

23 October 2017

## ALTECH – POSITIVE FINAL INVESTMENT DECISION STUDY (FIDS) FOR 4,500TPA HPA PROJECT

### Highlights

- Positive outcome from Final Investment Decision Study (FIDS) for 4,500tpa HPA project
- Study economics include:
  - Pre-tax NPV<sub>7.5</sub> US\$ 505 million
  - Internal Rate of Return (IRR) 22%
  - Payback (full rate) 3.9 years
  - EBITDA US\$ 76 million p.a.
  - Capital cost US\$ 298 million
- Total target debt by KfW IPEX-Bank of US\$ 185 million
- US\$ 165 million export credit finance, US\$ 20 million at commercial terms
- Target date for export credit cover approval remains 14 December 2017

Altech Chemicals Limited (Altech/the Company) (ASX: ATC) (FRA: A3Y) is pleased to announce the positive results from a Final Investment Decision Study (FIDS) for the development of a 4,500tpa high purity alumina (HPA) plant at Johor, Malaysia and kaolin mine at Meckering, Western Australia (the Project).

The FIDS incorporates up-to-date project assumptions including the final capital cost estimate. The estimate includes: a fixed-price lump-sum engineering, procurement and construction (EPC) contract value for the construction of the Malaysian HPA plant by a consortium led by German engineering firm SMS group GmbH (SMS); and a fixed-price lump-sum EPC contract value for construction of the Meckering kaolin container loading facility by Perth based Simulus Engineering Pty Ltd. In addition the capital cost estimate includes owner costs during HPA plant commissioning and the initial kaolin mining campaign. HPA plant capacity is now 4,500tpa (was 4,000tpa) and assumptions for operating costs, HPA selling price, HPA plant production ramp-up, exchange rates, total envisaged debt, and the expected German government export credit finance amount have been updated in the FIDS to reflect current conditions and outlooks.

The Company is extremely pleased with the achievement of this significant milestone of project development. Altech's management team have successfully progressed the Project through the extensive lender due diligence process, with an extremely positive outcome. Whilst the due diligence process has taken longer than expected and has resulted in additional capital cost, the Project has been significantly de-risked as a result. The transition to SMS as EPC contractor has been seamless. The final fixed-price lump-sum EPC contract that includes completion guarantee, throughput and process/quality guarantees is an exceptional outcome.

The financial metrics from the FIDS are extremely robust. Project Net Present Value (NPV) is US\$ 505.6 million at a discount rate of 7.5%, payback (at full rate) is 3.9 years and annual EBITDA is US\$ 75.7 million at full production. The internal rate of return (IRR) is 21.9% with a gross margin on sales of 63%. The Company's weighted cost of capital (WACC) has been recalculated taking into account the higher planned debt and assumed interest, debt mix, and total project costs; it is reflected as the discount rate of 7.5% used in the 30-year discounted cash flow model for the FIDS. The beta used in the calculation is 0.83. A summary of the key financial metrics and key assumptions of the FIDS is set out in Table 1. The full executive summary of the FIDS is attached as Appendix 1.

The HPA price assumption used in the FIDS is based on an independently supplied forward HPA price curve from Persistence Market Research (Persistence). The HPA price used in the Project financial model is US\$ 33.72/kg in year 1, reducing to US\$ 26.18/kg in year 9 and maintained at this level until year 30. This results in a weighted average HPA price of US\$26.90/kg over the 30-year project life. In its market report Persistence noted that the current market price of HPA in Japan is ~US\$ 40/kg; in this context the 30-year average HPA price of US\$ 26.90/kg from the FIDS financial model is conservative. If a HPA price of US\$ 40/kg was applied to the FIDS financial model (High Case), the Project financial metrics are: NPV of ~US\$ 1.09 billion, payback (at full rate) of 2.2 years, annual EBITDA of ~US\$ 133 million at full production and an internal rate of return of 33%.

### **FIDS Operating Costs**

The technical advisor to German government owned KfW IPEX-Bank has reviewed the capital cost and the operating costs assumed in the FIDS and has stated that it considers both reasonable. The FIDS Project operating costs include updated firm quotations from key services and consumables suppliers where appropriate. This includes quotations for; contract mining at Meckering; land transport and shipping of containerised kaolin from Meckering to Johor; HPA plant consumables such as electricity, natural gas, hydrogen chloride, limestone, and other materials. A detailed manning schedule has also been fully costed using local Malaysian and expatriate labour rates. Operating costs are forecast at US\$ 44.6 million p.a. at full production with a cost of goods sold of US\$ 9.90 /kg.

**Table 1 - FIDS Financial Metrics (Equity Model) with High Case (Current Market Price)**

4,500tpa HPA Project US\$	FIDS Ave Price ~\$27/kg	High Case Price \$40/Kg
Project Capital Costs	<b>297.6</b>	293.6
Revenue p.a.	<b>120.3</b>	180.0
Operating Costs p.a.	<b>44.6</b>	46.9
EBITDA p.a.	<b>75.7</b>	132.7
Net Present Value (@7.5%)	<b>505.6</b>	1,087
Payback (incl. ramp-up)	<b>4.5 years</b>	3.3 years
Payback at full production	<b>3.9 years</b>	2.2 years
Internal Rate of Return (IRR)	<b>21.9%</b>	32.9%
NPV/Capex Ratio	<b>1.70</b>	3.66
Project Life	<b>30 years</b>	30 years
Annual HPA Production	<b>4,500tpa</b>	4,500tpa
HPA Production Costs	<b>US\$ 9.90/kg</b>	US\$ 10.5/kg
Long term HPA Sale Price (Avg)	<b>US\$ 26.9/kg</b>	US\$ 40.0/kg

4,500tpa HPA Project US\$	FIDS Ave Price ~\$27/kg	High Case Price \$40/Kg
Gross Margin on Sales	<b>63%</b>	74%
USD:AUD	<b>0.75</b>	0.75
Construction Period	<b>24 months</b>	24 months
Production Ramp-up	<b>3 years</b>	3 years
Corporate Costs	<b>US\$ 7.7 million</b>	US\$ 7.7 million
Target Total Project Debt	<b>US\$ 185 million</b>	US\$ 185 million
Target ECA Covered Debt	<b>US\$ 165 million</b>	US\$ 165 million

**Table 2 – Major Capital Expenditure**

Area	US\$m
Meckering EPC (incl. contingency & land)	5.3
HPA plant land	4.1
Johor HPA plant EPC fixed price	280.0
Owner cost and Insurances etc	8.2
<b>TOTAL CAPITAL COSTS</b>	<b>297.6</b>

### **Project Finance**

German government-owned KfW IPEX-Bank has proposed a revised total target debt package of US\$ 185 million and is targeting to obtain debt approval as sole debt provider. This is subject to the sourcing split and eligibility for German government export credit cover (ECA cover) of up to US\$ 165 million. The ECA cover loan is targeted as long tenure and on attractive terms. The balance of US\$ 20 million will be a 5-year tenure loan at customary lending terms. By comparison to typical project finance the proposed debt is extremely attractive, which is why the Company persisted with the longer than expected due diligence and approvals process. The target date of 14 December 2017 (as per ASX announcement 15 Sep 2017) remains unchanged as the date for the final decision by German government inter-ministerial committee (IMC) for the ECA cover. At the same time KfW IPEX-Bank is targeting to gain its credit approval by the competent bodies of the bank.

A positive decision from the IMC will result in a legally binding *offer of cover* by the Federal Republic of Germany to KfW IPEX-Bank and permit KfW IPEX-Bank to finance the Project debt package of in total US\$ 185 million, consisting of the up to US\$ 165 million covered debt and US\$ the 20 million commercial debt. An *offer of cover* coupled with a separate bank commitment letter based on a pre-negotiated debt term sheet package provided by KfW IPEX-Bank will position Altech to then proceed to secure project equity.

### **HPA Plant Throughput and Process/Quality guarantees**

The SMS fixed-price lump-sum EPC contract now includes a completion guarantee with liquidated damages provisions; it also includes throughput and process/quality guarantees supported by a substantial performance bond. All plant and equipment will be accompanied with warranty guarantees supported by a significant warranty bond. Obtaining these extensive guarantees for a chemical processing plant is an exceptional outcome that significantly de-risks the Project. These guarantees were one of the instrumental factors in bringing the technical project due diligence process to a satisfactory conclusion.

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## **HPA Plant Capacity and Enhanced Impurity Management**

The scope of work for the Malaysian HPA plant has changed substantially under the fixed-price lump-sum turnkey EPC contract proposed by SMS. Plant capacity has been upgraded to 4,500 tonnes per annum and the plant design now incorporates a flexible finished product line capable of producing HPA for both the synthetic sapphire industry (up to 4,500tpa of high density pellets) and HPA for the lithium-ion battery industry (up to 1,500tpa of powder at sub-micron particle size). Total plant output is designed at 4,500tpa HPA with the flexibility to balance the finished product mix.

Superior lining materials have been incorporated into selected equipment proposed for the back-end of the HPA plant (after roasting) to minimise finished product contamination risk. Whilst the materials are significantly more expensive than the original design, the incorporation further de-risks the Project by ensuring the plant's capability to achieve the required 99.99% finished product purity standard. Also, plant emissions targets are now significantly more stringent compared to local requirements due to incorporating international requirements (Equator Principles and OECD Common Approaches). The technical due diligence consultants have positively opined on the Company's revised process design assumptions, impurity management changes and additional test work results from the due diligence program.

In compiling the final EPC price, SMS has now detailed the majority of the previously "factored" construction costs by requesting firm quotations from vendors and service providers. Previously "factored" costs include freight, mobilisation and demobilisation, temporary facilities, final engineering, insulation and commissioning. Overall quotations were substantially higher than was originally factored. The final capital costs include the land purchase cost for Johor and Meckering; owner costs during commissioning; a first mining campaign costs, first fills; insurance; and other establishment costs.

Based on the FIDS results, the Altech Board has decided that the Project proceed to the next stage, the ECA application process. Assuming that the ECA debt component is approved in December 2017, the Company will focus on finalising the equity component of funding in the first half of 2018.

Commenting on the FIDS, Altech's managing director Mr Iggy Tan said, "*The FIDS has confirmed the financial and technical robustness of the Company's HPA project. The focus for Altech over the next two months is to continue to work closely with KfW IPEX-Bank and the appointed independent expert consultant to prepare for the German government inter-ministerial committee meeting on 14 December 2017. A positive outcome will mean we attain the US\$165 million "offer of cover" for the majority of the Project debt and as the bank approvals process will run in parallel; the total target debt amount of US\$ 185 million*", he concluded.



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## **APPENDIX 1 – FINAL INVESTMENT DECISION STUDY 4,500TPA HPA PROJECT (EXECUTIVE SUMMARY)**

### **1.1 Introduction**

Altech Chemicals Limited (Altech/the Company) (ASX: ATC) (FRA: A3Y) is aiming to become one of the world's leading suppliers of 99.99% (4N) high purity alumina ( $Al_2O_3$ ) through the construction and operation of a 4,500tpa high purity alumina (HPA) processing plant at Johor, Malaysia. Feedstock for the plant will be sourced from the Company's 100%-owned kaolin deposit at Meckering, Western Australia and shipped to the processing plant in Malaysia.

HPA is a high-value, high margin and highly demanded product as it is the critical ingredient required for the production of synthetic sapphire. Synthetic sapphire is used in the manufacture of substrates for LED lights, semiconductor wafers used in the electronics industry, and scratch-resistant sapphire glass used for wristwatch faces, optical windows and smartphone components. There is no substitute for HPA in the manufacture of synthetic sapphire.

The Final Investment Decision Study (FIDS) is a comprehensive and detailed study, which incorporates up-to-date project assumptions including the final capital cost estimate comprising of fixed-price lump-sum engineering, procurement and construction (EPC) contract values for the construction of the Company's proposed Malaysian HPA plant and Meckering kaolin mine and container loading facility.

The FIDS includes and considers:

- Significant detailed design and engineering work;
- Final EPC fixed contract values for both Johor and Meckering;
- Updated operating costs;
- Status of permitting and financing due diligence;
- HPA market analysis of potential product sales and revenue; and
- Financial analysis and scenario modelling.

### **1.2 HPA Market and Demand**

High purity alumina (HPA) is one of the purest forms of commercially produced aluminium oxide ( $Al_2O_3$ ) with a minimum purity level of 99.99% (4N). HPA is white in appearance and typically granular; its value is significantly higher than aluminium oxides of less purity. HPA is the critical ingredient for the production of synthetic sapphire and is also used in an expanding range of high-tech applications.

Synthetic sapphire is used in the manufacture of substrates for LED lights; semiconductor wafers used in the electronics industries; and scratch-resistant glass used for wristwatch faces, optical windows and components for smartphones and other handheld devices. Consumption of HPA in non-tradition applications such as the lithium-ion battery sector is forecast to experience significant growth. Electric vehicle manufacturers are increasingly demanding lithium-ion batteries with cathode and anode electrode separator sheets coated with 99.99% (4N) HPA for fire resistance.

HPA is an essential and high-value material for the lighting, electronics, aerospace, defence and medical industries. In terms of value, the global HPA market is forecast to grow over two-fold, reaching around US\$2.2 billion by 2024 according to Persistence Market Research (PMR).



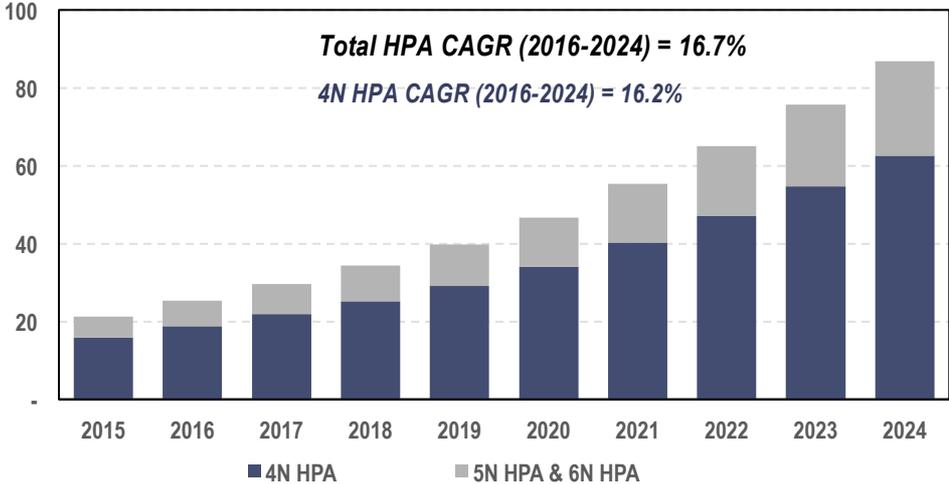
For 2016 the global HPA market was estimated by PMR at 25,315tpa and annual HPA demand is expected to increase to 86,821tpa by 2024. HPA demand is currently rising at a forecast compound annual growth rate (CAGR) of 16.7% (2016-2024). HPA demand is underpinned by its status as the non-substitutable material for the production of synthetic sapphire and the use of synthetic sapphire for the manufacture of substrates used in the LED industry. The worldwide transition from energy-hungry, inefficient incandescent lighting to energy-efficient LED lights is ongoing. The continued increase in global electricity prices is expected to support the continued increase in LED production, for which an annual growth rate of 17.6% year-on-year between 2016 and 2024 is forecast (PMR).

In addition, increasing demand for HPA is attributable to synthetic sapphire wafers used as semiconductor substrates. HPA is a preferred material for semiconductor substrates because of its superior plasma corrosion resistance and high bending strength. Semiconductor demand is expected to experience steady growth because of increased global use of electrical and electronic appliances and continued rapid economic development in emerging countries.

Sapphire is second only to diamond when it comes to hardness; this attribute combined with its scratch-resistance has seen polished synthetic sapphire shapes (sapphire glass) used for applications such as wristwatch faces and camera lenses. Demand for synthetic sapphire glass by handheld electronics manufacturers is expected to continue to grow, as smartphone producers increasingly demand synthetic sapphire for various product components such as the camera lens, home button, as well as the smartphone display screen.

The manufacture of synthetic sapphire requires the production of a large single crystal synthetic sapphire boule, which is made from melting 4N HPA (pure aluminium oxide  $Al_2O_3$ ); synthetic sapphire cores in various size diameters are cut from the boule and shaved into wafers or shaped depending on their target end-use; there is no substitute for HPA in the manufacture of synthetic sapphire crystal boules and synthetic sapphire.

**Figure 1-1**  
**Forecast annual consumption of HPA (kt) 4N, 5N, 6N**



Source: Persistence Market Research

Another key driver for increasing HPA demand is its use in separator coatings for lithium-ion batteries (electric vehicles and energy storage).



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Electric vehicle manufacturers are increasingly demanding lithium-ion batteries with cathode and anode electrode separator sheets coated with 99.99% (4N) HPA. The particle size of HPA used as the coating for this application is ultra-fine, less than 1 micron, which Altech's HPA plant is designed to achieve.

Lithium-ion batteries using separator sheets coated with HPA consume between 40-120g of HPA per kilowatt-hour (kWh). With the forecast rapid expansion of the lithium-ion battery market driven by the demand for electric vehicles and green energy power storage (solar and wind), HPA consumption in the lithium-ion battery sector alone is forecast to rise from around 1,000tpa in 2016 to 15,000tpa by 2025. According to a lithium-ion battery market research report published by Deutsche Bank (2016), lithium-ion battery usage is forecast to rise more than 7-fold, from 70GWh per year in 2015 to 535GWh per year by 2025.

Altech is positioned to take full advantage of this forecast impending surge in demand for lithium-ion batteries and HPA.

HPA demand is generally highly concentrated within the Asia Pacific region, driven by China, Japan and South Korea (collectively >42% of total LED market in 2015). The Asia Pacific region was the largest market for HPA, accounting for nearly 72% of global HPA consumption in 2015. Consumption of HPA is concentrated in electronics production hubs, the majority of which are located in the Asia Pacific region.

### 1.3 HPA Pricing, Supply and Market Dynamics

The most common variants of alumina and HPA, with associated indicative prices are:

- Smelter Grade Alumina (SGA) (99.5% purity): US\$400/t
- 3N HPA (99.9% purity): US\$6,000/t
- **4N HPA\* (99.99% purity): US\$25,000/t – US\$40,000/t (or US\$25/kg to \$40/kg)**
- 5N HPA (99.999% purity): US\$50,000/t

*\*Altech's target HPA product grade*

#### 1.3.1 Current HPA supply

There are a small number of HPA producers globally. The seven (7) largest HPA producers supply around 63% of the global HPA market according to PMR; 14 of the top 20 global HPA producers Chinese-based companies. Currently Sumitomo Chemicals of Japan, with a 17% share of the global HPA market by volume (2016), is the largest producer of HPA.

Established HPA producers reportedly produce HPA using highly processed feedstock such as aluminium metal or aluminium sulphate; they then apply one of four (reported) re-processing methods for HPA production; hydrolysis of aluminium; choline hydrolysis of aluminium; thermal decompression of ammonium aluminium sulphate; or thermal decomposition of ammonium aluminium carbonate hydroxide.

Because the established HPA producers use a refined aluminium metal product as feedstock, current HPA production costs have been estimated to be significantly higher than those for Altech's HPA project. Altech has the advantage of using kaolin (ore) feedstock that is very low in both sodium and iron, impurities that are not ideal for HPA processing. Aluminium metal typically has higher levels of sodium and iron, which are known to impact the processing of HPA, and can increase processing costs.

Overall:

- Existing supply of global HPA is dominated by large diversified chemicals companies and is highly concentrated in the APAC region (>80%);



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- Major HPA producers tend to be business conglomerates that derive a low proportion of total revenue from HPA production (e.g. less than 5% for Sumitomo Chemicals);
  - Significant opportunity exists for specialty HPA producers to bridge the looming HPA supply shortage, in particular those HPA producers with lower processing costs because of the use of alternative feedstock materials such as kaolin clay;
  - There is significant advantage to be derived from a large scale, lower cost HPA producer and being first to market, because of long development lead times, substantial capital outlay, product qualification periods and the customer relationship building required.

### 1.3.2 Market dynamics

An independent assessment of the global high purity alumina (HPA) market from 2016 until 2024 was conducted by Persistence Market Research (PMR).

PMR determined that the outlook for HPA demand is strong and the threat to demand from substitute and/or rival products is low. Consequently, it is expected that the bargaining power of HPA suppliers will remain strong despite the forecast of a moderate threat from new entrants to the supply side of the HPA market, of which Altech will be one.

### 1.3.3 HPA Pricing in FIDS Model

The FIDS had adopted the PMR forward pricing curve for HPA and used a HPA price that is mid-way between the high price group and industrial average group, reflecting the quality of Altech's proposed HPA product. Year 1 of sales assumes a HPA price of US\$31.6/kg, gradually reducing to US\$26.18/kg in year 9 and maintained at this level until year 30. This results in a weighted average HPA price of US\$26.90/kg over the 30-year project life.

In its market report Persistence noted that the current market price of HPA in Japan is ~US\$ 40/kg; in this context the 30-year average HPA price of US\$ 26.90/kg from the FIDS financial model is conservative. If a HPA price of US\$ 40/kg was applied to the FIDS financial model (High Case), the Project financial metrics are: NPV of ~US\$ 1.09 billion, payback (at full rate) of 2.2 years, annual EBITDA of ~US\$ 133 million at full production and an internal rate of return of 33%

PMR's assessment of HPA (4N) pricing was based on actual figures obtained from a number of major HPA producers including Sumitomo (Japan), Sasol (South Africa) and Baikowski (France). The reported prices provided by these producers for 4N HPA products intended for the synthetic sapphire and lithium-ion battery markets ranged from US\$40 to US\$45 per kilogram (2017). The producers sell HPA products at relatively high prices compared to products offered by a range of Chinese based producers, where products are generally priced lower, but quality is purportedly variable. In the case of pricing obtained from China-based companies producing 4N HPA for the same target markets, prices ranged from US\$20 to US\$25 per kilogram.

Figure 1-2  
Price Forecast 4N Grade HPA (Source. PMR)



#### 1.4 HPA from Kaolin

The production of alumina or aluminium oxide from kaolin (or ‘aluminous clay’) is not a new concept.

Compared to the Bayer refining and Hall-Heroult smelting techniques, which are process technologies widely used for the industrial scale production of aluminium (smelter grade alumina) from bauxite ores, the chlorination (or acid processing) of alumina containing clays (such as kaolin) promised many advantages historically and as a result industry spent many years perfecting the extraction of alumina from clays.

During the 1980’s the United States of America’s Bureau of Statistics conducted pilot plant trials to determine other feedstock materials’ suitable for the production smelter grade alumina (>99.5% Al<sub>2</sub>O<sub>3</sub>), because of the depleting availability of high-quality bauxite resources. Kaolin, ‘aluminous clay’ or alumina-bearing clays combined with hydrochloric (HCl) acid-based processing was demonstrated to be ideal for producing aluminium oxide, however, aluminium oxide of very high purity (>99.99% Al<sub>2</sub>O<sub>3</sub>) resulted from the process. This was primarily due to the absence of sodium ions in the kaolin/clay feedstock (the presence of sodium ions in refined alumina feedstock such as aluminium metal or aluminium sulphate introduces processing complexities). However, due to the limited demand for an aluminium oxide product of such high purity (HPA) at the time, the HCl processing technology for extracting alumina from clays did not commercialise. Instead, the Bayer/Hall-Heroult process, which is unable to produce HPA, continued as the only processing technology for large-scale commercial production of smelter grade alumina (SGA) using bauxite ore as feedstock.

Significant information and historical research exists on the HCl processing technology, including United States government data relating to various pilot plant investigations for alumina extraction via acid-based processing, including the trials conducted in the 1980’s. These documented successes were catalysts for Altech’s HPA project and the concept of its kaolin-to-alumina/HPA acid-based processing.

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Now, with a global market for HPA well-established and forecast for healthy annual growth, the commercial viability of HCl processing of kaolin to produce HPA is apparent, as set out in this FIDS.

#### **1.4.1 Altech's HCl Process Development**

Since 2011 Altech has undertaken considerable test work to confirm and refine the application of HCl processing of kaolin sourced from its Meckering kaolin deposit in Western Australia for the production of HPA. Successful laboratory scale test work was initially conducted in Perth, Western Australia by leading forensic and analytical chemists TSW Analytical Pty Ltd (TSW). By early 2014 larger scale batch processing of kaolin sourced from a bulk-trial test pit at Meckering commenced, being undertaken by the Stimulus Engineering Pty Ltd; a Perth-based hydrometallurgical and mineral process services group; TSW continued to provide analytical services during the large scale batch processing trials.

Batch processing included the bulk wet processing of representative samples of future run-of-mine (ROM) kaolin from Meckering to optimise and confirm the beneficiation flow sheet. Beneficiated kaolin was then subjected to HCl processing, which involved calcination; acid leaching to produce aluminium chloride; crystallisation of aluminium chloride; two stages of purification; roasting for acid recovery; and final calcination for the production of finished product HPA.

Results enabled the optimisation of the Company's HCl process flow sheet as well as the simplification of the final HPA plant design. Significantly, the batch processing results confirmed that the HCl "kaolin to HPA direct route" was valid for the kaolin sourced from the Company's Meckering deposit. The process flow sheet has been further refined during the final detailed engineering and design phase, predominantly at the back-end of the HPA plant after roasting.

#### **1.5 Due Diligence Test Work**

In August 2016 an independent Project due diligence program initiated by KfW IPEX-Bank, commenced with the appointment of technical, market, legal and independent expert consultants.

The technical consultant is retained by KfW IPEX-Bank to provide services as an independent engineer on behalf of the senior lender for the HPA project. The role of the lender's technical consultant as independent engineer will be undertaken in three phases, commencing with the due diligence phase, followed by the construction phase and finally the post-completion monitoring phase.

Due diligence commenced with the various due diligence consultants, KfW IPEX-Bank, members of the EPC team and Altech representatives travelling to Johor, Malaysia and Perth, Western Australia and accompanied by an extensive and detailed data exchange.

The technical consultant completed a thorough examination of all aspects of the HPA project, including propriety of the kaolin reserve estimate, the adequacy of physical facilities to meet mining and processing design criteria, the ability to achieve the proposed construction schedule, the reliability of capital and operating cost estimates and conformance of the project with World Bank/International Finance Corporation (IFC) policies and guidelines, and with the Equator Principles.

A variety of confirmatory test work to demonstrate specific processes and equipment selection for the proposed HPA plant were requested by the technical consultant and subsequently completed to its satisfaction. The following items were completed:

- In December 2016, roaster kiln pilot plant trials that were conducted in South Africa, which successfully demonstrated the operational effectiveness of the selected kiln technology for the proposed HPA plant.



- Laboratory test work to investigate the alkali volatilisation and impurity ingress for the alumina refractory lining of the alpha alumina calciner was undertaken in March 2017. Further laboratory test work was carried out at Perth's Curtin University's laboratory facilities to expose Altech's manufactured alumina to the roaster refractory lining.
- Jet milling test work was undertaken to confirm the target particle size for the final HPA product was achievable by the jet mills selected for the proposed plant. Test work trials were conducted in Germany and China, with additional studies around the materials of construction (alumina linings) successful. Test work to confirm the final HPA product quality in relation to the selected pelletising equipment was also undertaken with successful results.

The following additional items were successfully concluded during due diligence at the request of the technical consultant:

- Integrated environmental and social report of HPA project: Hatch, South Africa
- steam/jet mill tests: Netzsch, Germany
- Additional ACH roaster tests: Drytech Pty Ltd, South Africa
- Impurity management SiC, Inconel 600 and Alumina: Curtin University, Perth
- Jet mill tests: Shenyang Research Institute Powder Co. (SARI), China
- Bead mill tests: Tsingtao Union Process Precision Machinery and Sanxing Feirong Machine Co. Ltd China
- Spray dryer tests: Wuxi Shenyi Machinery, China
- HPA pelletising tests: Changzhou Chongsheng Machinery, China
- Pellet calcination tests: Wuxi Zhengda Ceramics, China

All test work trials were successfully completed with results to the satisfaction of the technical consultant. The successful completion of the due diligence program was announced by the Company in August 2017 and the outcome from the various consultants' assessments (as per independent due diligence report dated 19 October 2017) was that **no fatal flaws** were identified in the Company and its HPA project.

## 1.6 Meckering Kaolin Deposit

Altech's Meckering kaolin deposit contains high-quality primary kaolin that is extremely low in impurities (sodium and iron) and is therefore an ideal feedstock for the Company's HPA processing plant.

Figure 1-3  
Location of Altech's Meckering kaolin deposit (Western Australia)



The deposit is located within the Shire of Cunderdin about 8km south of the town of Meckering, approximately 130km east of Perth in Western Australia. The deposit is easily accessible by road via the Great Eastern Highway; a well maintained all weather national highway linking Perth to eastern Australia.

Mining lease (ML) M70/1334 was granted over the Meckering deposit on 19 May 2016 by the Department of Mines and Petroleum (DMP) and is approximately 86 hectares in size; the Company's wholly owned subsidiary Altech Meckering Pty Ltd is the registered tenement holder and the Company holds a 100% interest. The tenement is situated on the eastern portion of Lot 1 Leeming Road, Meckering. The relatively flat lying, private, freehold, cleared farmland is predominantly used for the growing of wheat and sheep.

In October 2017 the Company exercised its option to purchase the freehold land (approximately 94 hectares) over the boundaries of its mining lease M70/1334, as per a pre-negotiated purchase agreement executed with the freehold landowner.

### 1.6.1 Ore Reserve

In October 2016 the Company announced a maiden Ore Reserve (JORC 2012) of 1.2Mt @ 30% Al<sub>2</sub>O<sub>3</sub> in the minus 300 micron fraction with a cut-off grade of 25% Al<sub>2</sub>O<sub>3</sub> for the Meckering deposit, sufficient ore for a 30-year mine-life at the production rate required to supply Altech's HPA plant. The Ore Reserve lies within the Mineral Resources estimation of 12.7Mt at 30% Al<sub>2</sub>O<sub>3</sub> in the same minus 300 micron kaolin fraction with a cut-off grade of 25% alumina; the Mineral Resources estimation would support a HPA processing operation for over 250 years.

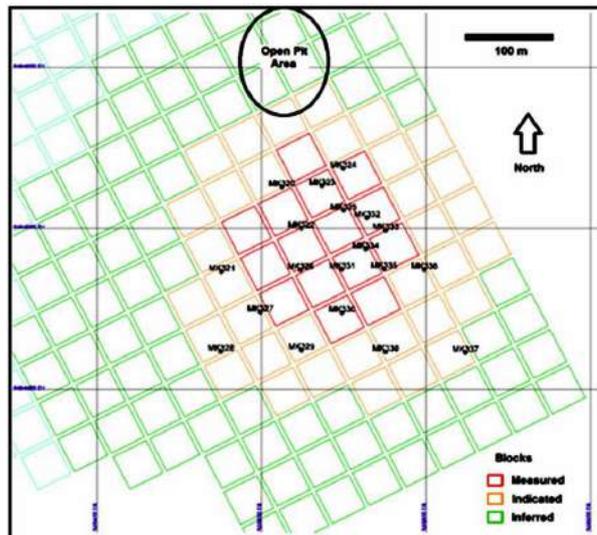
The lender's technical consultant has reviewed the Meckering resource and reserve estimate and reported no fatal flaws. As observed during the consultants site visit to Meckering, the kaolin deposit's zone of economic interest is visually identifiable, which will serve to assist grade control during mining.

The mineral reserve and resource are detailed below.

**Table 1-1**  
**Meckering Mineral Resource and Reserve estimates**

	Category	Quantity (Mt)	Yield % of minus 300µm	Minus 300µm Al <sub>2</sub> O <sub>3</sub> (%)
<b>Ore Reserve</b>	<b>Proved</b>	0.45	69	30.1
	<b>Probable</b>	0.77	71	30.0
	<b>TOTAL</b>	<b>1.22</b>	<b>70</b>	<b>30.0</b>
<b>Mineral Resources</b> (including Ore Reserve)	<b>Measured</b>	1.5		30.0
	<b>Indicated</b>	3.3		30.0
	<b>Inferred</b>	7.9		29.1
	<b>TOTAL</b>	<b>12.7</b>		<b>29.5</b>

Figure 1-4  
Meckering resource block model (Source. technical due diligence report)



## 1.6.2 Kaolin test work

In March 2017, at the request of the technical consultant, resource variability test work on eight (8) drill core samples from the Meckering deposit was completed. The results demonstrated that mineral resource displays small variations in the concentration of various elements, however the variability/concentration levels of Fe, K, and Na will not have a major influence in the production of HPA, as the concentration of these elements (in the mining range of 8m to 25m depth) is well within the tolerance limit of the designed HCl leaching and HPA purification process.

A geotechnical assessment of the deposit was also concluded and confirmed that site conditions are reasonably competent, enabling the adoption of conventional foundation arrangements for the proposed container loading facility development. Based on the mine plan at Meckering, the planned open pit development was determined to be well suited to the approach proposed by the geotechnical consultant Terra Firma. This was based on the proposed pit at Meckering being mined in stages and progressively backfilled as the mining operation progresses; the mine is to be excavated in ten (10) separate stages (campaigns), each lasting no more than two-three months; typically there will be about three years between each mining stage, during which time only the reclaim of ore from the ROM stockpile will take place.

## 1.7 Meckering operation

### 1.7.1 Mining schedule

The proposed mining schedule at Meckering is based on a kaolin ore delivery rate of ~43,500tpa to the Company's Malaysian HPA plant for a target production rate of 4,500tpa. At this rate of production, the Meckering deposit is capable of satisfying the HPA plant's kaolin requirements well beyond the current planned mine-life of 30 years.

Approximately 1.36Mt of ore will be mined over 30 years in 10 discrete mining campaigns or stages. The life of mine strip ratio is a very low 0.64:1. Life of mine waste tonnage is estimated at 0.867Mt for the mining of 1.36Mt of kaolin. A mining contractor will conduct mining campaigns at three-yearly intervals and the mine will be a simple quarry-style operation. Mining will take place during the summer to avoid wet conditions with a small mining fleet consisting of excavators, articulated dump trucks, a tracked dozer, water truck, elevating motor scrapers, road rollers and a front-end loader. During mining, contractor staff numbers will be in the region of seven people, comprising six operators and one shift supervisor (holding a Restricted Quarry Manager certification).

Mined ore will stockpiled on the Run of Mine (ROM) stockpile adjacent to the container loading facility, from which ore will be drawn for screening and loading into standard 20-foot sea containers, with approximately 36 containers loaded per week. Loaded sea containers will be initially transported ~150 km by road to the port of Fremantle, for on-shipment to Malaysia on a weekly basis.

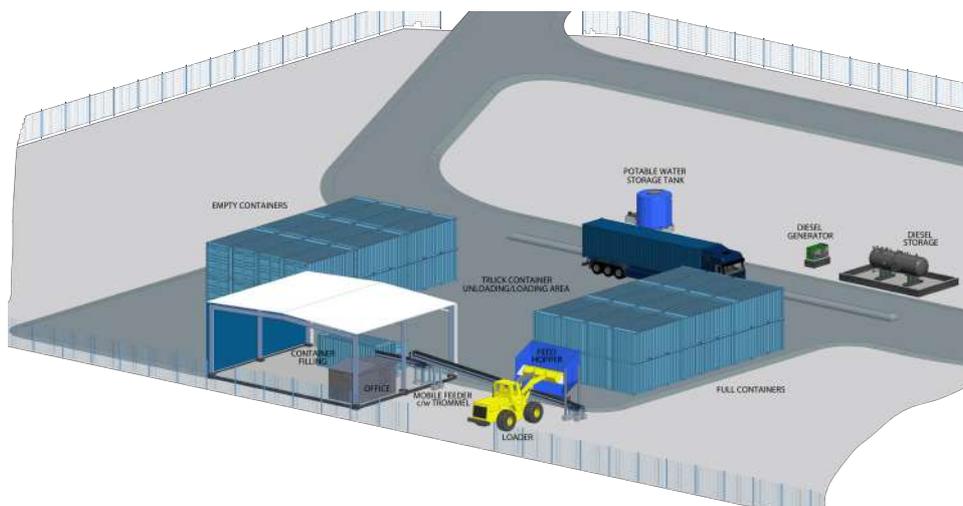
The first mining campaign of 140,500t of kaolin is planned for construction Year-2, with 147,800t of waste to be extracted; the campaign will last between two and three months. The proposed 30-year mining schedule and kaolin transport schedule allows for the HPA plant's production ramp in the initial 3 years, ore loading and transport will eventually increase to a steady rate of annual kaolin delivery of 43,500tpa.

Raw kaolin will be supplied by Altech Meckering Pty Ltd to Altech Chemicals Sdn Bhd (Altech's Malaysian subsidiary) under a kaolin supply agreement executed in March 2017.

### 1.7.2 Screening/Loading Facility

The container loading facility will be adjacent to the raw kaolin ROM stockpile which will be located to the south of the mining operation. The loading shed will also include office space, a crib room and toilet facilities. Raw kaolin will be reclaimed from the ROM stockpile by means of a front-end loader and transferred to a trommel screen to reject material over a 12mm trommel, undersize material will be conveyed by the same mobile unit to the loading shed to an extendible conveyor unit that can extend the full 20-ft length of a shipping container and retracts during loading to ensure even distribution of kaolin over the length of the container.

Figure 1-5  
Meckering screening/loading facility site layout



It is intended to operate the container loading facility a total of 3,120 h/y, based on 5 day-12 hour shift operation. The availability is given at 85%, which is typical for mineral processing facilities. As the nominal throughput of the equipment is well above the required average loading capacity, the availability assumptions are considered reasonable. In total 43,538 t/y of raw material have to be loaded to sea containers. Based on the given time frame and availability assumption, an average loading capacity of 16.4 t/h of raw material to the sea containers has to be realised.

Filled containers will be stacked in the loading yard by a heavy duty diesel forklift also used for truck loading, and unloading of empty containers. The container loading facility will be a two-man operation, planned to operate at 2,210 h/y, based on a 5 d/w at 12-hour per shift and 96% capacity utilisation. Approximately 36 containers, each with capacity of around 22t of kaolin will be loaded and transported per week. Filled containers will be sealed with a numbered seal that will be used for customs clearance in Australia and on arrival in Malaysia.

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## 1.8 Logistics/Freight

The Meckering kaolin deposit is located approximately 8km south of the wheat-belt town of Meckering, Western Australia. Access to the site is via the Great Eastern Highway; from which several route options via a combination of sealed and unsealed all weather roads provide direct access to the site.

Haulage of the 43,500tpa of kaolin will be undertaken by Altech's appointed freight partners, Seatram Pty Ltd. Each week approximately 37 standard 20-foot shipping containers will be transported by road the ~153kms to the port of Fremantle, Western Australia.

From Fremantle port, a weekly consignment of loaded sea containers will be transported by sea directly to the Malaysian container port of Tanjung Pelepas, and finally by road again (approx. 90kms) to the HPA plant site at the Tanjung Langsat Industrial Complex. Customs clearance in Malaysia will be arranged by Seatram's agent, Bersatu Integrated Logistics Sdn Bhd. Containers will be transported by road from Tanjung Pelepas to the HPA plant site at an average rate of approximately seven per day. An inventory of at least 20 filled containers will be maintained at the HPA plant. Storage capacity at the site will be up to 40 filled and 20 empty containers. Empty containers will be back-hauled to the port by the delivery trucks.

Both the Meckering and the Tanjung Langsat sites are serviced by well established transportation infrastructure. Road access to both sites is excellent. Both sites are also relatively close to international container ports and international airports.

## 1.9 EPC contracts

### 1.9.1 HPA plant

Capital costs for the Malaysian HPA plant are entirely covered by the scope of the SMS group GmbH (SMS) EPC contract. The EPC contract cost breakdown is well within typical limits in the opinion of the lender's advisers. Equipment costs are in the lower end of the range, which implies that direct and indirect costs are more pronounced, this is typical for a more sophisticated processing plant like the Company's proposed high purity HPA plant.

The SMS fixed-price lump-sum EPC contract includes a completion guarantee with liquidated damages provisions and throughput and process/quality guarantees supported by a substantial performance bond. All plant and equipment will be accompanied with warranty guarantees supported by a significant warranty bond.

Obtaining these extensive guarantees for a chemical processing plant is an exceptional outcome that significantly de-risks the project. The contract provides for:

- Liquidated damages for delay (after 10 weeks);
- Liquidated damage for failure to perform; and
- Performance bond and warrantee bonds.

The SMS EPC contracting parties are Altech Chemicals Sdn Bhd (the Owner), Altech Chemicals Ltd (the Guarantor) and a Consortium consisting of SMS group GmbH, Metix Sdn Bhd, and Metix Pty Ltd, South Africa, (the Consortium). SMS has extensive experience with German ECA cover and is amongst the top three users of this facility in Germany.

### 1.9.2 Meckering loading/screening facility

The EPC contract for the Meckering container loading facility is with Simulus Engineers Pty Ltd (Simulus). The EPC contract provides for performance warranties and tests of the process equipment with a detailed test procedure and



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measurement protocol during the test period fully describing the quality acceptance criteria. The parties to the EPC agreement are Altech Meckering Pty Ltd (Altech) (the Owner), Altech Chemicals Ltd (the Guarantor) and Simulus Engineers Pty Ltd (Simulus) (the Contractor).

## 1.10 HPA Processing Plant

### 1.10.1 Plant Location - Malaysia

The selected site for the HPA plant is within the Tanjung Langsat Industrial Complex, which is a 2,000ha industrial area located at the south eastern tip of the Malay Peninsula. It is adjacent to the industrial town of Pasir Gudang, (approximately 5km) and approximately 40km southeast of the Johor provincial capital, Johor Bahru. The complex was developed in 1993 and is managed by TPM Technopark Sdn Bhd, a wholly owned subsidiary of Johor Corporation, a state investment corporation established by the Malaysian state of Johor. The complex is supported by a dedicated port and both wet and dry bulk cargo jetties are available.

Johor is currently a preferred destination for business investment in Malaysia. With three ports; low cost and established power, gas, road, telecommunications and other business infrastructure and its proximity to Singapore, Johor is the ideal site for Altech's HPA plant.

The Company secured the HPA plant site (PLO 14) within the established Tanjung Langsat Industrial Complex during 2016, via the execution of a 30-year lease agreement with a 30-year renewal option with Johor Corporation. The ~4ha site is in a section of the industrial park specifically reserved for chemical facilities.

The Tanjung Langsat Industrial Complex caters to light, medium to heavy industries. The industrial hub contains multinational production groups from petrochemical, oil and gas, resource-based, ferrous and non-ferrous metal, biofuel, marine, palm oil and oleochemicals. The HPA plant site was specifically chosen for its proximity to hydrochloric acid and quicklime plants – all required consumables. In addition, reticulated natural gas, high voltage power and access to processing water are all readily available.

**Figure 1-6**  
**Altech Chemicals Sdn Bhd site office, Johor**



In November 2016 the Company opened a local site office for its Malaysian subsidiary Altech Chemicals Sdn Bhd in Johor. Located within the Tanjung Langsat Industrial Complex, the site office is within walking distance from the Company's HPA plant site. Manned by a full-time project co-ordinator, the site office was the temporary base for visiting EPC engineers working on the HPA project's detailed design throughout 2017. Various contractors involved in soil survey drilling (as part of the civil engineering design requirements) at the HPA plant site used the site office as a base.

Figure 1-7  
Tanjung Langsat Industrial Complex, Johor, Malaysia



### 1.10.2 HPA process description

Run of mine (ROM) kaolin ore will be loaded into standard sea containers and trucked from the Meckering site in Western Australia to Fremantle port, before being shipped to Tanjung Pelepas port, Johor, Malaysia. Upon arrival at Tanjung Pelepas the containers will be either stored at the port, or directly trucked to Altech's HPA plant site in the Tanjung Langsat Industrial Complex.

At the HPA plant loaded shipping containers will be discharged into a wet screening circuit consisting of a drum scrubber, a filter and various screens. This operation ensures kaolin particle size is reduced to  $<300\mu\text{m}$  and the majority of oversize silica/quartz will be removed. The resultant beneficiated kaolin will be calcined at around  $700^{\circ}\text{C}$  in an indirect rotary kiln to convert the crystal structure of the clay to a more reactive form (meta kaolin) for leaching. The kiln will be indirectly fired by natural gas with associated cyclone and bag-house to collect off-gas fines. The calcine will be cooled, screened and any oversized material crushed to a particle size of  $<300\mu\text{m}$ .

Leaching follows, during which the calcine will be mixed with recycled wash liquor containing hydrochloric acid (HCl) at  $\sim 30\%$  w/w. The leach reaction is exothermic and the oxide components (except silica) are converted to soluble chlorides, producing a high concentration of aluminium chloride ( $\text{AlCl}_3$ ) in solution. The leached slurry is then pumped to leach residue filtration. The silica residue slurry is filtered and the silica residue neutralised before being provided to local vendors, such as brick works or cement plants.

The pregnant liquor solution (PLS), from leach residue filtration is directed to crystallisation where aluminium chloride hexahydrate ( $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$  or ACH) is crystallised out of solution. This is achieved by increasing the hydrochloric acid concentration of the liquor (ACH is insoluble in concentrated HCl) by bubbling in anhydrous HCl gas. ACH crystals are then centrifuged and washed from the solution.

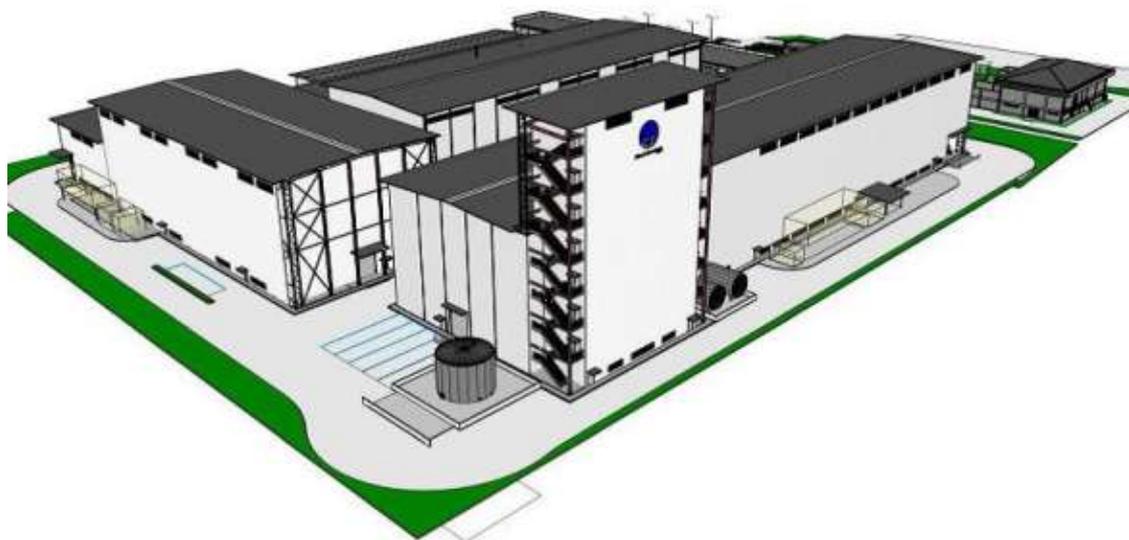
The resultant ACH solids will be transferred to a re-dissolution tank where the ACH crystals will be dissolved in demineralised water and then fed to the second crystallisation circuit. This dissolution process makes it possible to release residual impurities, which may have become trapped in the crystals during the first crystallisation. Like the first stage crystallisation, the ACH acid concentration in the liquor is increased by bubbling in HCl gas, and crystallised ACH is centrifuged and finally washed to remove any residual acid and/or impurities. The third stage of

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crystallisation is identical to the second, however the centrifuge has no washing stage and the ACH crystals are not redissolved.

The purified ACH crystals are heat treated in two stages via natural gas fired rotary kilns. The first stage involves heating the ACH to around 700°C in order to decompose the ACH to alumina, with trace amounts of basic aluminium chlorides (oxychlorides). Almost all of the chloride is liberated as HCl gas, recovered and reused in the process. The solids from the roaster fall directly into the second rotary kiln that then heats the solids further to remove the remainder of the HCl and water (H<sub>2</sub>O) to produce HPA: highly pure alpha alumina ( $\alpha$ -Al<sub>2</sub>O<sub>3</sub>). The HPA will discharge to a cooler and is then fed directly to a final wash stage to remove surface trace impurities. The flexible product finishing line is designed to initially grind all HPA to an average particle size of less than 1 micron by wet milling using bead mills. Upon the milled HPA achieving the designated particle size range it will be dried via a conventional spray drier. The finely ground, dried HPA will then be aggregated in beads for heat treatment in a tunnel kiln; the finished product being HPA beads for use in the synthetic sapphire industry. Alternatively, the finely ground HPA will be fed to a de-agglomeration unit (microniser) to produce fine HPA powder for use in the lithium-ion battery industry. Both products will be bagged via an automated bagging machine.

**Figure 1-8**  
**HPA Plant General Layout and 3D View**



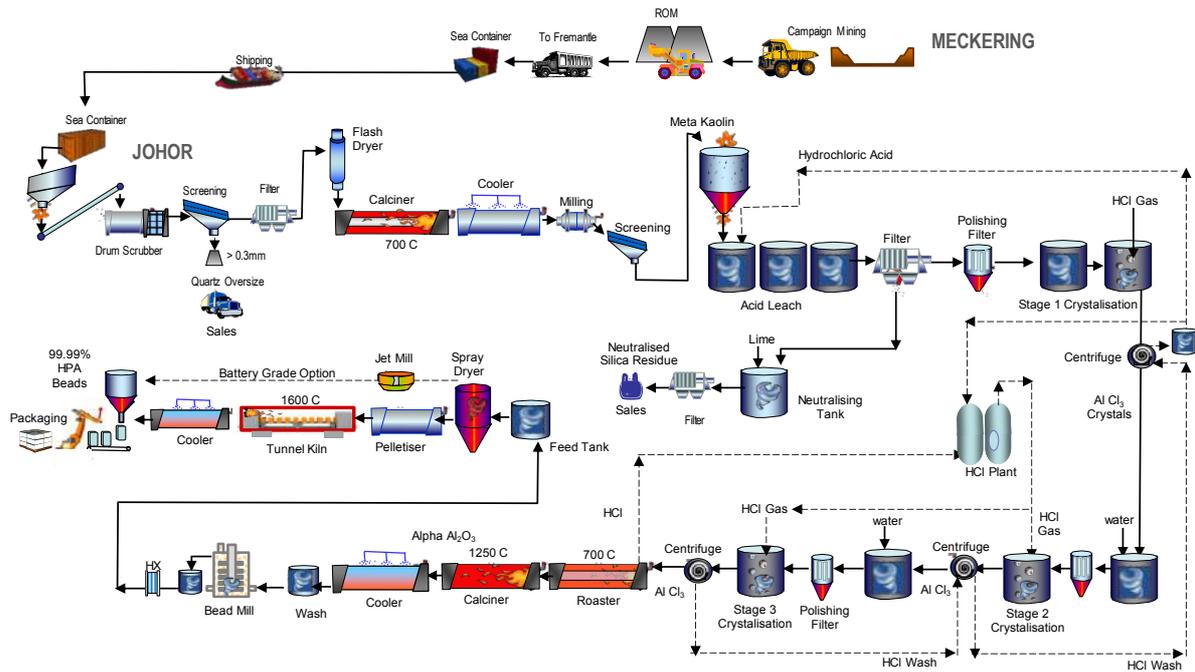
### 1.10.3 Detailed design

Superior lining materials have been incorporated in equipment used at the back-end of the HPA plant (after roasting) to minimise final product contamination risk. Whilst the materials command a higher price than the original design, their incorporation further de-risks the project by enhancing plant capability to achieve the required 99.99% finished product purity standard. Also, plant emissions targets are now significantly more conservative compared to local requirements due to international requirements (Equator Principles and OECD Common Approaches).

Working in conjunction with its appointed German engineering, procurement and construction (EPC) contractor SMS group GmbH (SMS), Altech completed optimisation of the HPA plant process flow sheet (see below). The majority of the changes compared to earlier flow sheets have impacted the HPA finishing section of the plant. This section now incorporates a flexible finished product line capable of producing HPA for both the synthetic sapphire industry (up to 4,500tpa of high density pellets) and HPA for the lithium-ion battery industry (up to 1,500tpa of powder at sub-micron particle size). Maximum plant output is designed at 4,500tpa HPA, with flexibility to balance the finished product mix.

The flexible product finishing line is designed to initially grind all HPA to an average particle size of less than 1 micron by wet milling using bead mills. Upon the milled HPA achieving the designated particle size range it will be dried via a conventional spray drier. The finely ground, dried HPA will then be aggregated in beads for heat treatment in a tunnel kiln; the finished product being HPA beads for use in the synthetic sapphire industry. Alternatively, the finely ground HPA will be fed to a de-agglomeration unit (microniser) to produce fine HPA powder for use in the lithium-ion battery industry. Both products will be bagged via an automated bagging machine. See final flow diagram below:

Figure 1-9  
Final flow diagram



### 1.10.3.1 Sapphire Grade HPA

Altech's sapphire grade HPA product will be 4N (99.99%) high purity alumina ( $Al_2O_3$ ) in the form of a high-density HPA bead of around 3-4mm in size. The higher bulk density of HPA beads (versus HPA in powder form) is preferred by synthetic sapphire manufacturers as it maximises the amount of alumina that can be placed into the furnaces and kilns used in the production of synthetic sapphire. The target loose bulk density of Altech's high-density HPA beads will be around  $2.2t/m^3$ .

Sapphire Grade Spec	Chemical Content	Spec Limit
Alumina	$Al_2O_3$	>99.99%
Silica	Si	<20ppm
Sodium	Na	<10ppm
Magnesium	Mg	<10ppm
Calcium	Ca	<10ppm
Iron	Fe	<10ppm
Copper	Cu	<10ppm
Crystal Structure		alpha
Bulk Density*	t/m <sup>3</sup>	2.2

\*Dry Basis (1110°C)



Synthetic sapphire is used in the manufacture of substrates for LED lights; semiconductor wafers used in the electronics industries; and scratch-resistant glass used for wristwatch faces, optical windows and components for smartphones and other handheld devices.

### 1.10.3.2 Lithium-ion Battery Grade HPA

Over the last twelve months Altech has been developing a HPA product to meet the requirements of the lithium-ion battery industry. The finishing line of Altech's proposed HPA plant is designed to produce the ultra-fine HPA used in the lithium-ion battery sector; this product may also be sold in slurry form (drums).

Lithium-ion Battery Grade	Chemical Content	Spec Limit
Alumina	Al <sub>2</sub> O <sub>3</sub>	>99.99%
Silica	Si	<20ppm
Sodium	Na	<10ppm
Magnesium	Mg	<10ppm
Calcium	Ca	<10ppm
Iron	Fe	<10ppm
Copper	Cu	<10ppm
Crystal Structure		alpha
Particle Size	micron	<1.0



Consumption of HPA in non-tradition applications such as the lithium-ion battery sector is forecast to experience significant growth. Electric vehicle manufacturers are increasingly demanding lithium-ion batteries with cathode and anode electrode separator sheets coated with 99.99% (4N) HPA for fire resistance. The particle size of HPA used as the coating for this application is ultra-fine, less than 1 micron. Lithium-ion batteries using separator sheets coated with HPA consume between 40-120g of HPA per kilowatt-hour (kWh). With a forecast rapid expansion of the lithium-ion battery market driven by the demand from electric vehicles and green energy power storage (solar and wind), HPA consumption in the lithium-ion battery sector alone is forecast by Altech to rise from around 1,000tpa in 2016 to 15,000tpa by 2025.

## 1.11 Environmental and Project Approvals

Having completed visits to both the kaolin extraction (Meckering) and processing (Malaysia) sites, the technical consultant did not identify any environmental or social fatal flaws with the proposed HPA project. The consultant considers that the overall risk associated with environmental, social and health and safety considerations at the Meckering site to be low; at the proposed HPA plant Tanjung Langsat site the risks are also considered low. It is the technical adviser's opinion that all of the risks and issues should be amenable to effective management with the implementation of good international industry practice.

### 1.11.1 Meckering approvals

All Western Australian state government statutory approvals required for the commencement of the Meckering kaolin mining operation were successfully obtained during 2017. This means that construction and mining operations at the Company's mining lease M70/1334 are authorised to commence.

In December 2016 the Company submitted a mining proposal and mine closure plan, which was subsequently approved by the WA Department of Mines, Industry Regulation and Safety (DMIRS) (formerly the Department of Mines and Petroleum/DMP) in March 2017. From receipt of approval in March 2017 the Company's mining activities were able to commence. The Company also submitted a works approval application for the kaolin

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screening and loading facility. The Company's works approval application for the loading and screening facility was granted by the WA Department of Water and Environmental Regulation (DWER) (formerly Department of Environmental Regulation/DER) in August 2017. The works approval permits the construction and works for the kaolin screening and loading facility infrastructure. The screening and loading facility will be located adjacent to the ROM stockpile at the Company's Meckering kaolin deposit.

In addition to the above approvals the Native Title and Aboriginal heritage aspects of the proposed Meckering kaolin mine were also considered. Having executed a Noongar Standard Heritage Agreement (NSHA) with the South West Aboriginal Land and Sea Council (SWALSC) on behalf of the Ballardong People Agreement Group, a resultant heritage survey was undertaken, with an "Ethnographic Aboriginal Heritage Survey" report confirming that no sites of ethnographic significance as defined by Section 5 of the Western Australian Aboriginal Heritage Act 1972 (AHA) were identified within the M70/1334 tenement area. As the land on which M70/1334 is located does not constitute an Aboriginal site under Section 5(b) or 5(c) of the AHA, Altech is not required to request approval by the Minister for Aboriginal Affairs under Section 18 of the AHA to undertake works. As such Altech can proceed with plans without risk of a Section 17 breach of the AHA occurring in relation to the development of M70/1334.

### **1.11.2 Johor approvals**

The Company has received approval from the Department of Environment, Johor (DOE) of its Preliminary Site Assessment (colloquially referred to as a "PAT") for the HPA plant at a production rate of 4,500tpa. In general, the approval of the PAT confirms that the proposed location of the HPA plant at Tanjung Langsat and its proposed activity are compatible with gazetted structure and local plans, surrounding land use, provision of set-backs or buffer zones and waste disposal requirements.

The DOE, in its response to the Company's PAT, also advised that an Environment Impact Assessment (EIA) will not be required for the HPA plant, as the processing capacity of the plant will be less than 100 tonnes per day. This is a positive outcome for the Project and simplifies the permitting and environmental approval process. The next stage in the environmental approvals process is the approval and registration of air pollution control system, chimneys and fuel burning equipment, each required under various Malaysian environmental quality regulations. The Malaysian environmental approval process is relatively straightforward and the Company will continue to work with its local environment consultant (Daya Eco Techno Sdn Bhd) to satisfy these requirements.

Altech's proposed HPA plant has been designed to meet international environmental standards as well as the standards of the Malaysian Environmental Quality Act (EQA) 1974. Specifically, Altech has designed its plant to ensure that all off-gasses that vent to exhaust stacks meet Malaysian environmental emission limits and that any discharges vented to the atmosphere pass through appropriate dust removal systems such as bag-houses or electrostatic separators. In addition, any potential HCl vapour streams will be cleaned via caustic scrubbers before venting to atmosphere. Solid residue from the plant will predominantly be in the form of neutralised benign silica residue that will be made available to local brickworks or cement plants. Any acidic residue from the plant will be neutralised and treated on-site and disposed of via local waste vendors. All process water from the plant

### **1.12 HPA Sales and Off-take**

Altech executed a 10-year off-take sales arrangement (Agreement) with Mitsubishi Corporation's Australian subsidiary, Mitsubishi Australia Ltd (Mitsubishi).

The Agreement appoints Mitsubishi as the exclusive buyer of the HPA plant's production capacity and will commence on the date of first shipment of final HPA product. Under the Agreement both parties have set specific off-take sales target quantities, with pricing set quarterly at prevailing market price.

### 1.13 Financial Evaluation

The financial metrics from the FIDS are extremely robust. Project Net Present Value (NPV) is US\$ 505 million at a discount rate of 7.5%, payback (at full rate) is 3.9 years and annual EBITDA is US\$ 76 million at full production. The internal rate of return (IRR) is 22% with a gross margin on sales of 63%. A summary of the key financial metrics and key assumptions of the FIDS is set in the tables below.

**Table 1-2**  
Summary of key financial outputs from the Project Financial Model

	US Dollars	
HPA Production	4,500	tonnes
Exchange Rate	0.75	USD/A\$
Capex Exchange Rate	0.75	USD/A\$
Project Capex	\$297.6	million
Corporate Costs	\$7.7	million
Opex p.a.	\$44.6	million
NPV	\$505.6	million
Discount Rate	7.5%	
Payback (incl construction)	4.5	years
Payback (at full rate)	3.9	years
IRR (full rate)	21.8%	
Revenue p.a.	\$120.3	million
Costs p.a.	\$44.6	million
EBITDA p.a.	\$75.7	million
HPA Selling Price	\$26.90	per kg
Cost of production	\$9.90	per kg
Margin %	63%	
Margin \$/kg	\$17.15	per kg

A summary of the key assumptions of the FIDS is set out in the table below. KfW IPEX-Bank's technical consultants have reviewed projects capital and operating costs assumed in the FIDS and have confirmed the figures to be economical.

**Table 1-3**  
FIDS Key Assumptions

4,500tpa HPA Project	Assumption
Project Life	30 years
Annual HPA production	4,500tpa
HPA sale price (avg.)	US\$26.9/kg
HPA production cost	US\$ 9.90/kg
Gross Margin %	63%
Construction period	24 months
Production ramp-up	3 years
Corporate Costs	US\$7.7 million
Total Project debt target	US\$185 million
ECA covered debt target	US\$165 million

### 1.13.1 Capital and Operating Costs

The FIDS incorporates up-to-date project assumptions including the final capital cost estimate. The estimate includes; a fixed-price lump-sum engineering, procurement and construction (EPC) contract value for the construction of the Malaysian HPA plant by German engineering firm SMS group GmbH (SMS); a fixed-price lump-sum EPC contract value for construction of the Meckering kaolin container loading facility by Perth based Simulus Engineering Pty Ltd. In addition the capital cost estimate includes owner costs during HPA plant commissioning and the initial kaolin mining campaign. HPA plant capacity is now 4,500tpa (was 4,000tpa) and assumptions for operating costs, HPA selling price, HPA plant production ramp-up, exchange rates, total envisaged debt, and the expected German government export credit finance amount have all been updated in the FIDS to reflect current conditions and outlooks.

The Lender's technical consultant has reviewed the capital costs of both operations. The scope of the Meckering facility is minor compared to the HPA plant and the associated capital costs are a relatively small fraction of the total Project costs. Lender's technical consultant concluded that the estimated costs for the Meckering site are reasonable. For the HPA plant in Malaysia, significant engineering and test work has been conducted in order to reduce the risk of product contaminations (for example, roasting tests, special linings in the ACH roaster and HPA calciner). All major capital costs expected for Johor Bahru HPA plant in Malaysia are now covered by the SMS EPC contract.

The final fixed-price lump-sum EPC contract that includes completion, throughput and process/quality guarantees is an exceptional outcome.

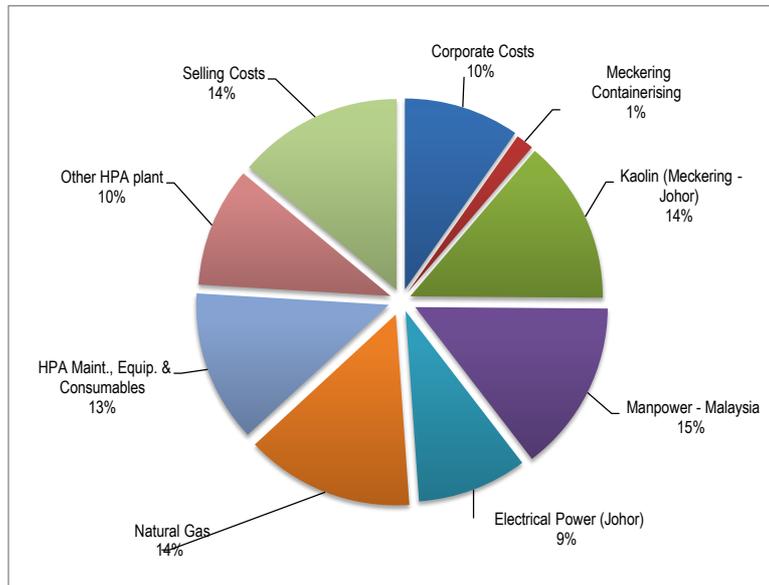
Table 1-4  
Capital cost summary

Area	US\$m
Meckering EPC (incl contingency & land)	5.3
HPA plant land	4.1
HPA Johor EPC fixed price	280.0
Owner cost and Insurances etc	8.2
<b>TOTAL CAPITAL COSTS</b>	<b>297.6</b>

Table 1-5  
Operating cost summary (per kg HPA)

Activity	US\$
Meckering Mining	\$0.06
Meckering Kaolin Loading	\$0.08
Transport (Meckering to Malaysia)	\$1.41
WA State Royalty	\$0.05
HPA Manufacturing (Johor)	\$5.45
HPA Selling Costs & Misc.	\$1.35
Corporate (Aust)	\$0.96
Corporate (Malaysia)	\$0.54
<b>TOTAL per kg</b>	<b>\$9.90</b>

**Figure 1-10**  
**Operating costs breakdown**



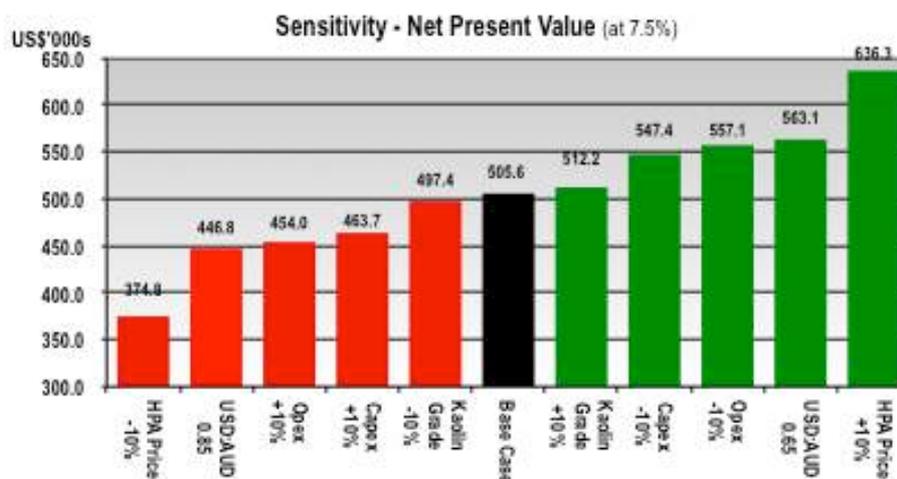
### 1.13.2 Owner's costs

Owner costs have been included in the financial model as pre-production operating costs. HP production commences in 2020. Operating costs are broken down per area and are based on detailed labour lists, labour rates, consumable lists, G&A expenses, power, gas, HCL and other consumables consumption and kaolin shipping details. Ramp-up factors have then been applied for the first 2 years of production and the commissioning period for the items although certain costs such as mining and recruitment were included as single costs.

### 1.13.3 NPV sensitivity

The sensitivity of the FIDS model was tested with various changes to the assumptions of the model including a +/- 10% variation of capex; +/- 10% variation of price; +/- 10% variation of Opex costs; +/- 10% variation of kaolin feed grade; and USD:AUD exchange rate (0.85 and 0.65). As can be seen in the figure below the NPV is most sensitive to price variation. Considering that the capital cost is supported by a fixed price turn key contract, the risk of capital costs changes has been largely mitigated. The very conservative price assumption in the FIDS model has been used to mitigate price variation risks. The next most sensitive area is the USD:AUD exchange rate and since revenue, capex and loan are all in USD, the risks have been minimised.

Figure 1-11  
Sensitivity Analysis



#### 1.13.4 Discount rate

The Company's weighted cost of capital (WACC) has been calculated taking into account the planned debt and assumed interest, debt mix, and total project costs; it is reflected as the discount rate of 7.5% used in the 30-year discounted cash flow model for the FIDS. The beta used in the calculation is 0.83.

#### 1.13.5 Operating Costs and Sustaining Capital

Project operating costs include updated firm quotations from key services and consumables suppliers, where applicable. This includes quotations for; contract mining at Meckering; land transport and shipping of containerised kaolin from Meckering to Johor; HPA pant consumables such as electricity, natural gas, hydrogen chloride, limestone, and other materials. A detailed manning schedule has been fully costed using local Malaysian and expatriate labour rates. Sustaining capital of ~2.5% per annum of initial plant and equipment cost has been allowed over the life of the project. At the full rate of production this is amount to approximately US\$6.3 million per annum.

Assumed operating costs and the annual sustainable capital allowance have been audited by the lender's technical adviser.

The technical adviser considered the mining unit costs to be reasonable given the low tonnage to be mined in each campaign and the need to mobilise and demobilise equipment for each campaign. Operating costs, reasonableness and likelihood of achieving forecast main consumable and reagent consumption for the HPA operation in Malaysia were reviewed based on the mass balance developed by Altech and stated price assumptions.

#### 1.13.6 Capital Costs Variation

In compiling the final EPC price, SMS costed a majority of the previously "factored" construction costs by requesting firm quotations from vendors and service providers. Previously "factored" costs include freight, mobilisation and demobilisation, temporary facilities, final engineering, insulation and commissioning. Quotations are overall substantially higher than was factored. The final capital costs include land purchases at Johor and Meckering, owner costs during commissioning and first mining campaign, first fills, insurance and other establishment costs.

Since Altech announced the updated BFS in March 2016, there has been a substantial depreciation of the USD against the Euro (0.98 to 0.83), which has been reflected in the FIDS. The change in exchange rate has resulted in

a substantial increase in the USD value of the majority of the equipment and installation services for the HPA plant, which are denominated in Euro.

**Table 1-6**  
**FIDS – BFS Indicative Variation Capital Cost Analysis**

Capital Cost Item (Estimates)	Indicative Variations from BFS (USD M)	Comments
Foreign Exchange Fluctuation	12.0	Euro USD FX +15% change from BFS
Sapphire Bead Finishing Plant	30.0	Customer requirements for sapphire production
Impurity Linings All Areas	20.0	Funding requirements
4,500tpa Throughput Increase	30.0	Extra output
Freight Costs	10.0	Previous estimation used factor
Site Est/Mobilisation	9.0	Previous estimation used factor
EPC Commissioning	6.0	Previous Owner to commission
Steel & Buildings	20.0	Design upgrade, increased building height etc
Environmental & Laboratory	5.0	Extra environmental requirements
Contingency	15.0	Previous estimate only 5% - now 15%
Overall EPC Costs, Design, Guarantees, Margins	33.0	Previous was an EPCM costs
Plant and Equipment Escalations	29.0	Increased German component & escalations
<b>Total</b>	<b>219.0</b>	

#### 1.14 Production ramp-up

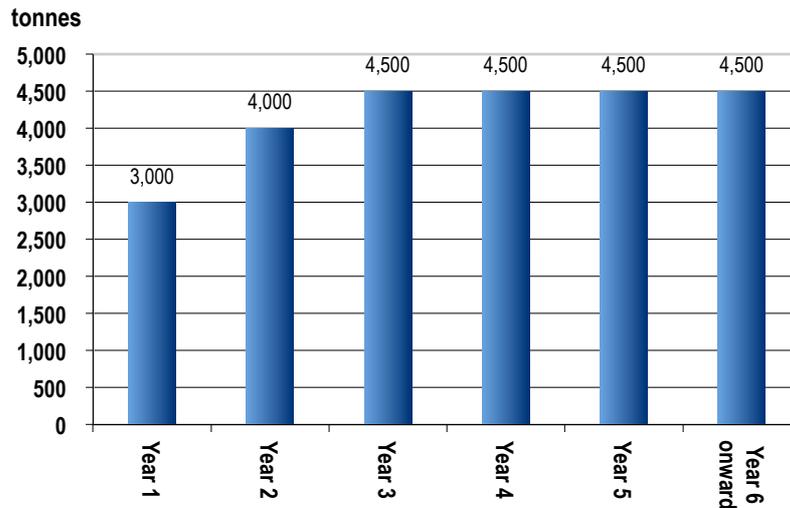
Altech revised the four-year ramp-up schedule and reduced it to three (3) years until full capacity and steady state production are attained. In addition, the maximum capacity of the plant is increased by 12.5% from 4,000tpa to 4,500tpa HPA production. To meet the ramp-up schedule all equipment is appropriately sized and unit processes tested to qualify. In general the planned buffer volumes in the plant and their capacities were considered reasonable by the lenders' advisers.

The plant commissioning phase is intended to span the months 25 to 30. The commissioning phase shall realise a significant increase in the plant support requirements. It is planned that 50% of the operating plant personnel including engineering, maintenance, processing and laboratory teams shall be in place from months 24 to 27, and 100% of the positions filled for months 28 to 30. This ramp-up in site personnel enables Altech to support the EPC contractor in operation and maintenance of the plant equipment during the commissioning phase, as well as provide sufficient time for on-site operator training.

Months 31 and 32 of the project schedule represent the ramp up phase after facility handover, followed by a 6-month production phase to end of Month 38 during which performance testing and final acceptance shall be completed. Plant operations shall be managed by the fully manned Altech team during this phase.

The technical consultant considers the production ramp-up included in the FIDS to be reasonable and appropriate.

Figure 1-12  
HPA Plant Assumed Production Ramp Up



## 1.15 Project Finance

### 1.15.1 Background

German government-owned KfW IPEX-Bank was mandated to provide certain arranging & advisory services to Altech including the application for cover by Euler Hermes Aktiengesellschaft (Euler Hermes) under the German export credit scheme in respect to the HPA project. In July 2016, the Company was officially advised of the positive pre-assessment by the German government inter-ministerial committee (IMC) of its export credit project finance application for cursory review.

After receiving the IMC's positive pre-assessment, the commencement of a formal due diligence program was initiated immediately thereafter. With instructions from the Company's mandated German financier KfW IPEX-Bank GmbH, a number of experienced consultants were appointed to complete the various areas of assessment including the technical, market and legal aspects of the Company and the HPA project. The due diligence was conducted on behalf of Germany's government-owned KfW IPEX-Bank supported by German export credit agency Euler Hermes.

Based on the extensive independent project due diligence the Company's HPA project has been significantly de-risked and the program has, at the very least, prepared the project for near-term commercial development. In September 2017 it was agreed by all parties (KfW IPEX-Bank, SMS and Altech) that based on the successful outcome of due diligence the Company's HPA project is ready to proceed to the ECA cover final assessment for debt financing approval.

### 1.15.2 Project Finance

German government-owned KfW IPEX-Bank is aiming to obtain debt approval as sole debt provider for the Project and has proposed a revised total target debt package of US\$185 million. This is subject to the sourcing split and eligibility for German government export credit cover (ECA cover) of up to US\$165 million, available at long tenure and at low interest rate. The balance of US\$20 million will be at customary lending terms. A target date of 14 December 2017 is set for the final decision by German government inter-ministerial committee (IMC) for the ECA cover. At the same time KfW IPEX-Bank is targeting to gain for credit approval by the competent bodies of the bank. A positive decision from the IMC will result in a legally binding offer of cover to Altech by the Federal Republic of Germany for up to US\$165 million. An offer of cover coupled with a separate bank commitment letter

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based on a pre-negotiated debt term sheet package provided by KfW IPEX-Bank will position Altech to proceed to secure project equity.

The proposed debt structure, underpinned by an ECA cover loan of long tenure and low interest rate, is by comparison to typical project finance, extremely attractive.

### **1.16 Project Schedule**

The Lender's technical adviser has reviewed the project development schedule and consider the proposed schedule to be reasonable, assuming that the long lead equipment items will be specified and procured as soon as possible following the provision of financing.

A period of 18 months is scheduled for construction of the Meckering screening/container loading plant, including six months for equipment procurement and delivery. A period of 24 months is envisaged for construction of the HPA plant in Malaysia with five months for commissioning. The schedule includes a total of 20 months for equipment procurement, manufacture and delivery. An elapsed time of approximately 30 months has been allowed for activities such as installation of underground utilities, site infrastructure and landscaping at the plant site.

Full production of 4,500tpa HPA at a grade of 99.99% Al<sub>2</sub>O<sub>3</sub> (4N) is expected to be achieved in Year 3 of operations.

The commencement date of the Malaysian HPA project signifies the beginning of Month 1 of the overall project schedule. The major project phases shall be completed during the project months as follows;

- Engineering Phase – Project Months 1 to 14
- Procurement Phase – Project Months 5 to 25
- Construction Phase – Project Months 7 to 31

The plant construction phase at the Tantung Langsat site shall span months 7 to 31, including site preparation activities, civil and structural works beginning in Month 12 and equipment erection in Month 14. Major site activities and works progress shall be overseen by the Altech project support team and supported Altech's local project co-ordinator (full-time). In addition to the project support team already in place, Altech has also accounted for the hiring of the HPA site director after Month 12 to assist with engineering support and site supervision activities.

- Commissioning & Start-up Phase – Project Months 25 to 39

The plant commissioning phase is intended to span the months 25 to 30 after a number of milestones are achieved for plant readiness. The commissioning phase shall realise a significant increase in the plant support requirements.

Months 31 and 32 of the project schedule represent the ramp up phase after facility handover, followed by a 6-month production phase to end of Month 38 during which performance testing and final acceptance shall be completed. Plant operations shall be managed by the fully-manned Altech team during this phase.

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### 1.17 Project Risk

An Integrated Risk Assessment has been undertaken on the Project that included qualitative and quantitative analysis of the risks and uncertainties associated with the Projects' development and culminated in the development of a comprehensive risk register, which included mitigation actions. The identification and management of risk is an ongoing process and as such will form part of the approach that the Company will adopt as it advances the Project to final design and construction.

The lender's technical consultant conducted an independent risk assessment of the Project, the results of which were presented in their Interim Report of October, 2016. Work undertaken by Altech over the past year has had the objective of reducing the identified risks. For the present report, the lenders' technical consultants have updated their risk assessment based on a ranking of key project risk items. Ranging from 1 to 5, where a ranking of 1 represents a catastrophic issue or concern, or probable project fatal flaw; and 5 represents negligible issue or concern with a negative but not material effect on Project economics, environment, or health and safety.

The technical consultants consider that overall the Altech HPA project presently carries low risk.

### 1.18 Conclusion and Recommendations

The FIDS is a comprehensive and detailed study of the technical and commercial viability for the construction and operation of a 4,500tpa HPA processing plant at Tanjung Langsat, Johor, Malaysia, and the associated development of a campaign mining and container loading operation at the Company's 100% owned kaolin deposit at Meckering, Western Australia to provide feedstock for the HPA plant.

The FIDS has identified the preferred chemical processing method and associated design for the HPA plant, the preferred mining method for the Meckering kaolin deposit and other infrastructure requirements and capacities for the Project. Detailed capital cost and operating cost estimates have been obtained from prospective suppliers, contractors, or expert consultants, enabling detailed financial modelling of the proposed development.

Overall, Altech anticipates that its proposed HPA plant will be in the bottom quartile of the production cost curve for the world's HPA producers.

The FIDS has established that Altech's HPA Project is a financially robust and attractive business case. The Project is a high margin, high value proposition. Considering the technical and commercial analysis presented in the FIDS, the Company will now proceed to the funding phase of the Project, and concurrently the Company intends to proceed to detailed design, permitting and approvals, and subject to funding, ordering long lead items, commence site clearance and proceed to construction.



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*Wir sprechen Deutsch.*

**About Altech Chemicals (ASX:ATC) (FRA:A3Y)**

**Altech Chemicals Limited** (Altech/the Company) is aiming to become one of the **world's leading suppliers of 99.99% (4N) high purity alumina (HPA)** (Al<sub>2</sub>O<sub>3</sub>).

HPA is a high-value, high margin and highly demanded product as it is the critical ingredient required for the production of synthetic sapphire. Synthetic sapphire is used in the manufacture of substrates for LED lights, semiconductor wafers used in the electronics industry, and scratch-resistant sapphire glass used for wristwatch faces, optical windows and smartphone components. There is no substitute for HPA in the manufacture of synthetic sapphire.



Global HPA demand is approximately 25,315tpa (2016) and demand is growing at a compound annual growth rate (CAGR) of 16.7% (2016-2024), primarily driven by the growth in worldwide adoption of LEDs. As an energy efficient, longer lasting and lower operating cost form of lighting, LED lighting is replacing the traditional incandescent bulbs.

Current HPA producers use expensive and highly processed feedstock materials such as aluminium metal to produce HPA. Altech has completed a Final Investment Decision Study (FIDS) for the construction and operation of a 4,500tpa HPA plant at the Tanjung Langsat Industrial Complex, Johor, Malaysia. The plant will produce HPA directly from kaolin clay, which will be sourced from the Company's 100%-owned kaolin deposit at Meckering, Western Australia. Altech's production process will employ conventional "off-the-shelf" plant and equipment to extract HPA using a hydrochloric (HCl) acid-based process. Production costs are anticipated to be considerably lower than established HPA producers.

The Company is currently in the process of securing project financing with the aim of commencing project development in 2018.

**Competent Persons Statements – Meckering Kaolin Deposit**

The information in this announcement that relates to Mineral Resources and Ore Reserves is extracted from the report entitled "Maiden Ore Reserve at Altech's Meckering Kaolin Deposit" released on 11 October 2016; the report is available to view of the Company's website [www.altechchemicals.com](http://www.altechchemicals.com). The Company confirms that the new information or data used in its Financial Investment Decision Study (FIDS) does not materially affect the information included in the original market announcement and, in the case of estimates of Mineral Resources and Ore Reserves, that all material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and that any changes not impacted the estimates. The Company confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from the original market announcement.

**Forward-looking Statements**

There is no certainty that German government project finance export credit cover (ECA) and/or project debt finance will be approved. The Company makes no representations or warranties whatsoever as to the outcome of the ECA application process. In addition, the Company to date has not been provided a final executable EPC price from its appointed proposed EPC contractor, which is still finalising the detailed design of the proposed Malaysian high purity alumina (HPA) plant.

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.