Canaccord Genuity Capital Markets

Industry Update

Industrial Minerals

Australian Equity Research
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Conor O'Prey | Analyst | Canaccord Genuity (Australia) Ltd. | cjoprey@cgf.com | +61.2.9263.2716
Reg Spencer | Analyst | Canaccord Genuity (Australia) Ltd. | rspencer@cgf.com | +61.2.9263.2701
James Bullen | Analyst | Canaccord Genuity (Australia) Ltd. | jbullen@cgf.com | +61.2.9263.2728

Companies mentioned in report

Company	Symbol	Price (A$)	Market Cap (A$m)
Andromeda Metals	ADN-ASX	0.165	406
Suvo Strategic Minerals	SUV-ASX	0.165	97
Latin Resources	LRS-ASX	0.04	56
WA Kaolin	WAK-ASX	0.23	65
Altech Chemicals	ATC-ASX	0.053	68
FYI Resources	FYI-ASX	0.63	197
Alpha HPA	A4N-ASX	0.47	372

Kaolin and HPA: Something old and something new

Kaolin — a versatile material in use for a thousand years

Kaolin is a versatile, plentiful material which has a wide range of uses, including paper, ceramics and coatings and the market is large and mature: 29.4m tonnes in 2019, growing at around 3.5% p.a., which means a net incremental 1mtpa of supply is needed to keep up with demand. The kaolin market is widely dispersed: leading producer, Imerys (NK-PAR: €39.58 | Not Rated), accounts for around 16% with the next three combining for 10%. Australia is endowed with high quality kaolin and there are a number of ways to play the thematic: **Andromeda Metals** (ADN-ASX | Not Rated) is the largest by market cap and offers exposure to the rare halloysite grade of the material; **Suvo Strategic Minerals** (SUV-ASX | Not Rated) has a profitable operation at an ex-Imerys site at Pittong in Victoria and is developing a project in Western Australia, and **WA Kaolin** (WAK-ASX | Not Rated) has the largest deposit and is readying for production start-up in Q1 CY22. **Latin Resources** (LRS-ASX | Not Rated) has also published promising study results.

Enhancing lithium-ion battery performance

The performance of lithium-ion batteries (LiBs) is substantially improved by the application of high purity alumina (HPA) to the separator, slowing battery degradation and materially improving discharge periods. HPA is a very specific grade of alumina with a minimum purity of 99.99% (4N). Standard alumina from the Bayer process does not lend itself to LiB or other high-end electronics applications (e.g. LEDs) due to the presence of sodium as a contaminant. Therefore, another route to HPA production is required and kaolin offers potential as a starting material.

High purity alumina — a new and emerging market

Alumina, like kaolin, is an established industrial mineral but emerging applications in electronics and LiBs require ultra-pure grades, which therefore calls for a re-evaluation of the HPA production process. In a market, amounting to tens of thousands of tpa, raw aluminium metal has been the expensive starting material for HPA production but Kaolin offers a potential solution as a long-term, cost-effective feedstock. Two ASX-listed companies, **Altech Chemicals** (ATC-ASX | Not Rated) and **FYI Resources** (FYI-ASX | Not Rated), offer exposure to this relatively new process. A third, **Alpha HPA** (A4N-ASX | Not Rated) solves the problem using a fundamentally different process but producing promising results with comparable, and possibly lower, unit costs. Industry forecasts project the HPA market to grow at 17% p.a. over the next seven years (Figure 5), suggesting that supply will need to grow to match that demand.

Different markets, different risks, different returns

Kaolin links the two markets together, but we believe they should be analysed separately. Whilst ATC and FYI have their own deposits, they do not plan to be full-time kaolin producers: 'campaign' mining will supply several years' worth of HPA feedstock. Kaolin production and processing tends to be relatively straightforward and there is a ready and growing market for the material. SUV, WAK and ADN either have, or are in the process of negotiating, offtake agreements for their products, often with distributors or users in the Asia-Pacific region. Capex is relatively low (tens of millions of dollars) and payback periods are fast, mostly measured in months. The HPA market enjoys very dynamic growth potential over the next five years at least. There appears little dispute about the benefits of HPA in LiBs and LEDs, so the challenge remains for the industry to meet the demand. The projects tend to require significant capex running to hundreds of millions of dollars, whilst HPA pricing is projected to be an order of magnitude higher than for kaolin.

For important information, please see the Important Disclosures beginning on page 35 of this document.

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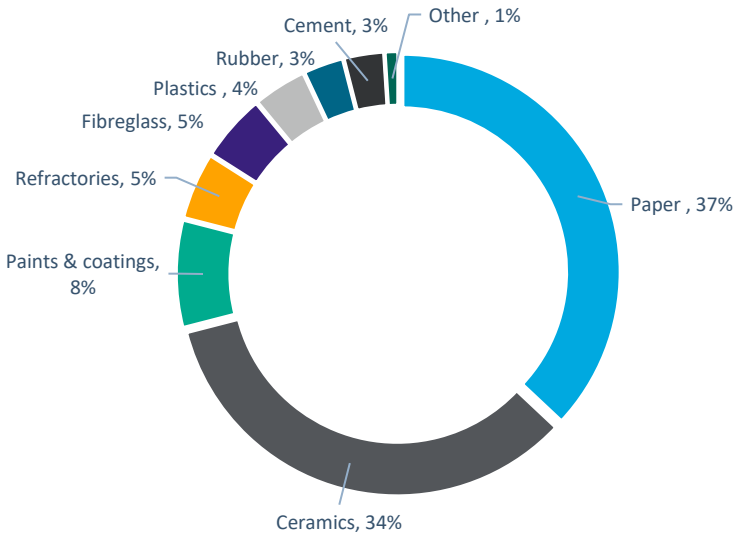
Market profile for kaolin

Kaolin – a versatile, well understood raw material

According to ADN the market for kaolin in 2019 was 26.5m tonnes, whilst in its IPO prospectus, WAK estimated that the value of the kaolin market in that year was US$4.76b.

Imerys is the largest kaolin producer in the world with a 16% share of the market. Two markets, Paper (37%) and Ceramics (34%), account for over 70% of kaolin's end use. Kaolin is not currently used as a feed anywhere for high purity alumina (HPA) but the sorts of volumes that are predicted for 2022, and which rely on kaolin as a feedstock, represented only around 30,000 tonnes in 2019, which would put it into the 1% 'Other' category of the market. Other categories would also include applications like adhesives, animal feed, medical, crop protection, household products and remediation.

Figure 1: End uses for kaolin



Source: Andromeda Metals

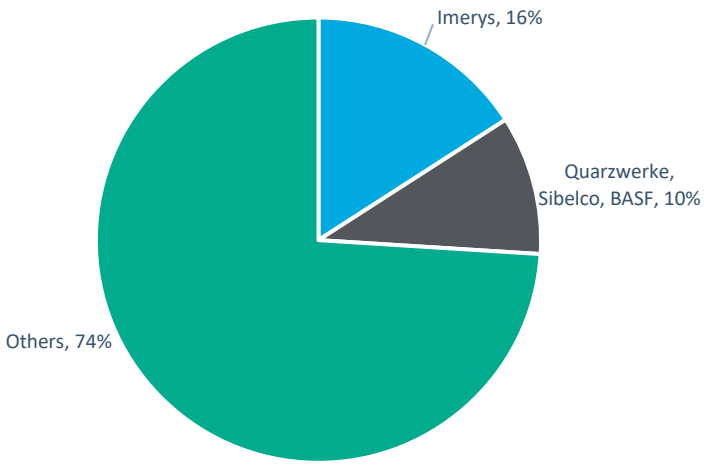
WAK offered further detail on the end use of kaolin across key use cases:

- **Paper (37%):** Kaolin is known to be most extensively used as a coating and filler material in paper manufacturing. It improves the appearance of the paper by providing gloss, brightness and opacity as well as increasing the smoothness of the paper. Additionally, kaolin improves the printability of the paper, meaning it is preferentially used.
- **Ceramics (34%):** Kaolin is used in the ceramic industry owing to its resistance to heat and its high fusion point. Kaolin finds application in sanitary ware, tiles, tableware, refractories, and electro-porcelain insulators. In addition to improving the optical properties of whiteware products, kaolin imparts a smooth and strong finish. Kaolin-based ceramics are used as metal substitutes in aerospace applications.
- **Paint and coatings (8%)**: When added to paint, kaolin offers stain and scrub resistance, improved pigment suspension and increased opacity and tint strength, amongst other properties. It is used as a substitute for titanium dioxide as it results in a reduced manufacturing cost of the final product.

- **Fibreglass (5%)**: Fibreglass is drawn from a molten glass furnace similar to everyday glass, and kaolin provides the alumina content in the glass formation because it helps strengthen the integrated glass fibres in the material. In fibre reinforced plastic (FRP) kaolin also helps in improving the integration between the fibres and strengthens the plastic. FRP is used in sporting goods, automobiles, ships and boats, aerospace products, tanks and pipes, building and construction, and recreational goods.
- **Rubber (3%):** When used in rubber applications, kaolin acts as a processing aid, imparting rubber with better resistance to abrasion and tears, increased strength, and an improved curing rate. That rubber is used in tires, hoses, car door seals, gaskets, fibre reinforced cable, hydraulic and industrial hoses, and other products.

Kaolin production is characterised by a relatively fragmented profile, with the largest operator, Imerys, enjoying a 16% share of the market in 2019. The top four producers represent around 26% of the global market.

Figure 2: Global kaolin producers

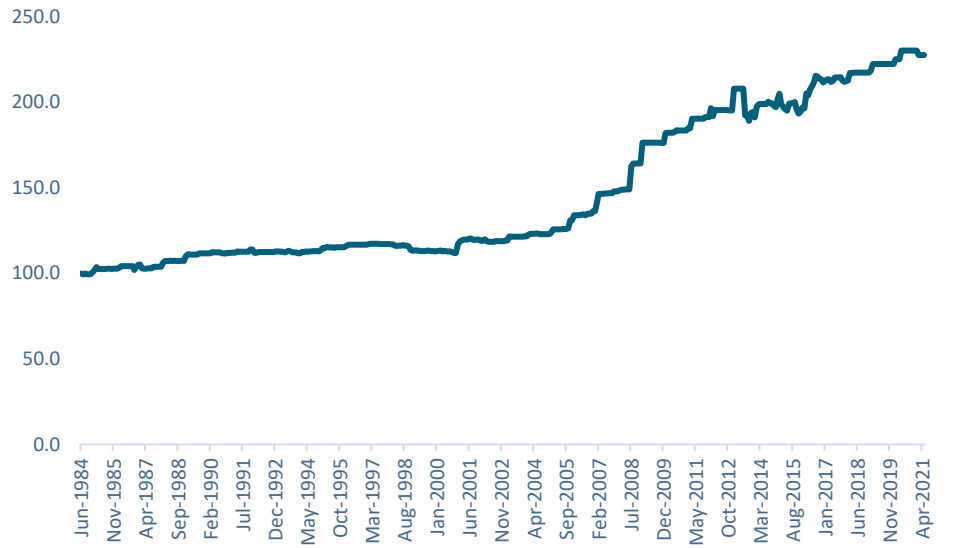


Source: Grand View Research, WAK IPO Prospectus

Historic kaolin pricing

When adjusted for inflation, Kaolin pricing has been relatively stable over a long period of time. Data from the US Fed shows that the price index has risen from 100 in June 1984 to 230 today, implying a compound price increase of an inflation-like 2.2% per annum. We view this stability as a positive for Australia's kaolin developers and their investors as it provides perspective on a key area of potential risk when assessing the potential outcomes for a project.

Figure 3: Kaolin pricing indexed to June 1984

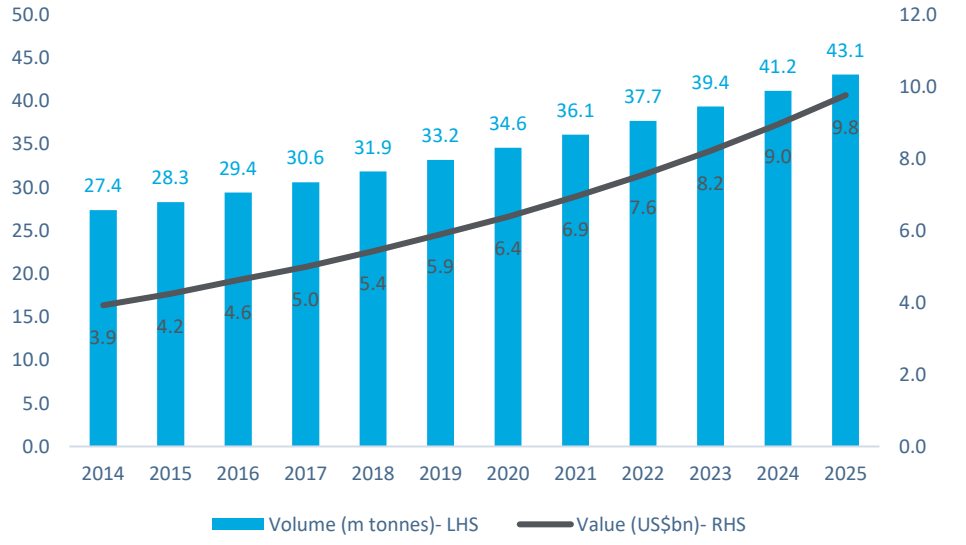


Source: US Bureau of Labor Statistics, Producer Price Index by Industry: Kaolin and Ball Clay Mining: Kaolin and Ball Clay

Outlook for the kaolin market

As a mature product, the macro-outlook for kaolin demand is GDP-like, with forecasts from Grand View Research, which were incorporated in the WAK IPO prospectus, estimating volume growth of 4.5% p.a. between 2020-25 with the market's value rising at 8.8% p.a. over the same period, implying positive pricing and mix trends over the forecast period.

Figure 4: Global kaolin market and forecast, 2014-25



Source: Grand View Research, WAK DFS

Within the industry's supply profile, which draws from Grand View Research, WAK asserts that there will be a number of moving parts which will create opportunities for new entrants to the market:

- Increasing investments from manufacturers to meet the regulatory norms coupled with rising labour, energy, and logistics costs have led to an increase in the prices of kaolin. Companies including Imerys and KaMin (unlisted) have announced an increase in the price of kaolin products, effective from 2018, to ensure long-term sustainability in the market. Companies also take efforts to maintain strong relationships with logistics partners to optimise cost.
- Pressure from regulators in China to improve environmental and safety standards has led to the closure of kaolin producers and a tightening of supply.
- Market consolidation has occurred over the last five years with key players such as Imerys acquiring assets from competitors.
- From 1 June 2019 China has increased the tariff on US kaolin imported into China.
- Globally, high quality deposits are being exhausted and the volumes being sourced from lower quality deposits require extensive processing to achieve customer quality parameters.

In addition, we note that some operators, notably ADN (confirmed JORC resource) and LRS, which is in exploration, have potentially commercially relevant deposits of halloysite, a premium and rarer grade of kaolin which has possible future applications in concrete strengthening and handling, carbon capture and storage, and nanotechnology.

On the forecasts above, demand for kaolin increases at around 1.7-2.0mt per annum out to 2025, which is a figure net of any resource exhaustion as well as other factors above and which suggests that gross incremental supply will have to be some way higher than 1.7-2.0mt per annum.

High purity alumina – an important emerging industrial material and an application for kaolin

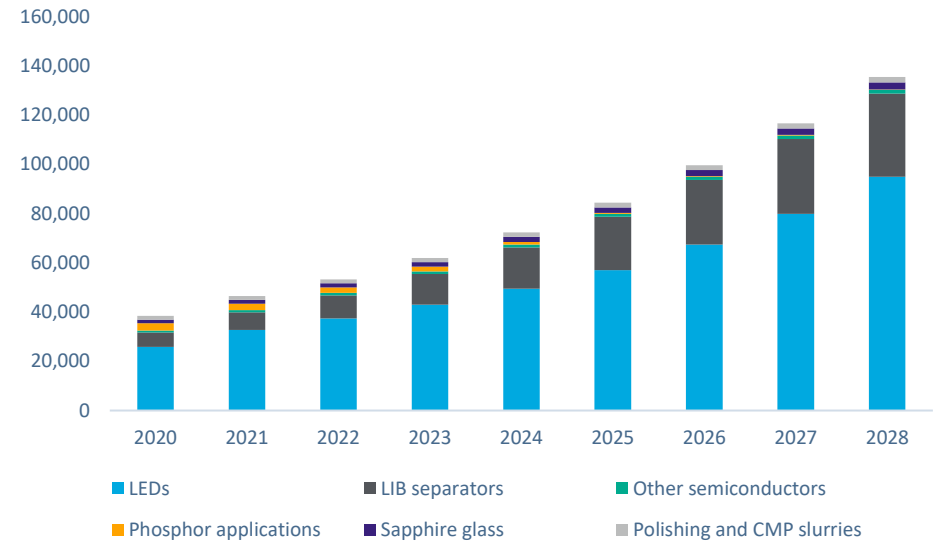
High purity alumina (HPA), aluminium oxide, is an emerging application for kaolin for which the common use today is in lighting and other applications using LED technology.

However, HPA has potential important applications in lithium ion battery (LIB) separators and electrodes (both cathode and anode), helping to improve battery safety and performance. According to data from FYI, an aspiring HPA producer, the global 4N (>99.99% purity) HPA market was 30k tonnes per annum in 2021 with LED applications the dominant use case for the material.

Indeed, demand for HPA from the LED market is set to grow at a very healthy 19.8% p.a. between 2020 and 2028.

According to Allied Market Research, demand for HPA-coated LIB separators, which are set to become the second-most common use for HPA, is expected to grow at 24.5% p.a. over the same time period, and the LED and LIB separator applications alone are projected to see the HPA market reach 104k tonnes p.a. in 2028, from c.30k tonnes in 2021, for a CAGR of around 17% p.a.

Figure 5: Global HPA market outlook (tonnes per annum)



Source: Allied Market Research, FYI Resources presentations

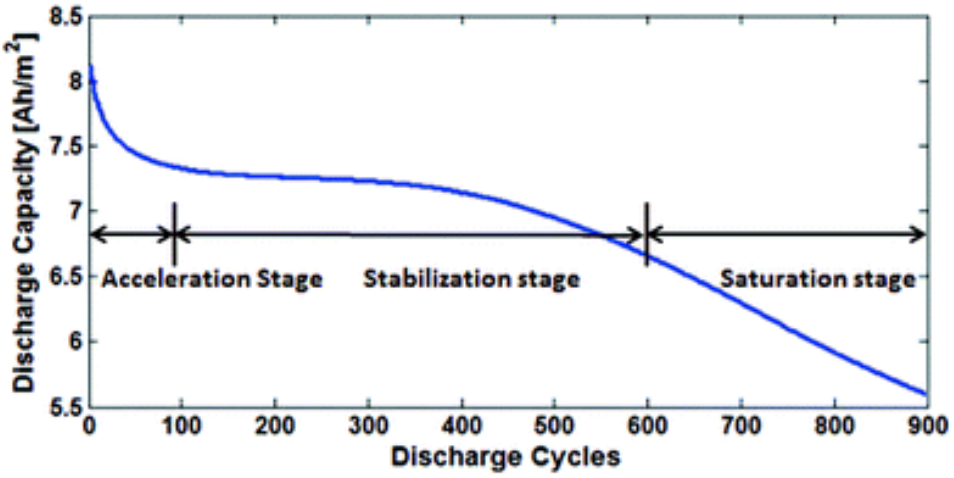
What problem does HPA solve for lithium ion batteries?

Scientific literature points to at least two key performance attributes for alumina-coated anodes over non-coated versions: performance and safety.

Battery performance

LIBs suffer degradation over time, as shown in Figure 6.

Figure 6: Lithium ion battery degradation profile



Source: Lithium ion battery degradation: what you need to know; Edge, O'Kane et al, 2021
https://pubs.rsc.org/en/content/articlehtml/2021/cp/d1cp00359c

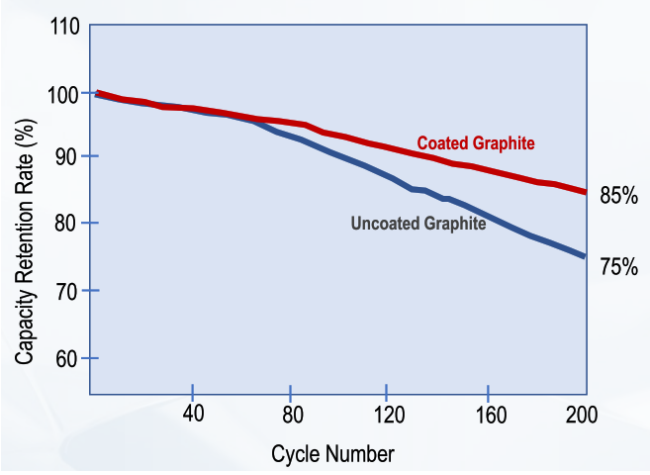
According to *Edge et al* (*Physical Chemistry Chemical Physics, 2021*), there are three main stages of battery degradation:

- Acceleration, caused by the initial Solid Electrolyte Interphase (SEI) layer on the anode, which captures available Li ions, rendering them inactive;
- Stabilisation (linear ageing); and
- Saturation (non-linear ageing).

A 2019 paper (Synthesis of Alumina-Coated Natural Graphite for Highly Cycling Stability and Safety of Li-Ion Batteries Tao Xu, Chengkun Zhou, Haihui Zhou,* ZekunWang, Jianguo Ren) indicates that an alumina-coated graphite anode enjoys significantly better performance over 200 battery cycles than an uncoated electrode.

In addition to the initial cycles loss, battery degradation occurs as corrosive hydrofluoric acid (HF) ions in the electrolyte attacks the SEI layer, requiring more Li ions to repair it. By contrast, the alumina coating scavenges the HF, protecting the anode and lengthening the life of the battery.

Figure 7: Lithium ion battery performance, with and without alumina coatings



Source: Synthesis of Alumina-Coated Natural Graphite for Highly Cycling Stability and Safety of Li-Ion Batteries Tao Xu, Chengkun Zhou, Haihui Zhou,* ZekunWang, Jianguo Ren, Altech Chemicals

Battery safety

The dominant application of HPA in LIBs by volume is in the fine coating of lithium-ion battery separators. The alumina coating assists the thermal regulation of the battery, as well improving mechanical strength of the separator and a number of electrochemical benefits.

As an example, a destructive nail test (ibid) showed that an alumina coating had the potential to greatly improve the safety and stability of the battery by preventing runaway thermal reactions and maintaining much lower temperatures (100°C versus 600°C for an uncoated anode).

LEDs – the main application for HPA and still growing fast

Whilst potential LiB applications have increased the profile of HPA, the dominant source of demand for the material is, and will continue to be through very healthy growth, in LED lighting. The worldwide transition from energy-inefficient incandescent lighting to LED technology continues. LEDs are used in a wide range of applications, including home lighting, advertising signage, automotive, and television and monitor screens.

HPA is used in the LED context as a non-substitutable starting material in the production of LED phosphors and for synthetic sapphire, which is the dominant substrate for LED lights.

According to a 2020 paper published by ATC, electronic signage will constitute comfortably more than 50% of demand for LED units over the short and medium-term.

In addition, we believe the emerging technology trend of mini-LEDs and micro-LEDs could potentially rapidly accelerate HPA demand for synthetic sapphire and LED phosphors.

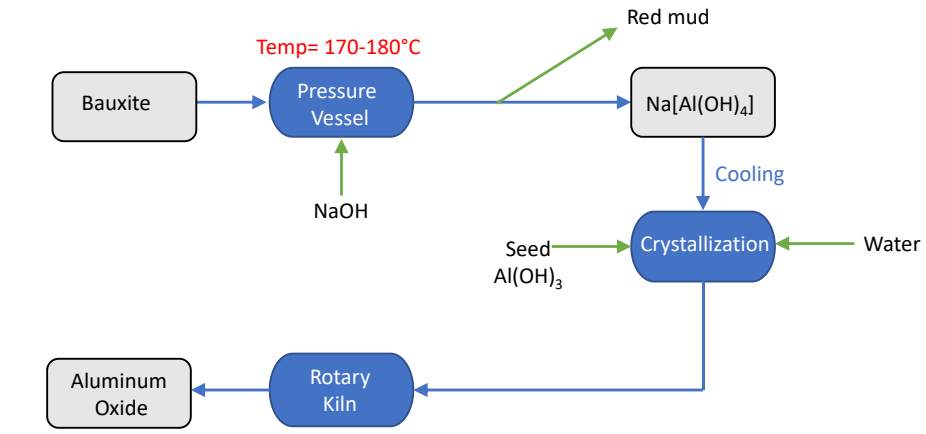
Data from FYI's DFS indicate that demand for HPA from LED applications will grow at 17.6% p.a. between 2020 and 2028.

Synthetic sapphire also finds uses in semiconductors and high-performance electronics in particular.

Alumina, the Bayer process and the opportunity for a new generation of HPA producers

Developed in 1888 by its eponymous inventor, the Bayer process is a long-established industrial process for the conversion of bauxite ore into aluminium oxide (alumina). 134m tonnes of alumina was produced in 2020, with the vast majority being converted to aluminium metal.

Figure 8: The Bayer process for the manufacture of alumina



Source: Canaccord Genuity

According to CSIRO, Australia produces 20m tonnes per annum of 'smelter grade' alumina (SGA) via the Bayer process with purity of up to 99.7%.

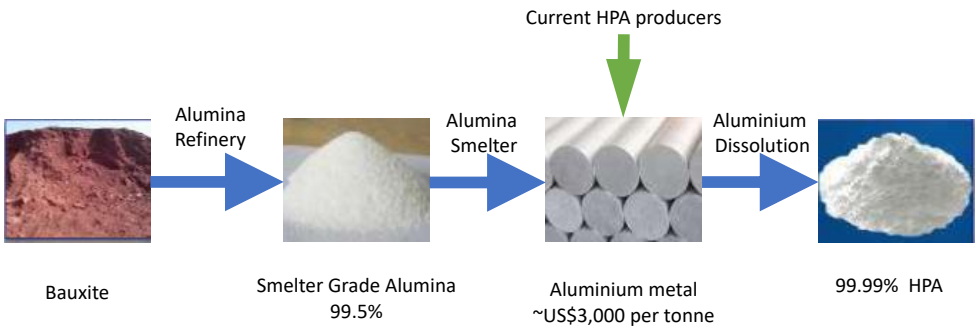
However, the Bayer process is not suitable for the production of HPA due to impurities in the final product – sodium (always), calcium, iron, silicon and titanium and mostly iron.

HPA requires purities of >99.99% (so-called 4N) or 99.999% (5N) or above and these grades cannot be achieved through traditional means efficiently and cost effectively.

Kaolin and the route to HPA

Kaolin has been proposed as a suitable feedstock for the production of HPA due to its availability in a relatively pure ore form and at least two ASX-listed companies, FYI and ATC plan to produce HPA from kaolin as a starting material.

Figure 9: Current HPA production process – from aluminium metal



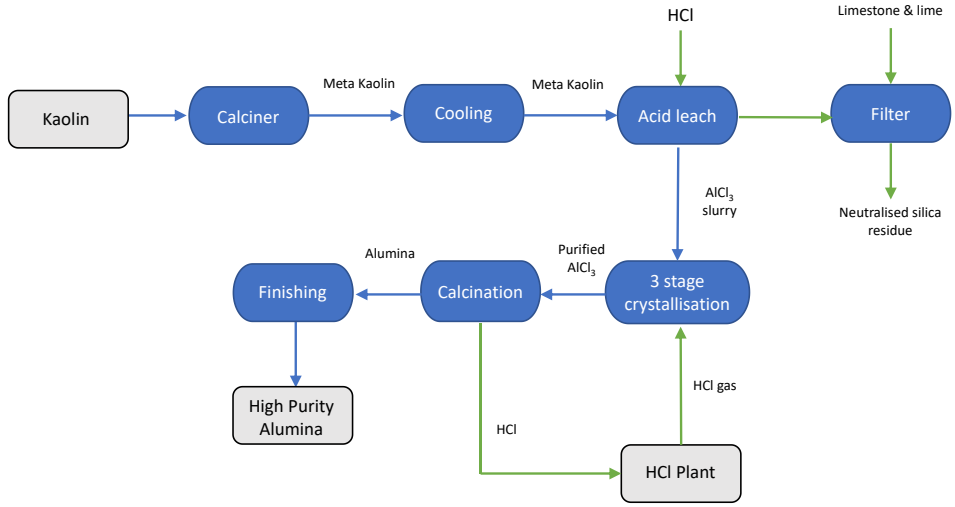
Source: Altech Chemicals

The key insight from Figure 9 is that the starting point for the production of HPA from aluminium metal means sourcing feedstock at US$3,000 per tonne (A$4,000 per tonne) before starting the process to manufacture HPA.

By contrast, kaolin offers a much cheaper option as a starting material for the production of HPA. Based on published scoping and banking studies, high quality kaolin can be sourced for around A$700 per tonne, offering a huge cost advantage over aluminium metal.

The most common form of HPA production from kaolin we have identified involves heating the material to a high temperature (calcination) the material which removes entrapped water, then leaching it with hydrochloric acid (HCl) to produce aluminium chloride ($AlCl_3$), which is then roasted to replace chloride ions with oxygen, thereby forming alumina. Final stages of the process involve a final calcination stage before cooling and bagging the HPA, which should be at least a 4N grade.

Figure 10: HPA from kaolin feedstock

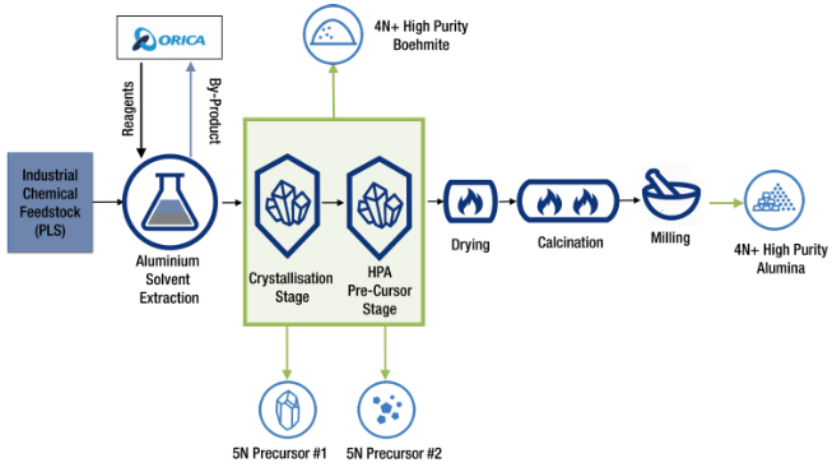


Source: Canaccord Genuity

Alpha HPA – the non-kaolin route to HPA

A4N offers an alternative process for the manufacture of HPA, and one which does not involved kaolin as the primary feedstock and utilises solvent extraction rather than acid leaching. A4N maintains an operating demonstration plant at kg per hour scale and continues towards its plan to move to full production. We discuss the process in more detail in the company profile section.

Figure 11: Alpha HPA process flowsheet



Source: Company reports

Kaolin versus HPA production

It is important to distinguish between kaolin and HPA projects. The former are principally mining operations with some processing to add value to the raw material, whilst the latter are focussed principally on the HPA production process. In most of the cases we have read about, there is an expectation that the kaolin-only operators believe their product is suitable as a feedstock for the HPA process.

Secondly, we have observed that where kaolin is the feedstock for a HPA process and where the HPA producer (e.g. FYI and ATC) has a kaolin deposit, mining will take place in short bursts of 'campaign' mining of several months, which is sufficient to provide several years of HPA feedstock.

Finally, the economics of the two types of operation are quite different. Kaolin mining, being surface extraction, and production requires generally modest capex (as low as $18m in the case of WAK's modestly processed kaolin) and offers fast paybacks and very high IRRs. HPA plants, with much higher capex (hundreds of millions of dollars) offer much higher NPVs but longer paybacks and lower IRRs. Driving the NPVs of the HPA operations are selling prices, which are an order of magnitude higher.

Figure 12: Differences between kaolin and HPA projects

	Kaolin	HPA
Capex	Low - tens of millions $	High - hundreds of millions $
Product selling price	Low - hundreds of $/tonne	High - tens of thousands $/tonne
Payback period	Months - up to 15 months	Years - up to four years
IRR	Often >100%	20-50%

Source: Canaccord Genuity

The economics for kaolin projects

Of the active kaolin producers and developers, three have published studies, either scoping or definitive. A common theme among these studies is:

- low capital cost to develop the operations, emphasising the relative simplicity of the kaolin mining process; and
- high NPVs and IRRs, and short payback periods based on the project economics.

Of the three producers, SUV offers the highest NPV, taking the middle route on assumed production and unit costs whilst assuming a slightly higher price than ADN ($720 per tonne versus $700).

WAK's $322 per tonne assumed sales price reflects processing differences compared to SUV or ADN, a fact which is reflected in WAK's much lower capital cost.

We have included LRS in this report as its mineral resource estimate showed promising evidence of halloysite – a rare form of kaolin with potentially novel applications.

Figure 13: Economics for kaolin projects

Company	Suvo Strategic Minerals	WA Kaolin	Andromeda Metals
Code	SUV-ASX	WAK-ASX	ADN-ASX
Market cap ($m)	91	64	378
Study type	Scoping	Definitive feasibility	Scoping
Date	May 2021	Sep 2020	Sep 2019
Currency	AUD	AUD	AUD
Deposit/Project	White Cloud	Wickepin	Poochera
Life of Mine (years)	25	31	15
Feedstock per annum (ktpa)	500	595	500
Annual kaolin production (ktpa)	200	313	187
Forecast sales price ($ per tonne)	720	322	700
Revenue ($m)	144	101	131
- per tonne of Kaolin sold	*720*	*322*	*700*
EBITDA ($m)	94	29	56
- per tonne of Kaolin produced	*468*	*93*	*301*
Capital cost ($m)	68	18	62
Payback period (years)	1	N/A	1.25
Project NPV ($m)	533	347	413 (pre-tax)
Discount rate (%)	8%	7%	8%
IRR	113%	47%	174%

Source: Company reports, Canaccord Genuity

The economics for HPA projects

Figure 14 summarises the projects from three aspiring HPA producers.

Of the three projects, two (FYI and ATC) use kaolin as the primary feedstock to a process which involves calcination, acid leaching, crystallisation, washing and drying to produce 4N and 5N HPA. The third project, A4N, uses a different aluminium-based feedstock and a solvent extraction process.

In contrast to the kaolin projects listed above, HPA plants tend to require much more capex but offer higher NPV values with longer payback periods and lower IRRs. The selling price of HPA – c.US$25,000 per tonne, is much higher than the price of quality kaolin (A$700 per tonne), reflecting the significant value-add within the production process.

Figure 14: Economics for HPA projects

	FYI Resources	Alpha HPA	Altech Chemicals
Code	FYI-ASX	A4N-ASX	ATC-ASX
Market cap (A$m)	221.7	422.3	68.2
Feedstock	Kaolin	Aluminium mineral	Kaolin
Process type	Acid leach	Solvent extraction	Acid leach
Study type	DFS	DFS	FIDS equity model
Currency	USD	USD	USD
Date	Mar 2021	Mar 2020	Oct 2017
Quantity of ore mined per annum (tonnes)	63,000	N/A	71,231
Feedstock per annum (tonnes)	44,000	18,592	43,500
Annual HPA production (tonnes)	10,000	10,000	4,500
Purity	4N and 5N	4N	4N
Capital cost ($m)	202	209	298
Forecast sales price ($ per tonne)	26,400	25,000	26,900
Average cost of production ($ per tonne)	6,661	8,670	9,911
Average cost of production inc. by-products ($ per tonne)		5,940	
Annual revenue ($m)	261	250	120
EBITDA ($m)	186	191	76
- Margin	*71%*	*76%*	*63%*
Payback period (years)	3.2	<2	4.5
Project NPV ($m)	1015	N/A	506
Discount rate (%)	8.0%	N/A	7.5%
IRR	55%	N/A	22%

Source: Company reports, Canaccord Genuity

Kaolin producers

Andromeda Metals | Mkt cap $406m | High quality assets with upside

Canaccord Genuity (Australia) Limited has received a fee as Joint Lead Manager to the Andromeda Metals Ltd placement announced on 29 June 2021.

Strategy

With access to extremely high-quality assets in South Australia, including deposits of the rare halloysite grade of kaolin, which is a tubular form of the mineral, ADN is positioned at the premium end of the kaolin market. Notable characteristics of the deposits include exceptional brightness and favourable particle size distribution. Halloysite offers multiple market opportunities, including improving the handling and performance of concrete, carbon capture and storage, and lithium batteries. The concrete application looks particularly exciting to us, given the size of the market and the performance improvements exhibited by halloysite-enhanced concrete and which requires only small quantities (1kg of halloysite in 3 tonnes of concrete) to potentially improve handling and strength of the finished product.

Assets

- **Great White Kaolin (75% JV with Minotaur Exploration)**, which is the company's main near-term focus. A summary of the mineral resource is shown in the table below. Total kaolin of 17.4m tonnes breaks down further into a halloysite zone of 15.9m tonnes and 1.5m tonnes of ultra-bright high purity kaolin. The latter showed very low iron contamination lending itself to high value markets in specialty coatings and polymers.

Figure 15: Great White Kaolin mineral resources

Millions of tonnes	Kaolinised granite	Yield <45 μm	Total kaolin
Measured	5.7	50%	2.9
Indicated	14.2	51%	7.3
Inferred	14.7	49%	7.2
Total	34.6	50%	17.4

Source: Andromeda Metals

- **Mount Hope (100% owned),** which has an inferred mineral resource of 18.0m tonnes of kaolinised granite, potentially yielding 7.5m combined tonnes of kaolin and halloysite.
- **Hammerhead (75% owned),** which has an inferred mineral resource of 51.5m tonnes of kaolinised granite, potentially yielding 27m combined tonnes of kaolin and halloysite.

ADN's kaolin deposits benefit from a number of attributes which take its products into the premium category. Figure 16 shows the comparison of testing of samples from ADN's two lead deposits compared to the specifications of commercially available product from industry leader, Imerys.

Figure 16: Comparison of ADN's kaolin products versus industry-leading grades

Producer	Andromeda		Imerys		
Asset	Great White	Mt Hope	Eckalite YMT	Supreme	Speswhite
Country	Australia	Australia	Australia	UK	UK
Brightness (%)	90.4	90.0	88.0	88.0	85.5
Yellowness (%)	4.2	4.1	4.5	3.8	4.7
Oil absorption (g/100g)	62	56	50	46	42
<2 micron (%)	94	92		94	80
<1micron (%)	81	75		80	60
Surface area (m^2/g)	16	17		16	14

Source: Andromeda Metals

ADN's Great White and Mt Hope deposits also contain the premium grade halloysite. According to the Australian Mining website pure halloysite sells for up to US$4,000 per tonne (c.A$5,000) compared to ADN's PFS which was prepared using a price of A$700 per tonne.

Halloysite has a range of potential uses, including nanotechnology, carbon capture and storage, water purification and, most recently, as an additive to concrete to improve both handling of the material and its strength.

ADN has entered an initial 90-day exclusivity period with AEM Technologies to explore a HPA licensing transaction that includes testing ADN kaolin feed, process feasibility studies and potential licencing and marketing arrangements. AEM operates a commercial scale HPA plant in Cap Chat, Quebec, Canada, which produces 4N and 5N HPA material.

Study status

In September 2019, ADN published a PFS for its Great White Kaolin asset at Poochera, South Australia and for which the results are summarised in Figure 17. Work is underway to complete a DFS, for which the scope has been changed to incorporate a 'multi-product' strategy, incorporating polymer-grade material (PRM) and ceramic-grade material (CRM). The DFS is scheduled for completion in early Q4 2021.

Figure 17: Great White Kaolin project scoping study results

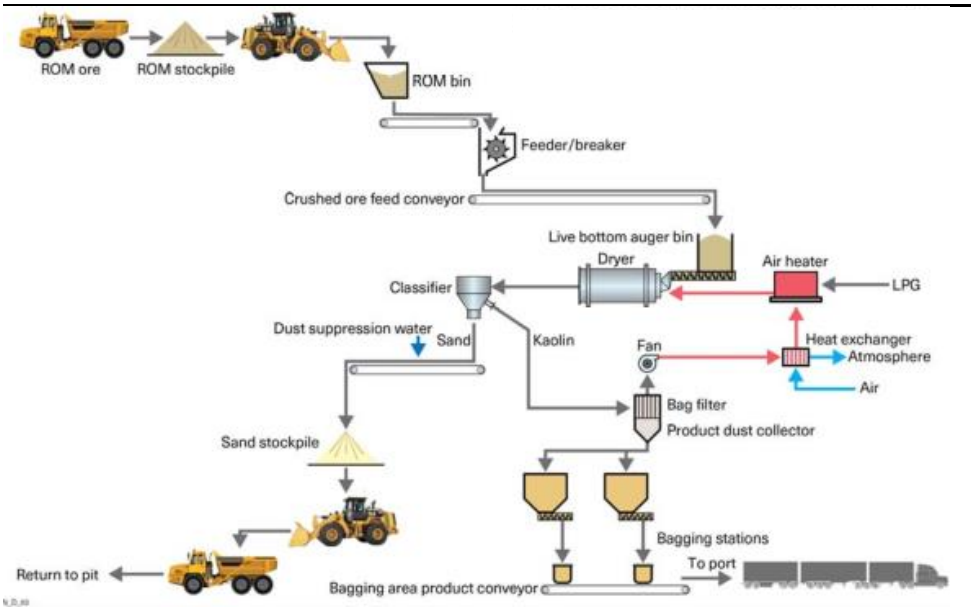
Mine plan - production target	Life of mine
From measured resources (m tonnes)	4.2
From indicated resources (m tonnes)	3.4
Total production target (m tonnes)	7.6
Capital costs	
Initial capital cost	9
Working capital	16
Processing plant costs (A$m)	28
Sustaining capital costs (A$m)	9
Production summary	
Mine life (years)	15
Processing rate of kaolinised graphite (ktpa)	500
Annual refined Kaolin produced (ktpa)	187
Yield of refined kaolin (%)	37%
Project economics	
Premium kaolin Price Average (per tonne, ex-works)	700
Revenue (A$m)	1,935
AISC equivalent (LOM average) (A$ per tonne)	396
EBITDA	844
Cash flow	798
Financial returns	
NPV pre-tax, 8% discount rate (A$m)	413
IRR pre-tax	174%
Payback from start of production and sales (months)	15

Source: Andromeda Metals, Canaccord Genuity

Process flowsheet

The flowsheet from ADN's 2019 scoping study is shown in Figure 18 and shows a dry process for the production of kaolin whereby the ore is dried and then classified (separated by particle size). Kaolin is then sent to a bag filter before packing. Waste sand is returned to the pit.

Figure 18: Poochera kaolin project processing flowsheet



Source: Andromeda Metals

Offtake agreements

On 17 March 2021, ADN announced an offtake agreement for 5k tonnes per annum of ceramic-grade Great White Kaolin at A$700 per tonne with Japanese porcelain manufacturer Plantan Yamada.

On 10 June 2021, ADN announced a binding offtake arrangement with Chinese commodity trading house Jiangsu Mineral Sources International Trading (MSI) for an initial volume of 70ktpa ± 10% for five years at a price "significantly higher" than the A$700 per tonne used in the PFS, implying annual revenue of at least A$49m. The kaolin material will be used for the coatings and polymer markets.

The agreement represents around 60% of the planned 116ktpa of refined halloysite-kaolin product, which will be manufactured from the initial 250ktpa feed rate capacity plant to be built on site.

Funding

ADN raised $30m of new equity in June 2021 via a placement with an SPP in place to secure a further $15m of funding. The principal use of funds will be on pre-construction and long-lead items for the Great White Kaolin project with other funds being deployed on the DFS, R&D, product development and marketing and general purposes.

Figure 19: Andromeda use of funds from June 2021 equity transactions

Item	Value ($m)
Great White Project pre-construction and long lead items	20
Great White Project studies (inc DFS)	6
Product Development and Marketing	5
Working capital and costs of offer	5
R&D	4
Corporate expenses	4
Exploration	1
Total	45

Source: Andromeda Metals

Key personnel

ADN CEO James Marsh is a kaolin specialist with more than 30 years' experience in industrial minerals comprising senior roles with leading industry operators, including Imerys. At Imerys he was Technical Manager, successfully commercialising several new grades of product. At Minerals Corporation, he commercialised kaolin sales in Australia and China and established a global sales and distribution networks.

Next steps

- Binding offtake agreements (ongoing).
- Definitive/bankable feasibility studies (Q4 CY21).
- Mining approvals.
- High purity Halloysite.
- Concrete application testing (ongoing).
- Nanotechnology commercialisation.
- High purity alumina (evaluation period).

Latin Resources | Mkt cap $56m | Halloysite potential in WA

Strategy

LRS is a mineral exploration company with several projects in Latin America and Australia. The Australian projects include the Yarara gold project in the NSW Lachlan Fold belt, Noombenberry Halloysite-Kaolin Project near Merredin, WA, and the Big Grey Silver-Lead Project in the Paterson region, WA.

LRS recently signed a JV agreement with the Argentinian company Integra Capital to fund the next phase of exploration on its lithium pegmatite projects in Catamarca, Argentina and is also actively progressing its Copper Porphyry MT03 project in the Ilo region.

Assets

LRS recently published its maiden inferred mineral resource at its Cloud Nine kaolin project in Merredin, WA. The study showed inferred mineral resources of 207m tonnes of kaolinised granite with the potential for 87m tonnes of kaolin which includes the premium form of kaolin, Halloysite.

Figure 20: Cloud Nine halloysite-kaolin deposit

	Kaolinised granite	Yield <45 µm	Kaolin
Mineral Resources			
Inferred	207	42%	87
Total	**207**	**42%**	**87**

Source: Latin Resources

Key personnel

Chris Gale, Executive Director, has extensive experience in senior management roles in both the public and private sectors, especially in commercial and financial roles. He has also held various board and executive roles at a number of mining and technology companies during his career.

Tony Greenaway, Exploration Manager, has nearly 30 years' experience in a variety of roles across the mining industry, including senior Geologist, Managing Director, General Manager. As Exploration Manager, he oversees projects across LRS's international portfolio.

Next steps

- Commencement of Cloud Nine deposit northern extension aircore drilling campaign.
- Commencement of northern extension infill aircore drilling campaign.
- Granting of regional tenements and commencement of regional sampling campaign.
- Commencement of Cloud Nine inferred MRE infill and upgrade drilling.
- Results from step-out drilling.
- Commencement of Cloud Nine PFS.

Suvo Strategic Minerals | Mkt cap $97m | Operating profitably in Victoria with plans for development in Western Australia

Strategy

SUV will continue to operate and expand its profitable Pittong operation in Victoria. Management believes there is robust demand for its products which justifies it increasing capacity. Longer-term development of the White Cloud Kaolin asset continues, with Nova Silica Sand to follow.

Assets

SUV has two primary kaolin assets, one in production and generating positive cash flow and a second in development.

- **Pittong:** SUV acquired its operational Pittong asset from Imerys, the world's leading kaolin producer, for a modest price of $1.8m. The asset delivered $0.7m EBITDA in the March quarter and SUV expects to be able to expand production materially over the next year. Pittong benefits from a reserve of pharmaceutical grade kaolin, which attracts a premium price over more standard grades. SUV reported that in CY19, pre-COVID-19, the Pittong asset sold 25k tonnes of kaolin products for total revenue of A$13m, and had returned to that production rate in January 2021, with 6,544 tonnes in the June 2021 quarter (annualising to >26k tonnes).
- **White Cloud** is SUV's development asset. Situated in Gabbin, WA, 210km from the port in Fremantle and 400km from Geraldton, White Cloud has an indicated resource of 6.9.6m tonnes. The White Cloud mineral resource estimates are shown below.

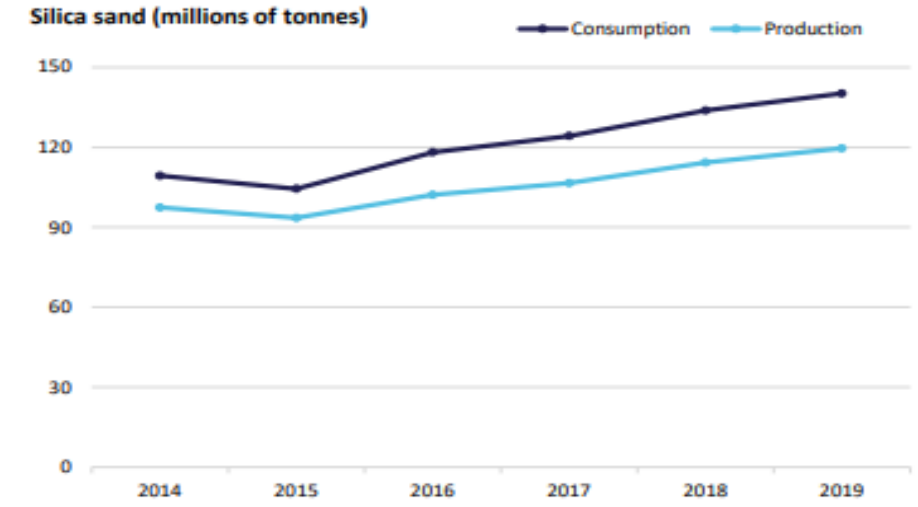
Figure 21: White Cloud mineral resources

Millions of tonnes	Kaolinised granite	Yield <45 µm	Total kaolin
Indicated	26.9	41%	11.1
Inferred	45.6	41%	18.8
Total	72.5	41%	29.9

Source: Suvo Strategic Minerals

- **Nova Silica Sand** is a potential multi-commodity large-scale project in WA, 110km from the port of Geraldton. Perhaps counterintuitively, there is a global shortage of quality silica sand, as demonstrated in the figure below.

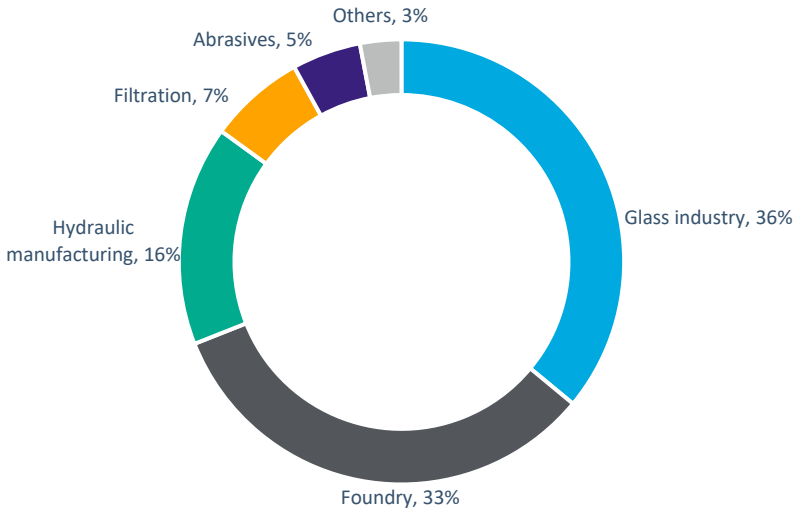
Figure 22: Supply and demand for silica sand in Asia Pacific markets



Source: IMARC Group, VRX Silica

Silica Sand can be used in construction, glass, water filtration, paints & coatings and industrial abrasives.

Figure 23: End uses of silica sand



Source: IMARC Group, Diatreme Resources

Initial test work indicates that the asset includes potential for high-value silica flour (grouting compounds, concrete fines and refractory mixes) and AFS 60 foundry sand, which are among the highest-value sand projects.

Study status

SUV has completed a scoping study at White Cloud pointing to attractive project economics, including a payback period of less than one year and pre-tax IRR of 113% based on a 25-year life of mine and a hydrous processing capacity of 500,000 tonnes per annum producing 200,000 tonnes per annum of refined kaolin products.

Figure 24: White Cloud Kaolin Project scoping study results

Mine plan - production target	Life of mine
From indicated resources	13.7
Capital costs	
Processing plant costs (A$m)	68
Sustaining capital costs (A$m)	15
Production summary	
Mine life (years)	25
Processing rate of kaolinised graphite (ktpa)	500
Annual refined kaolin produced (ktpa)	200
Yield of refined kaolin (%)	40%
Project economics	
Premium kaolin price average (per tonne, ex-works)	720
Revenue (A$m)	3,600
AISC equivalent (LOM average) (A$ per tonne)	256
Cash flows (pre-tax) (A$m)	2,222
Cash flows (post-tax) (A$m)	1,642
Financial returns	
NPV pre-tax, 8% discount rate (A$m)	705
NPV post-tax, 8% discount rate (A$m)	533
IRR pre-tax	113%
IRR post-tax	108%
Payback from start of production and sales (months)	12

Source: Suvo Strategic Minerals, Canaccord Genuity

Offtake agreements

In March 2021, SUV has signed a non-binding offtake agreement with CMM Toye Industrial Mineral Consultants (CMM) for 10,000 tonnes per annum at A$850 per tonne, which is $150 above the price used in the PFS. CMM is a substantial buyer of high grade kaolin products for use in the manufacture of specialist ceramic products.

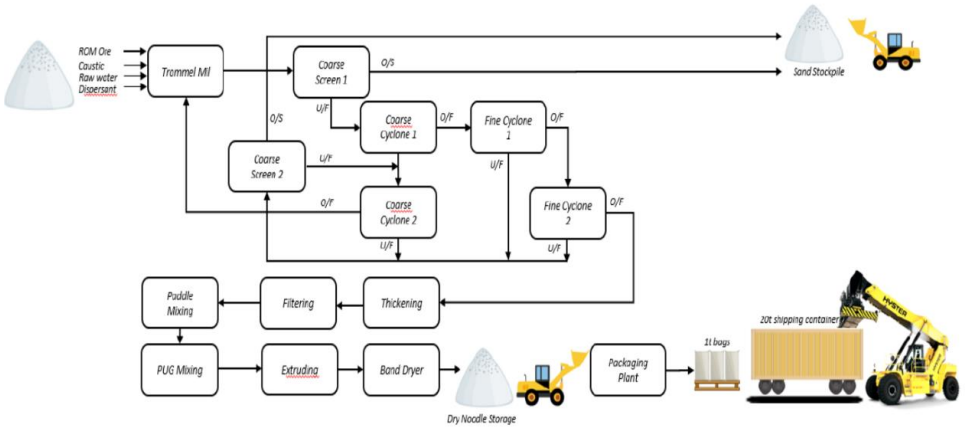
Later the same month, SUV announced an MoU with LIXIL, a large Japanese producer of sanitary ware, with a market cap of ¥911b (A$10b).

In August 2021, SUV announced an MOU and collaboration agreement with Rezel Catalysts Corporation to define a 5-10 year supply agreement for up to 10,000tpa of refined kaolin products. In the short term, orders will be filled from SUV's Pittong operation with the potential for product from White Cloud to be used pending the results of testing.

Production process

Figure 25 shows the production process for White Cloud from SUV's recent scoping study. The kaolin will pass through screens and several cyclone stages before thickening, filtration, extruding, drying and, finally, packing.

Figure 25: White Cloud Kaolin Project flowsheet



Source: Suvo Strategic Minerals

Funding

At its most recent quarterly SUV had $5.0m cash on hand. Pittong is a cash-positive asset, delivering $0.8m EBITDA in the June 2021 quarter from sales of 6,522t.

Potential future major capital investments for the business include:

- At Pittong, SUV has announced that, due to increased demand and significant sales potential, a decision to materially upgrade the plant will be finalised in the first quarter of FY22.
- Capital may be required to fund development of the White Cloud Kaolin project where capital costs are $68m with a further $18m in working capital, based on the project scoping study.

Key personnel

In terms of driving its kaolin business forward, Suvo Strategic has two key personnel in the organisation who have vast experience in industrial minerals markets generally and kaolin in particular:

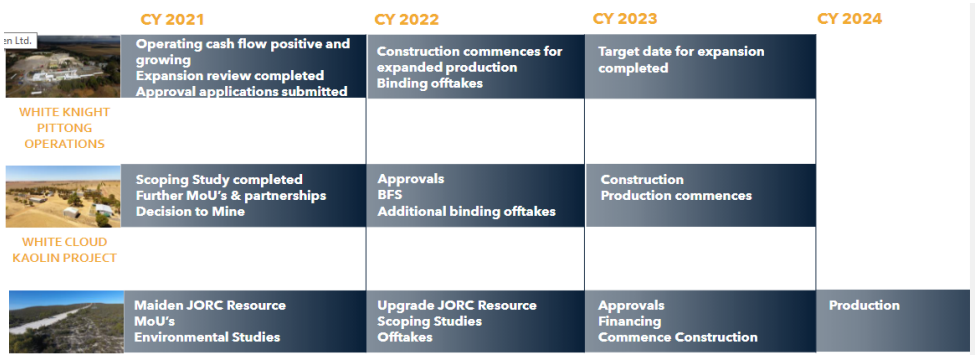
- **Dr Ian Wilson**, non-Executive Director, has 45 years' experience in industrial minerals. He held senior management positions at Imerys for nearly 20 years before establishing his own consultancy.

- **Eileen Hao**, SUV's Global Sales Executive, has over 25 years' technical, commercial and business development expertise in industrial minerals, having worked for English China Clay International and Imerys in senior roles in China and the rest of the world.

Next steps

In the short run, SUV's priorities revolve around increasing production at Pittong, where demand for its products remains strong. The board is nearing a decision to mine on White Cloud, with a Banking Feasibility Study coming in CY22 and production potentially in CY23. Finally, for Nova Silica Sand, a maiden JORC resource is being developed with a longer-term objective to be in production in CY24.

Figure 26: Next steps for Suvo Strategic's three operations



Source: Suvo Strategic Minerals

WA Kaolin | Mkt cap $65m | Fully funded for production start-up in Q4 CY21

Canaccord Genuity (Australia) Limited has received a fee as Lead Manager to the WA Kaolin Limited Initial Public Offering announced on 23 September 2020.

Strategy

WAK's objective is to become a globally significant kaolin producer, leveraging its large 100m tonnes Wickepin project in the process. In order to reach that goal, WAK has a staged development plan which it believes should ultimately see it produce 400kt per annum of kaolin within the next three years. Stage 1, for which procurement and construction are underway, will see WAK reach 200kt per annum of kaolin production with Stage 2, should it proceed, bringing production to 400kt per annum. Subsequent stages to increase capacity will be implemented in response to market demand. WAK's kaolin will be processed using its K99 process, with air separation the principal process in use, the effect of which is to minimise the upfront capex but also potentially excluding sales of the product from the premium fine kaolin markets which command higher prices as contemplated by fellow prospective kaolin producers.

Assets

WAK operates the Wickepin Project, located 220km south-east of Perth. The asset has JORC ore reserves of 30.5mt of kaolinised granite and 109mt of mineral resource (both JORC basis). WAK has the best-defined kaolin deposit among ASX-listed operators, with probable ore reserves of 30.5m tonnes at a 52% yield leading to nearly 16m tonnes of kaolin.

Figure 27: Summary of WA Kaolin's Wickepin mineral resources and ore reserve

Millions of tonnes	Kaolinised granite	Yield <45 μm	Total kaolin
Mineral resources			
Measured	38.0	51%	21.3
Indicated	27.7	50%	13.9
Inferred	43.3	45%	19.3
Total	**109.0**	**48%**	**54.5**
Ore Reserve			
Proved	-	-	-
Probable	30.5	52%	15.8
Total	**30.5**	**52%**	**15.8**

Source: WA Kaolin

Wickepin is one of the largest known remaining primary resources of kaolin in the world and WAK currently produces kaolin at a 'proof of concept' 40ktpa scale in Kwinana, WA, with small amounts of commercial sales to key customers. The Stage 1 ramp-up, which is underway with the procurement of equipment, will see production shift to Wickepin and increase to 200ktpa of kaolin. Stage 1 is fully permitted and approved.

WAK has developed its own proprietary dry processing method for kaolin (K99) which it has validated and optimised at its Kwinana plant. Before its IPO in late CY2020, WAK's founders and owners had invested $43m to develop and progress the Wickepin asset.

Study status

WAK has completed a DFS with an NPV of $257m (post-tax) comprising a 31-year mine life with an average production rate of 313ktpa of kaolin, including both the Stage 1 ramp-up above and Stage 2, which will take production to 400ktpa. WAK's DFS includes a conservative kaolin selling price which is much lower than peers as it is proposing to sell a hydrous version of the product, which has not been calcined.

Figure 28: Wickepin kaolin project DFS results

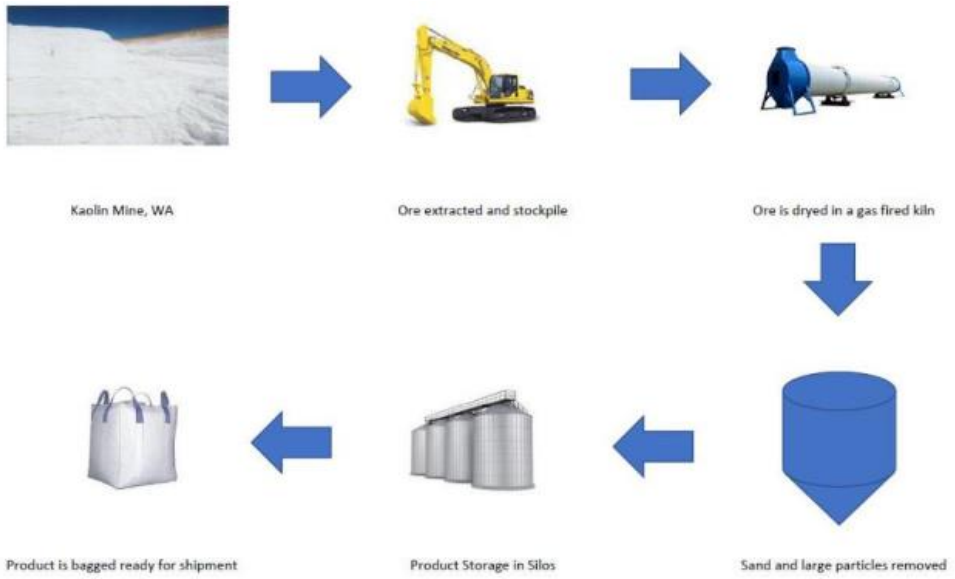
Mine plan - production target	Life of mine	Average
From ore reserves (m tonnes)	30.5	
Capital costs	18.0	
Production summary		
Mine life (years)	31	
Processing rate of kaolinised granite (ktpa)	9,394	782
Annual refined kaolin produced (ktpa)	3,760	313
Yield of refined kaolin (%)	40%	40%
Project economics		
Premium kaolin price average ($ per tonne)	321	321
Revenue (A$m)	1,208,159	100.7
Cost of sales (inc freight to port) (A$m)	-601,737	-50.1
Operating costs (A$m)	-253,628	-21.1
EBITDA (A$m)	351	29.2
Profit before tax (A$m)	342,200	28.5
Profit after tax (A$m)	261,276	21.8
Cash flow from operations (A$m)	250,423	20.9
Financial returns		
NPV post-tax, 7% discount rate (A$m)	256.7	
IRR post-tax	47%	

Source: WA Kaolin, Canaccord Genuity

Production process

Figure 29 shows the process flowsheet for WAK's kaolin production and highlights the dry processing method for the product which results in a lower cost of production than others which use chemical bleaching and multiple wet mechanical and magnetic separation processes. This lighter-touch processing is evident is WAK's much lower capital cost. WAK's DFS shows a lower anticipated sales price for its kaolin, reflecting the lighter-touch processing.

Figure 29: WA Kaolin process flowsheet



Source: WA Kaolin

Funding

The Stage 1 ramp-up is fully funded, with WAK having $10.9m of cash available in its last quarterly. Total capex to develop the project was projected at $18m, with the schedule well underway and remaining on budget.

Key personnel

WAK's CEO, Andrew Sorensen, joined in 2006 and has over 30 years' experience across a broad range of industries, including chemicals, materials and general industrials.

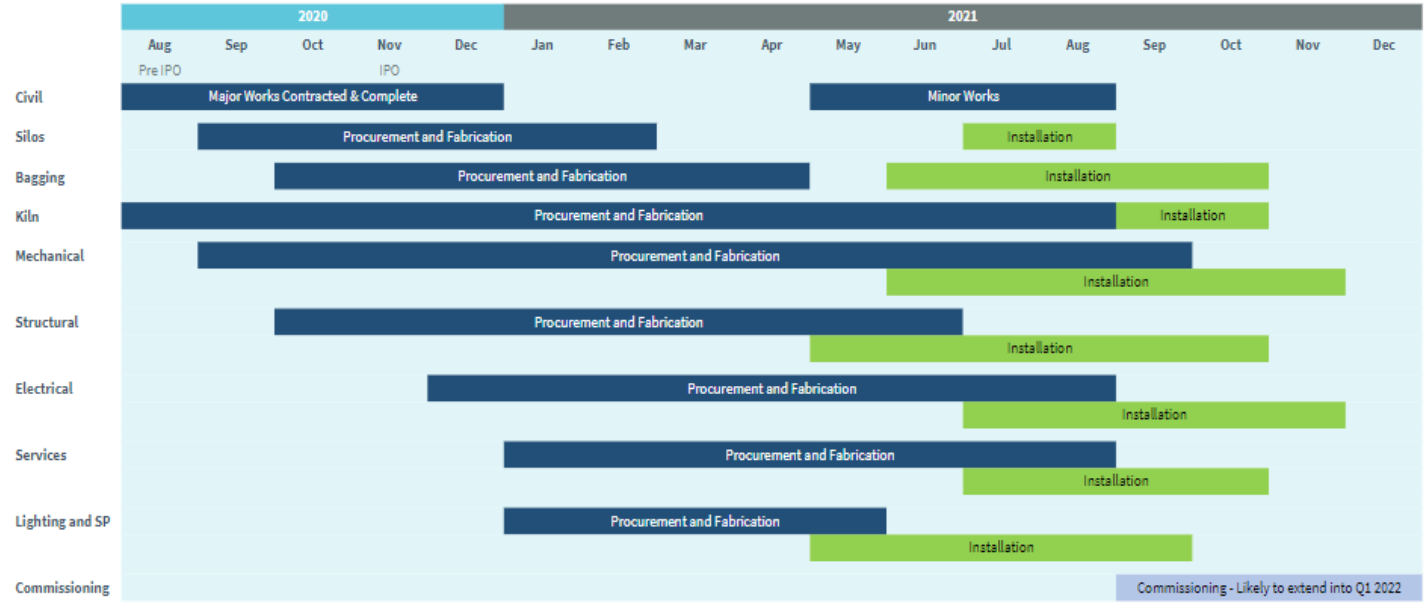
Offtake agreements

WAK has signed a 10-year distribution agreement with Dak Tai Trading (DTT) with a six-year offtake agreement. The target offtake is 432k tonnes over the six years, with 271k tonnes in the first three years. Taken together with LOIs totalling 280k tonnes, 83% of total target production for the first three years (664k tonnes) could be already accounted for should those convert to offtake agreements. In its June 2021 quarterly, WAK announced several new customers including an Australian brick company; a Vietnamese ceramic business; a fibreglass producer in Japan and a Chinese rubber company. The quarterly also states that indicated prices are higher than anticipated in the DFS.

Next steps

Procurement of key items of the plant is well underway, with installation of some items already in progress. Commissioning of the plant is due to start in July and run through the rest of the CY21. In its June 2021 quarterly update that construction and installation will be completed in Q4 CY21 with commissioning extending into Q1 CY22, which is a slight delay from the previous programme.

Figure 30: WA Kaolin Stage 1 project program



Source: WA Kaolin

High purity alumina producers

Alpha HPA | Mkt cap $372m | A new approach to HPA production

Strategy

As well as aiming to be a leading producer of HPA, A4N emphasises that ESG is central to company strategy, with a process which produces sellable by-products and where reagents can be recycled back into the process, minimising waste discharges. In addition, the company is pursuing up to 100% renewable energy supply under a MOU with CleanCo QLD.

Assets

A4N differs from the other HPA companies in this note in that it does not use kaolin as a feedstock for its process and, therefore, does not own its own kaolin deposit. The feedstock is described in the DFS as "an internationally traded industrial commodity" and A4N is currently in negotiation to purchase feedstock from a local Gladstone supplier with pricing referenced to international indices.

Study status

A4N published the DFS for its HPA plant in March 2020. Coming from a chemical engineering start point rather than from mining, the DFS focuses less on project life, NPVs and IRRs but on the economics of the process, which shows a cash flow (EBITDA proxy) margin of 76% on a US$250m per annum revenue base and a payback of 4.5 years.

Figure 31: Summary of Alpha HPA DFS

Capital costs	US$m
Capital costs (US$m)	209
Production summary	**Tonnes per annum**
Feedstock used	18,600
HPA produced	10,000
Project economics	**US$m per annum**
HPA price average (US$ per tonne)	25,000
Revenue	250
Variable costs	-65
By-product credits	27
Fixed costs	-22
Pre-tax cash flow/ EBITDA	191
Financial returns	
Payback period (years)	4.5

Source: Alpha HPA, Canaccord Genuity ~~estimates~~

Production process

The A4N production process is fundamentally different from those of FYI and ATC in that it uses a different feedstock and employs solvent extraction (SX) as its primary purification process. Whilst FYI and ATC will use kaolin as their primary feedstock, A4N will source its main input material from the local alumina refinery in Gladstone and use solvent extraction as the primary unit operation as opposed to acid leaching in kaolin-fed processes. The key aspects of A4N's process are:

- Preparation of industrial feedstock blend sourced from bulk chemical market.
- Solvent extraction of feedstock solution to produce a selectively loaded organic with alumina and an aqueous solution of diluted fertiliser by-product as a raffinate (liquid solution from which the feedstock material has been extracted).
- Production of fertiliser by-product from the raffinate using evaporative crystallisation, filtration, drying and packaging.
- Stripping of alumina from the organic mixture to yield a saturated high-purity aluminium bearing electrolyte solution.

- Solution crystallised and converted into high purity aluminium precursors or a high purity alumina (4N HPA) product.
- 4N HPA product is then micronised to a customised particle size to meet end-user specifications.

HPA assays and solvent extraction process stream analyses have identified the key impurities as sodium (Na), gallium (Ga), iron (Fe) and magnesium (Mg) that total less than 100ppm.

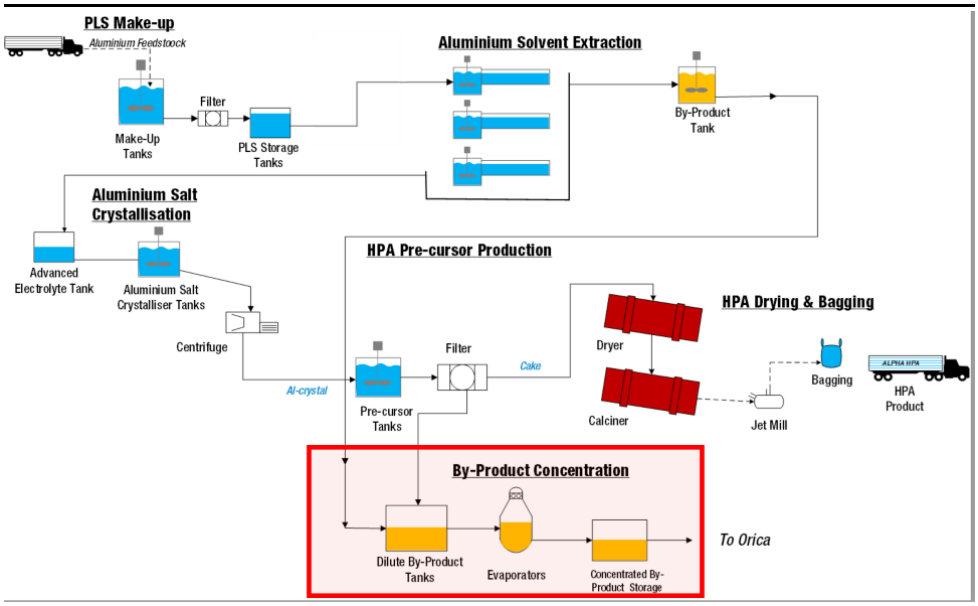
Reagents will be sourced from a nearby Orica plant, with a direct pipeline feed, while diverse suppliers exist for the process feedstock with a market size of over US$20b globally and over 200 industrial users within Australia.

Process by-products are readily marketable in the fertiliser market with combined markets of over US$85b globally.

The process also has the flexibility to produce two HPA precursor products: HPA nitrate and aluminium sulphate. Indeed, A4N recently raised A$50m in new equity to construct plant which will allow for production of 200 tonnes per annum of these precursors, accelerating cash flow into the business.

Licence agreement: A4N has access and commercialisation rights to the proprietary aluminium solvent extraction and HPA refining technology. The agreement is for 20 years (from June 2018) for an annual fee of $50,000 plus 1% of A4N's HPA sales.

Figure 32: Alpha HPA process flowsheet



Source: Alpha HPA

Funding

A4N raised $50m in new equity in early June 2021 to support a new initiative which will see the company produce and market high 4N and 5N HPA precursors, aluminium nitrate (precursor #1) and aluminium sulphate (precursor #2) in a precursor production facility (PPF). Volumes will be up to 200 tonnes per annum of the precursors and up to 2 tonnes per annum of pre-commercial production 4N HPA.

The PPF is projected to cost A$27.6m including a 15% contingency and generate $1-5m per annum of free cash flow depending on the pricing of finished product. Importantly, the PPF will serve to showcase A4N's products on a global basis.

We would expect the long-term financing to comprise both equity and debt, with the latter secured against good quality offtake counterparties.

Key personnel

Rimas Kairaitis, Managing Director, has more than 20 years' experience in minerals exploration and resource development in gold, base metals and industrial minerals. He led the geological field teams to the discovery of the Tomingley and McPhillamys gold deposits in NSW and steered the Hera gold-lead-zinc project from discovery through to successful commissioning and commercial production. Mr Kairaitis was previously founding Managing Director and CEO of ASX-listed Aurelia Metals.

Rob Williamson, Chief Operating Officer, is a mechanical engineer and joined A4N having recently rebuilt and started up a new 155ktpa solvent extraction zinc refinery in the US. Mr Williamson brings 20 years of experience in large facility operations to Alpha HPA. Based in Brisbane, he is responsible for building a project delivery team for the HPA project in Gladstone.

Marketing and offtake agreements

In August 2020, A4N announced an MoU with Traxys, a global commodities merchant with annual revenue in excess of US$6b, which provides a services to a wide range of clients and is deeply embedded in the global LiB supply chain. The MoU covered four areas: product marketing and offtake; finance and logistics support; working capital facilities and direct investment.

For its precursor sales, A4N has established a network of MoUs, including:

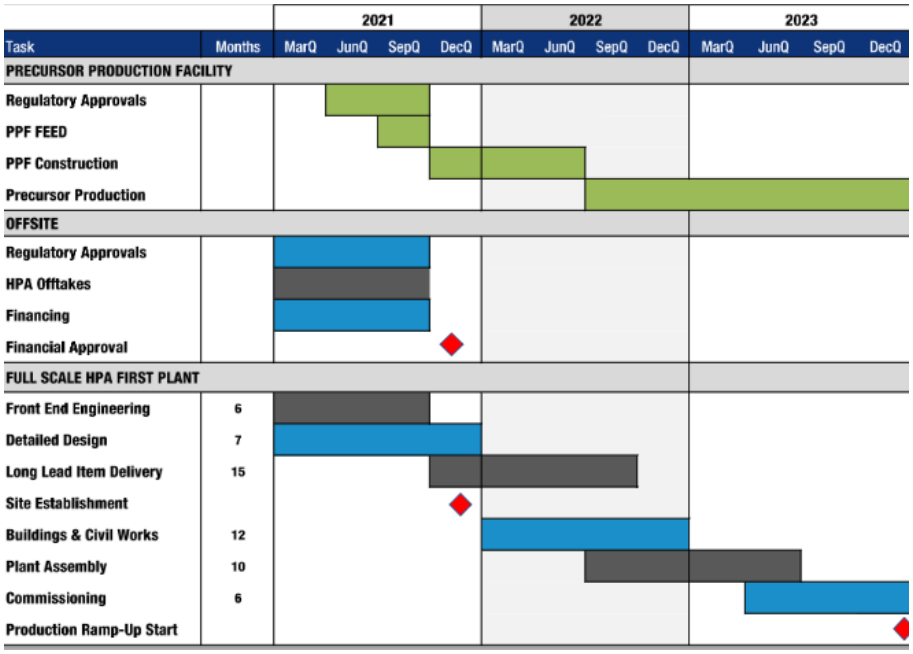
- Rhineland Specialties in North American markets;
- APL Engineered Materials in Japan and China; and
- Technologica in the European Union.

Next steps

The construction of the PPF is the immediate operational priority for the business with a view to start of production in the December quarter 2022. On the full-scale plant, Worley has been appointed as the preferred ePCM contractor for the HPA plant, with Worley also appointed to commence the front end engineering and design (FEED).

A4N targets full scale production of HPA by late CY23.

Figure 33: Alpha HPA project schedule



Source: Alpha HPA

Altech Chemicals | Mkt cap $68m | Early adopters of the HPA thematic

Strategy

ATC aims to be one of the world's leading suppliers of 4N HPA through the construction of a 4,500 tonne per annum plant in Johor, Malaysia. Feedstock will be sourced from ATC's own kaolin deposit in Meckering, WA. ATC also offers optionality over the use of coated HPA-silicon as a further improvement to performance of LIBs.

Kaolin asset

ATC has a 12.7m tonne kaolin resource at its Meckerling asset. Meckering has both mining and works approval granted and is described as "simple, free dig mining". As decried previously, ATC will 'campaign' mine for two months to produce three years' worth of feedstock for the HPA plant.

Figure 34: Altech Chemicals' Meckerling kaolin asset

	Quantity (m tonnes)	Al_2O_3 concentration
Mineral Resources		
Measured	1.5	30%
Indicated	3.3	30%
Inferred	7.9	29%
Total	**12.7**	**29%**
Ore Reserve		
Proved	0.45	30.1%
Probable	0.77	30.0%
Total	**1.226.9**	**30.0%**

Source: Altech Chemicals

Study status

ATC completed its final investment decision study (FIDS) in 2017 and the results are summarised in the table below. For a 4,500 tonnes per annum HPA plant, revenue, at a unit sales price of US$26,900 per tonne, is US$120m with EBITDA of US$76m.

Figure 35: Altech Chemicals Final Investment Decision study

Asset profile	Life of project	Average p.a.
Proved and probable ore reserves (m tonnes)	1.2	
JORC Resources (m tonnes)	12.7	
Capital costs		
Capital costs	298	
Lender contingency	28	
Debt reserve and working capital	46	
Sustaining capital (2.5% of capital costs, annually)		8
Production summary		
Period modelled (years)	30	
Ore mined and beneficiated (tonnes)	2,136,930	71,231
HPA produced (tonnes)	135,000	4,500
Yield of refined Kaolin (%)	6%	6%
Project economics		
HPA price average	26,900	
Revenue (US$m)	3,609	120
Operating costs (US$m)	-1,338	-45
EBITDA (US$m)	2,271	75.7
Financial returns		
NPV 7.5% discount rate (A$m)	506	
IRR	22%	
Payback period (years)	4.5	

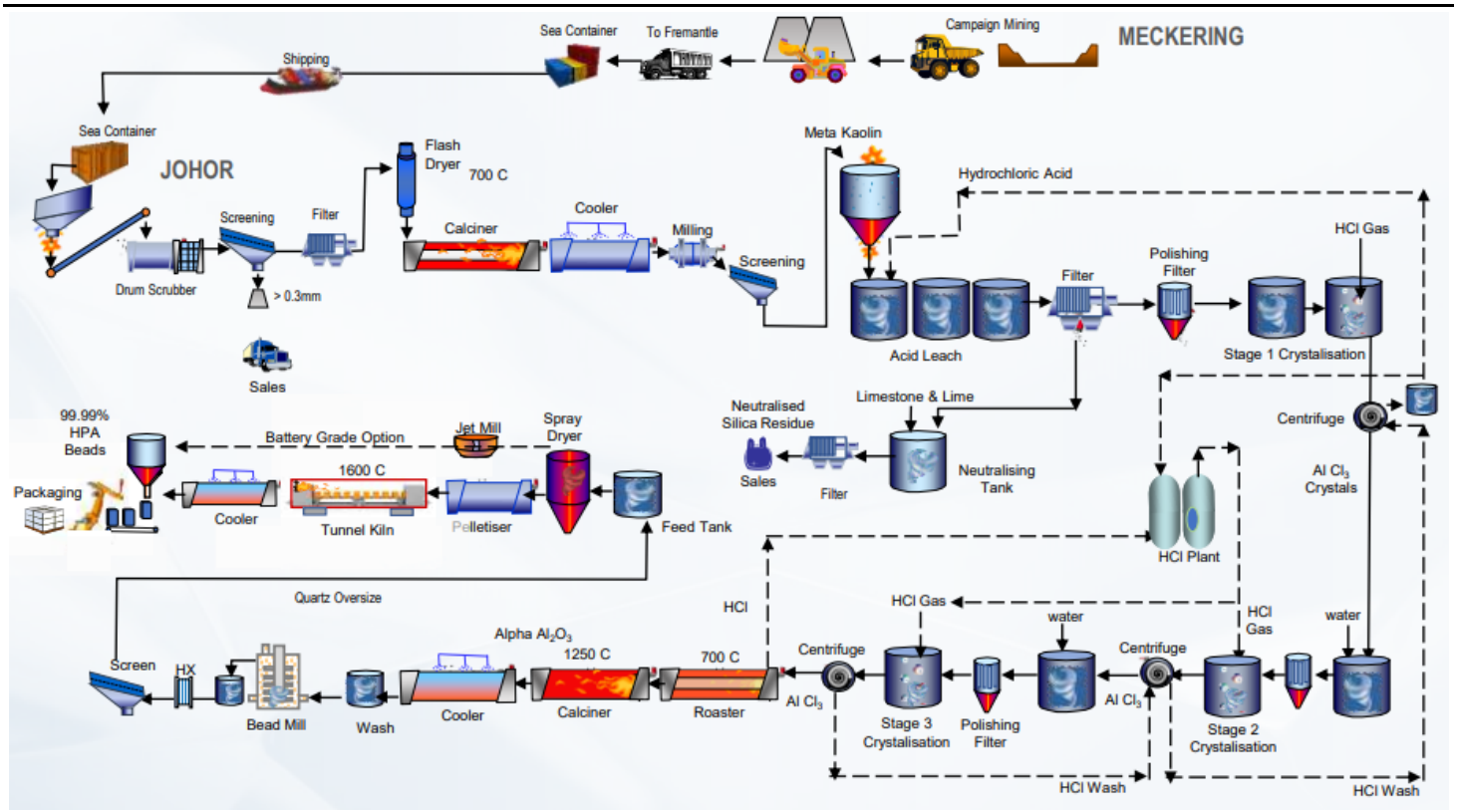
Source: Altech Chemicals, Canaccord Genuity

Production process

ATC has offered the most detail about its HPA production process in its disclosures to the market. The process involves heating the kaolin feedstock to drive of moisture and other volatiles, then leaching with hydrochloric acid followed by a three-stage crystallisation process to produce alumina followed by finishing operations like washing, drying, calcination and cooling to create the 4N product. Product will be shipped to customers in 20kg bags.

ATC has contracted with SMS, a German EPC contractor for the construction of the plant, which has come with an equity investment. The use of a German supplier has led to ATC financing part of the project with a bank in that country and the potential for Frankfurt-listed 'green bonds', which we discuss below.

Figure 36: Altech's HPA process



Source: Altech Chemicals

Funding

ATC has made significant strides towards finalising financing for the construction of its HPA plant, including senior debt funding of US$190m from KfW-IPEX Bank from Germany. The group is also working towards US$100m of project debt as 'green bonds' which would be listed in Frankfurt. SMS will contribute US$10m of equity leaving US$100m to finance through equity, either through a sale of a proportion of the project or at the ATC corporate level.

Figure 37: Altech Chemicals funding (US$m)

Uses of funds		Sources of funds	
Plant capex	298		
KfW contingency	28	KfW senior loan	190
Debt reserve and working capital	46	Green bonds	90
Fees and costs	41	SMS equity contribution	10
Less amount already spent	-23	Project equity	100
Total use of funds	390	Total funding	390

Source: Altech Chemicals, Canaccord Genuity

Key personnel

ATC Managing Director, Iggy Tan, is a very experienced executive in the mining and chemicals sectors. Among other roles, Mr Tan is an ex-MD of Galaxy Resources where he was responsible for the funding, construction and start-up of the Mt Cattlin spodumene mine ($80m) and the Jiangu lithium carbonate plant ($100m).

Offtake arrangements

ATC has an offtake agreement in place with Mitsubishi for the sale of all of the plant's production at market prices for 10 years, a period which comfortably covers the 4.5-year payback period on the plant.

Next steps

With process design agreed and completed, ATC will finalise financing of the project before commencing construction of the Johor plant.

FYI Resources | Mkt cap $197m | Partnering with a leading alumina producer

Strategy

FYI's strategy is to develop an integrated HPA project with the goal of becoming a leading producer of quality aluminium oxide (alumina).

Kaolin asset

FYI has its own kaolin deposit at Cadoux with a combined 3.2m tonnes of proved and probable reserves with an average grade of 24.8% and providing comfortably sufficient capacity to supply all of FYI's HPA production needs (63k tonnes per annum to produce 10k tonnes per annum HPA). For HPA producers, kaolin mining is unlikely to be a full-time operation, with 'campaign' mining running for three months at a time to provide three years' of HPA plant feedstock.

Figure 38: FYI Resources Cadoux kaolin asset

	Quantity (m tonnes)	Al_2O_3 concentration
Mineral Resources		
Measured	0.4805	24%
Indicated	5.7427	23%
Inferred	5.0455	21%
Total	**11.3**	**23%**
Ore reserve		
Proved	290	24.8%
Probable	2,914	24.9%
Total	**3,204**	**24.9%**

Source: FYI Resources

Study status

FYI has published an updated DFS, reporting improved project economics and increased learnings from several pilot plant runs.

Figure 39: Summary of FYI Resources DFS

Asset profile	Life of project	Average p.a.
Proved and probable ore reserves (m tonnes)	3.2	
JORC Resources (m tonnes)	11.3	
Capital costs		
Capital costs	202	
Working capital	5	
Sustaining capital (2% of capital costs, annually)		4
Production summary		
Period modelled (years)	25	
Annual ore mined and beneficiated (k tonnes)	1,575	63
Annual HPA produced (k tonnes)	250	10
Yield of refined kaolin (%)	16%	16%
Project economics		
HPA price average	26,400	
Revenue (US$m)	6,100	261
Operating costs (US$m)	-1,450	-75
EBITDA (US$m)	4,650	186.0
Cash flow after finance and tax		131
Financial returns		
NPV post-tax, 8% discount rate (A$m)	1,014	
IRR post-tax	55%	
Payback period (years)	3.6	

Source: FYI Resources

Production process

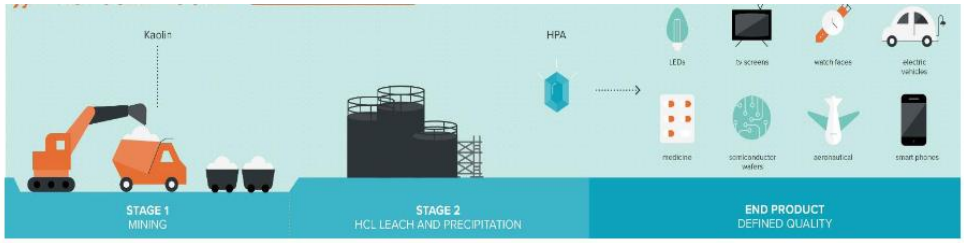
Similar to ATC, FYI's HPA process involves acid leeching followed by precipitation to deliver the final product, although FYI believes its competitive advantage comes from the IP derived from extensive pilot scale testing which has optimised the process. A description of FYI's laboratory work includes a three-stage precipitation followed by calcination process.

FYI has conducted extensive pilot plant testing of its process, running the plant continuously for one week. In February, FYI reported the results of pilot plant trials run jointly with Alcoa Australia which showed average HPA purity of 99.998%, comfortably in the 4N category and pushing towards the 5N, for which FYI's DFS assumes will constitute 15% of sales.

In May, FYI announced that it had entered into a 90-day exclusivity period with Alcoa Australia, producer of both aluminium and alumina, to determine the technical and commercial viability of establishing a JV for the production and commercialisation of HPA. FYI's expectations are that any JV arrangement with Alcoa should provide a clear path for HPA project development, funding, operation and product marketing.

The DFS states that FYI will mine and beneficiate 63,000 tonnes per annum of kaolin from its Cadoux deposit to produce 44,000 tonnes per annum of feedstock for the Kwinana refinery which, in turn, will produce 10,000 tonnes per annum of HPA.

Figure 40: FYI Resources process flowsheet



Source: FYI Resources

Funding

At its last quarterly report, FYI had A$9.1m of cash on hand and no debt.

FYI's April DFS indicates that debt financing could represent 70% of the capex (US$142m) depending on the finance structure.

Key personnel

FYI's Managing Director, Roland Hill, has over 20 years' experience in mining and exploration both in contracting and in roles with Western Mining, Normandy Poseidon ad Crescent Gold. He also has extensive experience working in the finance sector.

Offtake arrangements

FYI's DFS states that it expects that one of the outputs of a formal JV arrangement with Alcoa Australia will be the establishment of offtake partners via the commercialisation programme.

Next steps

The 90-day exclusivity with Alcoa expires in early August and the outcome of that process is likely to dictate FYI's subsequent actions.

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Investment Recommendation

Date and time of first dissemination: August 08, 2021, 17:00 ET

Date and time of production: August 07, 2021, 22:10 ET

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	950*	100.0%	

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