Altech Batteries Ltd

Green energy storage and EV battery anodes

Share Price: A$0.093

ASX: ATC

Sector: Materials

16 May 2023

Altech Batteries Ltd (ASX:ATC) is a Perth-based company developing two key battery technology products. The first is CERENERGY® - sodium chloride solid state batteries for grid energy storage (solar, wind etc.). The second is Silumina Anodes™ - an EV battery anode material that increases battery capacity by utilising high-purity alumina coating technology on silicon and graphite and increasing EV capacity by 30% compared to standard graphite only anode.

CERENERGY®: a game changing battery pack

CERENERGY® is a solid-state sodium chloride (SAS) battery developed and patented by the Fraunhofer Institute for Ceramic Technologies & Systems (Fraunhofer), the world leading German government owned scientific research organisation. CERENERGY® is a serious alternative to lithium-ion batteries for several reasons, including that they are fire and explosion proof, have a far longer-life span and can operate in extreme climates. In September 2022, Fraunhofer and Altech announced a JV to commercialise the CERENERGY® battery - 75% owned by Altech and associated entity Altech Advanced Materials AG, with Fraunhofer owning 25%. The JV is commercialising a 100 MWh battery plant in Germany on Altech's land.

Silumina Anodes™ project pilot plant nearing completion and DFS underway

Silumina Anodes™ is a composite silicon-graphite anode material, that uses patented high-purity alumina coating technology. The resultant product has been tested and shown to increase capacity of the conventional EV lithium-ion battery by ~30%. By Q4 of 2023, Altech anticipates having completed construction of a pilot plant in Germany, that will produce 120kg per day of the Silumina Anodes™ product. The product will be provided to potential end users for their internal test work. Concurrently, Altech is preparing a Definitive Feasibility Study (DFS) for a 100% green energy plant in the Schwarze Pumpe district of Germany that will be able to produce 10,000tpa of Silumina Anodes™. A PFS has already been completed, reflecting an NPV of US$507M.

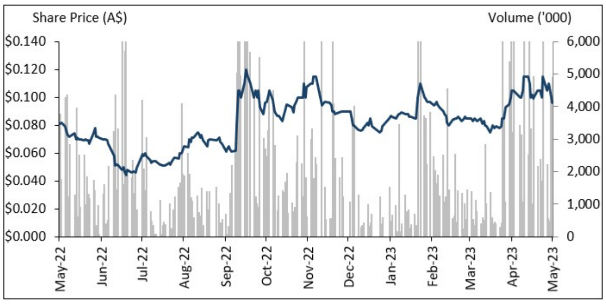
Valuation range of A$0.28-0.39 per share

Using a DCF methodology, we value ATC at A$0.28 per share in our base-case scenario and A$0.39 per share in our bull-case scenario. We expect ATC to re-rate after concluding an offtake agreement for CERENERGY® batteries and completing a DFS for the Silumina Anodes™ project. The key risks, outlined on page 23, include execution and funding risks.

Market cap. (A$ m)	132.7
# shares outstanding (m)	1,426.8
# shares fully diluted (m)	1,456.8
Market cap ful. dil. (A$ m)	135.5
Free float	64.8%
12-months high/low (A$)	0.13 / 0.043
Avg. 12M daily volume ('1000)	2,442.3
Website	www.altechgroup.com

Source: Company, Pitt Street Research

Share price (A$) and avg. daily volume (k, r.h.s.)



Source: Refinitiv, Pitt Street Research

Valuation metrics	
DCF fair valuation range (A$)	0.28–0.39
WACC	12.6%
Assumed terminal growth rate	2.0%

Source: Pitt Street Research

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Analysts: Stuart Roberts, Nick Sundich

Tel: +61 (0)447 247 909

Stuart.roberts@pittstreetresearch.com

Nick.Sundich@pittstreetresearch.com

Financial Statements

Profit & Loss (A$'000)	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	2028F
Total Revenue	**933**	**8,059**	**469**	**294**	**9,206**	**29,566**	**70,360**	**115,994**	**158,308**
Total operating expenses	-4,431	-5,503	-6,204	-7,025	-12,325	-22,855	-42,853	-66,629	-83,803
EBITDA	**-3,498**	**2,556**	**-5,736**	**-6,730**	**-3,118**	**6,711**	**27,507**	**49,365**	**74,505**
Depreciation	-22	-231	-329	-612	-598	-615	-458	-458	-458
EBIT	**-3,519**	**2,326**	**-6,064**	**-7,343**	**-3,717**	**6,096**	**27,048**	**48,907**	**74,047**
Interest expense	0	0	-3	0	-156	-231	-231	-231	-231
Tax expense	0	0	265	0	0	-1,829	-8,115	-14,672	-22,214
Profit after tax	**-3,519**	**2,326**	**-5,802**	**-7,342**	**-3,873**	**4,036**	**18,703**	**34,004**	**51,602**
Non-Controlling Interest	0	0	73	92	48	-50	-234	-425	-645
(Loss) / Profit attributable to owners	**-3,519**	**2,326**	**-5,730**	**-7,251**	**-3,825**	**3,985**	**18,469**	**33,579**	**50,957**

Cash Flow (A$'000)	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	2028F
Profit after tax	-3,519	2,326	-5,802	-7,342	-3,873	4,036	18,703	34,004	51,602
Depreciation	22	231	329	612	598	615	458	458	458
Changes in working capital	-1,035	127	-252	91	-2,522	-5,740	-11,785	-14,274	-14,255
Other operating activities	1,992	-6,383	903	0	0	0	0	0	0
Operating cashflow	**-2,541**	**-3,700**	**-4,822**	**-6,639**	**-5,797**	**-1,089**	**7,375**	**20,188**	**37,805**
Acquistion of PP&E	-4	-96	-2,443	-4,264	-1,367	-1,392	-1,183	-1,208	-1,230
Other investing activities	-10,063	-6,693	-1,892	-533	-559	-586	-612	-639	-664
Investing cashflow	**-10,067**	**-6,789**	**-4,335**	**-4,798**	**-1,926**	**-1,978**	**-1,795**	**-1,847**	**-1,894**
Equity raised	6,955	16,658	10,331	0	5,000	5,000	0	0	0
Other	-1,781	-274	3,020	5,120	2,500	0	0	0	0
Financing cashflow	**5,174**	**16,384**	**13,351**	**5,120**	**7,500**	**5,000**	**0**	**0**	**0**
Net change in cash	-7,434	5,896	4,195	-6,317	-223	1,933	5,580	18,341	35,911
Cash at End Period	**833**	**6,729**	**10,913**	**4,596**	**4,373**	**6,306**	**11,886**	**30,227**	**66,137**

Balance Sheet (A$'000)	2020	2021	2022	2023F	2024F	2025F	2026F	2027F	2028F
Net Cash	833	6,645	10,823	-614	-3,337	-1,404	4,176	22,517	58,427
Total Assets	77,414	89,767	98,388	95,915	101,903	116,355	145,625	190,360	250,892
Total Liabilities	8,859	840	851	5,720	10,581	15,997	26,564	37,295	46,226
Shareholders' Funds	68,555	88,927	97,538	90,195	91,322	100,358	119,061	153,064	204,666

Ratios	2020	2021	2022F	2023F	2024F	2025F	2026F	2027F	2028F
Total Cash / Total Assets	1.1%	7.5%	11.1%	4.8%	4.3%	5.4%	8.2%	15.9%	26.4%
Return on Assets (%)	NM	2.8%	NM	NM	NM	3.7%	14.1%	20.0%	23.1%
Return on Equity (%)	NM	3.0%	NM	NM	NM	4.2%	16.8%	24.7%	28.5%

Estimates: Pitt Street Research

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Introducing Altech

Altech Batteries (ATC) (formerly Altech Chemicals) is a Perth-based battery technology development company. ATC's key projects include the CERENERGY® project and the Silumina Anodes™ project.

The CERENERGY® project

The CERENERGY® battery is a sodium nickel chloride battery (SAS battery) that is in a solid-state. Solid-state batteries are so-called because they use solid electrolyte materials rather than non-solid electrolyte materials (liquid or polymer gel for example). CERENERGY® consists of a solid inflammable ceramic tube. The cathode inside the ceramic tube is a mixture of sodium (common table salt) and nickel powder. The anode is self-forming molten sodium, created as the battery charges. The battery is charged when sodium ions from salt migrate through the ceramic electrode, forming the anode, and is discharged when the flow is the other way.

CERENERGY® batteries have several advantages over lithium-ion batteries.

CERENERGY® batteries have several advantages over lithium-ion batteries. These include:

- Being fire and explosion free,
- Having a longer life span (more than 15 years),
- The ability to operate in extreme cold and desert climates, and
- Being free from lithium, copper, cobalt, graphite and manganese, all of which are more expensive commodities than sodium salt.

Altech has a JV with the Fraunhofer Institute for the commercialisation of a 100MWh production facility on Altech's land in Saxony, Germany. Altech, together with associated Altech Advanced Materials AG, owns 75% of the project, with the remaining 25% carried interest being owned by Fraunhofer.

In March 2023, Altech launched the SAS 1MWh GridPack (ABS1000) for the renewable energy and grid storage market. The GridPack is a 1MWh sodium chloride battery pack that utilises the CERENERGY® technology. It can provide a source of backup power during periods of high demand or when renewable energy sources are not producing at capacity. The GridPacks have been designed to conform to the Ingress Protection (IP) 65 standard for complete protection from both dust and inclement weather.

The GridPacks have several distinct features and benefits such as the plug-and-play feature (making installation in remote locations easy), stackable containers and the ability to operate without moving parts (such as cooling fans). They can also operate in any climate without the need of thermal management and come with extremely low maintenance costs. Additionally, the larger battery packs can store greater amounts of energy resulting in more efficient utilisation of renewable energy sources such as wind and solar power, in turn significantly benefitting the renewable energy and grid storage sectors.

The Silumina Anodes™ project

Altech has cracked the 'silicon barrier' with EV batteries by creating a workable graphite-silicon anode. Silicon has ten times the capacity of graphite, but has inherit problems in that, untreated, it swells and cracks. The industry has been racing to solve the problem of how to get silicon into the anode of EV batteries. Altech has solved this problem. Silicon is a promising anode material used to replace graphite due to its higher theoretical energy density – US EV manufacturer Tesla SVP Drew Baglino told investors in its

ATC's technology has a 30% higher energy retention capacity, better cyclability and higher overall life compared to a conventional graphite-only anode.

3Q20 Earnings Call that it wanted more silicon in batteries used for its vehicles.

After cracking the silicon barrier, Altech started making a composite silicon-graphite anode. Altech developed a proprietary lithium-ion battery anode material, using high-purity alumina (HPA) coated silicon, and registered as Silumina Anodes™. Silumina Anodes™ uses metallurgical silicon. This composite material of silicon and graphite particle is coated with a nano-metre layer of HPA using Altech's proprietary technology. Altech's technology has a 30% higher energy retention capacity, better durability in individual cycles and higher overall life compared to a conventional graphite-only anode.

In January 2022, Altech Industries Germany Gmbh (AIG), Altech's German subsidiary, acquired a 14-hectare (ha) site at the Schwarze Pumpe Industrial Park in Saxony, Germany, to build a full-scale Silumina Anodes™ coating plant. The location is ideal due to its close proximity to current and proposed lithium-ion battery and EV plants across Europe. Altech announced outstanding results from its PFS that was conducted to validate the economics of its proposed 10,000tpa Silumina Anodes™ plant. The plant is likely to use 100% green energy from the European electricity market.

AIG has now commenced a Definitive Feasibility Study (DFS) study for the Silumina Anodes™ plant ahead of schedule. The DFS is being conducted in tandem with the construction of a pilot plant, adjacent to the proposed project site. Construction of the pilot plant is nearing completion in Q4 of 2023, to enable end user qualification of the Silumina Anodes™ product.

Seven key reasons to invest in Altech

1) **Altech's CERENERGY® project is a strong alternative to the grid storage market** – CERENERGY® batteries are a game-changing alternative to lithium-ion batteries for the grid storage industry. The solid-state sodium chloride (SAS) batteries have several distinct advantages over lithium-ion batteries. SAS batteries are fire and explosion proof, have a long lifespan of >15 years, can operate in different types of climates, including cold and hot desert climates, and are lithium, cobalt, cobalt, manganese and graphite free. They are also much cost-effective compared to lithium-ion batteries. CERENERGY® batteries provide a strong performance in terms of energy efficiency and power density providing charge and discharge of around 4-6 hours. This makes them ideal for the grid storage market.
2) **Altech is well positioned for commercialisation of the CERENERGY® SAS battery, thanks to a recently signed JV** – In September 2022, Altech and Fraunhofer entered into a JV for the commercialisation of the 100MWh CERENERGY® battery plant in Germany. We think this is a major sign of confidence in the CERENERGY® project and find it encouraging that ATC is likely to retain majority ownership (75%) of the project. The JV has commenced the planning process for the BFS which is required for the commercialisation process. Down the track, the Company plans to construct an additional facility for Gigawatt batteries, once the 100MWh plant is built and is operational.
3) **Altech is set to benefit from strong prospects for the grid storage market** – Batteries for grid storage do not face the limitations relating to mass and volume that most EV applications face. Consequently, ATC is targeting the grid storage market. Grid storage is a collection of methods used for energy storage on a large scale in an electrical power grid.

Electrical energy is stored when electricity is abundant and inexpensive or in times of low demand. The energy is later returned to the grid during high demand, when electricity prices are higher. ATC has launched the SAS 1.0MWh GridPack (ABS1000) for the grid storage market. The GridPacks have several distinct advantages such as a plug-and-play feature, modular and stackable containers, absence of moving parts (which makes the packs an ideal solution for noise-sensitive environments) and low maintenance costs. They can also operate in any climate without the need for thermal management. Additionally, the larger packs have the capability to store more energy resulting in more efficient utilisation of renewable energy sources such as wind and solar power.

Incorporation of the Silumina Anodes™ product in a lithium-ion battery results in battery with a higher energy retention capacity compared to one which uses an incumbent graphite-only battery anode

4) **Altech has achieved a breakthrough with its alumina coating of silicon –** ATC has cracked the code to unlocking silicon's potential for use in lithium-ion batteries for EVs. Incorporation of the Silumina Anodes™ product in a lithium-ion battery results in a battery with a higher energy retention capacity compared to one using a graphite-only battery anode. Furthermore, ATC has demonstrated that barriers to utilising silicon in lithium-ion batteries can be overcome. The Company's patented technology is expected to make conventional lithium-ion batteries more powerful and efficient, providing a big market opportunity for ATC to capture.
5) **The PFS study for Altech's proposed Silumina Anodes™ plant generated strong results –** In April 2022, ATC announced strong results from a PFS for its 10,000tpa Silumina Anodes™ plant. The PFS, based on a plant coating capacity of 10,000 pa, resulted in a low capital cost of US$95m, pre-tax NPV of US$507m, an IRR of 40% and a payback period of ~3.1 years. Total annual revenue from the plant is estimated at US$185m per annum. The plant is likely to use 100% green energy from the European electricity market. ATC has also commenced a DFS study for the Silumina Anodes™ full-scale plant. The DFS is running parallel to the construction of the pilot plant along with the transfer of German-based industrial plant EPC contractor Kuttner Engineering's detailed design team assigned to the DFS study.
6) **Altech has the ideal management team to accomplish its objectives –** ATC has an experienced board and management team that has diverse experience across a wide range of industries, including processing, mining, corporate governance and finance. In particular, Mr. Iggy Tan, the Company's Managing Director and CEO, has more than thirty years of experience in the chemicals sector and mining sector (including commercial mining projects such as capital raisings, funding, construction, start-ups and operations).
7) **We believe that Altech is undervalued at the current price –** Given the progress that has been made on the CERENERGY® Battery project (recent launch of 1MWh power grid battery pack), we believe that ATC is highly undervalued. Additionally, we believe the Silumina Anodes™ project (and the subsequent upgrade it provides to the lithium-ion batteries) further increases the attractiveness of ATC. Our DCF valuations (across base-case and bull-case scenarios) yield a target price range of A$0.28-$0.39 per share.

Altech's unique projects

Altech offers two unique projects that represent both upgrades and alternative to conventional lithium-ion batteries (Figure 1), resulting in greater performance of the end-products the batteries are used in.

Figure 1: Summary of Altech's key projects

CERENERGY® battery Project	• The Fraunhofer Institute in Germany has developed and patented a solid-state sodium chloride battery called the 'CERENERGY® Battery'. • Subsequently, in September 2022, a JV was entered into 75% owned by the Altech group, with Fraunhofer carried-free for the other 25%, for the commercialisation of the 100MWh CERENERGY® battery plant in Germany. • In March 2023, ATC launched the SAS 1.0MWh GridPack (ABS1000) for the renewable energy and grid storage market which is likely to be the preferred choice for companies seeking an energy solution which is reliable and long-lasting.
Silumina Anodes™ Project	• ATC has shown that coating silicon particles with alumina allows silicon to be safely incorporated into graphite anodes, allowing a 30% increase in energy density over conventional graphite anodes. • ATC intends to build a plant that can produce 10,000 tpa of its 'Silumina Anodes™' in the same Schwarze Pumpe district as the CERENERGY® Battery plant.

Source: Company, Pitt Street Research

Before we delve into the company's projects, we will outline why technologies such as ATC's are required.

The dilemma with lithium-ion batteries that ATC's technologies seek to resolve

It is common knowledge that demand for lithium-ion batteries will grow exponentially over the rest of this decade, although there are varying estimates as to just how much it will grow. One estimate, from global management consultancy McKinsley, predicts that demand for lithium-ion batteries generally is expected to grow over 30% annually from 2022 to 2030 when it would reach a value of over US$400bn and a market size of 4.7TWh[1]. Lithium-ion batteries are one of the most popular methods of electricity storage and control 90% of the global grid market. The high energy density and light weight of lithium-ion batteries has significantly boosted their adoption in EVs.

While China currently hosts 80% of the world's lithium-ion cell production, European capacity is also likely to witness a rapid expansion. Lithium-ion battery cell manufacturing capacity already under construction in Europe amounts to 600GWh annually by 2030. Despite certain advantages of lithium-ion batteries as mentioned above, they also suffer from some limitations (Figure 2) that need to be overcome as demand expands.

[1] https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/battery-2030-resilient-sustainable-and-circular

Figure 2: Limitations of lithium-ion batteries

Losses in lithium-ion batteries	• Losses in lithium-ion batteries are initially present as inactive layers that are formed in the first battery charge cycle. • The first cycle loss is a long-recognised issue that hasn't been resolved properly and still has an adverse effect on rechargeable lithium-ion batteries.
High costs of lithium-ion batteries	• Lithium-ion batteries, which make up majority of batteries of EVs, contribute to ~20-40% of the costs of EVs.
Insufficient progress on recycling of lithium-ion batteries	• Though lithium-ion batteries have the potential for repeated usage after being extracted once, there hasn't been enough progress in battery recycling in recent years.
Fire and Explosion Issues	• One of the key drawbacks of lithium-ion batteries is the risk of thermal runaway, fire and explosion. • Thermal runaway is a chain reaction within a battery cell that can be difficult to stop once started. This mainly occurs when the temperature inside a battery reaches a point that causes a chemical reaction (which in turn produces oxygen) inside the battery. This is mainly caused by overheating, physical damage and overcharging. • Lithium-ion batteries contain flammable liquid electrolyte and plastic separators – this is a key contributor to the risk of fire.
Narrow Operating Temperature Range	• Lithium-ion batteries can only operate in a narrow temperature range between 15 degrees Celsius and 35 degrees Celsius. • At zero degrees, lithium-ion batteries operate at 70% capacity, and a lot of energy is used just to keep the batteries warm. They do not operate well in close cold climates or the desert climates.
Lithium-ion battery lifespan	• The life of lithium-ion batteries is confined to 7-10 years depending on the applications. • Lithium ions face degradation with each cycle of charge and discharge.
Cobalt supply chain and ethical concerns	• Cobalt plays a significant role to boost energy density and battery life in lithium-ion batteries. • The Democratic Republic of Congo (DRC) produces 70% of cobalt globally, and the lithium-ion battery industry is exposed to supply chain issues. • Harsh working conditions, child labour, and human rights abuses in the DRC have resulted in ethical concerns over cobalt supply.
Graphite geo-political risk	• Graphite is an indispensable material in the global shift towards EVs. • The graphite needed to make lithium-ion batteries is 30 times more than lithium, owing to losses in the manufacturing process. • Currently, China produces 90% of the world's graphite anode material which represents a geo-political risk to the industry.
Copper shortage	• The copper required in an EV battery is 2.5 times more than that in a standard internal combustion engine (ICE) vehicle. • S&P Global estimates that there aren't sufficient copper mines being built or expanded currently for the copper required for the production of EVs projected to be sold annually by 2030.

Source: Company, Pitt Street Research

The limitations of lithium-ion batteries have led to the EV battery industry searching for alternatives ranging from sodium-ion batteries, aluminium ion batteries, solid state lithium-ion batteries and solid state sodium ion batteries

Against the backdrop of challenges facing the lithium-ion batteries, the EV industry is searching for a battery technology that resolves the aforementioned issues. Currently, there are a few alternatives that exist for lithium-ion batteries. These include:

- **Sodium-ion batteries** – These batteries have a cathode containing a sodium-based compound. Since sodium is more abundant and more easily sourced than lithium, sodium ion batteries are much cheaper than lithium-ion batteries. However, they provide less energy density than their lithium-ion counterparts and are not commercially available.
- **Aluminium-ion batteries** – These are much cheaper than other alternatives given the easy availability of aluminium. They also offer high theoretical capacity and safety. However, a key limitation of these batteries is that the electrochemical reaction associated with aluminium is sluggish, thereby limiting the power output of the batteries.
- **Solid state lithium-ion batteries** – Here, the electrolyte used is solid rather than a liquid one. Solid state batteries have higher energy density than traditional lithium-ion batteries. However, this technology is more expensive than liquid electrolytes and is also unstable during fast charging when scaled up to the level of battery packs.
- **Solid state sodium alumina batteries** – These solid-state batteries employ the use of sodium rather than lithium. Since they are solid state batteries, a solid electrolyte is used rather than a liquid electrolyte. Due to deployment of the sodium, they are cheaper than lithium-ion batteries. They also have strong energy density equivalent to lithium-ion batteries. Consequently, solid-state sodium alumina batteries can be considered as a suitable alternative to lithium.

Why SAS batteries are potentially superior to lithium-ion batteries

SAS batteries have several advantages over lithium-ion batteries.

SAS batteries (such as ATC's CERENERGY® batteries) have several advantages over lithium-ion batteries, including that:

- **They can't burn or explode –** SAS batteries are fire and explosion-proof and are not subject to thermal runaway unlike lithium-ion batteries. SAS batteries do not contain flammable liquid electrolyte or plastic separators. Instead, the electrolyte is a solid inflammable ceramic tube allowing the passage of sodium ions. Additionally, the battery does not contain oxides or generate oxygen at the cathode.
- **They can operate in extreme temperatures –** SAS batteries can operate in a much larger temperature range and can operate in cold climates and hot deserts as well. SAS batteries can operate between -40°C and +60°C and help in ensuring high performances and durability, irrespective of the ambient temperature. Ambient temperatures do not affect the batteries adversely, due to SAS batteries having a solid ceramic electrolyte.
- **They have a long-life span –** Sodium ions do not suffer from degradation during each cycle of charge and discharge unlike lithium-ion batteries. The lifespan of a SAS battery is beyond 15 years. SAS batteries are reported to have lifetimes of over 2000 cycles. Full-sized batteries usually can function efficiently for twenty years.
- **They are free of cobalt supply chain and ethical concerns –** Cobalt is not used in SAS batteries. As a result, SAS batteries are not exposed to cobalt's ethical or supply chain issues. SAS batteries benefit from an

excellent specific energy of 110-130Wh/kg as compared to LFP batteries of 90-110Wh/kg.

- **They are free of graphite and copper supply chain risks –** SAS batteries do not contain graphite or copper in the anode portion of the battery. Anodes in SAS batteries only get formed during the charging process in the form of a molten sodium film between the steel electrode and outer edge of the ceramic electrolyte. The steel canister serves as a negative electrode in a SAS battery (instead of copper which is the negative collector in the lithium-ion battery).
- **They are significantly cheaper than lithium-ion batteries** – SAS batteries (such as CERENERGY®) batteries are ~40-50% cheaper than lithium-ion batteries primarily as they do not use expensive materials like lithium, graphite, copper or cobalt. Instead, SAS batteries use iron and manganese which are relatively cheaper.

The use of silicon as an anode material

There are several reasons why silicon is considered as a promising anode material for the next generation of lithium-ion batteries.

Another alternative mechanism to overcome the problems with lithium-ion batteries in Figure 8 is the adoption of silicon as anode material for the next generation of lithium-ion batteries. Currently the anode (negative electrode) of a typical lithium-ion battery is graphite, coated with copper foil. Silicon, used as an anode material, has potential overcome the current issues with lithium-ion batteries. Indeed, the introduction of silicon in battery anodes was declared as a key step for an increase in energy density and cost reduction in lithium-ion batteries by Tesla, the world's leading EV manufacturer.

There are several reasons why but two are particularly critical. First, silicon's theoretical capacity (3,579mAh/g) is >10x than that of graphite (theoretical capacity is the amount of throughput that could be attained if a production facility were able to produce at its peak efficiency level). Second, silicon anodes possess a volumetric capacity of 2100mAh/cc compared with graphite's volumetric capacity of 700mAh/cc. The larger capacity of silicon implies that the volume of silicon required for the construction of an equivalent kWh battery pack is much lower compared to graphite. The high capacity is likely to result in cost reductions in lithium-ion batteries, reduced battery weight and extended capability of vehicle ranges.

We also observe that silicon is also the most abundant material on earth after oxygen, meaning there'll be no supply issues whatsoever. Against this backdrop, ATC realised the need for coating alumina with silicon, paving the way for the element to be incorporated into graphite-based battery anodes for usage within the EV battery market.

Where does ATC come into the picture?

ATC's technologies aim to overcome the current limitations of lithium-ion batteries. Silumina Anodes™ is a coating for lithium-ion batteries with Silicon and CERENERGY® is an SAS battery. Both of these technologies will be positive for the market, solving the aforementioned problems with lithium-ion batteries. Furthermore, ATC's technologies overcome barriers that other companies have been unable to overcome.

Silumina Anodes™: an upgrade to existing lithium-ion batteries

Silumina Anodes™ is ATC's proprietary lithium-ion battery anode material, using high-purity alumina (HPA) coated silicon, and registered as Silumina Anodes™. As we noted above, silicon has shown promise as an anode material for the next generation of lithium-ion batteries, but Silumina Anodes™ will unlock its full potential as it has overcome limitations of silicon particles.

The limitations of silicon particles and how they can be overcome

Silicon's limitations for use in lithium-ion batteries as an anode material include the following effects that can occur:

- Changes in intrinsic volume of 300% or more in its interactions with lithium-ion batteries during the process of battery charge and discharge. Reducing the particle size by 150nm will likely help overcome the expansion issue of 300%. However, it is also likely that this will be costly and uneconomical.
- Deactivation of a high percentage of lithium ions in a battery.
- Unstable formation of solid electrolyte interphase (SEI) stemming from the interaction between the silicon surface and the electrolyte.
- A low initial Columbic Efficiency implying high-capacity loss in the first battery cycle.

Alumina coating of silicon particles has the potential to solve the above-mentioned issues for silicon applications in lithium-ion batteries

Alumina coating of silicon particles has the potential to solve the above-mentioned issues for silicon applications in lithium-ion batteries. Encapsulation of silicon particles through the application of a nano layer of alumina is likely to be a game changer in the lithium-ion battery industry. We believe that this is further likely to pave the way for higher energy density and greater lifespan of lithium-ion batteries; and reduction in first cycle lithium loss (Figures 3 and 4).

Figure 3: Alumina coating on silicon and graphite

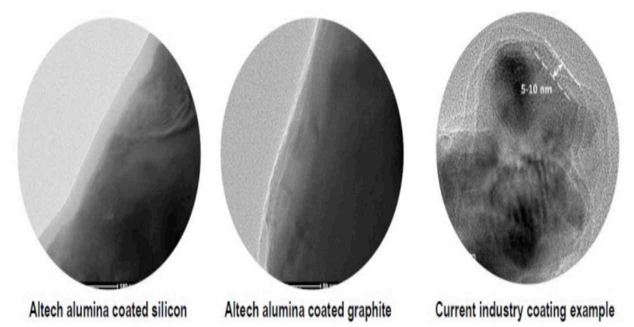
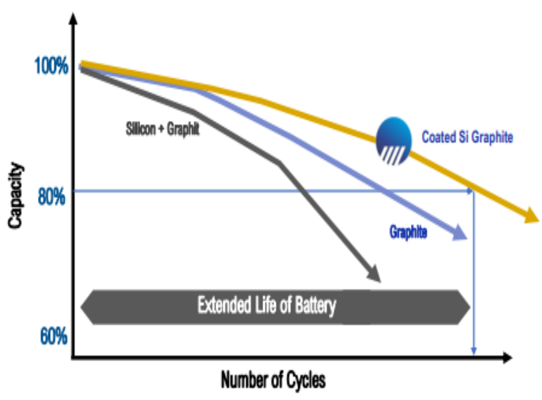


Figure 4: Theoretical increased energy density and extra battery life



Source: Company, Pitt Street Research

ATC's breakthrough

In November 2021, ATC cracked the silicon code. In other words, it created a lithium-ion battery anode material utilising silicon that overcame the previous unresolved issues of silicon usage in lithium-ion batteries including swelling of silicon particles, prohibitive first cycle capacity loss of up to 50% and a rapid battery degradation. ATC has created a battery anode with ~30% higher energy density than a conventional graphite-only battery anode. It achieved the breakthrough by creating a lithium-ion battery anode material in which silicon treated with its technology had been included in a composite silicon-graphite anode.

Higher-density batteries result in smaller, lighter batteries with substantially fewer greenhouse gases and are targeted at the EV market. The 30% higher energy capacity lithium-ion battery is also likely to result in significant cost benefits and an increased range for EVs. This was achieved through the combination of silicon particles (treated with innovative proprietary technology) with regular battery-grade graphite.

After the breakthrough achieved in late 2021, ATC pivoted its efforts to make battery anodes containing both silicon and graphite. ATC's proprietary alumina coated silicon graphite lithium-ion battery anode material was registered as the Silumina anode product. The Silumina anodes material is a premium product as compared to the graphite used in lithium-ion batteries. The Silumina anodes product (when incorporated in a lithium-ion battery) is likely to result in a battery with higher energy retention capacity by volume and weight compared to a battery using incumbent graphite-only battery anode. Silumina anodes are likely to be produced by AIG's pilot plant initially and subsequently by a full-scale plant. We believe that the Silumina anodes project represents a strong downstream opportunity for the utilisation of the high purity alumina coating technology in silicon and graphite.

ATC's coating plant is already Green rated

In November 2021, the Centre of International Climate and Environmental Research (CICERO) was deployed by AIG as part of the PFS study to conduct an independent evaluation of its battery materials coating plant. In December 2021, the battery materials coating plant was awarded the Medium Green rating for achieving an environmentally sustainable design.

The positive project assessment, termed as a Green Bond Second Opinion, was a confirmation of the fact that the plant aligned with all green bond principles and the project is suitable for future financing through green bonds. ATC's German subsidiary AIG finalised a detailed assessment of CO_2 footprint for the battery materials coating plant (Figure 5). The design of the plant was conducted in accordance with German, European and International environmental standards, with a specific focus on minimising the environmental impact.

Figure 5: The estimated reduction in CO2 footprint from use of coated silicon in lithium- ion battery anodes

Silicon Content %	Reduction in CO2 footprint in LiB (equivalent power)
5%	18.7%
10%	34.9%
15%	44.9%
20%	51.8%

Source: Company, Pitt Street Research

We believe that CICERO's independent assessment of ATC's proposed battery materials coating plant and its suitability for potential future green bond financing adds credibility to the proposed project.

The Pre-Feasibility study (PFS) generated strong results

In April 2022, ATC unveiled the results of a PFS study for the construction of a full-scale plant to produce 10,000tpa of Silumina Anodes™. The PFS incorporates up to-date project assumptions, including the final capital cost estimate from European vendors at plus or minus 30% accuracy level (Figure 6).

The PFS assumed a plant coating capacity of 10000tpa, low capital cost of US$95m with a pre-tax NPV of US$507m and an IRR of 40% with a payback period of ~3.1 years. Total annual revenue at the 10,000tpa full rate of production is estimated at US$185m per annum (Figures 6 and 7).

Figure 6: Project Capital Cost Estimate

	Capital Cost USD	
Plant	69.5	m
Contingency	13.9	m
Insurances	3.1	m
Commissioning	7	m
Land	1.2	m
TOTAL	**95**	**m**

Source: Company, Pitt Street Research

Figure 7: Silumina Anodes Project key financial metrics

Financial Performance Summary	US per annum	
Annual Production	10,000	tonnes
Exchange Rate	0.83	EUR/USD
Project Capex	95	m
Opex p.a.	122	m
NPV	507	m
Discount rate	8	%
Payback (real)	3.1	years
IRR	40	%
Revenue p.a.	185	m
EBIITDA p.a	63	m

Source: Company, Pitt Street Research

The plant is likely to use 100% green energy from the European electricity market. Green energy is typically provided to industrial consumers through power purchase agreements (PPUs) or through the supply of Guarantees of Origin (GoOs) under a supply agreement with energy retailers in the market.

Commencement of pilot plant construction for the project

In February 2023, Altech commenced the construction of a pilot plant adjacent to the proposed project site to enable the qualification process for its Silumina Anodes™ product. Against this backdrop, Altech has executed NDAs with two German automakers as well as a Europe-based lithium-ion battery manufacturing company.

ATC and Fraunhofer, the leading German battery research and development institute, entered into an agreement to expedite the testing and qualification process for the Silumina Anodes™ product. The pilot plant is likely to produce up to 36,680kg of anode grade coated battery material per year (120kg per day) of the Silumina Anodes^{TM} product for product qualification with end users. The pilot plant is likely to be installed in the Dock3 facility adjacent to ATC's designated site in Schwarze Pumpe Industrial Park.

The design of the pilot plant has been bifurcated into precursor production and coating and calcination of the Silumina Anodes^{TM} product. The operation of the precursor production equipment is likely to be done in batches producing 10kg per batch. Additionally, coating and calcination of the plant have been designed for continuous operation with minimal shutdowns to ensure consistency in the product material.

The foundations are being laid for the future

Over the last 18 months, ATC has taken several steps to position itself for the future.

Over the last 18 months, Altech has taken several other steps to position itself for the future. In particular, ATC acquired new land in Germany for the coating plant – a 14ha industrial site at the Schwarze Pumpe Industrial Park in Saxony, Germany - approximately 120km from Berlin and 78km from Dresden. Schwarze Pumpe is likely to be an ideal location for the full-scale Silumina Anodes^{TM} Coating plant as it is strategically located for supplying alumina-coated anode materials to the European lithium-ion battery markets and EV industry. The Park is well serviced by existing infrastructure, including reticulated electricity and natural gas, rail and roads.

ATC has also signed MOUs with leading European suppliers of high-quality materials back to secure future feedstock supply – SGL Carbon for graphite and Ferroglobe for silicon. If these agreements eventually become future commercial arrangements, they will ensure a high-quality supply of feedstock specifically suited for the Silumina Anodes process. These also help in achieving the company's goal of minimising the plant's carbon footprint and overall environmental impact.

Additionally, ATC expanded its R&D laboratories for production of batteries of pouch cell size for the next stage of the Silumina Anodes^{TM} project. The cell chemistry in the pouch cell size batteries is first optimised in coin cells of smaller formats and then progressively scaled up to full sized pouch cells for more information on electrochemical performance and energy density.

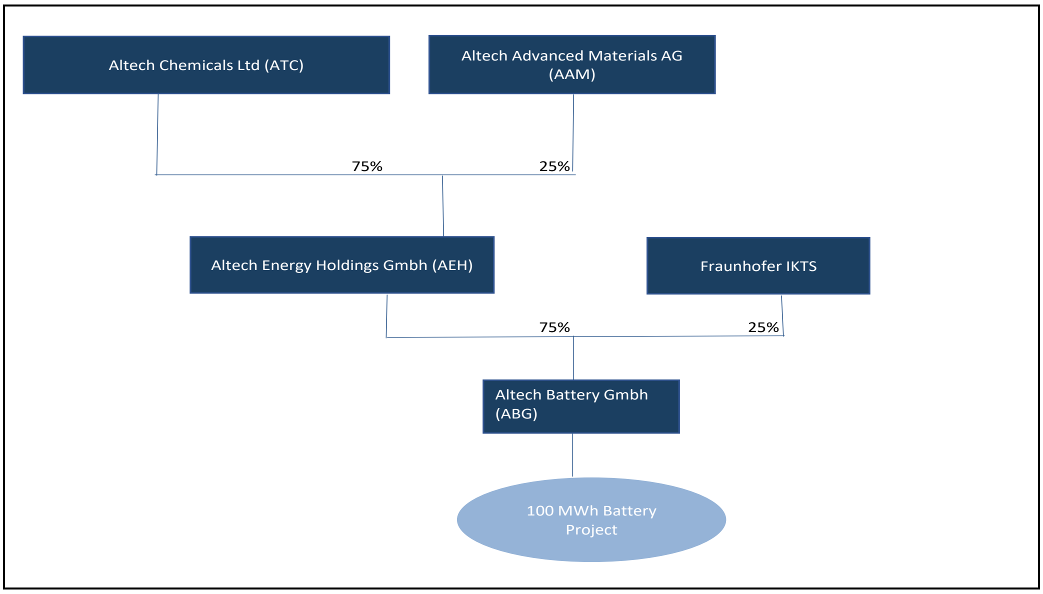
The pilot plant will produce its first anode in late 2023, allowing an anticipated Definitive Feasibility Study (DFS) in 2024.

The pilot plant will produce its first Silumina Anodes^{TM} material in late 2023, allowing for an anticipated Definitive Feasibility Study (DFS) in 2024. Altech has already commenced the DFS for the Silumina Anodes^{TM} full-scale plant. The mass and energy balance from the PFS has been finalised, paving the way for the progression of layouts and procurement of production-scale vendor equipment.

CERENERGY®: a unique SAS battery project

In September 2022, Altech Energy Holdings Gmbh (AEH) and Fraunhofer entered into a JV for the commercialisation of the 100MWh CERENERGY® battery plant in Germany. AEH is a holding company owned by ATC and Altech Advanced Materials (AAM) - ATC owns 75% and AAM owns 25% (Figure 8).

Figure 8: Details of the JV agreement between ATC and Fraunhofer FRAUNHOFER



Source: Company, Pitt Street Research

Fraunhofer was searching for an entrepreneurial partner that owns land in Germany, had access to funding, was a builder of projects and had technology in alumina used in ceramics. ATC matched all those criteria, and a JV agreement was signed between the two companies. The JV holds exclusive licensing rights to the intellectual property (IP) of the SAS technology. ATC will own 75% of the project, with 25% free carried interest of the 100MWh project owned by Fraunhofer. Fraunhofer has spent €35m on R&D and operates a €25m pilot plant in Hermsdorf, Germany. The CERENERGY® batteries have been successfully tested in stationary battery modules.

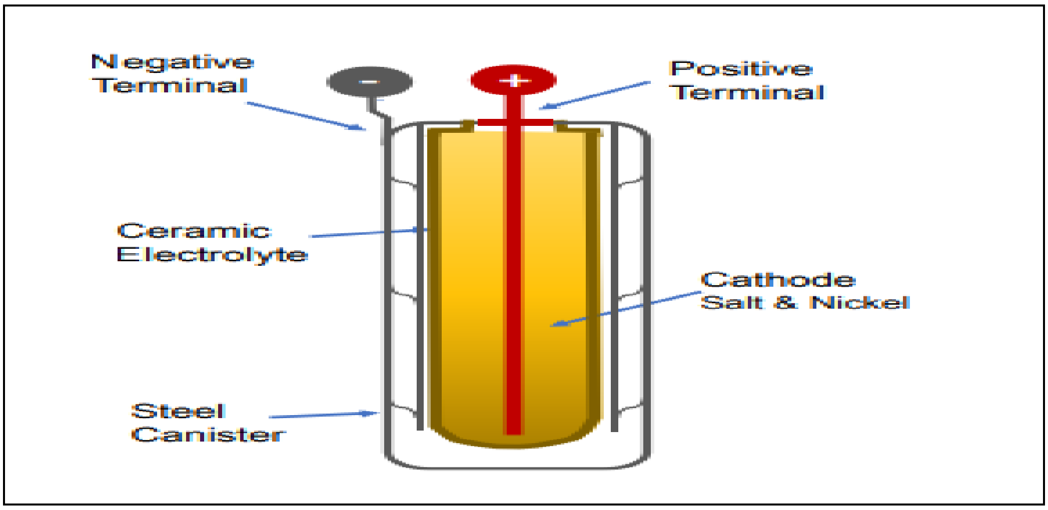
The Fraunhofer SAS batteries are in the final phase of product testing and are ready for commercialisation. The modules are also designed to fit in racks housed in sea containers that can be deployed for grid storage. SAS batteries are further likely to provide high security at low acquisition and operating costs for the stationary energy storage market.

What is a CERENERGY® battery?

The CERENERGY® battery is a solid-state sodium chloride (SAS) battery where the electrolyte is a solid inflammable ceramic tube, with a positive terminal in the centre. The cathode is a mixture of salt (i.e. sodium chloride) and nickel granules inside the ceramic tube, and the anode is self-forming molten sodium.

The battery charges when sodium ions from the salt migrate through ceramic electrode towards the anode, and discharges when the flow is the other way. The tube is flooded with sodium chloride and nickel powder to ensure contact between solid cathode granules and the ceramic electrolyte tube. The ceramic tube is placed in a steel canister, which acts as the negative terminal. The positive and negative terminals are installed at the top of the cell to transfer electrons and connect with other cells. Each cell operates at 2.58V and a collection of 240 cells is placed inside a modular casing which benefits from refractory insulation. Each module is rated at 60KWh and 100Ah (Figure 9).

Figure 9: Components of CERENERGY® batteries



Source: Company, Pitt Street Research

Sodium ions migrate from salt through the positive solid ceramic electrode towards the negative canister terminal. The remaining chloride ions attach themselves to nickel to form nickel chloride in the cathode medium. The sodium forms a molten anode layer on the external surface of the ceramic tube contacting the steel canister resulting in the battery getting fully charged. During the process of discharge, the electrons flow back, molten sodium is oxidised to Na+ ions, and is then transferred back through the tube to form sodium chloride. Nickel chloride is reduced back to metallic nickel (Figures 10 and 11).

Figure 10: Cross-section of CERENERGY® battery

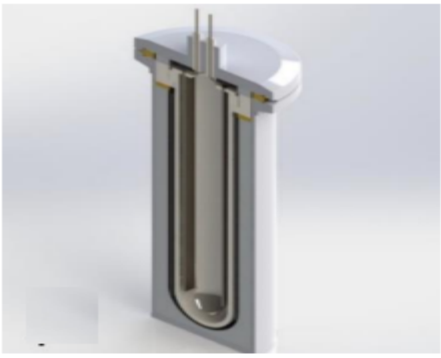
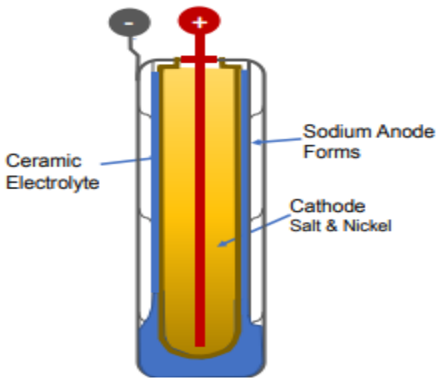


Figure 11: Fully charged, with sodium anode formed



Source: Company, Pitt Street Research

CERENERGY® batteries are very similar to the lithium-ion phosphate (LFP) batteries, providing an excellent performance in terms of energy and power density. CERENERGY® batteries provide charging of around 4-6 hours and discharge over similar times which is ideal for the grid storage market (Figure 12).

Figure 12: Battery Types Comparison

	CERENERGY battery	Redox Flow Battery	LFP Battery
Practical Energy Density (Wh/kg)	110-130 ✓	10-25	90-110
Energy Conversion Efficiency	80-85% ✓	70%	75-80%
Cycle Life	>6,000 ✓	12,000	3,000-5,000
Safety	Very High ✓	High	Medium
Capex	Low ✓	High	Medium
Operating Temp (degrees celsius)	minus 40 to 60 ✓	Sensitive to temp	15 to 35
Self discharge, % day	0 ✓	small	0.1-0.3
Maintainence Cost, USD/KW	minimal ✓	28	10

Source: Company, Pitt Street Research

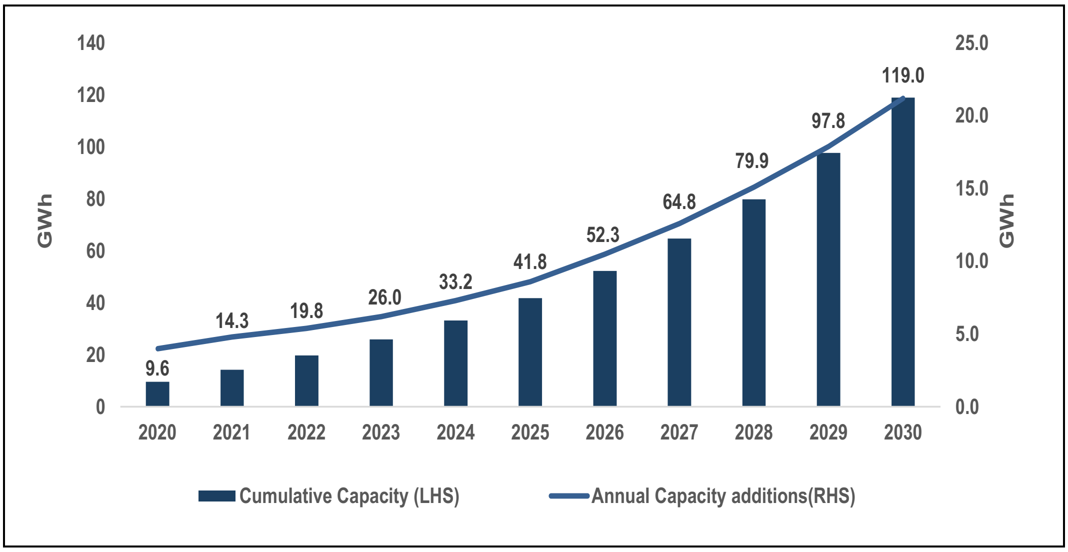
CERENERGY batteries are a better alternative to lithium-ion batteries in the grid storage market

We believe that the advantages of SAS batteries (as outlined earlier in the report) make CERENERGY® batteries a better alternative to lithium-ion batteries in the grid storage market.

Battery packs produced from the CERENERGY® battery plant will meet requirements of the grid storage market

Grid storage is a collection of methods used for energy storage on a large scale in an electrical power grid. Electrical energy is stored when electricity is abundant and inexpensive or during low demand and is returned to the grid later when demand is high and electricity prices are higher. The global grid energy storage market is an early-stage market but is expected to grow at a CAGR of 28%, from US$4.4bn in 2022 to US$15.1bn in 2027. The market is likely to grow from 20GW in 2020 to over 100GW by 2030 (Figure 13). We believe that CERENERGY® batteries are suitable for the grid storage or long-duration energy sector, where extremely high power in a short period is not required. The battery can be configured to meet >600V in grid storage. ATC is likely to manufacture its first CERENERGY® battery by early 2024.

Figure 13: Residential Battery Energy Storage Market



Source: Company, Pitt Street Research

The charge and discharge cycles of the ABS60 battery packs closely match the sun's power generation patterns

In November 2022, ATC designed and launched the CERENERGY® SAS 60KWh battery packs (ABS60) as a standard product for Europe's grid storage market for renewable energy sources. The CERENERGY® battery plant is likely to produce 1,666 battery packs per annum rated at 60KWh each. Using utility-scale storage has some advantages but is not without limitations. A key limitation of existing utility-scale storage is that it can only discharge energy for up to four hours at a time, indicating that the systems cannot provide widespread power for an extended duration of time such as during the night period. These issues are likely to be resolved by ABS60 battery packs. The battery packs are likely to take ~6 hours to charge and discharge.

Launch of 1MWh GridPack design for ATC's CERENERGY® project

In March 2023, ATC launched the 1MWh GridPack (ABS1000) for the grid storage market. Each GridPack has a rating of 600V DC and 100Ah and can be arranged in clusters or arrays for the required rating of thousand kilowatts for the functioning of grids. The GridPacks have been designed to adhere to the Ingress Protection (IP) 65 standard to ensure complete protection from both dust and inclement weather. This indicates that there isn't any need for additional shelters or buildings for the housing of ATC's GridPack batteries. The GridPacks are also likely to be constructed using a sea container design which makes transportation to the installation site by sea or road easier and helps to ensure simple installations.

Figure 14: 1 MWh GridPack (ABS1000)

Figure 15: Stackable and all-weather 1 MWh GridPack

Source: Company, Pitt Street Research

The ABS1000 GridPacks offer significant benefits ranging from a plug-and-play feature, stackable containers, absence of moving parts, low maintenance costs and ability to operate in any climate

The GridPacks (Figures 14 and 15) have several key benefits:

- **Plug-and-Play feature** - The site installation for the GridPacks benefits from a unique feature called the plug and play feature. This feature particularly ensures that they can be easily installed in remote locations.
- **Stackable containers** – The containers for the GridPacks have been designed to be modular and stackable which in turn minimises battery footprint. A key differentiating point for the stackable GridPacks is that they are stacked on top of each other unlike other mega battery pack designs currently available in the market.
- **No moving parts are required** – The GridPacks are designed without the requirement of moving parts such as cooling fans typically found in lithium-ion battery mega packs. This is a significant advantage amid concerns raised by end-consumers regarding the noise generated by

mega packs in turn preventing them from being placed near residential areas. The absence of moving parts makes ATC's GridPacks an ideal solution for noise-sensitive environments.

- **Low maintenance costs** – GridPacks have extremely low maintenance costs over their battery life
- **Ability to operate in any climate** – ATC's GridPacks are designed to operate in any climate without the requirement of thermal management. The internal temperature of the batteries is constant throughout the cycles of charge and discharge due to their endothermic and exothermic properties.
- **Benefits for the grid storage sector** – The larger battery packs have the capability to store more energy resulting in more efficient utilisation of renewable energy sources such as wind and solar power.

We believe that the proposed GridPacks are an excellent method of grid stabilisation as they provide a sound backup source during periods of high demand or when renewable sources of energy are not producing at capacity. They also serve as an economical solution for the storage and distribution of renewable energy across applications such as grid-scale energy storage, micro grids and charging of EVs. We believe that the GridPacks are likely to be the preferred choice for companies seeking an energy solution which is reliable and long-lasting.

Our Valuation of ATC

We value ATC at A$0.28 per share in our base case and A$0.39 per share in our optimistic case using a DCF valuation (as per Figure 17 on page 21). We believe this is a conservative estimate as our product build-up assumptions are highly subdued.

Our key assumptions are as follows:

- **Valuation Framework**: Given ATC is a young business operating in a consistently growing industry vertical, we have deployed a three-stage FCFF (Free Cash Flow to the Firm) as our valuation framework. In the first stage of 3 years (FY2023-2026) we believe ATC will initiate product commercialisation and try to achieve EBITDA break-even (expected in second half of the period). In the next stage of 4 years (FY2026-2030), the company will witness a strong market penetration, supported by cost rationalisation, resulting in superior profitability profile. Post the high-growth stage, we expect revenue growth to moderate over FY2031 to FY2033. Beyond FY2033, we factor in a 2% terminal growth rate.
- **Revenue**: We derive the total revenue as a function of the product volume and average sales price. The production volume has been calculated using varied capacity utilisation/product offtake scenarios, outlined where we note the differences between our base and bull cases.
- **Cost Inflation:** We are conservative on the overall operating cost. We believe that the cost inflation will keep the margin expansion limited mainly due to consistent investment requirements for research. We have assumed raw materials equate to just over 50% of revenue and depreciation as a % of the company's PPE balance. All other expenses are modelled as modest growth from FY22 levels, outlined below in the section detailing the differences between our base and bull cases.
- **Exchange rate**: We have used a 1 euro = A$1.6 exchange rate for CERNERGY – as per the average exchange rate in the month of March 2023, and a US$1=A$1.5 exchange rate for Silumina Anodes. The reason we have used different currencies is we thought it prudent to use the currencies the most recent studies were conducted in.
- **Profitability**: We have forecasted long-term EBITDA margin of >30%, possible through ATC's scale. Also, as a vertically integrated firm, ATC will have more control over its supply chain (post attaining scale), which could lead to efficiency gains.
- **Funding:** We have assumed that the company will have to raise equity (and some debt) aggressively in the next 2 years in order to fund the capacity build-up and product launches. We assume $5m in equity is raised in both FY24 and FY25. This results in 1,547.7m shares on issue by the end of FY25. We've also modelled for the receipt of the deferred consideration of 25% of Altech Industries Germany. $5.12m was received last month and a further $2.5m will be received in December 2023. The company has indicated to us that it might receive further grants and subsidiaries that could help with funding requirements. Although we have not assumed any for conservatism's sake, non-dilutive funding would inevitably be better for shareholders. If we assumed 1,080.7m shares on issue (the shares on issue during CY22), our projected equity value would be 38.6c per share in our base case and 53.8c in our bull case.
- **Discount rate and terminal value growth rate:** We have used a WACC of 12.6%. This is derived from a risk-free rate of 3.6%, a 1.50 beta and a 6.0% equity premium. We have roll-forwarded our DCF calculation to June 2024 and ***have factored in further equity dilution (FY2024 and FY2025)***.

Figure 16 depicts the sensitivity of our target share price to various WAACs.

Figure 16: Sensitivity analysis of target price for varied WACC and terminal growth rate (base case)

		WACC						
	0.277	11.1%	11.6%	12.1%	12.6%	13.1%	13.6%	14.1%
Terminal Rate	1.25%	0.34	0.31	0.29	0.26	0.24	0.23	0.21
	1.50%	0.34	0.32	0.29	0.27	0.25	0.23	0.21
	1.75%	0.35	0.32	0.30	0.27	0.25	0.23	0.22
	2.00%	0.36	0.33	0.30	**0.28**	0.26	0.24	0.22
	2.25%	0.37	0.33	0.31	0.28	0.26	0.24	0.22
	2.5%	0.37	0.34	0.31	0.29	0.26	0.24	0.23
	2.8%	0.38	0.35	0.32	0.29	0.27	0.25	0.23

Source: Pitt Street Research

Differences between our base and bull cases

The three major differences across our valuation scenarios are as follows:

- **Production ramp up**: Our base and bull cases both assumed production starts in FY24 modest amounts – 0.4% for Silumina Anodes (in conjunction with ATC's estimations that the pilot plant would produce just under 37kg per year) and 10% of CERNERGY. From there, our base case assumes 10% ramp up per annum for CERNERGY (70% by FY30). For Silumina Anodes, we assume 5% in FY26, 20% in FY26, 35% in FY27, 50% in FY28 and 70% by FY29. Our bull case assumes faster growth, both CERNERGY and Silumina Anodes reach 85% by FY30.
- **Higher sales price**: For both Silumina Anodes and CERNERGY we apply a 10% pricing premium across the life of our model.
- **Costs**: Our bull case is less conservative in relation to cost growth. The key cost to the company will be raw materials. We calculate this as a % of revenue – both start with 55% in FY24 but we assume a 1% decline per annum in our base case and a 2% decline in our bull case. We stress that although this is a decline as a percentage of revenue, this is still an increase in real terms. We assume slower growth in other expenses as well including R&D and employee benefit expenses. Depreciation & share in profit/loss of associate remains the same in both cases.

Figure 17: DCF valuation for ATC (post assumed equity dilution)

(A$ m)	Base Case	Bull Case
Enterprise Value (A$ m)	**414.5**	**578.8**
Net (debt) cash	(0.6)	(0.6)
Minority Interest	(0.2)	(0.2)
Other Investments	3.4	3.4
Provisions	(0.3)	(0.3)
Equity value (A$ m)	**416.7**	**581.0**
Diluted Shares (m)	1,502.3	1,502.3
Implied price (A$ cents)	27.7	38.7
Current price (A$ cents)	9.3	9.3
Upside (%)	198.3%	315.9%

Source: Pitt Street Research

Catalysts that could lead to a re-rating of ATC

We believe there are two main reasons for the undervaluation of ATC – a lack of funding clarity on the Silumina Anodes^{TM} project (DFS is pending) and a lack of awareness about the prospect of CERENERGY® batteries.

However, we foresee ATC being re-rated by the market, mainly driven by the following key factors/developments:

- An announcement of a **successful offtake agreement** for CERENERGY® batteries will increase confidence in the economics of the project as well as funding prospects.
- An announcement of a successful **funding arrangement**: The biggest catalyst for a value uplift would be successfully closing a favourable funding plan within the expected timelines, especially if such a deal is non-dilutive. We believe this will be a testimony of the project's economics.
- **Successful completion of the DFS**: A favourable DFS within the expected timelines would catapult the share price.
- **Timely commencement of production** for its CERENERGY® batteries and Silumina Anodes^{TM}.

Risks to our thesis

We foresee following key risks to our investment thesis for ATC:

- **Execution risk**: ATC's projects are in nascent stages. There is a risk associated with bringing the prospective product to the market and commercially establishing itself as an alternative battery manufacturer. In addition, any delay in the successful completion of DFS for the Silumina Anodes^{TM} project will also hamper the investor's confidence.
- **Funding risk**: ATC might be required to raise a substantial amount for the commencement of commercial production. Raising funds/offtake agreement on favourable terms (both debt and equity), along with timeliness, continues to be the biggest challenge for the company in the foreseeable future.
- **Commercialisation risk:** After the successful development of a new technology, it is imperative that the company has a well-rounded commercialisation strategy and the resources to implement it to gain market share in a competitive industry. Failure to execute a commercial strategy, and potentially pivot it if required, could prevent the company from realising its potential.
- **Key personnel risk:** There is the risk that the company could lose key individuals and be unable to replace them and/or their contribution to the business.

Risks related to pre-revenue Technology-driven companies in general

The stocks of technology-driven companies without revenue streams from product sales should always be regarded as speculative in character.

Since most technology-driven pre-revenue companies listed on the Australian Securities Exchange fit this description, the term 'speculative' can be reasonably applied to the entire sector.

The fact that the intellectual property base of these companies lies in technology not generally regarded as accessible to the layman adds further to the riskiness with which the sector ought to be regarded.

Caveat emptor. Investors are advised to be cognisant of the abovementioned specific and general risks before buying any the stock of any technology-driven pre-revenue stock mentioned on this report, including ATC.

Appendix I – ATC's leadership team

ATC has an experienced board and management team (Figure 18) with diverse experience across a wide range of industries including mining, processing, exploration, corporate governance and finance.

Figure 18: ATC's management and board members

	Name and Designation	Profile
	Mr. Luke Atkins **Non-Executive Chairman**	• Mr. Atkins is one of the founders of the company and has rich experience in the areas of mining, exploration, capital raising and corporate governance. • He is also the co-founder and Non-Executive Director of ASX-listed Australian Silica Quartz Group Ltd. (formerly Bauxite Resources Ltd). • He has held a variety of Executive and Non-Executive Director roles at various private and publicly listed companies, including mining and exploration companies.
	Mr. Iggy Tan **Managing Director and CEO**	• Mr. Tan has more than 30 years of chemical and mining experience in commercial mining projects, including capital raisings, funding, construction, start-ups and operations. • He has been an Executive Director in several ASX-listed companies and has previously held the position of Managing Director of Nickelore Limited, Galaxy Resources Limited and Kogi Iron Limited. • Mr. Tan holds a Bachelor of Science from the University of Western Australia and a Master of Business Administration from the University of Southern Cross. He is also a Graduate of the Australian Institute of Company Directors.
	Mr. Martin Stein **CFO and Company Secretary**	• Mr. Stein has over 20 years of international experience in capital raising, financial management, shareholder liaison and corporate governance. • He has held the positions of CFO and Company Secretary in several ASX-listed companies. He previously worked with Anvil Mining Ltd. and PwC, London. • Mr Stein holds a Bachelor of Business Degree in Finance and Accounting from Edith Cowan University. He is also a Fellow of the Institute of Chartered Accountants in Australia and New Zealand and a Chartered Company • Secretary from the Governance Institute of Australia.

	Mr. Daniel Lewis Tenardi **Non-Executive Director**	• Mr. Tenardi has over 40 years of experience across a range of commodities, including iron ore, gold, bauxite, and copper in the mining and processing sector. • His previous experience includes 13 years at Alcoa's bauxite mines in the Darling Range in Western Australia and at Alcoa's alumina refinery in Kwinana. • He has held senior roles in various ASX-listed companies, including the founding Managing Director of Australian Silica Quartz Group Ltd. (formerly Bauxite Resources Ltd) and a Non-Executive Director of Grange Resources Ltd.
	Mr. Peter Bailey **Non-Executive Director**	• Mr. Bailey has a lot of experience of over 40 years in the iron ore mining, bauxite mining, zinc-lead-copper mining, alumina refining and alumina chemicals industries. • Previously, he was the CEO of Sherwin Alumina, an alumina refinery based in Texas, US. Additionally, he was the President of Alcoa Bauxite and Alumina and the chairman of the Alcoa Bauxite JV in Guinea, Africa. • Mr. Bailey holds an electrical engineering degree from the University of London.
	Tunku Yaacob Khyra **Non-Executive Director**	• Mr. Khyra is the major shareholder and Executive Chairman of the Melewar Khyra Group of Companies (Melewar), a Malaysia-based diversified financial and industrial services group. • He sits on the Boards of various companies, including Khyra Legacy Berhad, Mycron Steel Berhad, MAA Group Berhad, Melewar Industrial Group Berhad and Ithmaar Bank B.S.C. • Mr. Khyra holds a Bachelor of Science (Hons.) Degree in Economics and Accounting from City University, London. He is also a fellow of the Institute of Chartered Accountants in England & Wales and a member of the Malaysian Institute of Accountants.
	Mr. Uwe Ahrens **Alternate Non-Executive Director**	• Mr. Ahrens is the Executive Director of Melewar Industrial Group Bhd and the Managing Director of Melewar Integrated Engineering Sdn Bhd. • Mr Ahrens has also held a senior management position in KOCH Transporttechnik Gmbh in Germany (now belonging to FLSmidth Group) for 12 years. • Mr Ahrens holds dual master's degree, in Mechanical Engineering and Business Administration, from the Technical University Darmstadt, Germany.

Source: Company

Appendix II – Glossary

Anode – An electrode in a polarised electrical device through which current flows in from an external circuit. The anode is the electrode where an oxidation reaction takes place. The charge of the anode is positive.

Capacity loss – A phenomenon in rechargeable battery usage where the amount of charge delivered by a battery at the rated voltage decreases with usage.

Capacity retention – A measure of the ability of a battery to retain stored energy during an extended open-circuit rest period. Retained capacity is a function of the length of the rest period, the cell temperature during the rest period and previous history of the cell.

Cathode – An electrode in a polarised electrical device through which current flows out. The cathode is the electrode where reduction reaction takes place. The charge of the cathode is negative.

Electrochemical – Relates to the production of chemical changes using electricity.

Energy density – Measure of how much energy a battery contains in proportion to its weight. The measurement is presented as Watt-hours per kilogram (Wh/kg).

Kaolin – A fine soft clay stemming from the natural decomposition of other clays. It is used for making porcelain and china as a filler in paper and textiles, and in medicinal absorbents.

Metallurgical silicon – Silicon metal is also called metallurgical grade silicon (MG Si, MGS). MG Si has a higher purity than the more common ferrosilicon, an alloy of iron and silicon at 15-90% silicon content. It is primarily used in large volumes in steel and cast-iron production.

Solid electrolyte interphase (SEI) – An ion conductive yet electron-insulating layer on battery electrodes, formed by the reductive decomposition of electrolytes during the initial charge. The nature of SEI significantly impacts safety, power and lifetime of batteries.

Appendix III – Major Shareholders

Investor Name	Ownership (%)
Deutsche Balaton Aktiengesellschaft	11.8%

Source: S&P Capital IQ

Appendix IV – Capital Structure

Class	In millions	% of fully diluted
Quoted Securities		
Ordinary shares on issue	1,427	97.9%
Unquoted		
Options and performance rights	30.1	2.1%
Fully diluted shares	**1,456.8**	

Source: Company, Pitt Street Research

Appendix V – Analysts' Qualifications

Stuart Roberts, lead analyst on this report, has been an equities analyst since 2002.

- Stuart obtained a Master of Applied Finance and Investment from the Securities Institute of Australia in 2002. Previously, from the Securities Institute of Australia, he obtained a Certificate of Financial Markets (1994) and a Graduate Diploma in Finance and Investment (1999).
- Stuart joined Southern Cross Equities as an equities analyst in April 2001. From February 2002 to July 2013, his research speciality at Southern Cross Equities and its acquirer, Bell Potter Securities, was Healthcare and Biotechnology. During this time, he covered a variety of established healthcare companies, such as CSL, Cochlear and Resmed, as well as numerous emerging companies. Stuart was a Healthcare and Biotechnology analyst at Baillieu Holst from October 2013 to January 2015.
- After 15 months over 2015–2016 doing Investor Relations for two ASX-listed cancer drug developers, Stuart founded NDF Research in May 2016 to provide issuer-sponsored equity research on ASX-listed Life Sciences companies.
- In July 2016, with Marc Kennis, Stuart co-founded Pitt Street Research Pty Ltd, which provides issuer-sponsored research on ASX-listed companies across the entire market, including Life Sciences companies.
- Since 2018, Stuart has led Pitt Street Research's Resources Sector franchise, spearheading research on both mining and energy companies.

Nick Sundich is an equities research analyst at Pitt Street Research.

- Nick obtained a Bachelor of Commerce/Bachelor of Arts from the University of Sydney in 2018. He has also completed the CFA Investment Foundations program.
- He joined Pitt Street Research in January 2022. Previously he worked for over three years as a financial journalist at Stockhead.
- While at university, he worked for a handful of corporate advisory firms.

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