



PURE  
ALUMINA

# Yendon High Purity Alumina Pre-feasibility Study



# Disclaimer



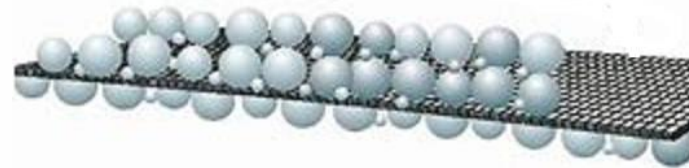
## Forward-looking Statements

This announcement contains forward-looking statements which are identified by words such as 'anticipates', 'forecasts', 'may', 'will', 'could', 'believes', 'estimates', 'targets', 'expects', 'plan' or 'intends' and other similar words that involve risks and uncertainties. Indications of, and guidelines or outlook on, future earnings, distributions or financial position or performance and targets, estimates and assumptions in respect of production, prices, operating costs, results, capital expenditures, reserves and resources are also forward-looking statements. These statements are based on an assessment of present economic and operating conditions, and on a number of assumptions and estimates regarding future events and actions that, while considered reasonable as at the date of this announcement and are expected to take place, are inherently subject to significant technical, business, economic, competitive, political and social uncertainties and contingencies. Such forward-looking statements are not guarantees of future performance and involve known and unknown risks, uncertainties, assumptions and other important factors, many of which are beyond the control of the Company, the directors and management. We cannot and do not give any assurance that the results, performance or achievements expressed or implied by the forward-looking statements contained in this announcement will actually occur and readers are cautioned not to place undue reliance on these forward-looking statements. These forward-looking statements are subject to various risk factors that could cause actual events or results to differ materially from the events or results estimated, expressed or anticipated in these statements.

**PFS Assumptions** - Refer to announcement titled, "PFS Results," dated 14 June 2018. HEG confirms that all material assumptions underpinning the pre-feasibility study continue to apply and have not materially changed.

# Our Goal

To be the  
premier supplier  
of quality high  
purity alumina



# Yendon HPA Pre-Feasibility Study generates outstanding technical and financial outcomes



**Low production costs underpin exceptional margins, resulting in potential average EBITDA of USD\$133m/annum**

<b>Annual HPA production</b>	<b>8,000 tonnes +99.99% Al<sub>2</sub>O<sub>3</sub> (4N)</b>
<b>Project Capex</b>	<b>USD \$271 m (including USD \$50.2 m in contingencies)</b>
<b>Capex Intensity</b>	<b>USD \$33,875 /t of HPA</b>
<b>Average cash cost of production</b>	<b>USD \$7,668/t</b>
<b>Forecast sale price</b>	<b>USD \$25,200/t</b>
<b>Average EBITDA</b>	<b>USD \$133 m</b>
<b>Project NPV<sub>10</sub></b>	<b>USD \$692 m</b>
<b>IRR</b>	<b>34%</b>

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# Yendon HPA Pre-Feasibility Study Parameters

The primary objectives of the PFS were to:

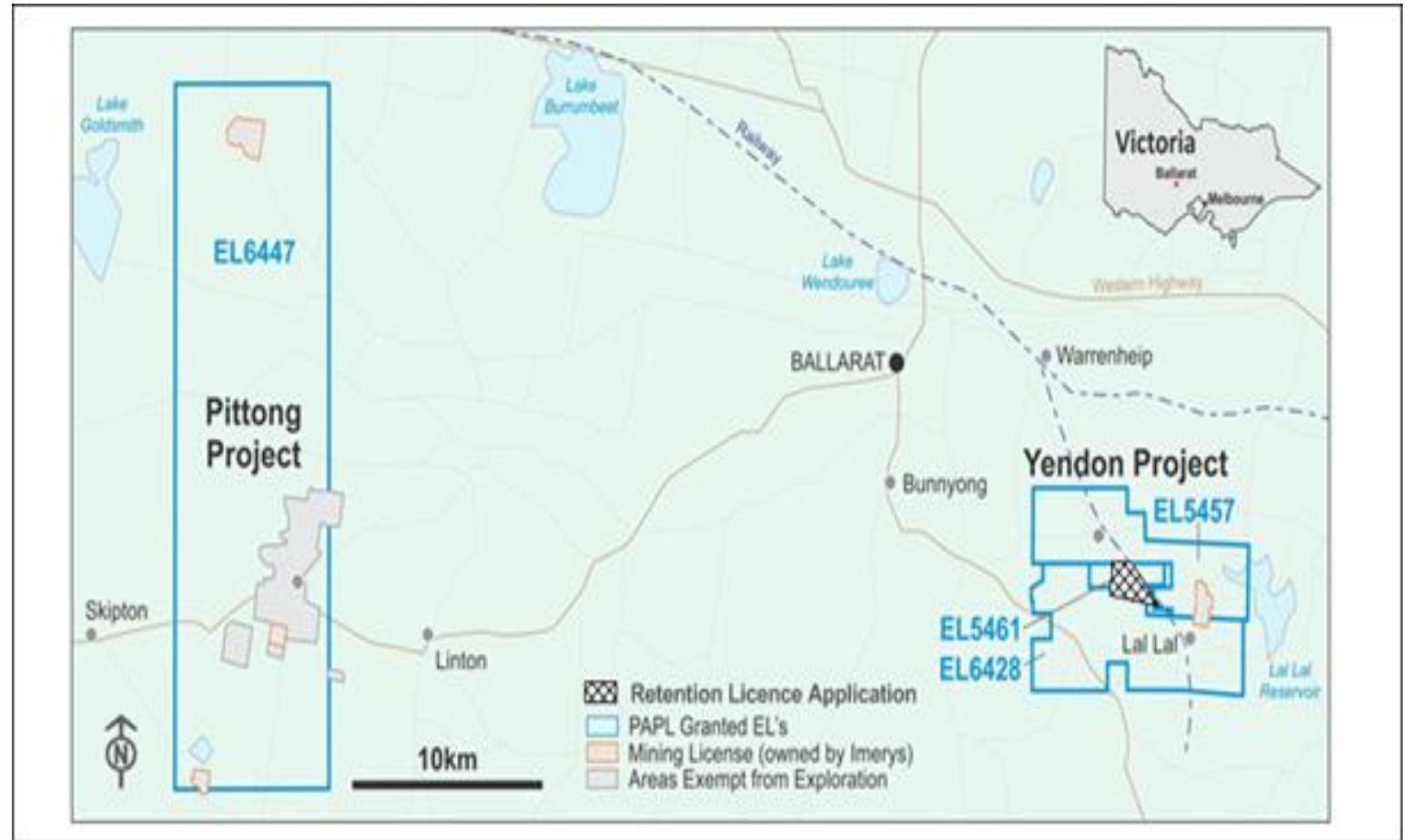
- Demonstrate that Yendon kaolin can be converted to HPA that exceeds the minimum requirements of the 99.99% HPA market;
- Define and optimise the process route to convert Yendon kaolin to HPA based on the industry standard process to enable a process flow diagram to be developed;
- Develop a mechanical equipment list and from this estimate capital and operating costs for the kaolin to HPA process;
- Develop a cash flow model to evaluate the financial feasibility of the project; and
- Develop the risks and opportunities arising from the study and identify further work to optimise the project.





# Yendon Kaolin Deposit – Great Location

- Yendon is located near Ballarat in Victoria, 100km via freeway to Melbourne port and possible process plant location
- Mining friendly – kaolin has been mined in the area for decades
- Possibility of purchasing kaolin from nearby producing Imerys mine



# Yendon Kaolin Resource- Long Life, High Grade

## Maiden JORC (2012) kaolin resource for the Yendon HPA Project

Class	Tonnage (Mt)		<63 µm Concentrate Grades (%)								
	In situ	Concentrate*	Mass Rec	Al <sub>2</sub> O <sub>3</sub>	CaO	Fe	K <sub>2</sub> O	MgO	Na <sub>2</sub> O	SiO <sub>2</sub>	TiO <sub>2</sub>
Measured	1.73	0.75	43.13	35.08	0.08	0.79	0.19	0.09	0.16	47.84	1.13
Indicated	1.95	0.84	43.14	34.33	0.07	0.85	0.25	0.10	0.17	48.94	1.12
<b>Total</b>	<b>3.68</b>	<b>1.59</b>	<b>43.14</b>	<b>34.68</b>	<b>0.08</b>	<b>0.82</b>	<b>0.22</b>	<b>0.10</b>	<b>0.17</b>	<b>48.42</b>	<b>1.12</b>



- Kaolin resource of 3.7mt ore, equivalent to 1.6mt of 34.7% kaolin concentrate. Sufficient for 39 years of 8,000 tpa HPA production ( 1/3 of current world HPA demand)
- Recent drilling has extended kaolin deposit to the north – potential to double project life
- Yendon kaolin contains consistent high grades of kaolin and low levels of deleterious impurities barred by HPA customers making it less costly to purify to HPA

\*\*All information within this release relating to Maiden JORC (2102) Kaolin Resource for the Yendon HPA Project as referred to in the above table are appended from the ASX market release “Initial Kaolin Resource” dated 12 February 2018. HEGL confirms that it is not aware of any new information or data that materially affects the information included in the relevant market announcement and all material assumptions and technical parameters underpinning the estimates continue to apply and have not materially changed.



# Shallow Simple Mining

Proposed mine design includes:

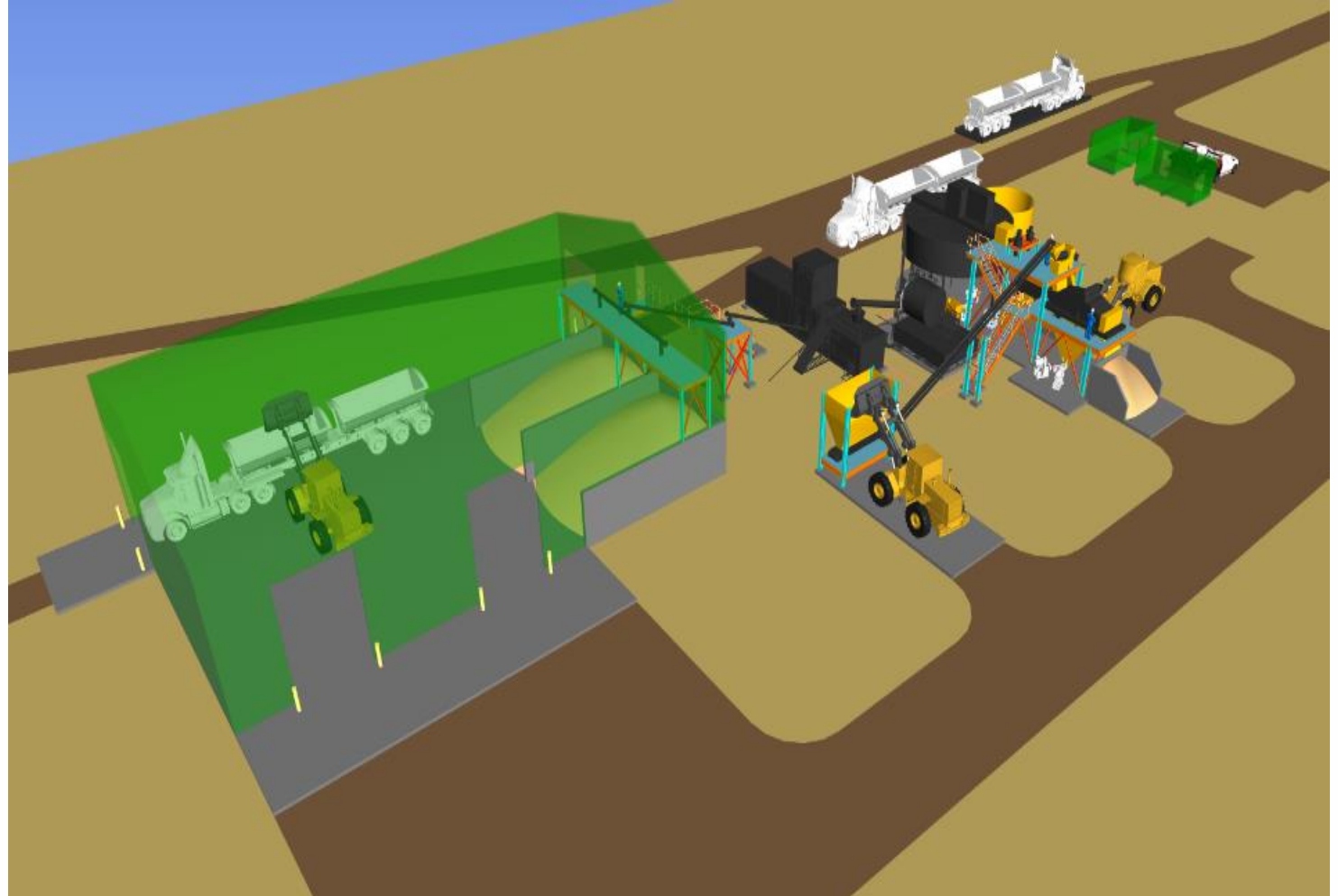
- Shallow pit with max depth 30m and average depth 20m
- Thin overburden ~2m
- Low stripping ratio ~0.7
- Low cost dig, open cut mining – no blasting, crushing or grinding
- 2-4 weeks annual mining campaign
- Ore stockpiled for onsite beneficiation





# Screening Yendon ore produces high grade kaolin concentrate

- Yendon ore consists of fine grained kaolin and coarse silica
- Screening to 63 micron produces a high grade 35% kaolin concentrate with very good recoveries
- Removing 57% of the mass as reject coarse silica
- Kaolin concentrate is trucked 100km to hydrometallurgical facility
- PFS assumes silica is stored at the mine, however potential exists to sell the silica, further reducing net costs



# Significant metallurgical test work defines effective process to convert kaolin to HPA

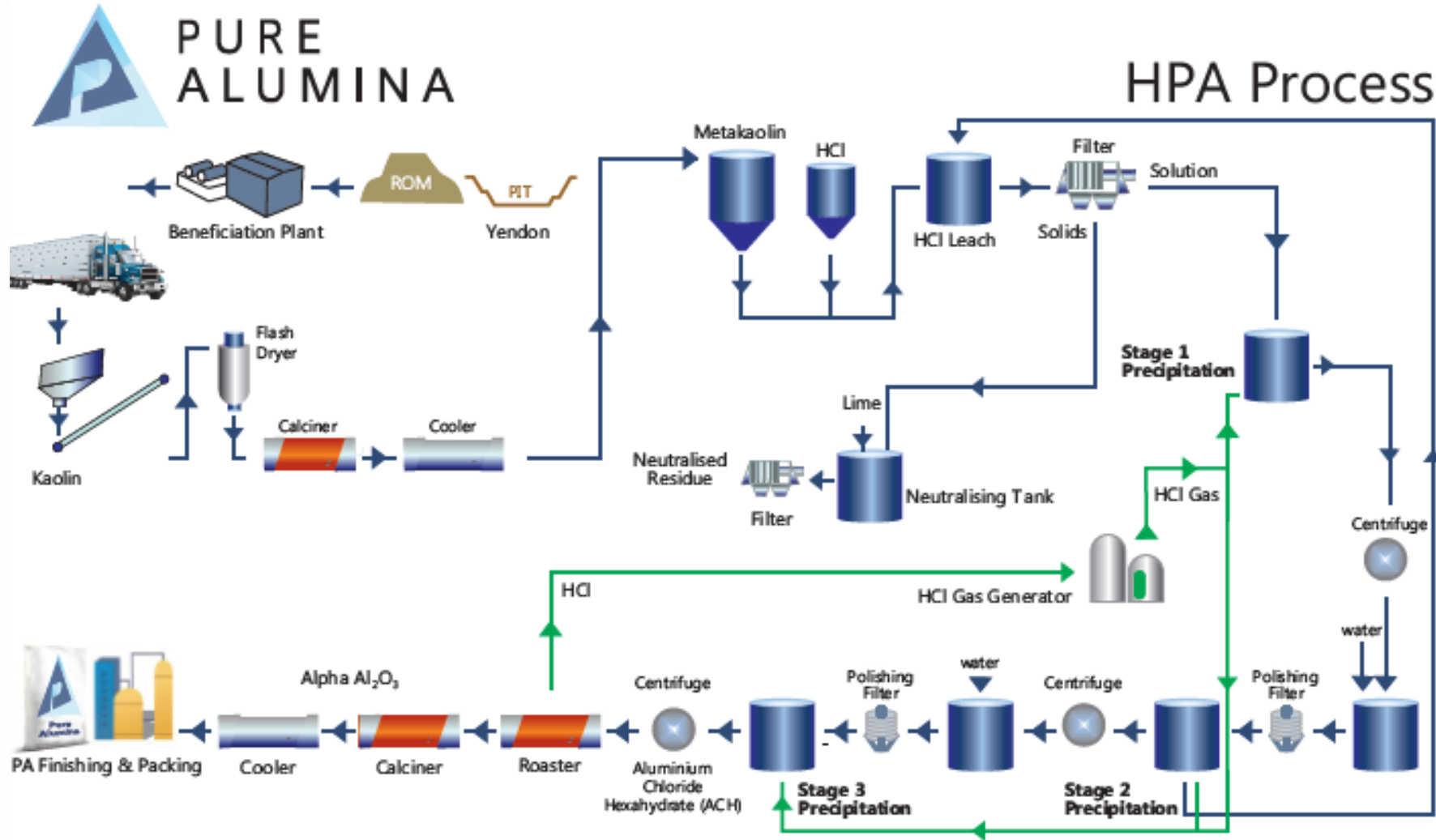
- HPA hydrometallurgy plant located in Melbourne for the study. Other locations will be considered to further reduce cost
- Industry standard process customised for Yendon kaolin delivers 99.99% HPA
- Simple process flowsheet, rapid chemical reactions, moderate acid strengths and temperatures assist to keep opex costs low
- Capex contained through significant use of commercially proven and off the shelf equipment
- PFS identified numerous opportunities to improve revenue, reduce opex and capex which will be investigated





# Project flowsheet

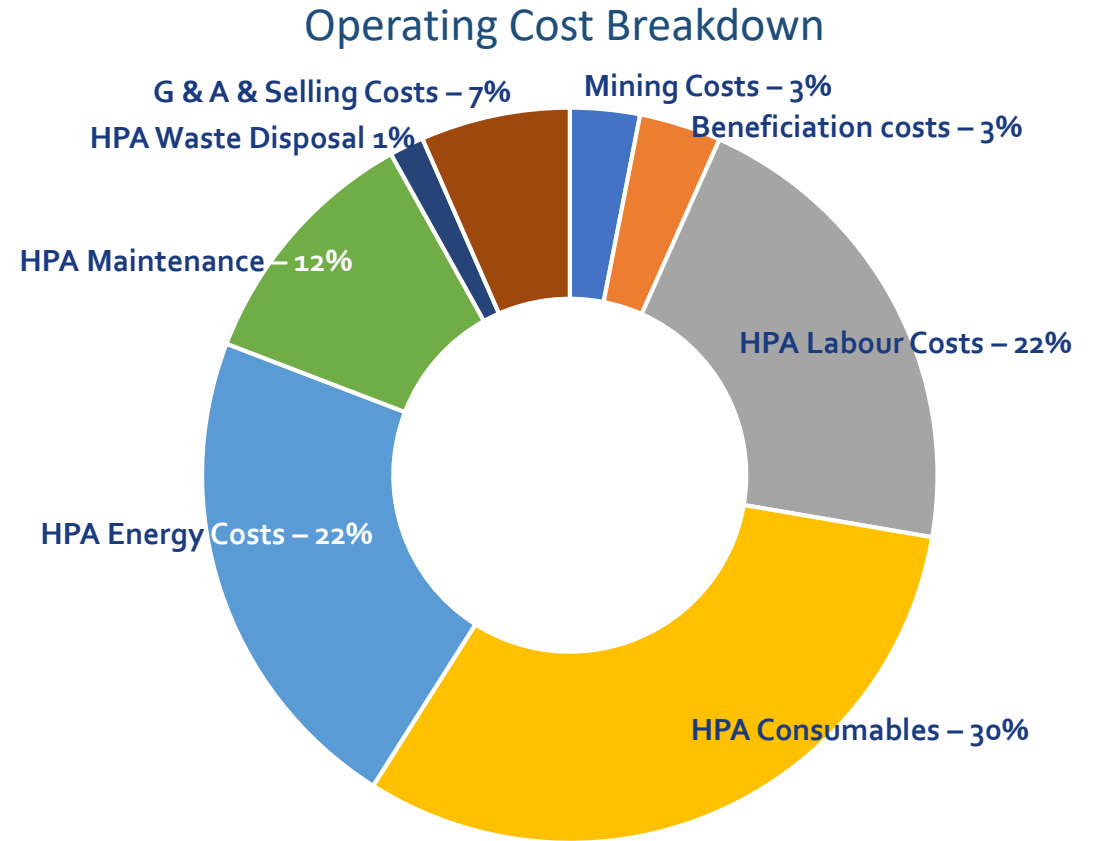
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# Competitive Operating Costs

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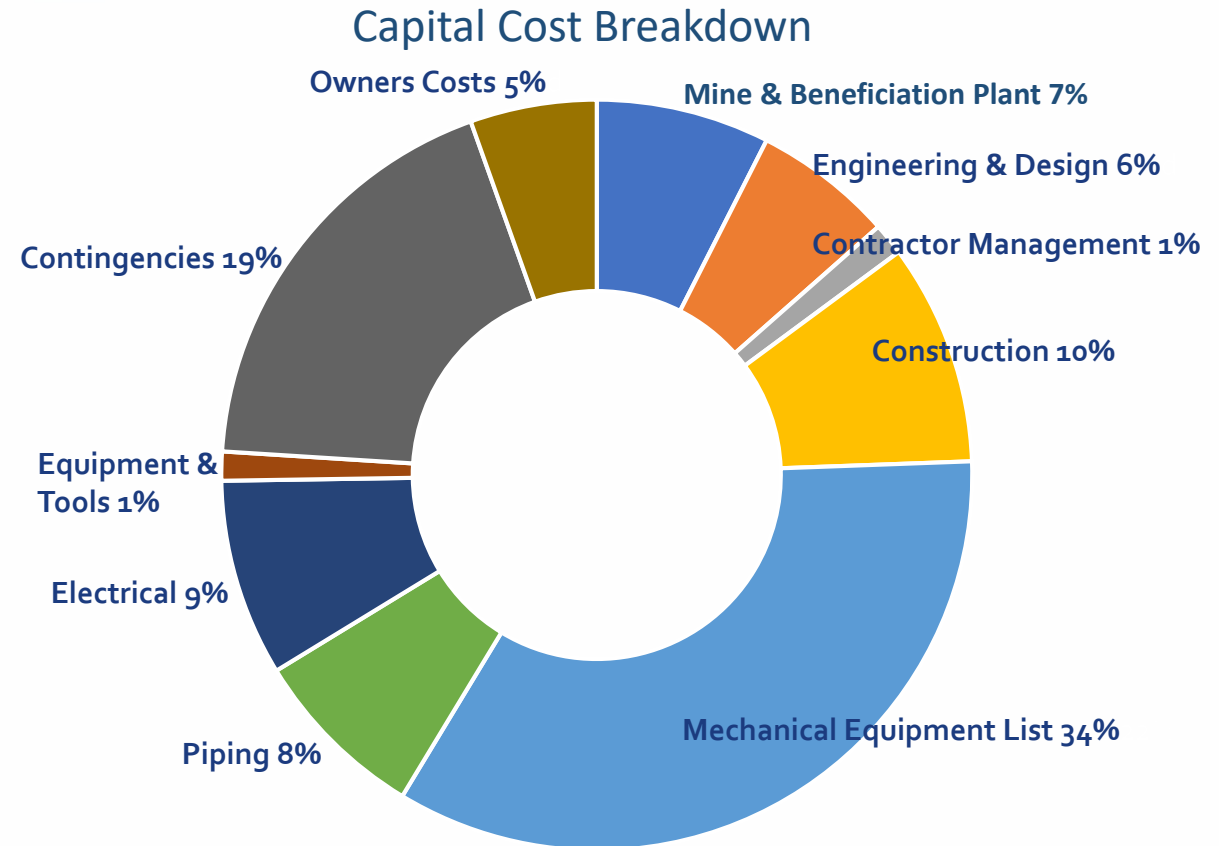
- Operating costs of US\$7,668/t HPA are lowest of those published
- Savings in major cost drivers consumables, energy and labour may be possible in offshore location
- Hydrometallurgical processing dominate total operating costs (85%) while mining and beneficiation costs are modest (6%)





# Low Capital Costs per Tonne of HPA produced

- \$271m capex for 8,000 tpa HPA is highly efficient
- Contingency, owners costs and working capital are included
- Acid regeneration plant is largest cost item with opportunity to reduce its cost
- Like opex, HPA plant accounts for most of total capital costs (93% ) with mining a small part (7%)



# Capital and Operating Costs

## Capital Costs

Beneficiation plant	\$ 20,257,225
Engineering & Design	\$ 16,317,079
Contractor Management	\$ 3,732,525
Construction	\$ 25,862,760
Mechanical Equipment	\$ 92,813,954
Piping	\$ 20,614,397
Electrical	\$ 22,991,531
Equipment & Tools	\$ 3,382,271
<b>Contingency</b>	<b>\$ 50,260,825</b>
Owners Costs	\$ 14,767,536
<b>Total Capex</b>	<b>\$ 271,000,103</b>

## Operating Costs

	Per Tonne HPA
Mining	\$ 230.42
Kaolin Beneficiation	\$ 224.92
<b>Total Mining &amp; Beneficiation</b>	<b>\$ 455.34</b>
Labour	\$ 1,705.40
Operating Consumables	\$ 2,328.06
Energy	\$ 1,672.34
Waste Disposal	\$ 112.83
Maintenance Materials	\$ 864.05
G & A	\$ 530.00
<b>Total HPA Processing</b>	<b>\$ 7,212.69</b>
<b>Total Operating Cost</b>	<b>\$ 7,668.02</b>



# DFS Scope Development Underway



## Capture Opportunities :

- 99.999% HPA (5N) trial to expand marketing opportunities and attract higher prices
- Hydrometallurgical plant location study to lower opex and fast track approvals
- Review big ticket capex items eg acid regeneration plant for capex & opex savings

## Manage Risks:

- Build and operate a HPA pilot plant to reduce the scale up risk of going from laboratory to commercial operation.
- Manage the market risk by the early engagement with customers, providing test and commercial HPA samples, leading to offtake agreements
- Engage funding sources early in DFS to address finance risk
- Careful selection of plant location to manage permit risk

# HEG News Flow



## Completed or In Progress:

- Aug '17 Acquisition of Pure Alumina
- Oct '17 Beneficiation Test work completed
- Jan '18 HPA Produced from Yendon kaolin**
- Jan '18 Yendon HPA Project PFS Commenced
- Feb '18 Yendon Kaolin Resource announced**
- April '18 HPA Marketing Strategy Commenced
- June '18 Yendon HPA PFS Results Announced**
- June '18 Gold asset sale process underway

## Anticipated:

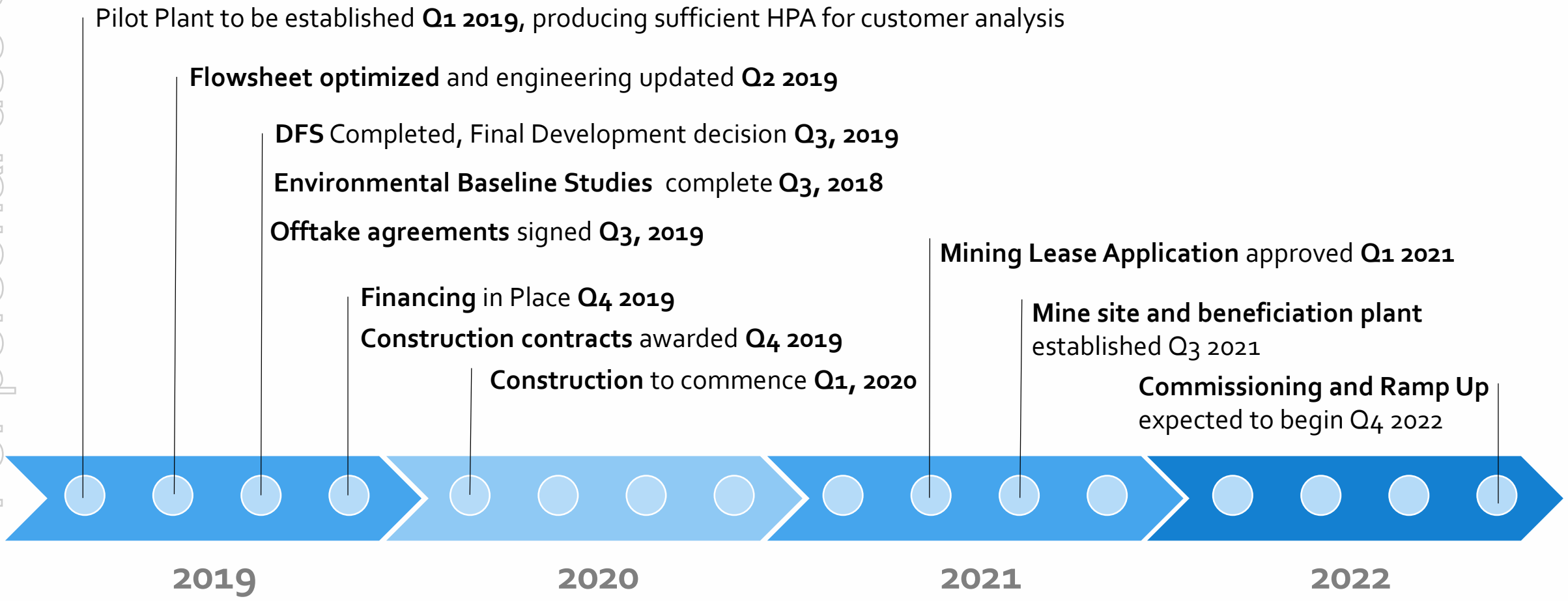
- Q3 '18 Proposed Company name change**
- Q3 '18 Gold assets sale outcome**
- Q3 '18 Definitive Feasibility Study commencement
- Q3 '18 99.999% HPA test work results
- Q4 '18 Location Study outcome
- Q4 '18 Baseline Environmental Study and Mining License Application Process commences**
- Q1 '19 Pilot plant starts operation**
- Q3'19 Offtake Agreement signed**
- Q3 '19 DFS Completed & Final Investment Decision**

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# Significant global producer of HPA by 2022



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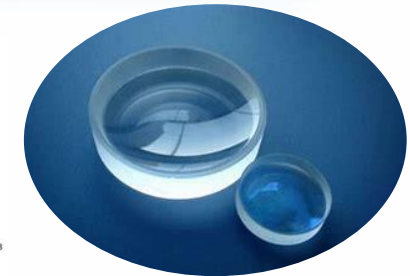
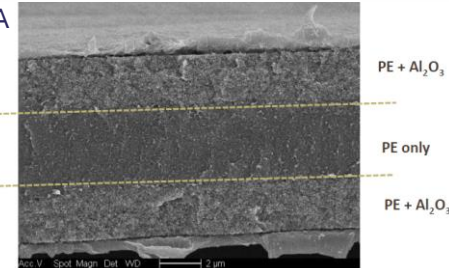




# What is High Purity Alumina

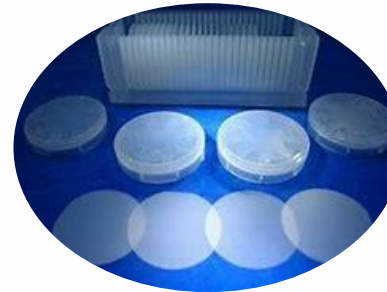
- HPA is a very pure form of aluminium oxide ( $\text{Al}_2\text{O}_3$ )
  - **99.99% (4N)**, <100 ppm of impurities
  - **99.999% (5N)**, <10 ppm of impurities
  - **99.9999% (6N)**, <1 ppm of impurities
- 4N is currently the most widely used grade
- 5N demand is expected to increase significantly as the requirements for batteries and high spec equipment grows
- HPA is chemically inert in most environments, has a very high melting point, doesn't conduct electricity and is very abrasive.

PE Li battery separator coated with HPA



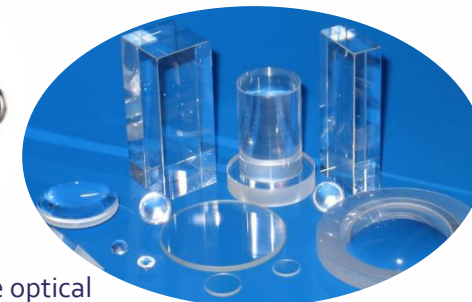
Sapphire optical lens

Sapphire LED & Semiconductor wafers



iPhone uses Sapphire camera lens

LED's



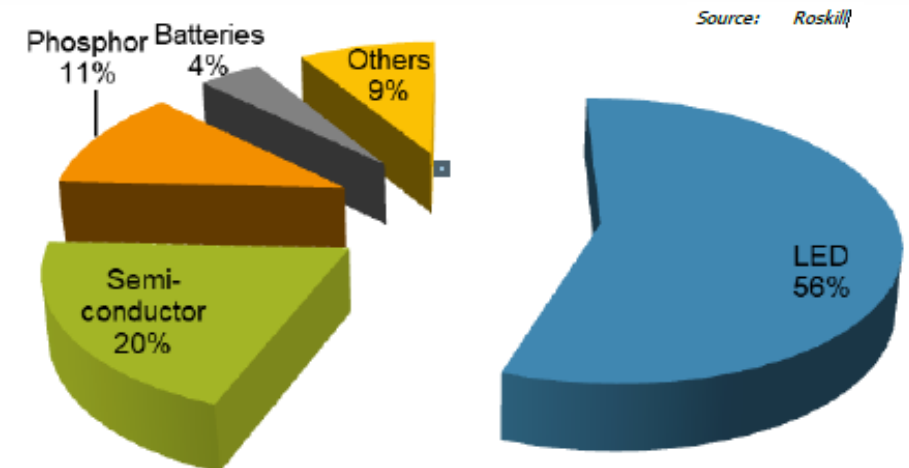
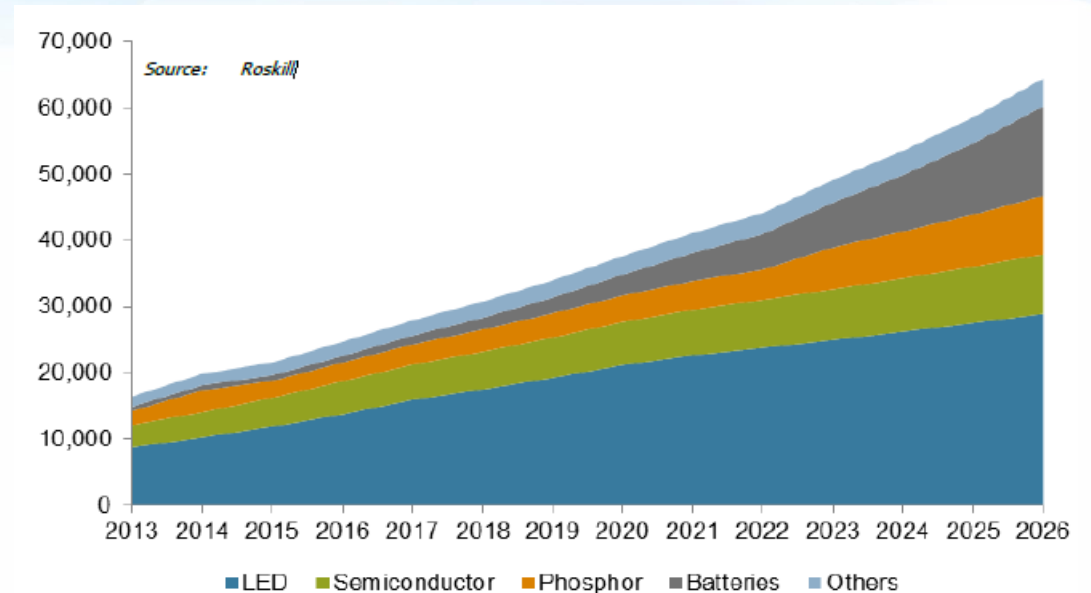
Sapphire optical devices



# HPA Demand Outlook

Demand for HPA has risen eight-fold since 2003 and is forecast to triple by 2030

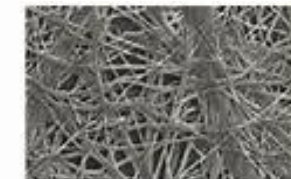
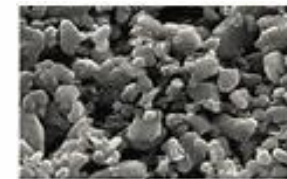
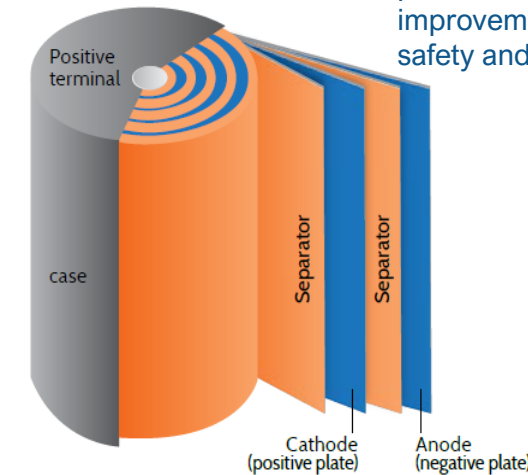
- LED's consume more than half the annual HPA production and is growing strongly. LED's currently have ~20% of the lighting market with saturation expected above 80%.
- Lithium batteries are an emerging HPA market and forecast to grow strongly as electric vehicle and power storage markets take off
- Additional demand includes medical, optical, smart phone camera lenses and screens, watch glass and bullet proof windows



# HPA Coated Lithium Batteries Separators

- Lithium batteries can generate significant heat that, if unmanaged, may result in thermal runaway events as happened to Samsung with their Galaxy Note 7
- The larger the battery the greater the thermal management issue, posing a serious risk for EV batteries
- Coating battery separators with HPA has been found to significantly improve safety and efficiency:
  - provide greater thermal stability to the battery,
  - significantly improves impedance (Macmullan number <3) allowing for high power capability,
  - improve battery life cycle and lower self-discharge

HPA coating of the Separator provides significant improvements in battery safety and efficiency



HPA Coating

PE/PP separator base





# Synthetic Sapphire: Continued Strong Demand



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85% of HPA produced today is to make synthetic sapphire. Properties of Synthetic Sapphire

- Extreme hardness (2nd only to diamonds on the Mohs scale)
- Transmits in UV, visible and IR wavelengths
- High heat resistance and excellent thermal conductivity
- High electrical resistance
- Chemically inert and insoluble (biocompatible)

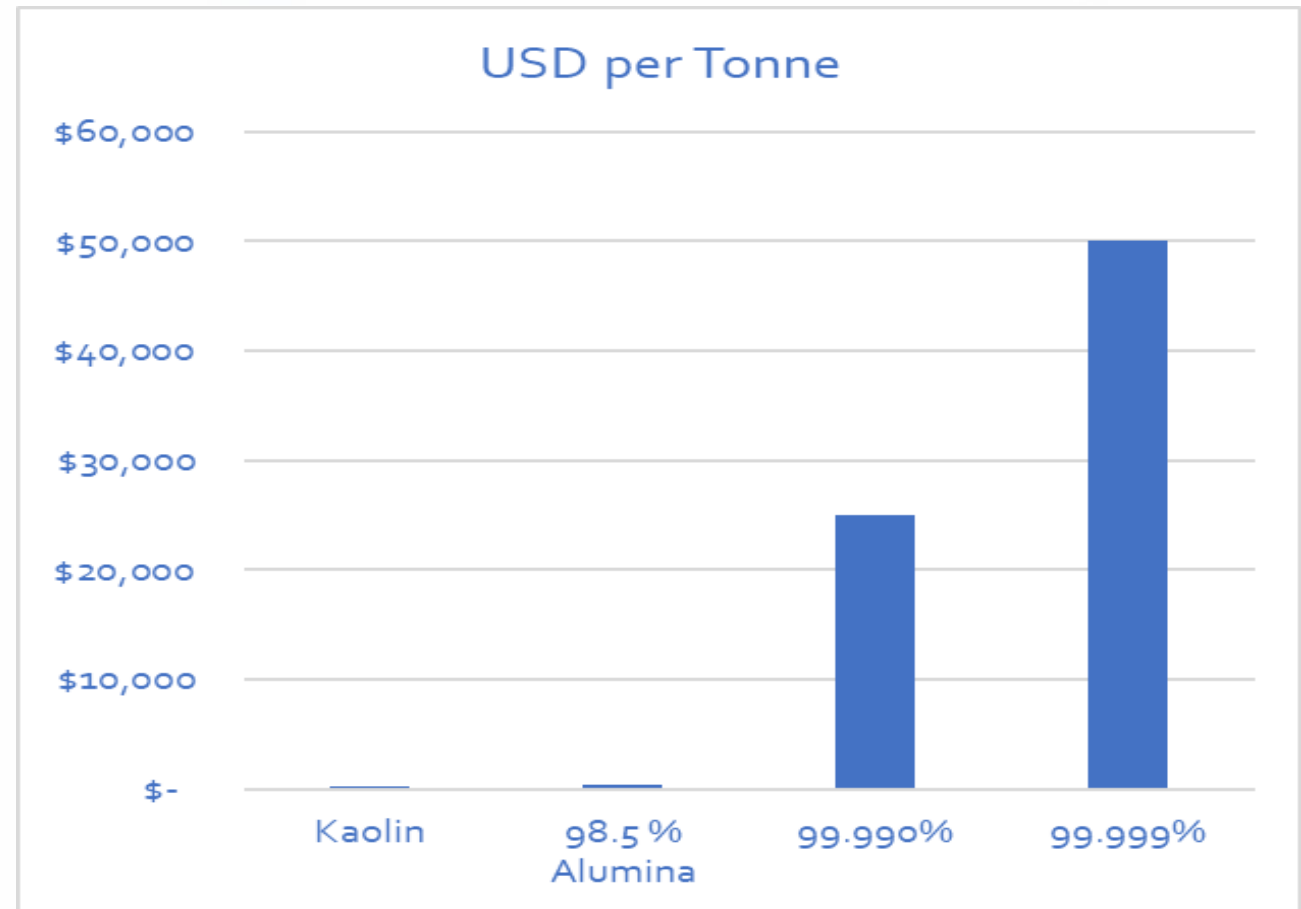
COMPARISON CHART				
	KRYSTAL Sapphire	Corning® Gorilla Glass II	Common Tempered Glass	Common PET Film
Fully Transparent	✓	✓	✓	✓
Smooth Surface	✓	✓	✓	✗
Nano-Silicone Adhesive	✓	✓	✓	✗
Hover Touch Applications	✓	✓	✗	✓
Shatterproof	✓	✗	✓	✗
Oleophobic Coating	✓	✗	✓	✗
Touch-Screen Optimized	✓	✓	✗	✗
Beveled Edges	✓	✗	✗	✗
3.3x Harder than Glass	✓	✗	✗	✗
Scratchproof	✓	✗	✗	✗
Hardness of 9H	✓	✗	✗	✗

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# HPA prices are attractive and forecast to remain so

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- 4N HPA currently sells for US\$25-35,000/t
- 5N HPA sells for US\$45-60,000/t
- Smelter grade 98.5% Alumina sells for circa US\$400/t
- HPA prices are forecast to remain firm with demand growth matching or exceeding supply.
- Quality challenges will constrain supply growth, particularly at the higher purity levels



# Corporate Overview



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## Board of Directors

- Graham Reveleigh: Chairman
- Martin McFarlane: Managing Director
- David Leavy: Executive Director
- Robert Boston: Non-executive Director

## Top 5 shareholders

Tolga Kumova	6.69%
Merrill Lynch Nominees	5.60%
JP Morgan Nominees	4.29%
CitiCorp Nominees	3.13%
Quartz Mountain Mining	2.13%

## Capital Structure

- Shares on issue: 147.791 mil
- Options on issue: 44.8 mil @ 7.5c, exp July '20  
26.6 mil @ 20c, exp July '20
- Market Capitalisation: \$11.8 m at 8c
- Cash: \$2.3m at March 31, 2018





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