20 April 2022

ALTECH – OUTSTANDING PRELIMINARY FEASIBILITY STUDY FOR SILUMINA ANODES™ BATTERY MATERIALS PROJECT

Highlights

- Highly positive preliminary feasibility study for 10,000tpa Silumina Anodes™ project
- Low capital cost (US$95 million) with outstanding economics
- Pre-tax Net Present Value (NPV_8) of US$507 million
- Attractive Internal Rate of Return (IRR) of 40%
- Site in Saxony, Germany already purchased
- Green accredited project using renewable energy
- European high quality graphite and silicon supply
- Pilot plant engineering for product qualification underway
- NDA executed with two German automakers and one European battery maker

Altech Chemicals Limited (Altech/the Company) (ASX: ATC) (FRA: A3Y) is pleased to announce the outstanding results from a Preliminary Feasibility Study (PFS) for the development of a 10,000tpa silicon/graphite alumina coating plant, in Saxony, Germany. The plant would be constructed by Altech Industries Germany GmbH (AIG), (ownership: 75% Altech, 25% Frankfurt stock exchange listed Altech Advanced Materials AG (AAM)), and would produce high capacity silicon/graphite battery anode materials "Silumina Anodes™" under exclusive license from Altech. Silumina Anodes™ products are targeted to supply the burgeoning European electric vehicle market.

With a capital investment of US$95 million, the Company estimates a project net present value of US$507 million ($NPV_8$), with net cash of US$63 million per annum generated from operations. The internal rate of return is estimated at 40%, with investment capital paid back in approximately 3.1 years. Total annual revenue at the 10,000tpa full rate of production is estimated US$185 million per annum.

Managing Director, Mr Iggy Tan, stated *"Whilst Altech's top priority continues to be financing its Johor HPA project, the Silumina Anodes™ project represents an exciting downstream opportunity to utilise its HPA coating technology in silicon/graphite battery materials. We are pleased and excited about the results of the 10,000tpa Silumina Anodes™ PFS. Due to the attractive economics of the study, a decision has been made by the AIG board to immediately progress to a definitive feasibility study (DFS) for the project. AIG has already purchased land in Germany suitable for the project, and the plan is* *for the AIG team in Saxony to immediately commence DFS work. We believe that the production of Silumina Anodes™ materials could be a game changing technology for the lithium-ion battery industry*".

Tesla, a global leader in the electric vehicle and lithium-ion battery industry, has declared that the required step change to increase lithium-ion battery energy density and reduce costs is to introduce silicon in battery anodes, as silicon has ~ten times the energy retention capacity compared to graphite. Silicon metal has been identified as the most promising anode material for the next generation of lithium-ion batteries. However, until now, silicon was unable to be used in commercial lithium-ion batteries due to two critical drawbacks. Firstly, silicon particles expand by up to 300% in volume during battery charge, causing particle swelling, fracturing and ultimately battery failure. The second challenge is that silicon deactivates a high percentage of the lithium ions in a battery. Lithium ions are rendered inactive by the silicon, immediately reducing battery performance and life. Industry has been in a race to crack the silicon barrier.

Through in-house research and development, Altech announced late last year that it has cracked the "silicon code" and successfully achieved 30% higher energy retention in a lithium-ion battery, with improved cyclability and battery life. Higher density batteries result in smaller, lighter batteries and substantially less greenhouse gases, and are destined for the EV market. To achieve its breakthrough, Altech successfully combined silicon particles that had been treated with its innovative and patented alumina coating technology, with alumina coated battery grade graphite, producing the Silumina Anodes™ product. So far, the major drawbacks outlined above for using silicon in lithium-ion battery anodes, have been substantially overcome with Altech's Silumina Anodes™ product.

The European graphite and silicon feedstock supply partners for AIG's plant in Saxony will be SGL Carbon GmbH (SGL) and Ferroglobe Innovation S.L. (Ferroglobe), respectively. The project has already received green accreditation from the independent Norwegian Centre of International Climate and Environmental Research (CICERO). To support the development, AIG has commenced construction of a pilot plant in Germany, at a location adjacent to the proposed site of 10,000tpa plant. Product from the pilot plant will be provided to potential buyers, such as automakers, to fast-track the Silumina Anodes™ product qualification process. AIG already has non-disclosure agreements (NDAs) in place with two German automakers, as well as with a European based lithium-ion battery manufacturing company.

PRELIMINARY FEASIBILITY STUDY (PFS)

A Preliminary Feasibility Study (PFS) has been completed for the development by Altech Industries Germany GmbH (AIG), in Saxony, Germany, of a plant to produced 10,000tpa of alumina coated silicon/graphite battery material (Silumina Anodes™), under exclusive European Union licence from Altech (the Project).

The PFS incorporates up-to-date project assumptions including the final capital cost estimate from European venders at a plus or minus 30% accuracy level. The costs include an estimate of engineering, procurement and construction (EPC) contract value for the construction of the Silumina Anodes™ plant in Saxony, Germany using local rates. In addition, the capital cost estimate includes owner costs during plant commissioning. The Silumina Anodes™ plant capacity is 10,000tpa with assumptions for operating costs, selling price, plant production ramp-up, and exchange rates.

1.0 ANODE PRODUCT MARKET

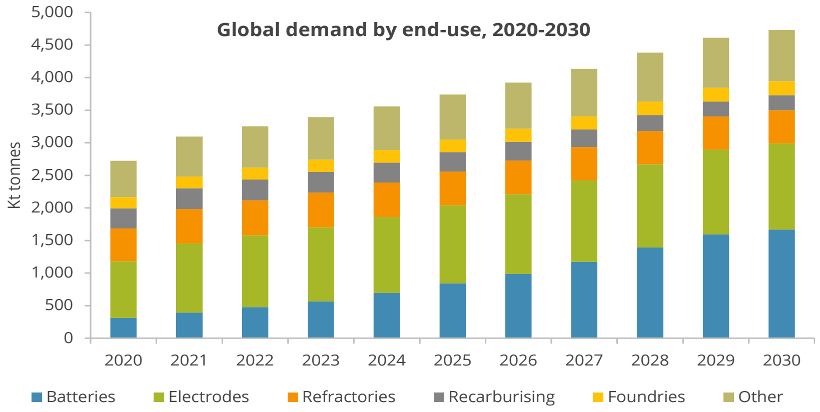
1.1 Graphite Anode Products

Lithium-ion batteries are nowadays playing a pivotal role in everyday life thanks to their excellent rechargeability, suitable power density, and outstanding energy density. A key component that has paved the way for this success story in the past almost 30 years is graphite, which has served as a lithium-ion host structure for the negative electrode (anode). Despite extensive research efforts to find suitable alternatives with enhanced power and/or energy density, whilst maintaining the excellent cycling stability, graphite is still used in the great majority of presently available commercial lithium-ion batteries. The vast majority of current batteries use either natural or synthetic graphite anode material, and often a blend of both, to achieve the best combination of performance and cost.

1.2 Graphite Market

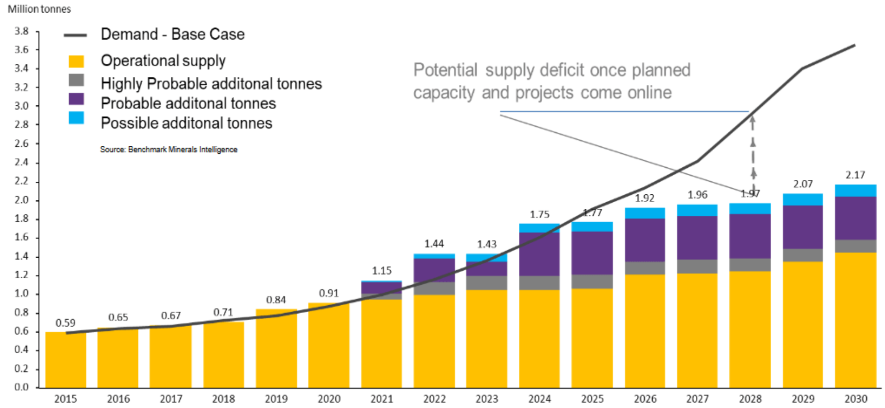
Altech's Silumina Anodes™ material would be a premium product compared to the graphite used in current lithium-ion batteries, so tracking graphite demand is sound proxy to establish potential demand for the Silumina Anodes™ products. Global demand for graphite is estimated to grow at 18% each year to 2030. Market forecaster Roskill predicts that global graphite demand from battery makers will grow to a total of 1.7 million tonnes per annum (blue and green in Figure 1.1). Benchmark Mineral Intelligence forecast that planned production capacity and projects in development will not be able to meet this growing demand by as early as 2025 (refer to Figure 1-2).

Figure 1-1 Global Demand Forecast by End User, 2020-2030



Source: Roskill

Figure 1-2 Supply and Demand for Graphite Anode Materials



Source: Benchmark Mineral Intelligence

1.3 European Graphite Market

AIG's Silumina Anodes[TM] strategy is to solely supply to the European battery and electric vehicle sector. According to the European Union Commission, the European Union could produce enough batteries by 2025 to power its fast-growing fleet of electric vehicles without relying on imported cells. By 2025, the EU will be able to produce enough battery cells to meet the needs of the European automotive industry.

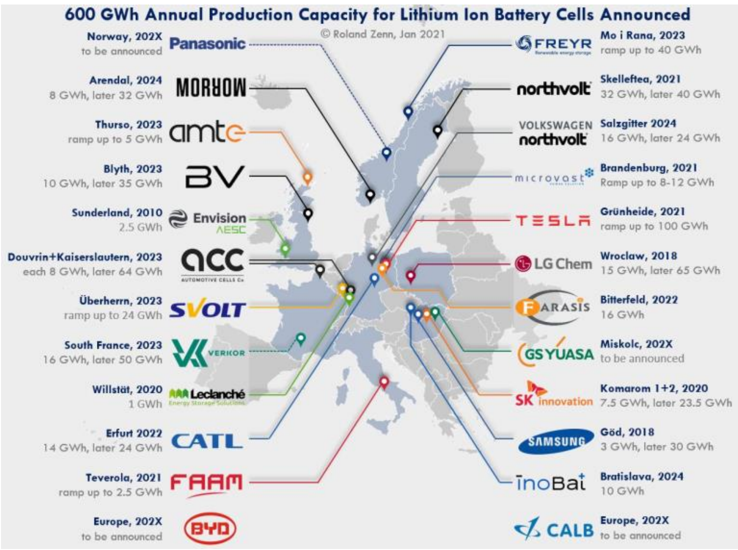
As part of its plan to become climate neutral by 2050, the EU wants to boost local production of the building blocks for green industries and batteries to power clean vehicles. Today, China hosts approximately 80% of the world's lithium-ion cell production, but Europe's capacity is set to expand rapidly. Europe has 15 large-scale battery cell factories under construction, including Swedish company Northvolt's plants in Sweden and Germany, Chinese battery maker CATL's German facility, and South Korean firm SK Innovation's second plant in Hungary.

The EU Commission said that by 2025, planned European facilities would produce enough cells to power at least 6 million electric vehicles. Whilst the coronavirus pandemic has seen overall car sales plummet, combined sales of battery and plug-in hybrid cars in Europe are expected to roughly double this year, to one million units, according to the NGO Transport & Environment.

With the Commission expecting 13 million low-emission vehicles on Europe's roads by 2025, further investments will be needed. The EU's 750 billion euro ($890 billion) coronavirus recovery fund was a "ready-made tool" to support projects. The Altech strategy fits into the domestic supplies of the raw materials needed to make lithium-ion battery cells in Europe. As estimated by Roland Zenn, lithium-ion battery cell manufacturing capacity already under construction in Europe amounts to 600GWh annually by 2030 (See Figure 1-3).

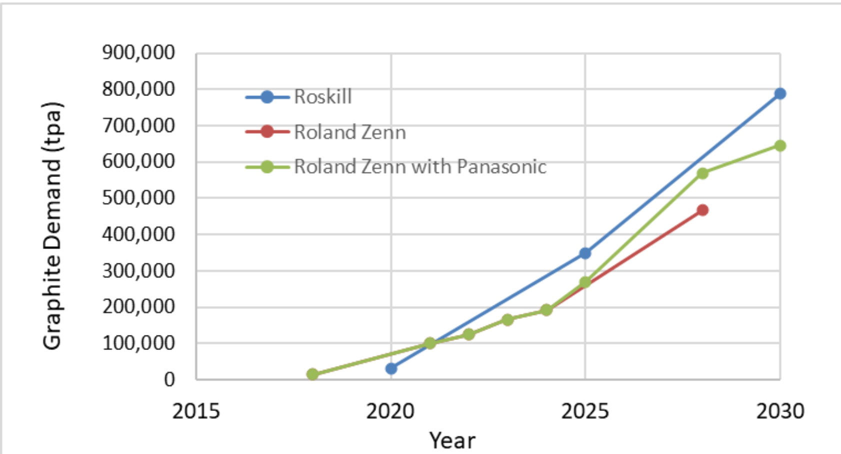
Calculated graphite demand using the Roland Zenn data, the Roskill data and Pansonic data, estimate the demand for graphite anode for Europe alone is to rise to around 600,000tpa by 2030. Market pricing for high quality, carbon coated graphite used in the manufacture of lithium-ion EV batteries is in the range of US$10,000 to US$12,000 per tonne.

Figure 1-3 Planned European Battery "Gigafactories"



Source: Roland Zenn, Q1 2021

Figure 1-4 Demand for Graphite Anode Materials in Europe



Europe's electrification goal in 2025 is strongly dictated by local automakers' electrification plans. Roskill's base-case scenario is predominantly driven by the EV manufacturing plans of the top six largest automakers in Europe that currently comprise 72% of market share by sales volume. When considering the top six automakers, with the assumption that their respective market shares will be maintained until 2025, EV penetration would reach 41%.

1.4 Silicon Anode Products

Silicon is an emerging anode material which has increased its market share in recent years, however, it still accounts for less than 1% of the active anode material market for EV battery production in 2020. Although the material offers consumers significant advantages with its much higher theoretical capacity, silicon undergoes much larger volume changes than graphite during battery cycling; 300% compared to 10% for graphite. Volumetric expansion of the silicon takes place during lithiation/delithiation phases, when lithium is intercalated between anode layers and causing it to crack and disintegrate. This process leads to a rapid reduction in cyclic capacity, and eventually results in battery failure.

Nevertheless, Roskill reports in their market research of silicon use in Li-ion batteries that most major anode producers are using silicon (as silicon monoxide), however in very small quantities, as additives to carbon based anodes. Current estimates are that silicon (silicon monoxide) is added at an average of 6% by weight of total anode material. Altech's Silumina Anode™ product uses metallurgical silicon rather than the lower energy capacity silicon monoxide.

There is a significant amount of interest by battery and EV manufacturers in increasing the proportion of silicon in anode production, and research programs are focused on overcoming or minimising the effect of expansion such that silicon loading can be increased.

1.5 Current Lithium-Ion Batteries

Performance of the current generation of lithium-ion batteries can be measured by a number of factors, including;

- Cost, the current benchmark being ~US$100/kWh
- Energy density, the current standard being >720Wh/L
- Battery life, being greater than 10 years
- Battery cycles, being greater than 5,000 full charge/discharge cycles
- Charging speed

Conventional batteries currently being manufactured fail to achieve satisfactory performance in all of these areas, with $/kWh the most common priority to reduce overall battery pack cost. The future development focus of electric vehicle and battery manufacturers, and producers of battery materials, is to address the technological limitations which limit battery performance in these key areas.

1.6 Silicon Graphite Capacity

One of the main barriers limiting future Li-ion battery improvements in the areas of vehicle range, battery weight, charging speed and cost, is the inherent energy capacity and performance of graphite as the anode material. Graphite anode material has a theoretical capacity of 372 mAh/g, and a volumetric capacity of approximately 700 mAh/cc, and takes up more space than any other component in the battery cell. As a result, many believe the next breakthrough in Li-ion battery technology will relate to anode performance, and specifically, replacement of graphite with ultra-high capacity silicon metal.

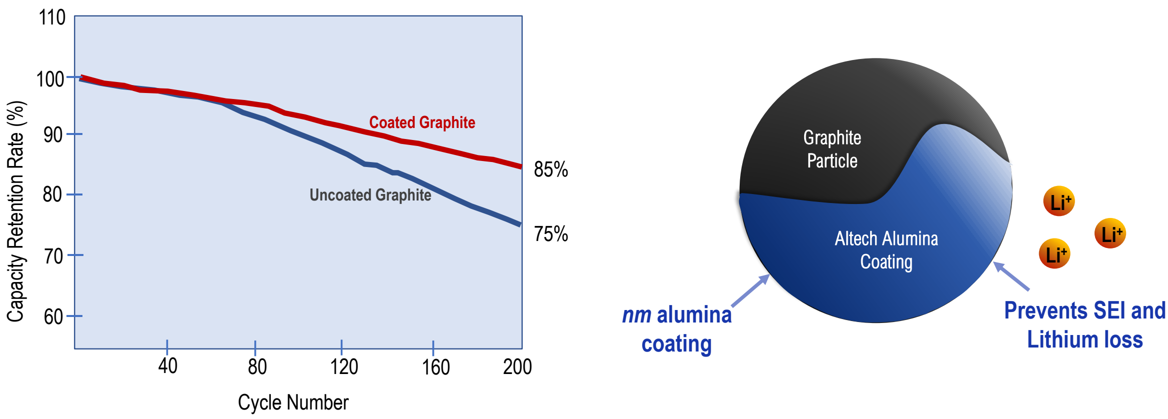
Silicon anodes have a theoretical capacity of 3,579 mAh/g, and a volumetric capacity of approximately 2,100 mAh/cc, meaning the mass and volume of anode material required to construct an equivalent kWh battery pack is significantly reduced. This equates to important reductions of the $/kWh costs of the Li-ion battery, reduced battery weight or extended vehicle range capability. Another major benefit is that thinner silicon anodes will enable much faster charging; thinner electrodes enable lithium ions to reach anode particles much faster. This decrease in the ion diffusion time results in significant improvements in charge speed.

Despite the significant performance improvements offered by high capacity silicon anodes, Li-ion battery manufacturers are yet to adopt their use in large volumes due to a number of critical technical challenges. Silicon anodes undergo volumetric expansion of 300% when reacting with lithium ions during charging, and a corresponding 300% contraction during battery discharge. In contrast, graphite expansion/contraction is in the order of 7%. Such changes in the anode volume result in fracture and pulverisation of the large silicon particles typically used, and damage to the passivating nature of the SEI, increasing lithium-ion loss and resulting in a rapid loss of battery capacity. Most of the development in silicon anodes to date has focussed on nano-sized particles which do not build up sufficient mechanical stress to fracture, and also the blending of relatively small amounts of silicon into existing graphite anode products to achieve relatively modest capacity increases.

2.0 High Purity Alumina (HPA) coating Technology

There is extensive research and literature in the field that demonstrate the use of alumina coatings in graphite applications. Alumina coated graphite has been shown to improve battery cycle and safety performance. For example, Tao et al (2019)1 and the team from PRC, demonstrated that alumina coated graphite, using the sol-gel method, demonstrated excellent cycle performance and safety performance. The cycling retention of coated graphite was 85% after 200 cycles (rate of 1 C) compared with 75% of non-coated graphite under the same test conditions. The test results show that the Al2O3 coating forms an artificial SEI layer and prevents 8-10% of lithium ions from being inactive at the commencement of battery life.

Figure 2.1 Tao et al (2019) research shows excellent cycle performance

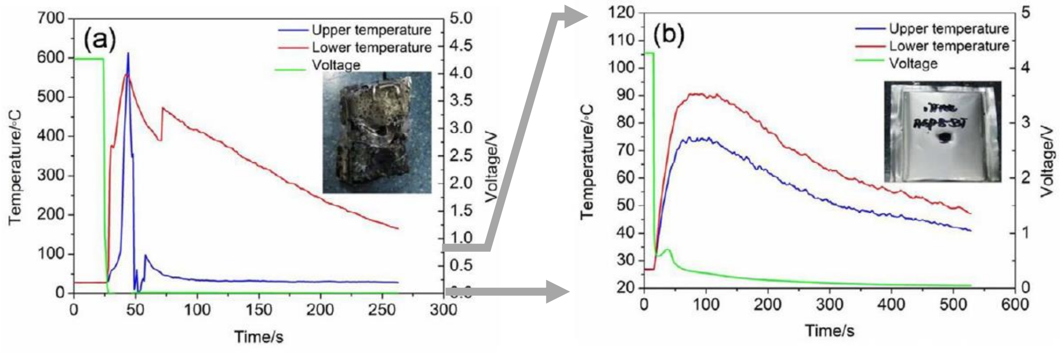


Other examples include Feng et al (2016)[1], which demonstrated that the alumina coating layer performs the same function as an SEI does, preventing an electron from getting to the outer electrode surface and allowing lithium-ion transport. Therefore, as a preformed SEI, the alumina coating layer reduces extra cathode consumption observed in commercial Li-ion batteries.

The safety benefits of alumina coating can protect batteries against a number of processes that lead to catastrophic failure events. For example, the Tao research also demonstrated that through nail penetration testing, the coating of graphite prevented thermal runaway compared with un-coated graphite anodes under mechanical abuse (See Figure 2-2). The uncoated graphite pouch battery ignited (reaching 600 ˚C), while the coated graphite battery remained intact and did not exceed temperatures of 90 ˚C. The explanation of how the alumina coating prevents thermal runaway relates to the mechanism by which elevated temperatures cause the separator to melt in the area of cell penetration. The melting of the separator leads to further expansion of the short-circuit area, heating the cell more fiercely. At this time, most of the temperature-activated decomposition reactions are exothermic,and can drive the cell into a thermal runaway. The alumina coating prevents further short circuits by dissipating heat in the cell more effectively, limiting the reaction and therefore preventing a thermal runaway. Alumina coating of graphite anode surfaces is a promising safety feature for large scale cells due to the protection provided under mechanical abuse.

[1] Low-Cost Al2O3 Coating Layer As a Preformed SEI on Natural Graphite Powder To Improve Coulombic Efficiency and High-Rate Cycling Stability of Lithium-Ion Batteries, Tianyu Feng,†,‡,§ Youlong Xu,*,†,‡ Zhengwei Zhang,† Xianfeng Du,†,‡ Xiaofei Sun,†,‡ Lilong Xiong,†,‡ Raul Rodriguez, // and Rudolf Holze*, §

Figure 2.2 Nail penetration test for coated vs non coated graphite

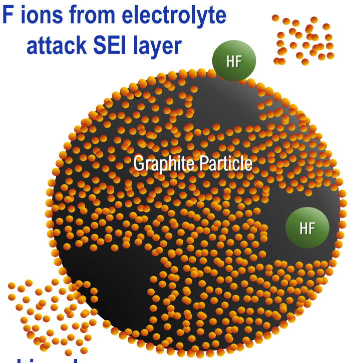


Non Coated graphite 600 Deg C

Coated graphite 100 Deg C

The electrolyte used in a Li-ion battery is usually a mixture of organic carbonates and the electrolyte salt that increases the lithium ion conductivity. Lithium hexafluorophosphate $LiPF_6$ is the state-of-the-art electrolyte salt in such electrolytes. It dissolves well in organic carbonates, is electrochemically stable and helps to conduct lithium cations. However, the use of $LiPF_6$ also creates a problem. It is not stable against hydrolysis. Traces of water in the electrolyte lead to the formation of hydrofluoric acid HF, which is considered as battery poison destroying the electrodes and lowering the capacity. There is a gradual decomposition of the electrolyte solution. Therefore, the amount of HF in the lithium-ion battery electrolyte should be as low as possible. It is suspected that the corrosive ions break down the SEI layer on the graphite particles, exposing more fresh surfaces for further lithium adsorption. New SEI layers are formed resulting in continual degradation of active lithium during the life of the battery.

Figure 2.3 Illustration of HF attack on SEI layer



Inorganic surface coatings such as alumina have been typically attributed to the chemical scavenging of corrosive HF and the physical blockage of electrolyte components from reaching the electrode surface. For example, in a study by Hall et al (2019)[2], where alumina coatings used on the positive electrode have shown to chemically scavenged the corrosive HF ions and convert to a

[2] New Chemical Insights into the Beneficial Role of Al2O3 Cathode Coatings in Lithium-ion Cells, David S. Hall,† Roby Gauthier,† Ahmed Eldesoky,‡ Vivian S. Murray,§ and J.R. Dahn*,†,‡

beneficial $LiPO_2F_2$, which is a well-known electrolyte additive. $LiPO_2F_2$, is an additive that improves the cycling stability and lifetime of a variety of lithium-ion cell chemistries. In other words, the corrosive HF is not only converted to inert material but a beneficial species. The study believes that alumina coatings in a Li-ion battery has lifetime and stability benefits to lithium-ion cells.

2.1 Coating Methods

There are several methods with which alumina coating can be applied to a graphite or silicon surface. This includes atomic layer deposition (ALD), solid method and hydrothermal method. In general, it has been suggested that ALD is costly and complex, and not suitable for mass production processes. Other coating methods such as hydrothermal and mechano-chemical processes have been developed but have significant drawbacks such as low yield or poor coating uniformity. However, some liquid coating methods such as the Altech coating technology have demonstrated a simple and low-cost treatment method.

2.2 Coating of Silicon

Extending the application of the graphite coating technology to the coating of silicon particles is a significant breakthrough for Altech, especially in the context of a recent public statement of US electric vehicle manufacturer Tesla, that its aim is to increase the amount of silicon in its batteries to achieve step-change improvements in battery energy density and life. Silicon has a significant advantage over graphite for use in lithium-ion battery anodes in that it has ten times the theoretical energy capacity compared to graphite. However, limitations for silicon use includes particle volume expansion of up to 300% when energised, a large *"first cycle lithium loss"* and capacity fade. The expansion on lithiation leads to Si fracture and subsequent delamination of the anode from the copper collector. Particle size reduction of Si down to 150 *nm* overcomes this expansion problem, however this is costly and uneconomical.

When going to smaller particle sizes to increase the surface-to-volume ratio and hence the power capability, the decomposition of the electrolyte by the so-called solid electrolyte interphase (SEI) formation can also be increased. This adverse effect can be reduced or possibly prevented by modifying the surface of the particles by applying a passivating or protective film. Such films need to be ultrathin to have high Li+ and electron conductivities while excellent conformality is needed to be sufficiently protective.

Altech believes that the encapsulation of silicon particles via the application of a nano layer of alumina can resolve these issues for cheaper larger Si particles (See Figure 2.4). The Company believes that its technology will be a "game changer", which would pave the way for increased lithium-ion battery energy density, battery lifespan and reduced first cycle lithium loss.

Figure 2.4 Altech alumina coating on Silicon and Graphite

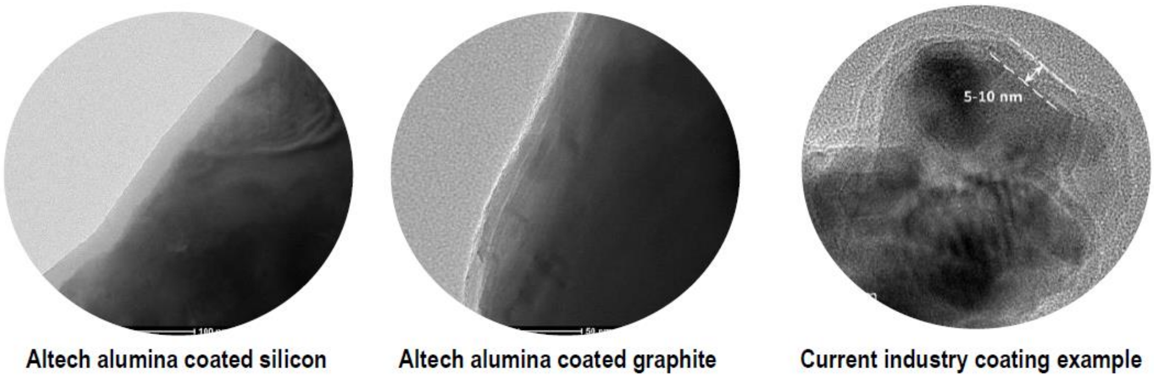
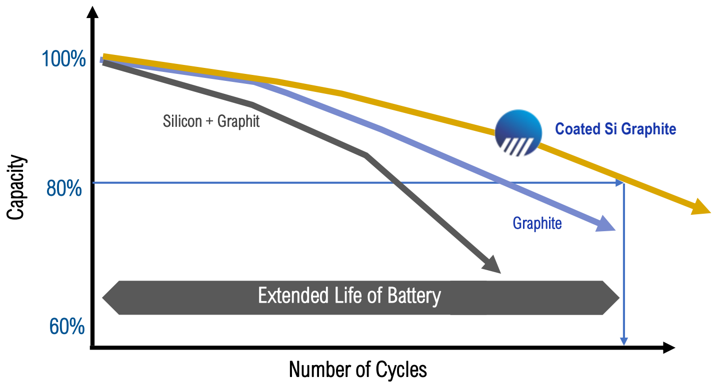
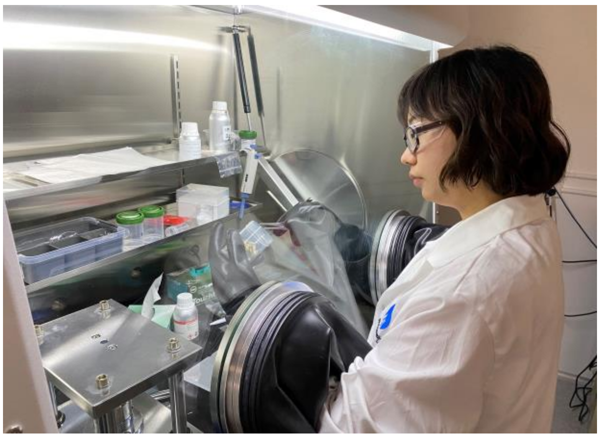
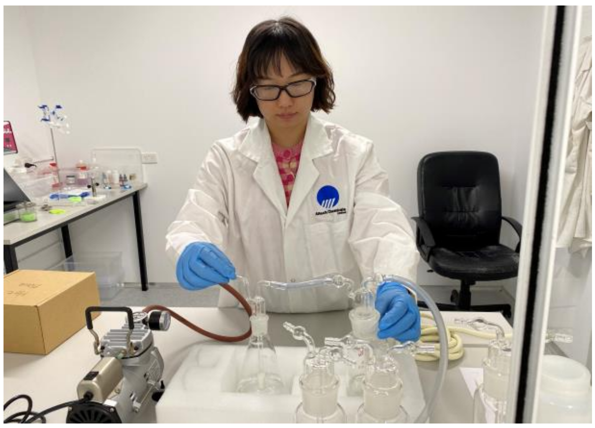


Figure 2.5 Theoretical increased energy density & extra battery life





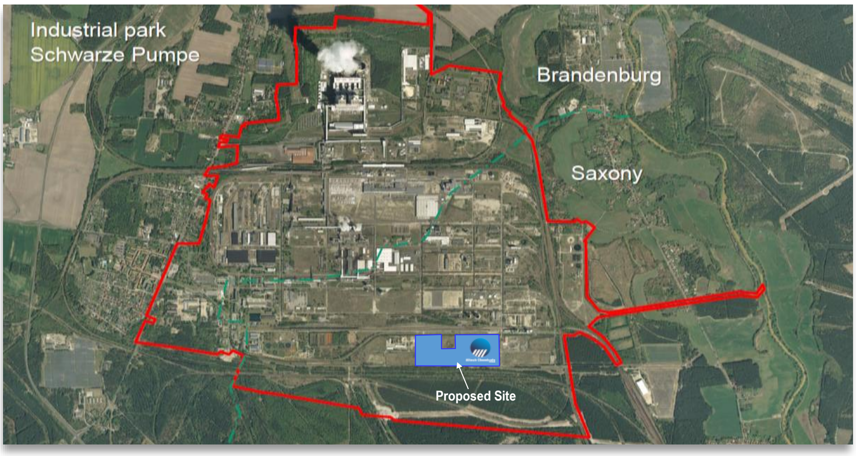


2.3 Plant Location - Saxony Germany

The selected project site is within the Schwarze Pumpe Industrial Park (ISP), which straddles the border between the federal states of Brandenburg and Saxony, approximately 120 km from Berlin and only 78 km from Dresden. The proposed AIG site is situated in the southern portion of the ISP, on the Saxony side of the border and within the municipality of Spreetal. The total project site area is 155,987 m², of which approximately 40,000 m² will be utilised for construction of AIG's battery materials alumina coating plant, administration and other ancillary buildings. The remaining site area shall be reserved for potential future expansion, construction of other facilities, or sub-division.

The Schwarze Pumpe Industrial Park is one of the largest industrial parks in Germany, covering 866 ha in total (2,140 acres), and is well serviced by existing infrastructure including reticulated electricity, natural gas, industrial and potable water, wastewater treatment facilities, rail and roads. Future development within the park includes infrastructure projects such as expansion of wastewater treatments; new roads and railway crossing points; truck storage space (north, south) and KV-Terminal/Rail port etc

Figure 2.6 Silumina Anodes™ site in Schmarze Pumpe industrial site



2.4 Silumina Anodes™ Process

The Silumina Anodes™ plant is designed for production of 10,000 tonnes per annum (tpa) of battery material coated with 99.99% high purity alumina. Battery materials, such as battery grade graphite and silicon anode feedstock, are received at the coating plant. The purified aluminium precursor solution is used to coat the materials and calcined into a 2 nanometre layer through a series of confidential steps and processes. The cooled Silumina Anodes™ material is then transported to a set of product storage bins. Samples are collected during calcination for QA/QC analysis in the on-site laboratory. The qualified product is bagged in 1 ton bulk bags by a fully automated bagging station and stacked on individual pallets. All pallets are wrapped by transparent plastic membrane to prevent the entry of moisture and dust from the environment. The product is stored and identified by bar code on each pallet before dispatch to customers.

2.5 Plant Layout

The design of the proposed 10,000tpa Silumina Anodes™ plant incorporates one main production building, and a further three ancillary buildings, to be constructed on the Schwarze Pumpe plant site. These include:

- Administration and Engineering building, which will include staff office areas, process control centre and QA laboratory facilities;
- Maintenance workshop and Stores building, which will include office areas for the maintenance team and mechanical, electrical and instrumentation workshop areas; and
- Guardhouse building, which will include security offices, visitor training areas and first aid facilities.

The site buildings and associated access roads and carparking areas take up approximately one quarter of the available Schwarze Pumpe 16ha site.

Figure 2.7 Site Layout of Silumina Anodes™ Plant

2.6 Environmental Approvals

Altech engaged a local environmental consultant, Arcadis Germany GmbH, to complete a preliminary due diligence review of the proposed Schwarze Pumpe site, and also to detail the permitting strategy which must be followed prior to construction and operation of a processing plant. The final Arcadis report due diligence found that although the wider Schwarze Pumpe Industrial Park (ISP) has known soil and groundwater contamination issues from previous operations, and which require ongoing monitoring and remediation, the selected Altech site is not believed to have any issues which will require remediation or prevent development of the project.

The licensing authority will be Landesdirektion Sachsen, who will be responsible for including other competent authorities in the permitting process such as the building authority and the municipality of Spreetal. Applications for the plant emission control permit as a new facility are expected to take between 9 and 12 months, and will include a public review and consultation period as part of the EIA which runs in parallel.

3.0 Financial Modelling

Preliminary tax net present value (NPV) for the Silumina Anodes™ project is US$507 million, at a discount rate of 8%. The internal rate of return (IRR) is calculated to be 40%, with a payback of capital of approximately 3.1 years. Annual average earnings before interest, tax, depreciation and amortisation (EBITDA) for the project at full production is estimated to be US$63 million per annum. The capital costs for the Silumina Anodes™ plant are estimated at US$95 million at a EUR/USD exchange rate of 0.83. Annual revenue at the full rate of production (10,000tpa) is US$185 million. This is based on a long term FOB price for Silumina Anodes™ providing the same energy unit price as conventional graphite products. Production costs including all chemical processing, corporate overheads and sales costs are estimated at US$ 122 million per annum.

A summary of the key financial metrics and key assumptions within the PFS is set in the tables below.

Table 3.1 Project Financial Model Summary Outputs

	US Per Annum	
Annual Production	**10,000**	tonnes
Exchange Rate	**0.83**	EUR/USD
Project Capex	**95**	million
Opex p.a.	**122**	million
NPV	**507**	million
Discount Rate	**8.0**	%
Payback (real)	**3.1**	years
IRR	**40**	%
Revenue p.a.	**185**	million
EBITDA p.a.	**63**	million

3.1 Discount Rate

The discounted cash flow model developed for the study uses a discount rate of 8.0% based on a weighted cost of capital (WACC) calculation. This rate was selected as a conservative input for the financial model, given the low risk profile of operations in Germany, and current interest rates remaining at record lows.

3.2 Exchange Rates

A EUR:USD exchange rate of 0.83 has been used for conversion of all capital and operating cost inputs to the preliminary study.

3.3 Owner's costs

Owner costs have been included in the financial model as pre-production operating costs. This includes corporate costs incurred during the construction and commissioning period, G&A costs during construction, and pre-production insurance premiums.

3.4 Price Assumptions

Based on industry feedback and Roskill, the long-term price forecast in the financial model for its Silumina Anodes™ material is the same energy unit cost price as conventional graphite anode material.

3.5 Production Ramp-up

A very conservative production and sales ramp-up has been used in the financial model, with a period of 3 years allowed for achieving the full rate production and sales of 10,000tpa. The following ramp-up profile and costs assumptions were used in the financial model.

3.6 Capital Costs Estimation

The major capital cost component for the project is the construction of the Silumina Anodes™ facility and the associated site infrastructure, such as the administration building, maintenance workshop and on-site QA laboratory. The engineering design and cost estimate for the battery materials coating facility has been based on the process design and equipment required to process 10,000tpa of anode materials, and utilises building layouts previously designed for Altech's Johor HPA facility. AIG has assessed its capital estimate for the Silumina Anodes™ plant to be accurate to ± 30% and can be defined as an Engineering Study Class Estimate (AACE Class 4).

Table 3.2 Project Capital Cost Estimate

	Capital Cost USD	
Plant	**69.5**	Million
Contingency	**13.9**	Million
Insurances	**3.1**	Million
Commissioning	**7.0**	Million
Land	**1.2**	million
Total	**95**	million

3.7 Basis of Estimate

The basis for the Schwarze Pumpe plant capital cost estimate is the mechanical process equipment required for the 10,000tpa facility. The process flow sheet and mass balance was used to develop a mechanical equipment list, with pricing enquiries sent to equipment suppliers in Germany and Europe for the majority of items. Vendor quotations were reviewed and total equipment pricing compiled. Costs associated with preparation of the site and construction of plant buildings were obtained from a number of local civil contractors based on the building designs used in Altech's Johor HPA plant.

3.8 Estimating Methodology

The capital cost estimate has been prepared as per the Association of Cost Engineers UK Standard Class III and American Association of Cost Engineers Class 4 for engineering studies, with estimates calculated to a degree of accuracy of +/- 30%.

The estimate has been developed based on detailed process equipment costs per the mechanical equipment list. Material take-off (MTO) estimates, developed for the Johor HPA plant, detailed engineering for the various disciplines of earthworks, civil and structural, were utilised after being updated to align with the plant configuration at Schwarze Pumpe. These material quantity estimates were provided to a number of nominated construction contractors who then provided local unit rates to develop total capital costs for these areas. The remainder of the plant direct costs have been factored by discipline, as is appropriate for the level and accuracy of the study being completed.

Indirect project costs have been calculated using factors in line with those typical for chemical production facilities of similar size and complexity. The factor used to calculate total freight cost considered the location of the site and the high proportion of process equipment and construction materials which would be sourced locally from German companies or neighbouring European countries. The factor used to calculate the design and EPC costs also takes into account the engineering work previously complete for the Johor HPA plant, from which some of the building design concepts shall be based.

3.9 Mechanical Equipment Costs

The capital cost estimate for mechanical equipment is based on vendor quotations received for all major equipment items after enquiries were sent during the course of 2021. Equipment sizing has been determined from process data for the 10,000tpa design basis.

The mechanical equipment installation costs have been calculated based on a factor of 30% of the total mechanical equipment supply cost.

3.10 Earthworks, Concrete and Structural Works

Concrete and structural steel quantities have been calculated using material take-offs developed from the 3D plant layout design and supporting design calculations for concrete, structural steel, platforms, walkways and cladding. Estimates for bulk earthworks, access road and in-plant road quantities have also been based on the preliminary plant layout. Local material and labour rates supplied by construction contractors have then been used to develop the total costs for these areas.

Site building cost estimates have also been determined using unit rates supplied by the construction contractor for the site. These costs include the construction of administration offices with complete staff facilities, process operations offices, control rooms, laboratory and the maintenance workshop/warehouse. Costs associated with the fit-out of the plant QA laboratory equipment have been based on vendor quotations from German suppliers, and are also included in this direct cost item.

3.11 Direct Costs Other Disciplines

Direct costs for the remaining disciplines and ancillary items have been included, but have generally been based on a factor applied to the total installed mechanical equipment cost where material take offs have not yet been developed as part of the engineering design. Additional direct costs included are:

- Critical spares - Factored as 4% of installed equipment costs
- Mobile Equipment – Estimated from equipment price database from previous quotations for forklifts
- Electrical and Automation - Factored as 20% of installed equipment costs
- Instrumentation and Control – Factored as 12% of installed equipment costs

- Piping and Valving – Factored as 18% of installed equipment costs
- First Fills – Calculated for major reagents from vendor minimum order quantities and unit costs

3.12 Indirect Costs

The following indirect costs have been determined by applying a factor to the total direct plant costs. These factors are in line with industry averages for complex hydrometallurgical plants in developed countries.

- Site temporary facilities - 2% of Direct Costs
- Mobilization and demobilization – 2.5% of Direct Costs
- Freight – 4% of Direct Costs
- Vendor representation and site commissioning – 2.5% of Direct Costs
- Design and EPCM Contract Costs – 15% of Direct Costs
- Extras incl. Taxes and Insurance – 5% of Direct Costs

3.13 Contingency

The contingency amount included represents the level of uncertainty inherent with this level of study. Although the estimate has been built up using equipment quotations and some material take offs for the construction of plant buildings, the contingency accounts for variations which may result from minor adjustments to the plant flowsheet and layout during the next phases of engineering, geotechnical conditions of the Schwarze Pumpe site or local building regulations which require modification to the civil and structural design, and price fluctuations during procurement negotiations. The capital cost as presented includes a contingency of 20%.

3.14 Feedstock, Reagent and Utility Costs

Project operating costs for the supply of aluminium precursor feedstock, all major process reagents, electricity, potable water and natural gas have been based on quotations from local suppliers or utility providers, received during 2021. No price escalation has been applied to these costs within the financial model for the life of the operating plant.

3.16 Electricity Supply Costs

The Schwarze Pumpe facility plans to be operated using 100% green electricity. This is most commonly provided to industrial consumers by way of power purchase agreements (PPUs), or by the supply of Guarantees of Origin (GoOs) as part of a supply agreement with any of the energy retailers in the market. Due to the nature of the Silumina Anodes™ plant demand, with high availability requirements for its nominal load, GoOs are proposed as the most appropriate method to purchase green electricity supply to the plant.

As a result of the total electricity demand of the Silumina Anodes™ plant, and the power cost as a proportion of total plant revenue, Altech is expected to be eligible for exemptions to a range of the standard electricity surcharges under the Special Compensation Scheme managed by BAFA. These exemptions result in a unit price reduction of almost 66%, resulting in a total electricity supply price to the plant of 8.22 EURc/kWh.

3.17 Labour Costs

A detailed manning schedule for the plant during both construction and operations phases has been developed, including operators, process engineering staff, administration, maintenance and management. Operating costs have subsequently been determined using local East German labour rates provided by labour consultants, including all on costs for items such as health, pension, unemployment and LTI benefits required under German labour laws.

3.18 Sustaining Capital

Sustaining capital of ~3.1% per annum of the initial plant buildings and equipment cost has been allowed over the life of the project.

4.0 European Feedstock Supply

Two Memorandum of Understanding (MoU) have been executed by AIG with two European based suppliers of lithium-ion battery grade anode materials. For graphite, Altech has executed a MoU with SGL Carbon GmbH (SGL), one of the leading producers of graphite in Europe. SGL Carbon is supporting AIG's development of high purity alumina coated graphite materials targeted for use by the lithium-ion (Li-ion) battery industry. In addition, the non-binding MoU details the potential future relationship whereby SGL would supply uncoated synthetic graphite anode material to the battery materials plant in Saxony. The indicative, non-binding volumes and prices set out in the MoU have been adopted in the PFS financial model. SGL Carbon is a world leader in the development and production of carbon-based solutions and reported sales of 919 million Euros in 2020.

For silicon, AIG have a supply MoU with Ferroglobe Innovation S.L. (Ferroglobe), a leading producer of high purity metallurgical silicon in Europe. The executed non-binding MoU details the relationship whereby Ferroglobe would supply silicon anode material to the Silumina Anodes™ plant in Saxony. Ferroglobe is a leading producer of silicon metal with a proven ability to create new solutions and applications using state-of-the-art technology to drive innovation. It has technologies to produce high purity grade silicon, and is specifically developing tailor made silicon powders for the anode of lithium-ion batteries.

The MoUs executed with both SGL and Ferroglobe not only ensure the future supply of high-quality feedstocks suitable for the Silumina Anodes™ process, but also align with the objective to minimise the plant's carbon footprint and overall environmental impact.

By securing high quality graphite and silicon from these leading European based materials suppliers, transport emissions attributed to feedstock shipments are reduced and supplier production facilities have the potential to utilise the extensive green electricity market in Europe. Importantly, these suppliers will, like Altech, be governed by the same stringent European Union (EU) environmental regulations. Altech has a strong corporate focus on sustainability and reducing the environmental impact of its operations. Finally, the selection of EU based feedstock suppliers is expected to reduce any potential future supply chain risks, when compared with non-European suppliers.

5.0 Silumina Anodes™ Pilot Plant

AIG has commenced engineering of a pilot plant, to be constructed in Germany, to demonstrate Altech's proprietary Silumina Anodes™ technology. The pilot plant is designed to produce up to 36,680 kilograms of anode grade coated Silumina Anodes™ per year (120 kg per day).
The pilot plant design is intended for installation in the Dock3 facility adjacent to Altech's designated site at the Schwarze Pumpe Industrial Park (see Figures 5.1 and 5.2). Altech has secured approximately 300m^2 of floorspace within the Dock3 where the pilot plant will be located. Also, an on-site analytical laboratory is planned for the pilot plant. The laboratory will allow for the rapid assessment of pilot plant product purity and monitor physical parameters which will enable changes in processing parameters and operational setpoints to be modified quickly, as required. The Dock3 space is already connected to all required utilities and includes office space for the project and operations team.

Figure 5.1 Dock3 facility, Schwarze Pumpe Industrial Park, Saxony, Germany

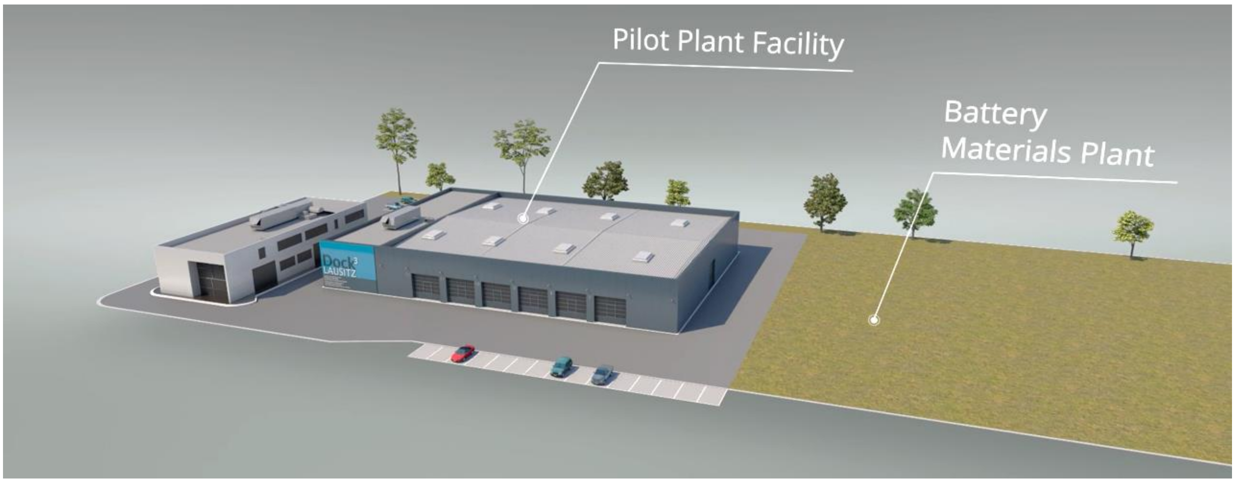


Figure 5.2: Leased bays in the Dock3 facility

The pilot plant design has been separated into two distinct areas of processing; precursor production, and Silumina Anodes™ coating & calcination. Precursor production equipment shall be operated in batch mode, producing approximately 10kg per batch. Production is sufficient to feed the downstream anode material coating stage for approximately 30hrs of continuous production. Due to the nature of the metallurgical leach and crystallisation processes, and the high purity requirements of the plant end product, the process equipment shall be manufactured using fluoropolymer and ceramic materials. The design for the pilot plant also leverages the knowledge that Altech, and selected equipment suppliers, have developed during the design of its Johor HPA production facility. Centrifuge, filtration and calcination equipment shall be supplied by equipment vendors of full scale designs to enable the assessment of operating parameters and sizing scale up calculations.

Figure 5.3: Pilot Plant design

The coating & calcination section of the pilot plant has been designed to operate continuously with minimal shutdowns, to ensure consistency in the product material. Final product purity has been the major design consideration when selecting process equipment and the main materials of construction. Production from the Silumina Anodes^{TM} pilot plant shall be used to confirm the Altech process consistently achieves product purity requirements, optimise equipment design and process parameters for a full scale 10,000tpa production plant, and to produce qualification samples for any potential joint venture offtake partners and end users.

Figure 5.4: Pilot Plant equipment

Figure 5.5: Pilot Plant equipment

German engineering firm Küttner GmbH & Co. KG (Küttner) has been awarded the contract for final plant engineering of the Silumina Anodes™ pilot plant, to be constructed in Saxony, Germany. Küttner have completed engineering work, with procurement of long lead items already underway. The pilot plant is designed to produce 120kg per day of coated battery anode material, which will be made available to selected European battery manufacturers and auto-makers. Küttner is a German-based industrial plant engineering and EPC contractor, with strong experience in design, procurement, project and construction management and plant commissioning across a range of industries. They have previously completed metallurgical plant, water and off-gas treatment projects in Germany. Küttner bringing valuable local knowledge to the execution of the project.

6.0 Silumina Anodes™ Product

AIG has registered the product name **Silumina Anodes™** for its alumina coated composite silicon/graphite lithium-ion battery anode material**.** Based on AIG's test work, its Silumina Anodes™ product is expected to provide for the manufacture of battery anodes, that when incorporated into a lithium-ion battery, result in a battery that has higher energy retention capacity by volume and weight compared to a battery using the incumbent graphite only battery anode. The key differentiation point of Silumina Anodes™ is that it will be a composite material of silicon and graphite particles that have been coated with alumina, using Altech's proprietary alumina coating technology.

Silumina Anodes™

Altech Chemicals Limited
ASX:ATC
ABN 45 125 301 206

Suite 8, 295 Rokeby Road,
Subiaco, Western Australia
6008 Australia

Telephone: +61 8 6168 1555
e-mail: info@altechchemicals.com
Website: www.altechchemicals.com

7.0 Green Accreditation of Silumina Anodes™ Project

As part of the preliminary feasibility study (PFS), the independent Centre of International Climate and Environmental Research (CICERO) in Norway has assessed the proposed German Silumina Anodes™ Plant project as "Green".

As announced to the ASX on 18 November 2021, CICERO were engaged by AIG to conduct an independent evaluation of the company's proposed Silumina Anodes™ plant that would be located at the Schwarze Pumpe Industrial Park, Saxony, Germany. The plant is being designed with a specific focus on minimising environmental impact, and in accordance with prevailing German, European and International environmental standards.

CICERO's review has now been completed, and a rating of "Medium Green" has been awarded to the project. This positive project evaluation, formally termed a *"Green Bond Second Opinion",* confirms that the project would be suitable for future green bond financing.

In determining the overall project framework rating of "Medium Green", CICERO assessed the proposed governance procedures and transparency as "Good" and confirmed that the project aligns with all green bond principles. In assessing the proposed plant design and coating process, CICERO noted "*The plant has near zero Scope 1 and 2 emissions as the plant's processes, including steam generation, are fully electrified, and it will use renewable electricity sourced from on-site solar panels and renewable energy certificates*". Although CICERO acknowledges the project is still in the development phase, in assessing governance and transparency considerations, it has encouraged Altech *"to implement and enforce a robust supply chain sustainability policy, as well as to engage with its suppliers to address their sustainability impacts",* given that >90% of the plant carbon footprint is attributable to plant feedstock such as graphite and silicon.

A CO_2 footprint assessment of the proposed 10,000tpa plant determined that, when compared to the incumbent lithium-ion battery technology that uses a graphite only anode, coated silicon anode material could result in a CO_2 emissions reduction of ~19% where 5% coated silicon is used in a battery anode, and a reduction of up to ~ 52% if 20% coated silicon was used (refer Table 7.1).

Altech Chemicals Limited
ASX:ATC
ABN 45 125 301 206
Suite 8, 295 Rokeby Road,
Subiaco, Western Australia
6008 Australia
Telephone: +61 8 6168 1555
e-mail: info@altechchemicals.com
Website: www.altechchemicals.com

Table 7.1: Estimated reduction in CO_2 footprint from use of coated silicon in Lithium-ion battery anode

Silicon Content %	Reduction in CO_2 footprint in LIB (equivalent power)
5%	18.7%
10%	34.9%
15%	44.9%
20%	51.8%

Authorised by: Iggy Tan (Managing Director)

\- end -

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

Altech Chemicals ("Altech" or "Company") is a specialty battery materials technology company that has licenced its proprietary high purity alumina coating technology to 75% owned subsidiary Altech Industries Germany GmbH (AIG), which has commenced a definitive feasibility study for the development of a 10,000tpa silicon/graphite alumina coating plant in the state of Saxony, Germany to supply its Silumina AnodesTM product to the burgeoning European electric vehicle market.

This Company recently announced its game changing technology of incorporating high-capacity silicon in lithium-ion batteries. Through in house R&D, the Company has cracked the "silicon code" and successfully achieved a 30% higher energy battery with improved cyclability or battery life. Higher density batteries result in smaller, lighter batteries and substantially less greenhouse gases, and is the future for the EV market. The Company's proprietary silicon graphite product is registered as Silumina AnnodesTM.

The Company is in the race to get its patented technology to market and recently announced the results of a preliminary feasibility study (PFS) for the construction of a 10,000tpa Silumina Anode material plant at AIG's 14 hectare industrial site within the Schwarze Pumpe Industrial Park in Saxony, Germany. The European graphite and silicon feedstock supply partners for this plant will be SGL Carbon and Ferroglobe. The project has also received green accreditation from the independent Norwegian Centre of International Climate and Environmental Research (CICERO). To support the development, AIG has commenced construction of a pilot plant adjacent to the proposed project site to allow the qualification process for its Silumina AnodesTM product. AIG has executed NDAs with two German automakers as well as a European based battery company.

HPA Project

Altech is also further aiming to become a supplier 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, and has finalised Stage 1 and Stage 2 construction of its HPA plant in Johor, Malaysia. Feedstock for the plant will be sourced from the Company's 100%-owned near surface kaolin deposit at Meckering, Western Australia and shipped to Malaysia. The HPA project is significantly de-risked with a bankable feasibility study completed, senior lender project finance from German government owned KfW IPEX-Bank approved, and a German EPC contractor appointed – with initial construction works at the site completed. In addition to the senior debt, conservative (bank case) cash flow modelling of the HPA plant shows a pre-tax net present value of USD 505.6million at a discount rate of 7.5%. The project generates annual average net free cash of ~USD76million at full production. Altech is in the final stages of project finance with a potential raising of US$100m of secondary debt via the listed green bond market. In addition, US$100m of project equity is being sought through potential project joint venture partners.

For more information, please contact:

Corporate

Iggy Tan
Managing Director
Altech Chemicals Limited
Tel: +61 8 6168 1555
Email: info@altechchemicals.com

Martin Stein
CFO & Company Secretary
Altech Chemicals Limited
Tel: +61 8 6168 1555
Email: info@altechchemicals.com

Shane Volk
Company Secretary
Altech Chemicals Limited
Tel: +61 8 6168 1555
Email: info@altechchemicals.com