 40 years

**Project cash flow:** US$1.5bn est. over 40-year Life of Mine

**Valuation**

Renascor is developing Australia's largest graphite deposit. The recent DFS appears well timed to meet new demand forecast by industry specialists for battery anodes and for other industrial graphite products.

The DFS shows competitive cash cost estimates with an EBITDA margin of 57%, an IRR of 33% and an NPV of US$271m on a post-tax basis. This looks like a good return compared with an initial capital outlay of just US$82m.

**We value Renascor at A$0.09/s** on a risked NPV basis using a 10% discount rate to NPV.

Our NPV calculation is based on our estimate of the company's post-tax cash flow using our own estimates of graphite prices based on recent reports to the market.

Our pricing estimates are skewed by recent announcements by Syrah Resources which has been forced to dramatically cut production and has warned of a significant fall in the value per tonne received.

We are told other, better quality, graphite producers have continued to see good demand and receive good prices for flake graphite and the DFS pricing is prudent for the Jumbo, Large, Medium and Small flake sizes.

We have reduced our price expectation on the small and fine flake sizes to account for potential further impact in the market from Syrah as it tries to restore cutback production.

Much depends on the quality and consistency of the graphite product being delivered which will depend on good plant design, build quality and the team running the operation.

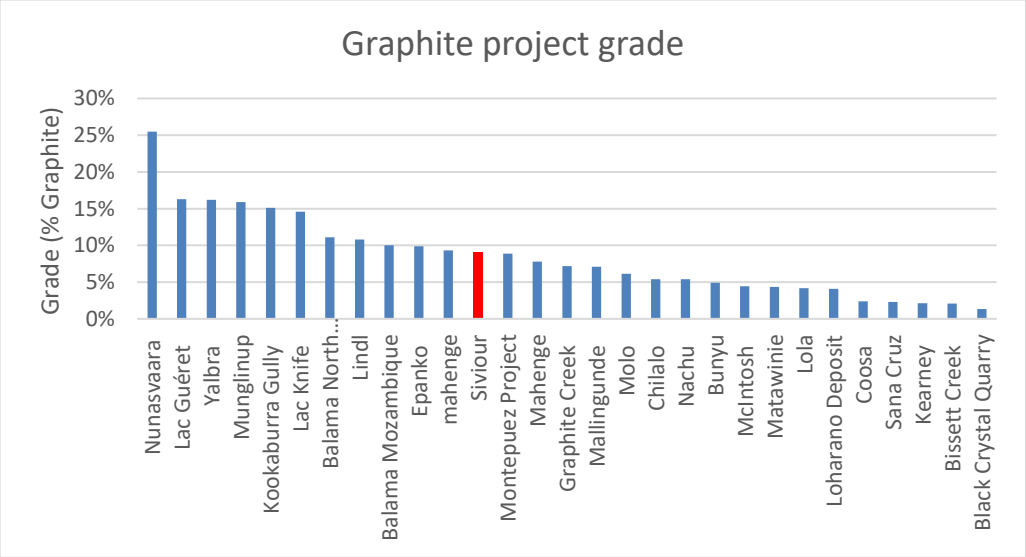
Renascor has an inherent advantage with its location in Australia where it should attract well qualified talent into a settled working environment. We expect better, more consistent quality graphite product to come from Renascor as a direct result of its location and access to local talent.

The CVs for the Renascor directors speak for themselves, they are an accomplished team who have a track record of innovation in the mining sector. (See section on directors)

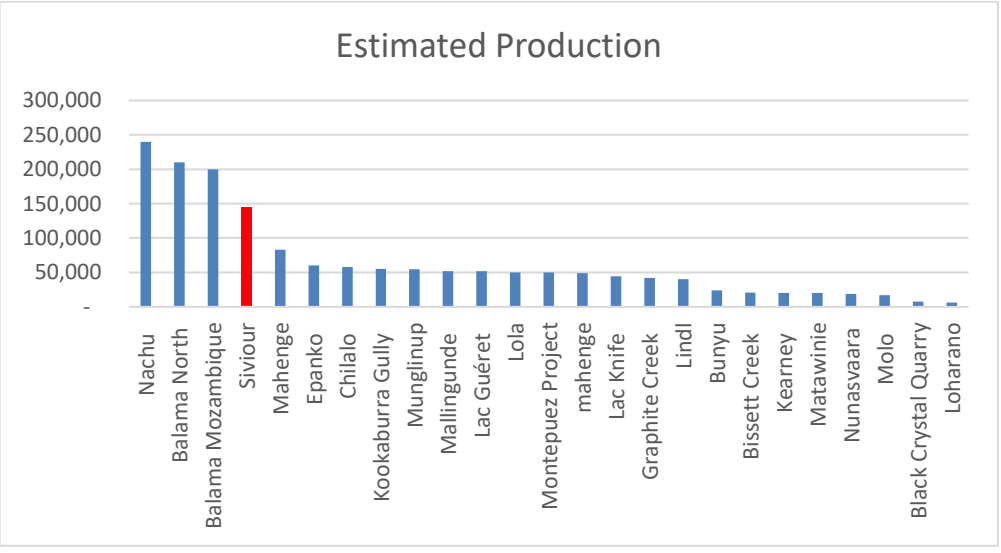
**Scale:** Siviour currently appears to be the fourth largest reported graphite resource in the world with its flat lying orientation likely to make it one of the lowest cost new graphite projects.

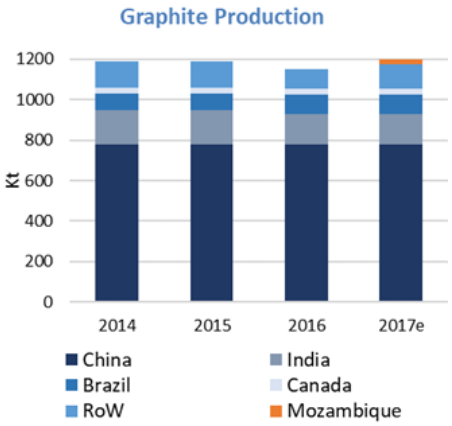
**Grade** While grade is not a key factor from a graphite quality or pricing perspective it is interesting to rank graphite development companies. Renascor's Siviour project sits in the top quartile in terms of grade in its mine plan. Note we do not show the full range of global projects below. We also use project names as some companies have multiple graphite projects.

Grades at Siviour are estimated according to JORC code Reserve and Resource standards. The mine has been optimised to bring forward the mining of better grades in the early years at lower mining costs to accelerate cash flows and for the early repayment of capital. Mine head grades are calculated to average 10.7% TGC for the first four years and 9.1% TGC over years 5-10. The total Life of Mine head grade is 7.4%TGC.




**Production** Siviour presents one of the world's larger producers of graphite concentrate with a forecast production rate of 80,00tpa for years 1-4 and 144,000tpa for years 5-10 following the expansion of the process plant. The average graphite concentrate production rate over the 40 year life of mine is forecast to be 105,000tpa. The relatively high production rate is a function of the project's grade and low operating costs.






**Processing and Metallurgy:**

A total of 72.4% of the product is likely to be below 150 µm. This has been determined through a 2 to 3 year process of metallurgical testwork and flowsheet optimisation involving batch, locked cycle and a pilot scale flotation program in China.

Locked cycle tests are those whereby the product is passed through a locked cycle in a repetitive cycle test to simulate a continuous circuit with the products reporting to the flotation concentrate or to tailings. The system is seen as the best way of predicting flotation results for process plants.

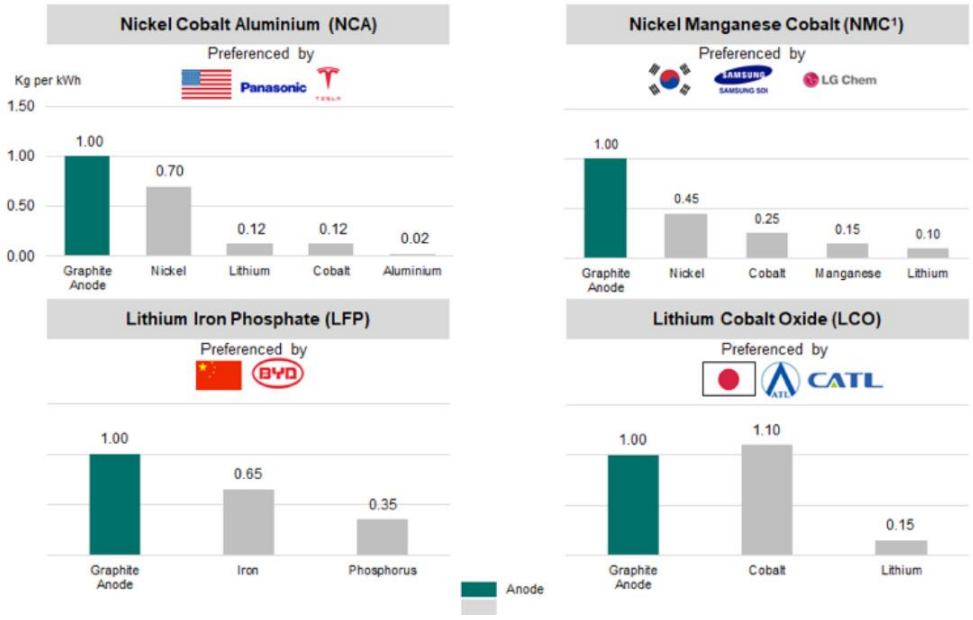
Graphite is about selling relatively small tonnages of good quality concentrates into specific applications. It is not a bulk market where producers can simply dump large tonnages into the market as others have recently found out.

While it is relatively simple to determine the difference between flake sizes, it is the quality of these flakes which are as significant as their size. For example, large flake graphite from Madagascar is softer and seen as of better quality for fire retardants.

**Fire retardants:** are a specialist market with estimated consumption at around 60,000tpa this year. Benchmark Minerals consultants expect this market to expand to 120,000tpa by 2030.

Spherical graphite currently represents some 20% of the total market for graphite with the market is expected to grow exponentially following new demand for electric vehicles. We expect the market to be subject to increasingly strict quality control as consumers demand better quality spheronised graphite to make better batteries and as China limits imports to protect Chinese-owned supply.

**Graphite content Kg per KWh in NCA, NMC, LFP and LCO batteries**




*Source: Syrah Reources*

**Battery grade:** Renascor has produced >99.95% Total Carbon (TC) battery-Grade Graphite from Siviour Concentrates via multiple techniques.

Testwork using hydrofluoric acid shows Renascor concentrate can produce 99.99% TC for battery-grade graphite.

China uses hydrofluoric acid to achieve carbon grades of around 99.95% carbon purity but this is not seen as acceptable to consumers by Western auto manufacturers from an environmental perspective.

Renascor has also achieved battery grade graphite through a more environmentally-friendly caustic roasting process. The process uses a standard caustic roast in which Renascor graphite concentrates are combined with a caustic solution and then roasted at low temperature before being leached with hydrochloric acid.

Renascor's studies suggest the caustic roast process has cost-savings over the conventional acid technique, and, importantly, it provides the added benefit of avoiding the use of dangerous and polluting acid.

**Urbix process:** Renascor used Urbix Resources to run the purification test using Urbix's proprietary low-temperature, 80°C, non-oxidative purification process which should reduce reagent and energy costs. The Urbix process produces battery-grade graphite from graphite concentrates.

Renascor sent a 96% grade graphite concentrate for testing to the Urbix laboratory in Arizona which converted the sample into battery grade graphite using the new Urbix technology. The Urbix process also showed the sample could be purified to > 99.95% using multiple processes.

The results demonstrate that Renascor is able to use a number of different processes to get to >99.95% Total Carbon content and can choose the most cost-effective process available to make spherical graphite for Li-ion batteries.

**Environmentally friendly:** The Urbix process does not use caustic roasting or hydrofluoric acid for purification to battery-grade anode material from Siviour graphite. Renascor is now working on a more advanced feasibility study for the production of spherical graphite and will continue with optimisation process design work.

**Consistency:** is of increasing importance to customers with significant lead times to accreditation within the industry. As a result we believe Chinese processors are able to command a significant margin for taking lesser quality product and upgrading this product to meet the demands of battery manufacturers and other industrial users.

We note there appear to be two different price structures in China with higher prices to support local producers and lower prices for imports.

Renascor aims to produce African quality graphite in South Australia but with better process control and better-quality product for sale into Asia, Europe or North America.

Management believe they can cost effectively make 94 to 95 %TGC material at a cost that should rank among the lowest of the new graphite producers.

**Graphene:** No report on graphite would be complete without mentioning graphene and while the market is hugely interesting it's use is relatively limited. We are currently not forecasting any value form this area in our current valuation but there is significant potential for Renascor team to develop production in this area in future years given their technical backgrounds. We see Renascor's location in Australia as making graphene production likely in future years adding option value for investors.

**The Siviour Resource**

Siviour is one of the world's largest graphite resources with 87.4mt of Resources at 7.5% TGC, comprised of:

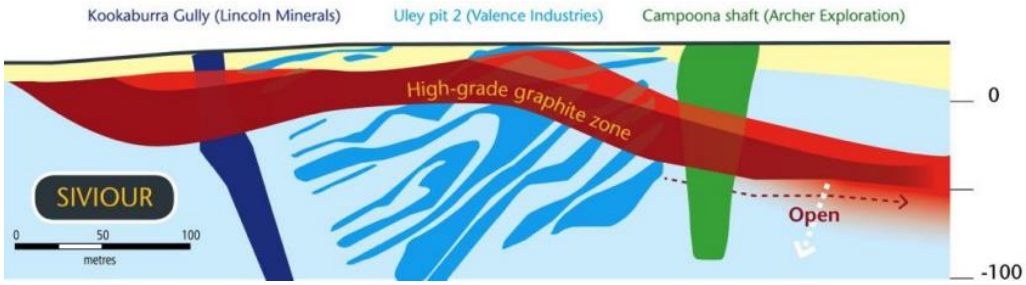
- **Measured** 15.8Mt grading of 8.8% TGC;
- **Indicated** 39.5Mt grading of 7.2% TGC; and
- **Inferred** 32.1Mt grading of 7.2% TGC.

**Reserve:** 45.2Mt @ 7.9% TGC for 3.6Mt of contained graphite (Total Graphitic Carbon). The DFS is based on the reserve grade with the mining schedule optimised for variable mining rates and varying grades as the mine progresses.

**Optimisation:** The project's capital requirement has been optimised to break down the capital expenditure into two stages reducing the initial capital to just US$82m in stage 1 and following this with a second stage expansion costing US$54m in year 5. The mining rate is also optimised showing a very high mining rate in the first two years to build a large stockpile for processing. The mining rate is then ramped up again in 2025 to feed the Stage 2 expansion.

**At surface, near-flat lying resource**

Renascor has a significant advantage over many other graphite producers in that it will mine a very simple orebody. The ability to mine / free dig directly from surface with very little waste material enables the use of large-scale machinery and for the mine plan to selectively pick better grade material in the early years to optimise cash flow recovery enabling rapid payback of capital.




**Approvals:**

The State of South Australia granted the Siviour Mineral Lease in Q2 2019 enabling Renascor management to move towards full approval for the mine.

**Project financing**

Management are working with the Netherlands Export Credit Agency, Atradius, which may provide up to 60% of initial capital expenditure if the project qualifies for Dutch export credit cover. We assume the rest of the capital is debt financed and while Renascor has not locked down the capital structure, there is likely to be some component of equity funding through sources such as strategic investors, private equity funds and or offtakers.

The Dutch Export Credit Agency scheme was identified as applicable to Renascor's Siviour Graphite Project based on the sourcing of Dutch content through Renascor's Dutch strategic engineering partner, Royal IHC which has already invested A$1m into the Project and is working on the front-end engineering design.

**Cash** of A$1.8m at end September 2019, and in December 2019 announced a A$1.4m placement and up to A$0.5m from a Share Placement Plan.

**Demand**

The market expects growth in most graphite categories over the next 15 years driven by larger flake graphite as a fire retardant and by new demand for Li-ion battery anodes.

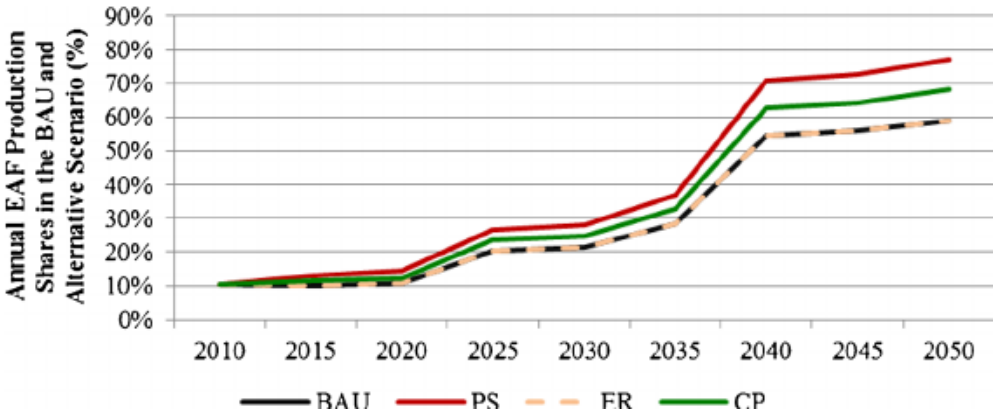
While sales figures for electric vehicles will be significant, demand is also driven by new Li-ion battery installations for grid supply. These large-scale Li-ion battery systems are being ordered for millisecond response to smooth out power supply interruptions and short peaks in demand. While many grid-scale Li-ion battery packs are in use a number have suffered catastrophic failure through battery fires, mainly in South Korea almost certainly due to imprecise battery manufacturing processes and possibly the use of poor-quality materials.

Graphite demand is increasing for nearly all graphite uses though their growth rates are dwarfed by expected expansion in the Li-ion battery market. The market for expandable graphite, used as a fire retardant should increase due to its non-toxicity and use in paint to keep heat away from steel beams in domestic and commercial fires.

Demand for Li-ion battery anodes should increase the most with current collectors for fuel cells also likely to grow if fuel cell technology becomes a popular alternative for longer-range vehicles.

**Critical material:** Given that battery grade graphite represents around half the mass of a Li-ion battery and all the processing is done in China this makes graphite a critical material from a Western EV manufacturing perspective.

Demand for anodes for EAF 'electric arc furnaces' should also rise as China. China is expected to raise its proportion of steel produced from scrap using Electric Arc Furnace production as scrap becomes more available locally as a result of the last 20 + years of industrialisation.

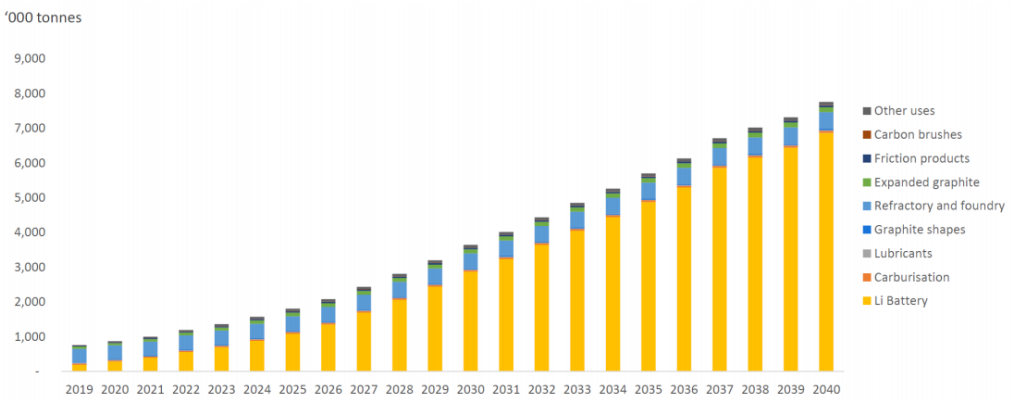



*BAU business-as-usual, PS production share, ER emission reduction, CP carbon pricing. Source: Berkeley National Laboratory & University of California.*

**Electric vehicle manufacturing**

Automotive manufacturing of batteries is expected to raise battery production capacity to 1,234.8 GWh in 2023 according to Benchmark Mineral Intelligence.

The proportion of electric vehicles sold is seen as rising to 25% by 2025 from 2% in 2018. This is expected to require some 800,000tpa of spheronised battery graphite representing >6x current production.




**Graphite demand expected to outstrip all available forecast supply by 2028**

Graphite is not a rare commodity from a geological perspective but available sources of suitable graphite in simple economic deposits are less common. This is partly due to a lack of focus in this specialist, industrial market and a lack of demand growth in previous eras.

We see new demand absorbing much of the world's available, probable, known supply within six years indicating that miners will need to bring in less well-defined resources by 2028 to meet expected demand. Some of these new deposits will realise their potential in terms of purity and flake quality while others, often in emerging market locations, will not. This is likely to create some volatility in prices as the supply / demand balance tightens.

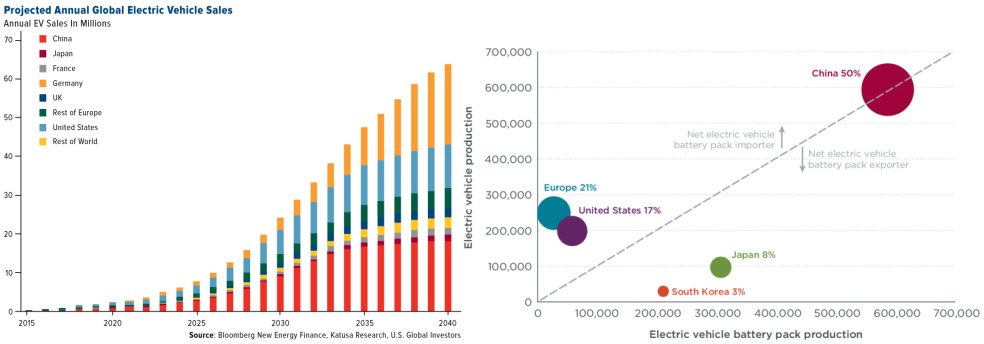
Graphite is sold into a number of very distinct markets with mines often selling product into a number of very different industrial applications. Certain of these market segments such as the Li-ion battery anode market are developing in scale driven by new technological advances and regulatory changes.

The market for Large Flake graphite remains strong driven by regulation for better fire protection in construction worldwide. Recent banning of chemical retardants in Anchorage, Alaska highlights the dangers of chemical fire retardants. California, Maine and Rhode Island already prohibit products with certain fire retardants as does the city of San Francisco. While graphite does burn it is seen as a non-toxic fire retardant in flake form.

**Electric vehicle demand**

Demand for new electric vehicles is forecast to rise dramatically as policymakers in developed nations push for cleaner air quality in towns and cities driven by strong electoral support and the rising cost of healthcare for suffers of asthma and other lung conditions.

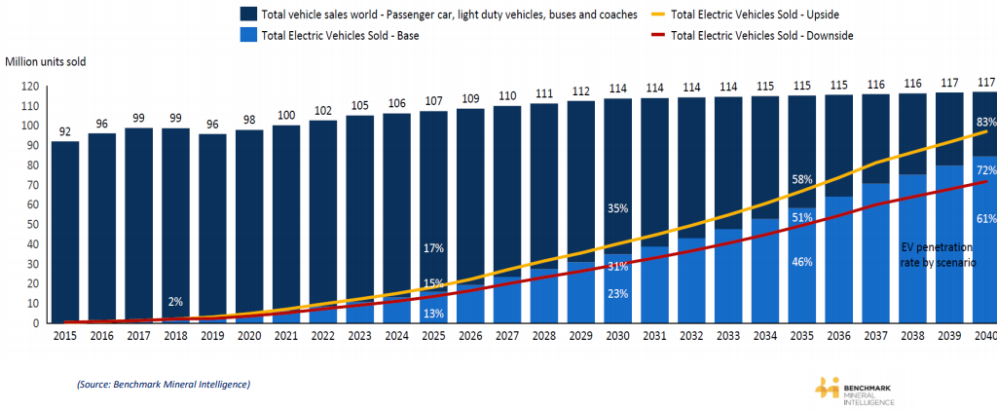
While the Trump administration may have slowed sales of Electric Vehicles into California and a reduction in subsidies in China has also slowed EV sales, the move to substantially greater electrification appears virtually unstoppable as policy makers respond to popular demand for cleaner air in cities.




*Source: Bloomberg NEF. Katusa Research, US Global Investors. ResearchGate*

The low cost per mile of electric vehicles is compelling for commuters driving regular journeys where they are able to recharge overnight. The comfort of an electric ride is particularly compelling for delivery drivers with the added bonus of being able to reuse just over half the energy normally lost in breaking in traffic where regenerative breaking is used.

News of new battery developments offering greater battery capacity, durability, cycle life, range and temperature tolerances could accelerate the uptake of Electric Vehicles and may cause current projections to look optimistic as EV manufacturers race to command greater market share.

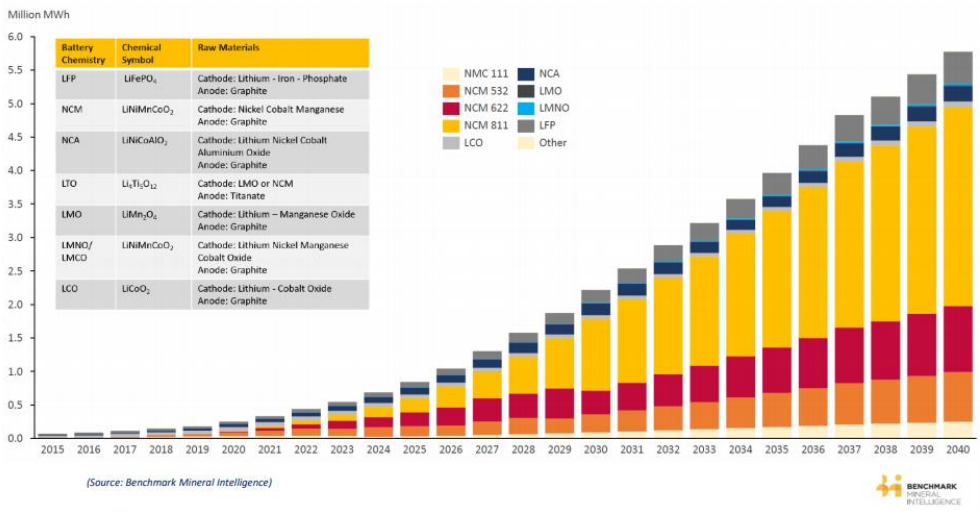



Prices for standard grade spheronised graphite rose 20% in 2018 to US$3,600/t from US$3,000/t are reported by Benchmark to have maintained this price level through 2019.

The German Government is supporting three battery cell alliances with €1bn for the domestic production of Automotive Li-ion batteries

**Graphite demand set to grow in most Li-ion battery chemistries**

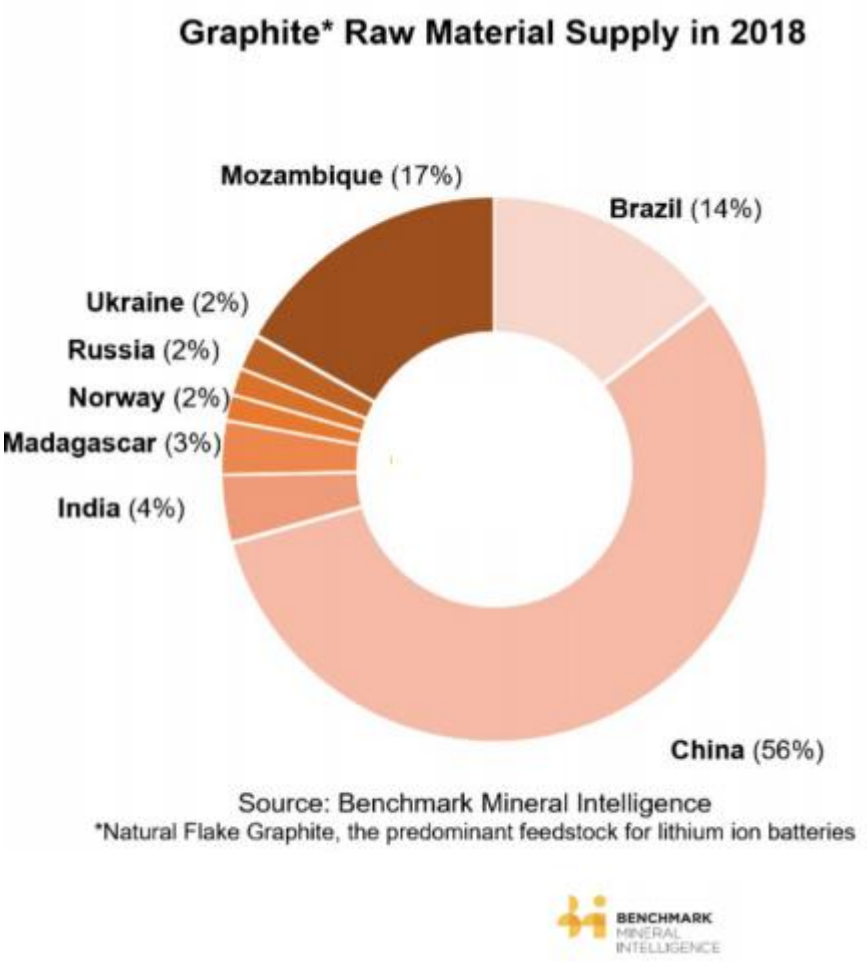
Graphite is critical in all Li-ion battery chemistries so while we see the mix of other metals changing according to the dominant battery chemistry, graphite should see steady and relatively strong growth in line with the capacity of batteries being produced.




| Battery Chemistry | Chemical Symbol | Raw Materials |
|---|---|---|
| LFP | $LiFePO_4$ | Cathode: Lithium - Iron - Phosphate<br>Anode: Graphite |
| NCM | $LiNiMnCoO_2$ | Cathode: Nickel Cobalt Manganese<br>Anode: Graphite |
| NCA | $LiNiCoAlO_2$ | Cathode: Lithium Nickel Cobalt Aluminium Oxide<br>Anode: Graphite |
| LTO | $Li_4Ti_5O_{12}$ | Cathode: LMO or NCM<br>Anode: Titanate |
| LMO | $LiMn_2O_4$ | Cathode: Lithium – Manganese Oxide<br>Anode: Graphite |
| LMNO/ LMCO | $LiNiMnCoO_2$ | Cathode: Lithium Nickel Manganese Cobalt Oxide<br>Anode: Graphite |
| LCO | $LiCoO_2$ | Cathode: Lithium - Cobalt Oxide<br>Anode: Graphite |

**Supply**

The majority of graphite is produced in China, with incremental supply coming from Mozambique, and Brazil, and less amounts from other countries.




China is also currently the only commercial producer of spherical graphite for Li-ion batteries giving the nation an unhealthy command on the supply chain and the ability to stop non-Chinese battery production in its tracks if the government wishes. The weaponising of Rare Earth Elements in recent years alongside the threat of disrupting sales by German auto manufacturers in China over a proposal to ban Huawei 5G technology from Germany demonstrates how important it is to ensure more of the spheronised supply chain exists outside of China.

China's historical position the dominant producer of graphite has recently been (temporarily) challenged by the start-up of production of Syrah's Balama project in Mozambique. Syrah was targeting production of up to 350,000tpa, and, after the start of commercial production in late 2017, Syrah reported production of 137,000t through the first nine months of 2018 before drastically cutting-back production to 15,000t for Q4 2019 and subject to further operational reviews going forward.

A large part of Syrah's difficulty can be inferred from their financial results: for the first three quarter of 2019, Syrah reported cash costs of US$577/t against an average selling price of US$441/t.

We believe that Syrah may have pushed its Chinese buyers too hard disrupting their negotiations and offending the other party.

Importantly, other operators appear to be expanding sales into China indicating to us that this particular buyers' strike may be specific to Syrah and may relate more to Syrah's product quality and specification which is at the low value end of the spectrum.

China is enforcing stricter environmental regulations restricting the use of hydrofluoric acid and potentially making the processing of Syrah's low value product uneconomic and possibly much more difficult to process.

We understand that this lower-value product may not be preferred by most Automotive battery anode producers with Syrah material sold to a low-end battery manufacturer which is seen as the lowest price buyer.

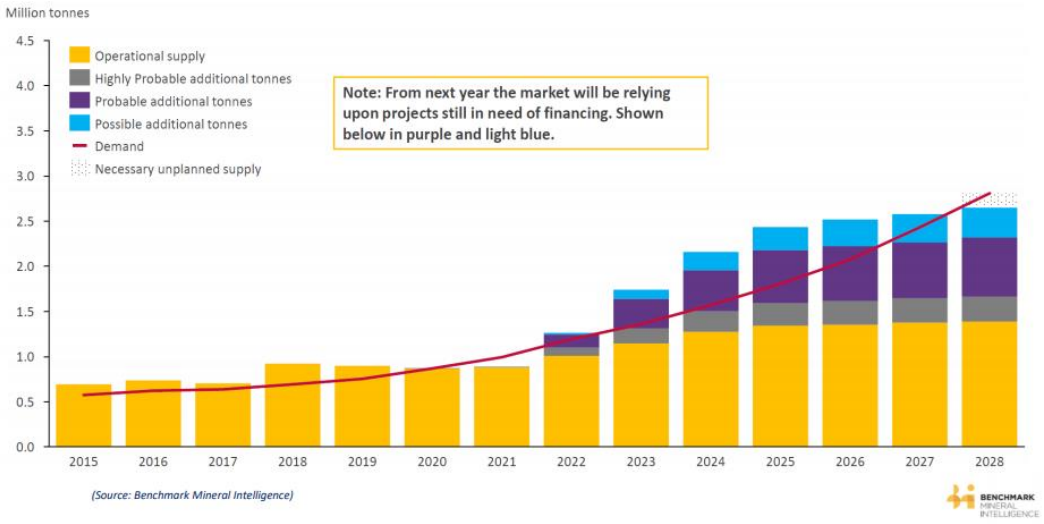
The rest of Syrah's material is for other industrial uses which may also be impacted by the US / China trade war.

We understand that demand from smaller, higher-value graphite producers is holding up and that interest in other parts of Asia remains strong. This may be due in part to China Minmetals Corporation consolidating production in the Heilongjiang region potentially tightening supply locally and squeezing out buyers from Korea and Japan.

For Syrah, the challenge is to produce consistent and better-quality battery grade graphite material economically at lower production levels.

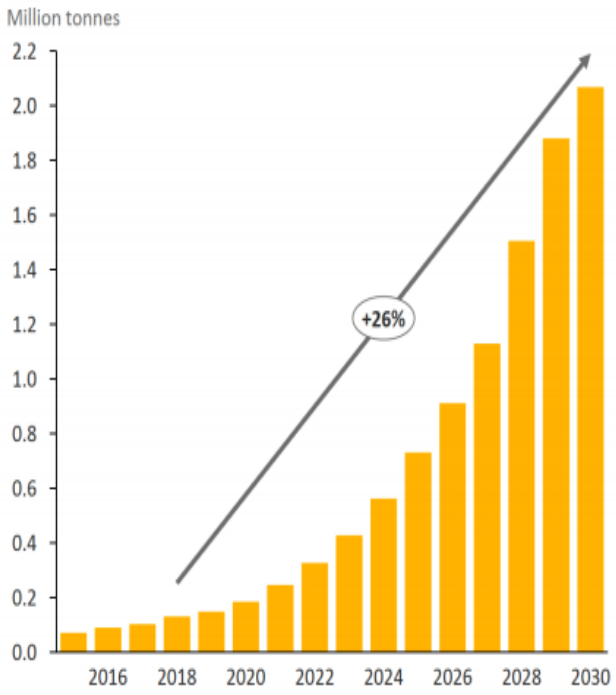
The company may also have some 90,000t of inventory to work through indicating that the mine could go to care and maintenance for some time.

**Operational graphite production pa**




**China Green Shield** policies are closing polluting graphite producers in Shandong and Heilongjiang which should serve to tighten the market in China and attract greater imports.

**Uncoated spherical graphite demand forecast 2015-2030,**



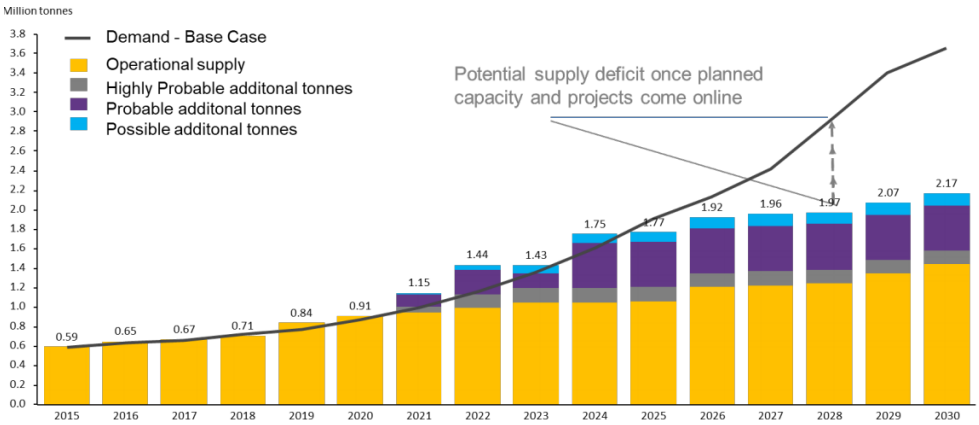

Source: *Benchmark Mineral Intelligence*

**Deficit forecast**

Benchmark Minerals Intelligence forecast a significant deficit to open up in the market for graphite principally due to new demand from battery manufacturers.

The view is supported by activity by Chinese companies looking to secure long-term supplies of graphite even when those mines are located in less politically desirable locations.

**Market deficit**




*Source: Benchmark Minerals Intelligence*

**Recycling:** the market does not currently recycle graphite from batteries as the recovery is achieved through burning off the graphite in the batteries to liberate the other materials.

It is unlikely that any other process for recycling will be used for many years as it just makes sense to burn off the graphite and melt the other metals as part of the recycling process.

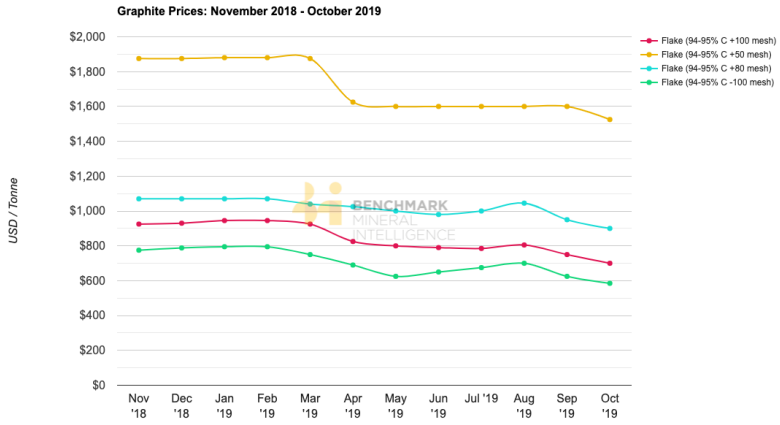
**Pricing**

Benchmark Minerals Intelligence gives price estimates over the next 10 years for each of the flake sizes sold in the market according to a report commissioned by Renascor.

- The DFS uses Benchmark's forecasts for graphite basket price starting at US$809/t in 2022. Prices are indicated by Benchmark for the key grades of Jumbo, Large flake, medium flake and small flake distribution.

- Benchmark's pricing gives US$804/t for the first five years of the project and US$925/t for the Life of the Mine representing an approximate 22% fall on the previous basket price used reflecting a pullback in the market.

- We have adjusted our price deck lower for this report based on a more conservative assumption for small flake and fine graphite of US$450 and US$500/t respectively. Our view is coloured by pricing and issues at Syrah Resources which has been forced to cut back production due to quality and offtake issues. While we are not as expert in the market as Benchmark we prefer to use more cautious estimates at this point in time.




*Source: Benchmark Mineral Intelligence*

**DFS study price forecasts**

| Graphite price | | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|
| Jumbo flake | US$/t | 1,354 | 1,309 | 1,232 | 1,254 | 1,258 |
| large flake | US$/t | 930 | 893 | 879 | 877 | 922 |
| medium flake | US$/t | 903 | 868 | 839 | 908 | 915 |
| small flake DFS | US$/t | 770 | 736 | 716 | 751 | 789 |
| DFS Basket Price | US$/t | 809 | 781 | 786 | 819 | 863 |

*Source: Renascor DFS study*

**SP Angel modelled forecasts**

| Graphite price | | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|
| **Jumbo flake** | **US$/t** | 1,354 | 1,309 | 1,232 | 1,254 | 1,258 |
| **large flake** | **US$/t** | 930 | 893 | 879 | 877 | 922 |
| **medium flake** | **US$/t** | 903 | 868 | 839 | 908 | 915 |
| **small flake** | **US$/t** | 475 | 475 | 475 | 475 | 475 |
| **Composite average** | **US$/t** | **613** | **603** | **596** | **601** | **609** |

**Spot natural flake graphite prices** fell suddenly and materially in China in 2019 across all flake sizes impacting existing contract price re-negotiations and contract renewal discussions.

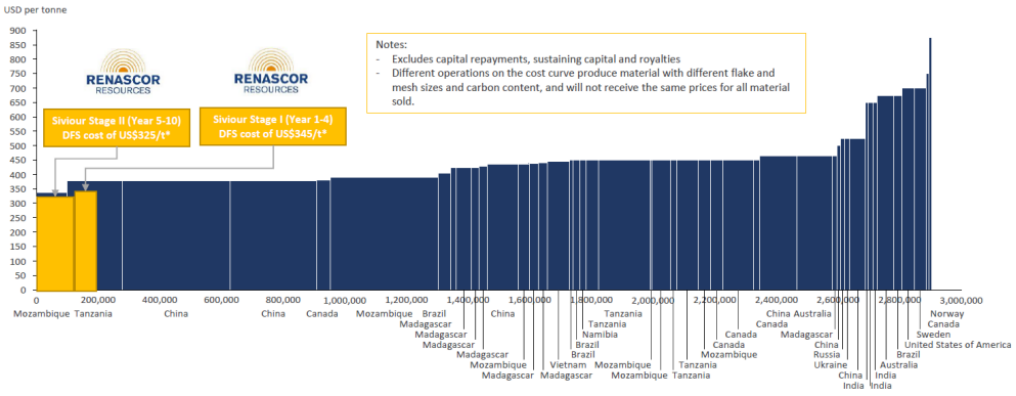
Additional production from Madagascar and a seasonal increase in domestic Chinese production has also added to market supply.

China imported 105,000t of graphite in the first six months of 2019 with 75% coming from Syrah's Balama mine mainly for battery manufacturing until Balama's Chinese offtaker refused to continue to take increasing shipments.

While Syrah can produce some 240ktpa it plans to limit sales to 45,000t in Q3. Syrah's Q3 average weighted average price is now expected to be US$400/t versus US$457/t in Q2.

**Costs**

Renascor's Siviour project should sit at the lowest end of the cost curve according to its DFS estimates superimposed onto the Benchmark Mineral Intelligence cost curve.




The DFS estimated the Siviour operating cost to be some US$345/t over the mine's first 4 years falling to US$325/t for years 5-10 after the expansion of the process plant and average US$355/y of the 40-year life of the mine.

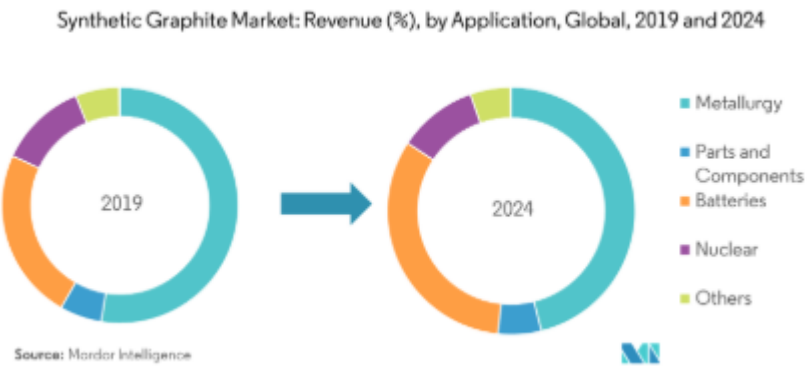
This compares with Syrah Resources which were targeting cash costs of US$400/t by end 2019 before they were forced to dramatically cut production by their major Chinese offtaker.

Renascor's PFS on Spherical graphite previously confirmed a projected gross cash operating cost of US$1,962/t for spherical graphite versus Chinese costs estimated at US$2,000-2,700/t in China. Being able to produce better quality graphite should add significant value in time and could see compound annual growth rates of up to 26% between 2015 and 2030 according to Benchmark Minerals Intelligence.

**Transport and logistic:** costs are estimated at US$73/t. Graphite is loaded into bulk bags for transport with Jumbo and larger flake sizes handled more carefully to maintain flake size.

The project could have the third lowest projected transport cost in the world.

**Synthetic graphite:** the market for graphite for battery anodes and for fuel cell current collectors is all about quality. Synthetic graphite is normally made from petroleum coke and is naturally pure giving it greater value for anode manufacturers. >60% of synthetic graphite is still used for metallurgical uses with new growth in the market to come from new demand for batteries in the next five years.




*Source: Mordor Intelligence*

**Offtake:** Mined graphite is most commonly sold as a concentrate by private, direct negotiation, leading to opaque pricing structures. Pricing details are posted via minerals intelligence companies, for example 'Industrial Minerals', who provide guideline quoted prices with respect to long-term trends after surveying industry participants. Most natural graphite is typically sold to traders who upsell to intermediary refiners, polishers and shapers before the product is sold to final customers. With China dominating the market, responsible for 67% production in 2017 (source: USGS), the Asian powerhouse nation is setting the global standard for the commodity's price.

**Flake distribution:**

Renascor have analysed the optimum distribution and recovery of graphite flake units for the Siviour project with the table below giving us the distribution of flake sizes to be sold.

Analysis of the concentrate shows 72.4% of the product to be small and fine flake size. This size range should see significant demand growth from Li-ion battery anode production.

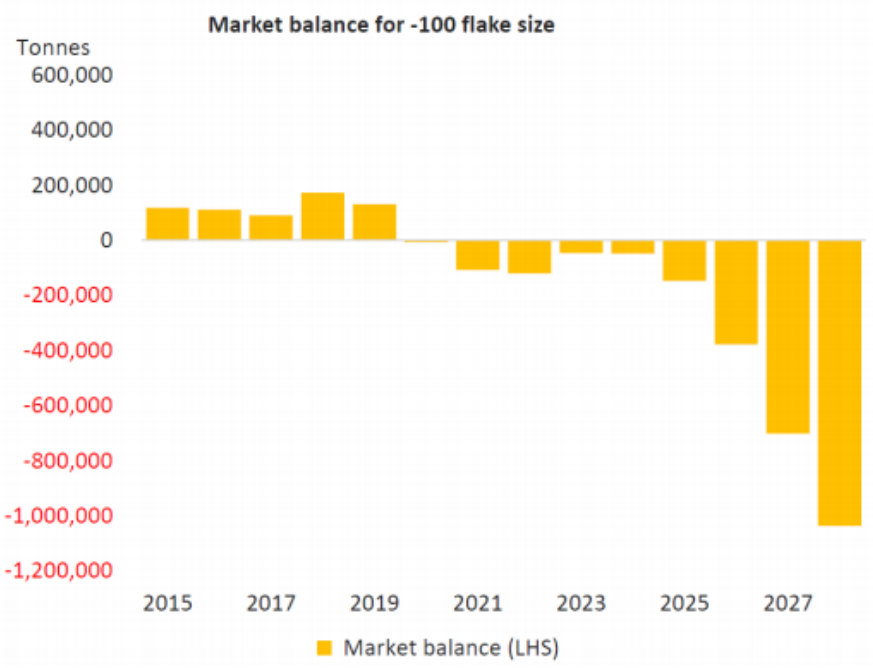
While the small flake and fines were of limited value some time ago, we understand there is strong demand for good, consistent quality fines with particular particle characteristics.

It is the processing and effective manufacturing of these particle characteristics which will be critical for higher prices and strong demand in this market area with customers demanding rigorous accreditation and quality control.

**DFS Study Siviour Flake distribution**

| distribution | | 2022 | 2023 | 2024 | 2025 | 2026 |
|---|---|---|---|---|---|---|
| **Jumbo flake** | **%** | 4% | 4% | 4% | 4% | 4% |
| **large flake** | **%** | 17% | 17% | 17% | 17% | 17% |
| **medium flake** | **%** | 7% | 7% | 7% | 7% | 7% |
| **small flake** | **%** | 37% | 37% | 37% | 37% | 37% |
| **fine graphite** | **%** | 35% | 35% | 35% | 35% | 35% |

*Source DFS study, Royal IHC

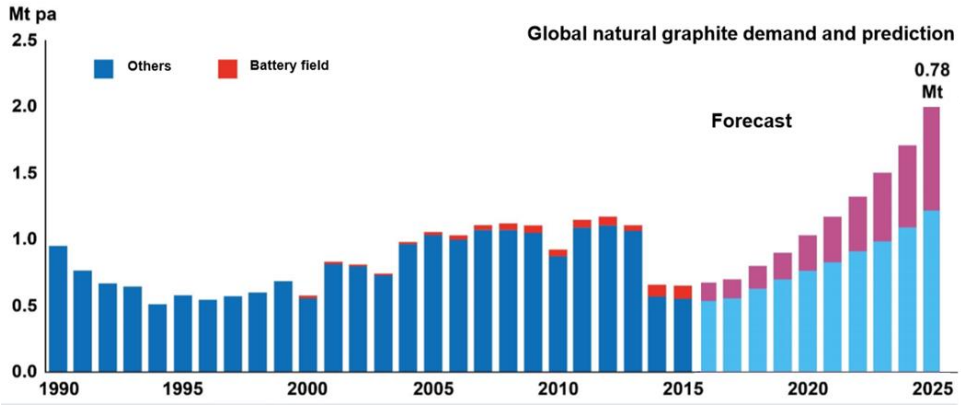


**Premiums:** We believe there is a significant opportunity to earn good premiums for the right type of fine graphite product going forward, though much will depend on the company's processing, quality control and marketing of its graphite products in order to realise good prices for its product.

**Li-ion battery anodes**

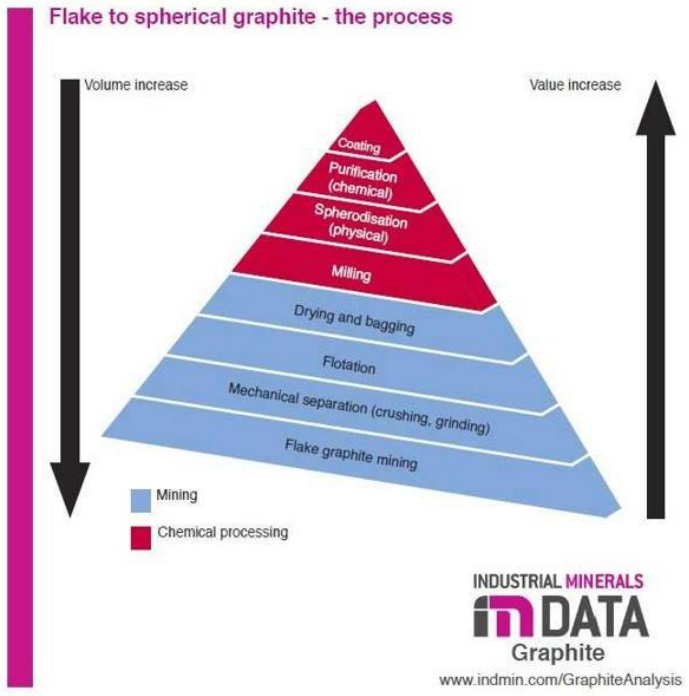
Li-ion battery anodes are the most exciting new product area for the graphite market at present. We expect significant growth in this area in both price and tonnage though this segment is still relatively small.

**Demand growth estimate for graphite in lithium-ion batteries >20% to 2025**

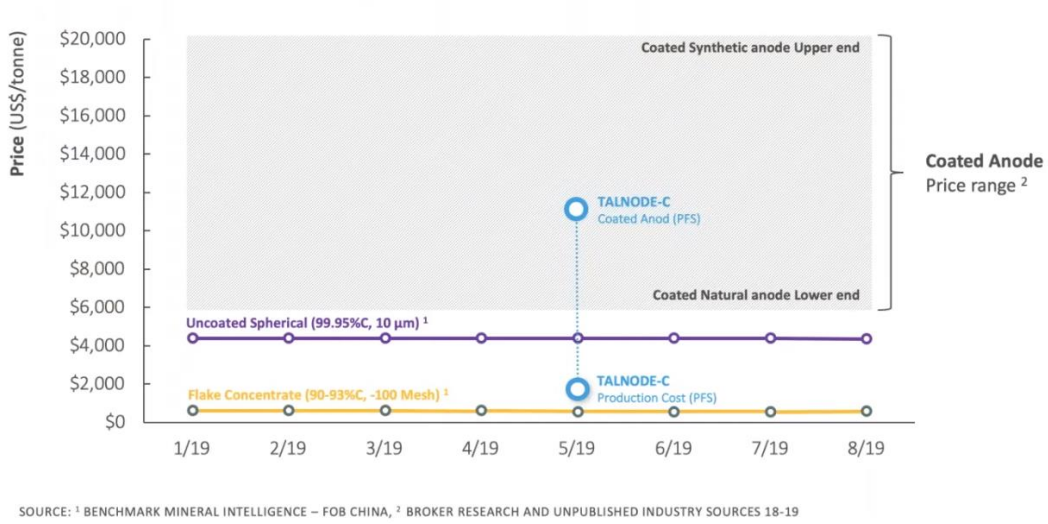



*Source: Historical data from Roskill, forecast data from Canaccord (2016)*

**Value added potential:** The chart below shows the price of small flake concentrate grading. 90-93% carbon vs higher-grade uncoated spherical graphite grading 99.85% carbon and 10µm size. The value of the much purer spherical graphite is about 10x that of the less-well refined material. The price for Coated Synthetic anode is substantially greater ranging from US$6,000-20,000/t reflecting its value to industry as well as its cost of production.

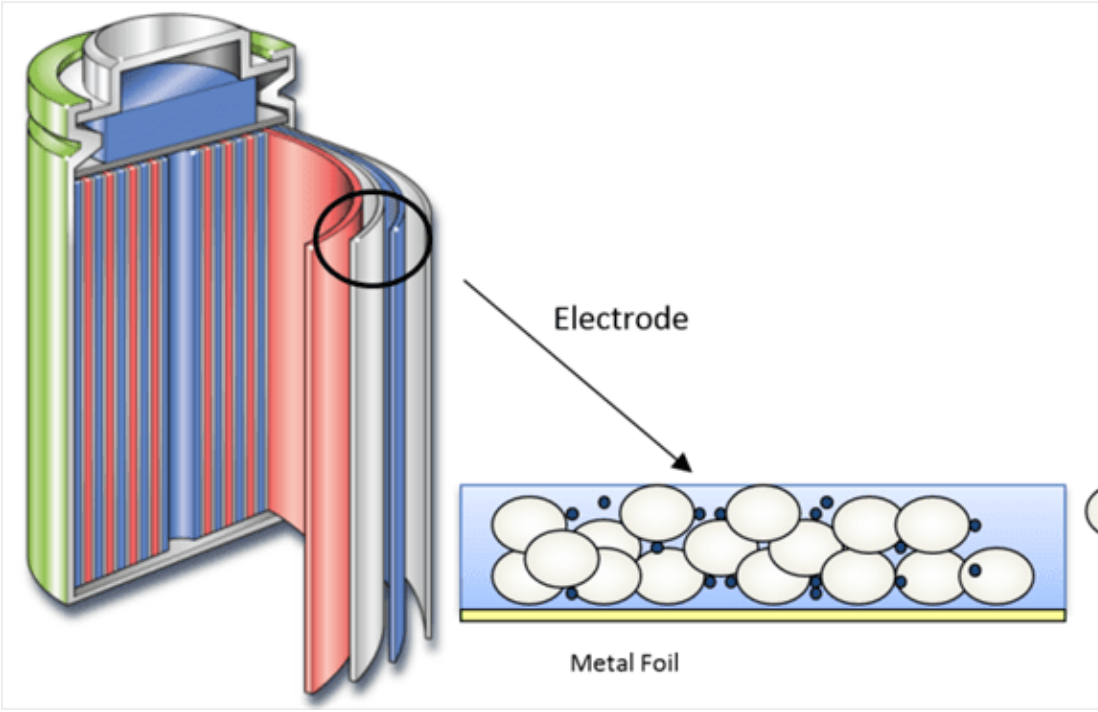


Estimates on the cost of Coated Spherical graphite is estimated to vary from US$4,500-7,000/t. Costs breakdown approximately as follows, around US$500-800/t for the flake material, US$1,000/t for spheronising, US$1,000/t for acid purification, US$2,000 for coating the anode material.



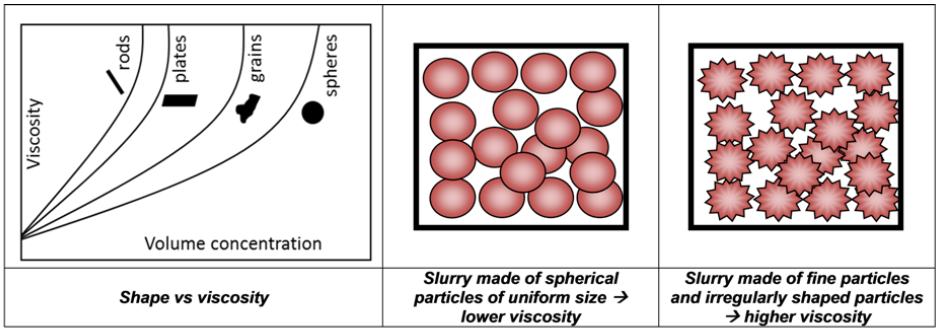

SOURCE: [1] BENCHMARK MINERAL INTELLIGENCE – FOB CHINA, [2] BROKER RESEARCH AND UNPUBLISHED INDUSTRY SOURCES 18-19

The size and shape of the fine particles is important for battery power capacity, charging rates and better battery life and we expect good quality fine particles to fetch premium prices contingent on consistent processing, accreditation and beneficial particle shapes.




*Source: AZO Materials*

Spherical graphite offers the best volume concentration to lowest viscosity as in the chart below. This offers the optimal path for the flow of electrons within the battery, raising capacity and reducing resistance. Some battery manufacturers are now advertising improved batteries made up of better quality materials indicating their recognition of the quality of material input.




*Source: AZO Materials*

**Risks**

**Water:** South Australia is a relatively dry place and Siviour will need to pipe in lower saline water for processing due to the very high salinity of the ground water in boreholes in the project area.

**Offtake contract:** Renascor is looking to secure binding offtake agreements in Asia, Europe and/or North America. Renascor has an existing MOU with a Chinese offtaker but though we also see potential to partner with Japanese or South Korean groups. Offtake contracts often work well but can come unstuck particularly if the offtaker has problems or the material being delivered is not up to specification.

China does not produce much in the way of coarse flake graphite and Chinese traders and consumers do not like to buy on long-term contract. While consumers may sign letters of intent there is no guarantee they will maintain their commitments particularly if they have issues on the quality of product received.

**Quality:** we expect Renascor be able to manage the quality of its graphite product from the Siviour project rather better than many other graphite miners based in less technically advanced countries. Renascor's team are more technology focussed than many other miners and this combined with the project's location in South Australia should enable the employment of a good quality technical plant management team. We see product quality as an increasingly important issue for graphite producers as the market grows and matures for graphite for battery anodes.

**Graphite prices:** reports indicate that graphite prices for larger flake sizes have remained relatively stable while prices have fallen for small flake eg. -150 µm to US$540/t from US$610/t in June 2019. We believe this has been driven by oversupply and quality issues at Syrah's Balama project in Mozambique. Prices appear stable at the lower US$540/t level

but should be higher for better quality product. Prices could fall further if Syrah ramps up production again at Balama though production issues may serve to restrict output for some time.

**Currency:** the Australian dollar has weakened from a high of 1.22 per USD to 1.45 per USD today. A strengthening of the Australian currency could have a material impact on US dollar-denominated returns. A fall in the Chinese Yuan / A$ rate could also affect margins on graphite sold into China which is likely to be Siviour's largest customer.

**Demand:** China is likely to remain the world's largest consumer of graphite products, though much of the end-product will be exported. Ongoing trade wars and tariff hikes may impact demand beyond our expectation.

**Management:** we see Renascor management as a key asset to the Siviour project. Changes to management may have a negative impact particularly if funds invested in Renascor view these changes as detrimental to the running of the company.

**Power prices:** Renascor's mining schedule is to accelerate mining in the early years to build a stockpile of product for longer-term processing. While the stockpile should be relatively stable the cost of fuel oil in the early years could impact margins. Power for processing will be dependent on grid power prices over the longer term.

**Labour:** labour costs are relatively high in Australia but should be less in South Australia than in the hot Pilbara. We do not expect the Siviour project to need to operate a fly-in fly-out type roster.

**Location:** Siviour is located on the Eyre Peninsula in South Australia. It is located in coastal South Australia and is relatively well served with nearby roads and is just 8km from the highway. The site is also remarkably close to two ports, power lines and other infrastructure.

.**DFS Consulting engineers**: The report has been done by Royal IHC a Dutch-based international engineering contractor which is best known for its dredging business in partnership with Wave International, an Australian-based engineering consultancy group. We have used their the IHC optimised DFS report as the basis for this note but with more cautious graphite price assumptions. While DFS consultants are normally cautious in their cost estimation there is always some risk may vary or that the scheduled optimisation does not go entirely to plan.

**Directors**

Renascor has an all-star list of board of directors under the leadership of Managing Director David Christensen and Non-Executive Chairman Dick Keevers.

The team have significant experience in the more challenging area of innovative uranium recovery and production and should be well placed technically to advance into graphite production and its value-added products.

**David Christensen, Managing Director**

David Christensen was previously CEO at Heathgate Resources and Quasar Resources.

Heathgate runs the Beverley and Beverley North Uranium Mines some 550km north of Adelaide in South Australia. Beverley is Australia's first operating In Situ Recovery (ISR) mine using world-leading technology to recover uranium in accordance with stringent safety and environmental standards and exported to be processed into fuel to generate clean energy.

David was formerly President of Nuclear Fuels Corporation, a trading and marketing company managing a uranium portfolio. David was formerly an attorney in California and London offices where he advised on corporate finance and mergers and acquisitions. David was educated at Cornell University (BA, Economics and Classical Civilizations), the University of California, Los Angeles (JD) and the Universitá di Bologna (Fulbright Fellow).

**Richard (Dick) Keevers, Non-Executive Chairman**

Dick Keevers is a mining veteran having served executive roles at Broken Hill South and Newmont Mining. Keevers formerly helped the giant Telfer gold and copper mine through development, the Phosphate Hill phosphate mine and the Baal Gammon copper mine. Keevers is currently a non- executive director of Santana Minerals Limited.

Prior to joining Renascor board Keevers was chairman at Eyre Peninsula Minerals Proprietary Limited (EPM), which holds an option over the Siviour graphite deposit and the wider Arno Graphite Project. Renascor completed the acquisition of 100% of EPM in 2016.

**Geoff McConachy, Non-Executive Director**

Geoffrey McConachy has been working as a geologist for over 30 years most recently working for Heathgate and Quasar Resources as MD Exploration.

While at Heathgate and Quasar, Geoffrey led the exploration and development team in the discovery, definition and evaluation of four uranium deposits including the Four Mile deposit, for which he was co-honoured with the Prospector of the Year award from the Australian Association of Mining & Exploration Companies.

Geoff was also instrumental in the discovery of the Fosterville gold deposit in Victoria and the Potosi base metal deposit in New South Wales. He is a fellow of the Australasian Institute of Mining and Metallurgy and a former Director of the Uranium Information Centre.

**Stephen Bizzell, Non-Executive Director**

Stephen is Chairman of Bizzell Capital Partners, a boutique corporate advisory and funds management group.

Stephen was a director at Arrow Energy until its acquisition in 2010 by Shell and PetroChina for $3.5bn.

He formerly worked in corporate finance at Ernst & Young and in the tax division of Coopers & Lybrand following qualification as a Chartered Accountant.

Stephen is a director of Queensland Treasury Corporation and has also served as a Director of Laneway Resources, Bow Energy, Dart Energy, Hot Rock Ltd, Diversa, Stanmore Coal, Titan Energy Services, Armour Energy and UIL energy.

**Pierre Van Der Merwe, Company Secretary**

Pierre is an experienced CFO and Chartered Accountant. He was a Partner at HLB Mann Judd, an accountancy and business advisory group offering services to exploration and mining companies on the ASX. Pierre has acted as company secretary to Bondi Mining (now World Titanium Resources Ltd), Papyrus Australia and Terramin Australia.

## Disclaimer – Non-independent Investment Research

This note has been issued by SP Angel Corporate Finance LLP ("SP Angel") in order to promote its investment services and is a marketing communication for the purposes of the European Markets in Financial Instruments Directive (MiFID) and FCA's Rules. It has not been prepared in accordance with the legal requirements designed to promote the independence or objectivity of investment research and is not subject to any prohibition on dealing ahead of its dissemination. SP Angel considers this note to be an acceptable minor non-monetary benefit as defined by the FCA which may be received without charge. In summary, this is because the content is either considered to be commissioned by SP Angel's clients as part our advisory services to them or is short-term market commentary. Commissioned research may from time to time include thematic and macro pieces. For further information on this and other important disclosures please the Legal and Regulatory Notices section of our website Legal and Regulatory Notices While prepared in good faith and based upon sources believed to be reliable SP Angel does not make any guarantee, representation or warranty, (either express or implied), as to the factual accuracy, completeness, or sufficiency of information contained herein. The value of investments referenced herein may go up or down and past performance is not necessarily a guide to future performance. Where investment is made in currencies other than the base currency of the investment, movements in exchange rates will have an effect on the value, either favourable or unfavourable. Securities issued in emerging markets are typically subject to greater volatility and risk of loss. The investments discussed in this note may not be suitable for all investors and the note does not take into account the investment objectives and policies, financial position or portfolio composition of any recipient. Investors must make their own investment decisions based upon their own financial objectives, resources and appetite for risk. This note is confidential and is being supplied to you solely for your information. It may not be reproduced, redistributed or passed on, directly or indirectly, to any other person or published in whole or in part, for any purpose. If this note has been sent to you by a party other than SPA the original contents may have been altered or comments may have been added. SP Angel is not responsible for any such amendments. Neither the information nor the opinions expressed herein constitute, or are to be construed as, an offer or invitation or other solicitation or recommendation to buy or sell investments. Opinions and estimates included in this note are subject to change without notice. This information is for the sole use of Eligible Counterparties and Professional Customers and is not intended for Retail Clients, as defined by the rules of the Financial Conduct Authority ("FCA"). Publication of this note does not imply future production of notes covering the same issuer(s) or subject matter. SP Angel, its partners, officers and or employees may own or have positions in any investment(s) mentioned herein or related thereto and may, from time to time add to, or dispose of, any such investment(s). SPA has put in place a number of measures to avoid or manage conflicts of interest with regard to the preparation and distribution of research. These include (i) physical, virtual and procedural information barriers (ii) a prohibition on personal account dealing by analysts and (iii) measures to ensure that recipients and persons wishing to access the research receive/are able to access the research at the same time.

SP Angel Corporate Finance LLP is a company registered in England and Wales with company number OC317049 and whose registered office address is Prince Frederick House, 35-39 Maddox Street, London W1S 2PP. SP Angel Corporate Finance LLP is authorised and regulated by the Financial Conduct Authority whose address is 12 Endeavour Square, London E20 1JN. Recommendations are based on a 12-month time horizon as follows:

Buy - Expected return >15%

Hold - Expected return range -15% to +15%

Sell - Expected return < 15%

## SP Angel Contact List


### Research

**Sergey Raevskiy**
+44 20 3470 0474
sergey.raevskiy @spangel.co.uk

**John Meyer**
+44 20 3470 0470
john.meyer@spangel.co.uk

**Simon Beardsmore**
+44 20 3470 0484
simon.beardsmore@spangel.co.uk

### Sales

**Richard Parlons**
+44 20 3470 0472
richard.parlons@spangel.co.uk

**Elizabeth Johnson**
+44 20 3470 0471
elizabeth.johnson@spangel.co.uk



4th Floor
Prince Frederick House
35-39 Maddox Street
London, W1S 2PP
United Kingdom

Tel: +44 20 3463 2260
Fax: +44 20 7629 1341
Web: **www.spangel.co.uk**