

A Work Project, presented as part of the requirements for the Award of a Master Degree in Economics / Finance / Management from the NOVA – School of Business and Economics.

Albemarle: Riding the EV Revolution – Is Lithium the Future?

António João Seco Serafim Eugénio Sabugueiro – MSc in Finance - 44008

A Project carried out on the Master in Finance Program, under the supervision of:

Angelo Corelli

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Abstract

This Report contains a valuation of Albemarle Corporation (Ticker:ALB) as of December 2021. In this reports objective is to accurately value the stock price returns on a 12 month basis. In this report it was used a discounted cash flow valuation in order to arrive at the intrinsic value of Albemarle. The report will discuss and analyze the drivers that will influence Albemarle in the future, more specifically their balance sheet, income statement, and free cash flows in the next 19 years. At the end of the report a sensitivity analysis as well as a scenario analysis were made as a way to validate the results and test the model against different variables. A multiple analysis was performed in order to compare Albemarle with its peers.

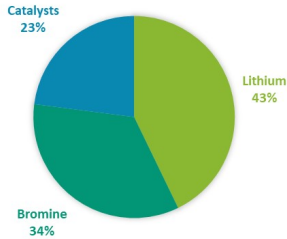
Albemarle, Lithium, Bromine, Catalysts

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This report is part of the ... report (annexed) and should be read as an integral part of it.

Company Description

SALES BREAKDOWN BY UNIT 2021



Graph 2, Source: Company Financials

SALES BREAKDOWN BY UNIT 2026

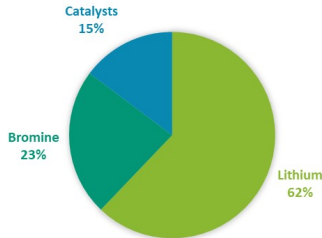


Table 1, Source: Company Financials

(\$ in Millions)	FY 2021			
	Q1	Q2	Q3	Q4
Lithium				
Revenues	279	320	359	438
% Revenues	34%	41%	43%	48%
Adj. EBITDA	106	109	125	138
Margin	38%	34%	35%	32%

Lithium is the biggest and most relevant unit for ALB going forward.

Albemarle Corporation (ALB) is a fine chemical manufacturing company that was founded in 1994 and is based in Charlotte, North Carolina. ALB focuses primarily in developing, manufacturing, and marketing of chemicals for consumer electronics, petroleum refining, utilities, packaging, construction, transportation, pharmaceuticals, crop production, food-safety, and custom chemistry services. ALB splits in three main business units, them being Lithium (which represents 41.84% of Albemarle's revenues in 2021), Bromine Specialties (33.47%), and Catalysts (22.45%). Additionally, the All-Other business unit accounted for 2.25% of sales; however, Albemarle conducted the sale of this segment in 2021. Currently, the Company has sales in 75 countries, with North America representing 26% of sales, EMEA representing 24%, Asia representing 48% (with China alone accounting for 14%), and the RoW representing 2%. ALB is a NYSE listed company, and part of the very restricted group of companies belonging to the S&P 500 Dividend Aristocrats Index. As of 17th of December 2021 the company has a market capitalization of \$27.01Bn

Business Units

▪ Lithium

Lithium is currently the largest unit and the one with the highest growth expectations. It is expected that Lithium will account for 62.24% of Albemarle's revenues by 2026. The Lithium unit engages in developing and manufacturing of basic lithium compounds. ALB produces **lithium carbonate**, which is the first chemical in the production chain, and it is where other lithium derivatives are derived from, such as **Lithium hydroxide** which is also produced by Albemarle. It is used in a great variety of applications, such as frits for the ceramic and enamel industries, heat resistant glass, aluminium production, pharmaceuticals, and lithium-ion batteries. Albemarle produces lithium carbonate at La Negra, Antofagasta in Chile, and in Nevada, USA. It produces **lithium hydroxide** in the USA and Germany. Its main use is as a reagent in high-performance lithium greases, dyes, and in lithium-ion batteries. Finally, ALB produces **lithium chloride**, which is a raw material required for the electrolysis of lithium metal, and is produced in Chile, USA and Germany.

ALB also produces **value-added lithium specialties** and **reagents**. ALB is the largest provider of lithium for electric vehicle batteries as of today. In fact, ALB, together with 3 other competitors (Ganfeng, Tianqi and Sociedad Química y Minera de Chile, or SQM), collectively produce over half of the worlds'

lithium and lithium storage products, thus making the lithium market an oligopoly.

Table 2, Source: Company Financials

	FY 2021			
(\$ in Millions)	Q1	Q2	Q3	Q4
Bromine				
Revenues	280	280	278	279
% Revenues	34%	36%	33%	31%
Adj. EBITDA	95	93	86	101
Margin	34%	33%	31%	36%

▪ Bromine Specialties

Bromine Specialties is Albemarle's second largest unit, expected to represent 23.1% of revenues by 2026, a decrease from the initial 33.47% in 2021, as the Company becomes more invested in its Lithium unit. The Bromine Specialties segment consists of products used in fire safety solutions and other specialty chemicals applications such as antioxidants and blends which concentrate on improving storage life and stability of fuel and other lubricant products, being a more stable business it contributes to the decrease in volatility of earnings of Albemarle.

Table 3, Source: Company Financials

	FY 2021			
(\$ in Millions)	Q1	Q2	Q3	Q4
Catalysts				
Revenues	220	148	194	187
% Revenues	27%	19%	23%	21%
Adj. EBITDA	25	21	33	43
Margin	12%	14%	17%	23%

▪ Catalysts

Catalysts is the smallest business unit and it is expected to represent only 14.66% of revenues by 2026. The Catalysts unit contains two main divisions: clean fuel technologies - through HPC catalysts that allow oil fractions to be upgraded into clean fuels and other usable oil products -, and heavy oil upgrading – through FCC catalysts which are used in the conversion of a variety of feedstocks. Additionally, the Company also produces PCS (Performance Catalyst Solutions) such as Organometallics and Curatives.

Industry Overview – Lithium

Lithium is the biggest and most relevant unit for ALB going forward. The unique business conditions that were created due to the exponential increase in the electric car market have given ALB a great opportunity to shift their focus to Lithium.

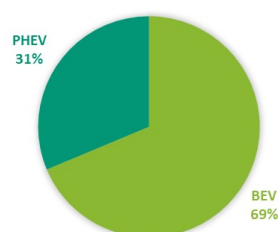
▪ EV Market

There are four main types of EVs: Battery (BEV), where the battery produces 100% of total electricity; Hybrid (HEV), which uses multiple different technologies, Plug-in (PHEV), which can run on both battery and gasoline and Fuel Cell (FCEV), which is similar to BEVs, but uses a fuel cell instead of a battery. All have experienced a great increase in sales from 2020 to 2021 across most geographies.¹ In fact, there have been more electric vehicles sold in the first three quarters of 2021 (4,329,227) than the whole year of 2020 (3,226,698).

EMEA: The EMEA region accounts for ~38% of EV sales worldwide and is mainly dominated by Germany, who sold 482,418 electric vehicles from Q1-Q3 2021 - an 11.29% increase compared to the whole year of 2019 -, and represents

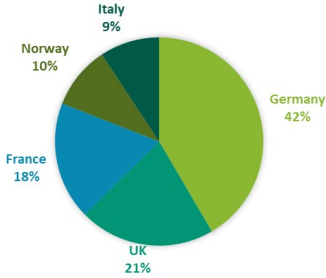
Graph 3, Source: Bloomberg

MARKET SHARE BY EV TYPE



Graph 4, Source: Bloomberg

MARKET SHARE BY COUNTRY EMEA



Graph 5, Source: Bloomberg

MARKET SHARE BY REGION

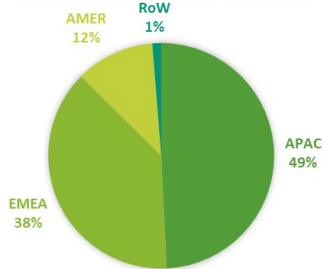
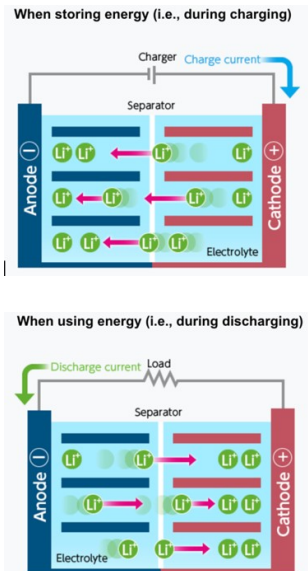


Figure 1: Source: Toyota website



~29% of the EV market in EMEA and ~11% globally. Second in line is the UK, with 244,524 electric vehicles sold from Q1-Q3 2021, compared to 182,618 in the previous year, followed by France, Norway and Italy, which, combined, sold 433,856 EVs in Q1-Q3 2021 versus 375,113 in 2020.

APAC: Accounting for ~49% of total EV sales in the world, it is almost entirely dominated by China, which represents for ~94% of the region and had 1,999,342 electric vehicles sold in the first three quarters of 2021, which translates into a staggering 65.23% increase from the whole previous year. China is, in fact, and by a large amount, the country with the highest market share of the electric vehicle market, followed by Germany (~11%) and the United States (~10%).

AMER: Having already sold 437,910 EVs in the first three quarters of this year, it follows the trend to have already surpassed the year before by 11.14% and is the country with the third largest EV market share (10%)

Because Albemarle sells its products worldwide, it should therefore capture the growth of the EV market on a global scale, which diversifies away the individual unsystematic risk of each geography. Additionally, the Company has started to heavily invest in the Chinese market, which has been the clear leader of the EV revolution with prospects to rise even further.

▪ Lithium Batteries

Lithium-ion batteries were the main driver for lithium demand in 2021, it is **expected that by 2030 lithium-ion batteries will be responsible for 93% of the total demand of lithium worldwide**. Lithium-ion batteries have 3 main uses: Portable devices, such as phones; Power tools such as drills and saws; and lastly Electric Vehicles which are the biggest and most important driver of the lithium demand in the future. Lithium batteries are still a relatively new technology, and it is increasing its efficiency year over year, making it possible to compact higher levels of lithium in smaller and smaller form factors, driving even higher the demand for lithium worldwide.

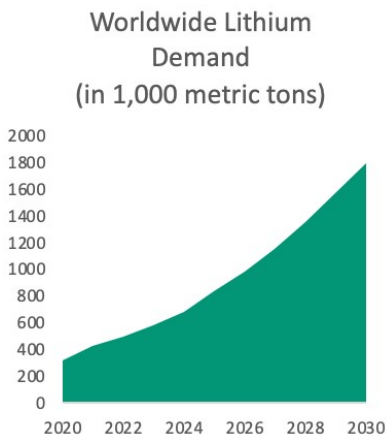
The principle behind the Li-ion batteries is the generation of electric energy through an electron discharge caused by a difference in potential between two electrodes (one negative and one positive), with these electrodes both being immersed in an ionic liquid, the electrolyte. Because the electrolyte is only permeable to positively charged particles, it forces the electrons to flow through an external circuit, attracted by the positive side of the power source, thus generating an oriented flow of electrons, i.e., electricity. When charging, the flow is opposite.

Because lithium is the element in nature with the highest electrochemical potential, i.e., it is the element with more tendency to lose electrons, hence being the element with the most potential to transmit energy, it is the best choice for powering EVs.

▪ Internal Combustion Engine vs Li-ion Battery (EV)

The majority of vehicles worldwide are Internal Combustion Engine (ICE) vehicles. However, these have, on average, a very low efficiency of only 25%, which means the remaining 75% of energy created is wasted (Verma et al, 2021). Conversely, EVs have an average efficiency of 80%. But, as in all, there is a trade-off: although EVs are much more efficient, they have considerably less total mileage per charge and present a considerably higher recharging time compared to simply refuelling an ICE vehicle (Verma et al, 2021). As of 2021, the top 3 best selling EV vehicles are Tesla's Model Y, with its price starting at \$41,190 and with a range of However, as technology progresses, automakers are able to pack more lithium in smaller batteries making the expected average KWh per EV 61KWh in 2025. The battery packs currently in production are capable of 20%-40% of improved energy density while lowering costs. This current technology is expected to be the standard of lithium batteries until 2025, where a new technology already in development is expected to be able to double the energy density while cutting in half the costs of production for the batteries. ALB is able to capitalize on these technologies advancements without the cost of developing them due to their position on the market, i.e., being a provider of lithium, rather than a producer of batteries.

Graph 6, Source: Comisión Chilena del Cobre



▪ Demand for Lithium

The demand for lithium worldwide is only expected to increase. In fact, forecasts suggest that lithium demand will double by 2025 as the total lithium demand is expected to be 839 ktpa vs the value of 2021 of 429 ktpa. The demand will be driven by the increase in EV adoption, as well as advancements in battery technology that will allow batteries to be more compact while being able to carry more lithium. (graph Source: Comisión Chilena del Cobre)

It is expected that the supply of lithium will be able to match its increasing demand in the next couple years, making it crucial for lithium producers/suppliers to be able to deliver and be able to supply this hot market. It is expected that lithium focused companies will be working at full capacity and looking to expand it as fast as they possible can in order to keep up with the exponential increase in demand for this metal.

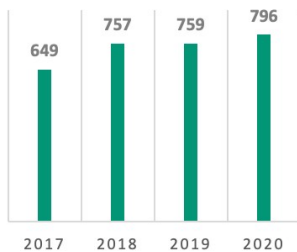
Competitors

As Albemarle heads towards a higher allocation to lithium, the Company's competition will revolve around lithium-intensive companies. Additionally, ALB being one of the top suppliers of lithium worldwide, its main competitors will also be major players in the industry. Global lithium producers are primarily located in the Americas, Asia and Australia.

▪ Ganfeng Lithium Co., Ltd

Graph 7, Source: Bloomberg

GANFENG REVENUE PER YEAR



Based in China and quoted on the Shenzhen Stock Exchange, Ganfeng positions itself along the lithium battery supply chain, from lithium resource development, refining and processing to battery making and recycling, with uses in the electric vehicle market, chemicals, and pharmaceuticals. The Company does business both domestically, as well as across the globe.

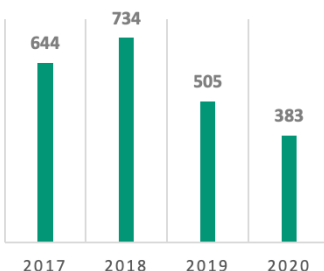
Ganfeng has been experiencing an exponential growth, with its market cap rising from \$5,963.8 Bn at the year-end 2019, to a current (as of 15th Dec. 2021) \$32,343.9Bn. Furthermore, Ganfeng's revenues have increased a staggering 86.2% since the beginning of the year, while still being able to increase its EBITDA margin, which was around 20% in both 2019 and 2020, which compares with the EBITDA margin of 34.4% of Albemarle in 2020. Albemarle's extra experience and bigger size allow them to create synergies with other business units which end up making their margins bigger which translate in larger bottom lines, and untimely will allow Albemarle to grow more sustainably than most of its competitors.

Additionally, there is a clear distinction with regards to capital invested compared to Albemarle, with the Chinese giant investing on average (in the period 2017 – 15th Dec.2021) a mere \$187Bn, which significantly contrasts from ALB's average investment in the same period of \$734Bn, i.e., ALB has invested, on average, ~293% more than Ganfeng.

▪ SQM

Graph 8, Source: Bloomberg

SQM REVENUE PER YEAR



SQM is a Chilean company that is currently trading in the NYSE with a market cap of ~\$16 billion. SQM is perhaps the peer that shares the most similarities with Albemarle, starting with the fact that they also have other business units related to other speciality chemicals like Albemarle, and they have a lot of their extraction coming from Chile. SQM's lithium unit had total sales of \$383 million in 2020, however this value is expected by analysts to be \$820 million in 2021 with an ebitda margin of 43% which is in line with that of Albemarle as they share

similar cost structures, and both can take advantage of the synergies that all the business units together can bring.

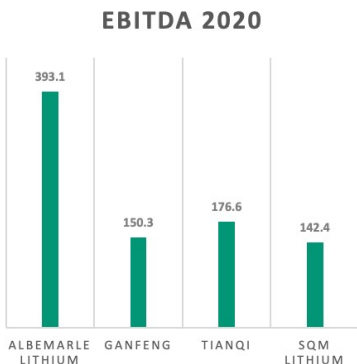
Graph 9, Source: Bloomberg



Graph 10, Source: Bloomberg



Graph 11, Source: Bloomberg



Graph 12, Source: Bloomberg



■ Tianqi Lithium

Tianqi Lithium is the third biggest Lithium producer based on market cap. Like Ganfeng, it is located in China, and it is also traded on the Shenzhen Stock Exchange. Tianqi is involved in the development, manufacturing and sale of lithium products worldwide, such as lithium chloride, hydroxide and other lithium-related products.

Like Albermale and Ganfeng, Tianqi saw its market capitalisation significantly rise from \$5,963.8 Bn at the end of 2019 to a current value (as of 15th December 2021) of \$32,343.9 Bn, which represents a ~442% increase in 2 years time. This growth was driven by the increase in revenue of 45.4%. On the other hand, Tianqi's EBITDA has been suffering constant hits, with the former decreasing from 553.3 in 2017 to 369.3 in 2019. In fact, Covid's impact on the Company is evident in their very modest EBITDA result in 2020 of just \$176.6Bn. Additionally, not only does the EBITDA significantly decrease, but also its margin, decreasing from 68.3% in 2017 to 52.7% and 37.6% in 2020 and 2021, respectively.

In line with Ganfeng, Tianqi's Capital Expenditures are situated at a much lower level, averaging ~\$322Bn in the period starting at 2017 until today (as of 15th Dec 2021), meaning that ALB has invested, on average, ~128% more than Tianqi in the past 5 years.

■ ALB vs Competitors

Capacity wise, Ganfeng has promised to reach a capacity of 200ktpa in 2025, while Tianqi has a current capacity of 44.8ktpa of lithium compounds, with a “mid-term” promise of reaching 112.8ktpa. This contrasts with the capacity that we predict for Albemarle of 287.5 ktpa in 2025. In an industry where all predictions point to a supply gap in lithium, it is extremely important to understand if Albemarle will be able to keep their market position as a prime supplier of lithium in the market. Because we believe Albemarle will be able to have their plants at constant full capacity, aligned with the fact that the Company is actively and heavily investing in more lithium plants – more than competitors, while at the same time being set to grow at a faster pace than competitors, we believe that ALB will improve its positioning in the market and will ultimately raise its market share. In fact, based on our analysis, Albemarle's market share in 2025 will be ~18% higher compared to 2021.

Industry Overview – Bromine

Bromine is Albemarle’s second biggest business unit. This unit plays a forefront role in providing performance products for fire safety, oil drilling, pharmaceutical manufacturing, high-tech cleaning, water treatment, food safety and many more. While fairly unknown to most people bromine is an essential chemical element which is present in almost every industry. This makes the Bromine business extremely stable, with high barriers of entry and healthy margins. ²

Bromine’s Industry

Bromine industry to grow at a CAGR of 5% until 2028.

The Bromine industry as a whole is expected to grow at a CAGR of 5% until 2028,³ it has recently been affected by the Covid-19 pandemic due to a disruption in the supply chain, as well as with a decline in the manufacturing industry which slowed down the market growth. This translated into a decline of Bromine sales for Albemarle of 3.91% in 2020. Albemarle was quick to recover with its sales in the Bromine expected to rebound by 15.78% in 2021. The 3.91% decrease was fairly small when compared to other industries because of the nature of this market. While oil and gas demand decreased severely, the demand for pharmaceuticals and wastewater treatment for example increased, offsetting the negative impacts of the oil and gas demand.

As previously said Bromine is mostly used as a flame retardant. There are around 80 types of brominated flame retardants, which have a wide variety of chemical properties. More than 50% of the use of bromine is for the prevention of fires in electronics and electrical equipment and with the increased demand for electronics, and technology advancements around the world, bromines’ importance in our day-to-day safety becomes even more important. Albemarle will be able to capitalize on this by according to our expectations achieving a Cagr of 5.76% in sales until 2026.

China presents itself as the main growth opportunity for Albemarle’s Bromine unit.

The Bromine industry typically moves with the GDP of a given country, one of the biggest opportunities for the industry currently is China, which is expected to grow in the high single digits in the following years. The country will be investing \$1.43 trillion in the next 5 years in major construction projects that consist of ultra-high voltage energy projects, big data centres, high-speed railway’s, 5G base stations, and electric vehicle charging stations. Bromine is essential in all of these developments and the industry will take full advantage of it. To add to this, China is known for being a global producer of electronics, such as smartphones, TVs, wires and cables which are highly dependent of the flame retardant

attributes of bromine. China is also the largest crude oil producer in the Asia-Pacific region, which is also an industry highly dependent on bromine, it is expected for China to increase the output of their oil drilling industry which will therefore require a higher demand for bromine.

▪ Competitive Environment

The Bromine industry is a highly concentrated one, with few players, and high barriers of entry.

The Bromine market is an extremely concentrated one, this is naturally an advantage to Albemarle as it solidifies its position in the market. The market is dominated by 5 major players, them being ICL, Gulf Resources, Inc., Jordan Bromine Company, Lanxess, and Albemarle. Due to this highly concentrated market, we believe that growth through acquisitions to not be a viable option for Albemarle as any merger between 2 of these 5 players would potentially be denied by the regulators. Albemarle consistently experiences EBITDA margins of their Bromine unit in the low 30% (34% in 2020) versus margins in the low 20's for ICL (who is the biggest player in the market in sales revenue) which had an EBITDA margin of 19.6% in 2020. Albemarle is able to have higher margins mostly due to synergies that they can create within their three business units, but mostly between the Lithium and Bromine units, which many times share characteristics and can share costs.

Industry Overview – Catalysts

The Catalysts' unit is highly dependent on the oil and gas industry

The Catalysts unit focuses primarily in two types of businesses, one being fluid catalytic cracking catalysts (**FCC**) which is a substance that increases the rate of chemical reaction, this is key in the oil and refinery industry as it allows them to become extremely more efficient, since the activation energy is reduced making the process of rupturing high molecular weight hydrocarbon chains a lot for efficient, resulting in a higher proportion of gasoline produced. The Clean Fuel Technologies associated with **HPC** (hydroprocessing catalysts) focuses in allowing oil fractions to be upgraded into clean fuels, and other usable oil products. They achieve this by removing sulfur, nitrogen and other impurities, not only by applying their products but also due to their application expertise that drivers the optimum catalyst system design for each client. Lastly, **PCS** (Performance Catalyst Solutions) are subdivided in organometallic products, which are used in packaging, toys, pharmaceuticals and electronic devices and curatives, which are used to cure polyetheranes, epoxies and polyureas.

Catalysts Industry

Catalysts are a crucial part of both the chemical industries and research industries due to their use for accelerating chemical reactions without being

Catalysts' industry severely affected by plunging oil demand in 2020

subject to any change in the reaction itself. In 2020 the catalysts industry was heavily affected by Covid-19, mostly due to the sharp decline in oil demand, this translated into a decrease in sales of 24.85% for Albemarle's Catalysts unit. The decline is expected to be carried through 2021 where we expect a decline of another 6% in sales, mostly due to the still below ideal oil demand in part of 2021. Positive growth is expected in 2022 as the oil demand comes back to pre-covid levels as well as the volatility in oil prices decreases. Catalysts are naturally dependent on the oil cracking industry.

▪ Oil and Gas Industry

The current high prices of oil are a disincentive for the industry to seek cleaner and more efficient fuels

As previously discussed, the catalyst unit of Albemarle is almost fully dependent on what the trends of the oil and gas industry are. This is an industry that has rebounded in 2021 but still shy of the pre-covid levels, while the recovery was better than expected, uncertainty remains over market developments for 2022 and the future. Going forward the key factors that will determine how well the oil and gas industry will succeed in the long term will naturally be linked to their capability to become more environmentally friendly as well as more efficient, reducing their hefty carbon footprint in our plant. This is where the FCC and HPC can be of great help. FCC's help plants to become more efficient, effectively reducing energy waste, and HPC allow fuels to be transformed into better alternatives, one of the main ways that this is achieved is by removing through a chemical reaction the sulfur present in fuels. While energy transition is definitely in the industry future going forward, such transition might be jeopardized due to the current oil prices. With oil prices at all-time highs, the industry has little to no incentive to change to more environmentally friendly alternatives, making them more focused in the short term with their core business, capitalizing on the current oil prices. This is key not only to the catalyst's unit for Albemarle, but for the company as whole, as the Lithium unit benefits heavily on a fast transition to cleaner fuels. While at the moment this is an industry that is growing at the pace of GDP, we have reasoning to believe that with the electrification of the vehicle market, and the transition to cleaner energy will make the oil and gas industry a slow grower.

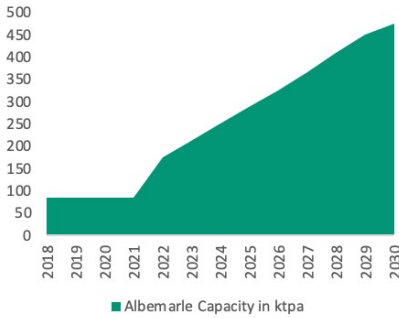
Soaring oil prices produce a negative effect on Albemarle's core businesses.

Investment Strategy

▪ Capex

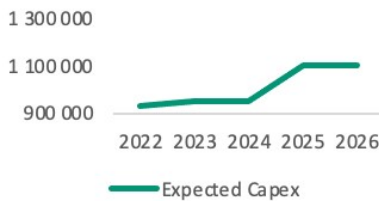
In 2015, ALB acquired their first lithium conversion plant. With a total capacity of 30 kilotons per Annum (ktpa) this marked the start of ALB's strategy to invest heavily on lithium. Fast forward to today and ALB has a total capacity of 150 ktpa, with expectations to arrive at **175 ktpa by the end of 2022**. We believe

Graph 13, Source: Analyst Estimates



Albemarle set to increase its capacity to 475 ktpa by 2030.

Graph 14, Source: Analyst Estimates

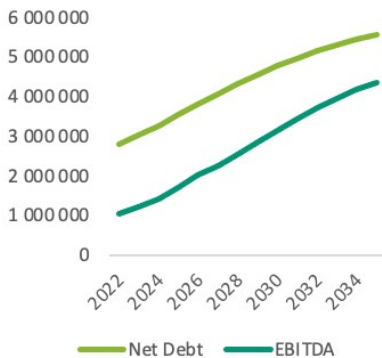


this target will be achieved as its La Negra III and IV plants construction is already on its final stages and because Covid related restrictions are being eased around the globe, hence no more delays are expected on the plant openings. This puts ALB in the forefront of lithium production, which sets the Company in an extremely favourable position in the lithium market, which is increasing at a rapid pace. With the current plants in place ALB expects to have a potential resource capability of around 475ktpa by 2030. ALB has one of the most diversified networks of plants in the industry, currently having plants in the Americas, China, and Australia. This diversification of plants keeps ALB's risk of regulation relatively low when compared to its peers. It is ALB's will keep pursuing expansion, ALB plans to spend ~\$4B in CapEx in the next 3-5 years. This will allow them to construct 4 new plants that should increase capacity by another 150ktpa. From 2017 to 2020 Albemarle spent more than \$2B in Lithium Capex, and we thus have reason to believe that this trend will continue going forward and at a faster rate due to the various agreements that Albemarle already has in place for plant constructions. With this in mind, we believe that a predicted capex of \$930 million for 2022 is reasonable for the next year, with two plants coming online. This value will not suffer significant increases through 2023 and 2024, as the availability of funds is lacking, and Albemarle has several times expressed their unwillingness to fund their growth with debt that would exceed their ideal capital structure. As earnings increase, they then plan to further increase their capacity by another 125-175 ktpa with further investment (\$1.1B in 2025 and 2026) that the Company will fund through enhanced FCF. As the increase in plant capacity is crucial for Albemarle's success going forward and driven by this increase in FCF, we have reasons to believe that these investments will be realized.

We additionally expect Albemarle to have their costs of expansion significantly reduced due to their expertise in large-scale project construction, as well as the use of standardized projects that can be rapidly repeated and at a lower cost. This will ultimately allow the Company to become more efficient with their capital allocation and therefore increase shareholder value. It is important to have into consideration that as PP&E increases, so does the depreciation expense, with this value being \$304 million in 2024, due to the heavy maintenance costs and need of constant reinvestment, we assumed that Albemarle will spend part of their CapEx in keeping the PP&E of their Bromine and Catalyst units constant. The company shows no interest or plans of expanding either one of these units, with an expected depreciation that we estimate to be around the \$120 million mark, we believe that most of the Capex will still be available to fund growth of the Lithium unit.

▪ Leverage

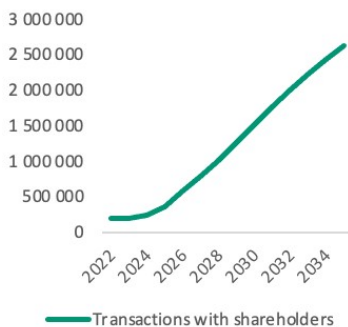
Graph 15, Source: Analyst Estimates



When it comes debt usage, ALB wants to sustainably increase their capacity, meaning they do not want to increase their debt levels past a certain threshold. We estimate that Albemarle will target a debt to value ratio of 30.5% and will remain at this level in the foreseeable future. ALB's net debt to Adjusted EBITDA was around 4.4x during 2020, with this value now sitting at 2.6x. It is ALB's objective to be between 2.5x and 2.0x Net Debt to Adjusted EBITDA in order to maximise their capital structure. This means that ALB still has a little room to increase their debt in order to fund part of their future CapEx. We believe that Albemarle will keep their total invested capital constant at 40%, as this value is consistent with their short-term goal of 2.0 to 2.5x adjusted EBITDA. This value will also allow Albemarle to keep their weighted average cost of capital both lower and constant. Based on the company annual and quarterly reports, we know that the company's ideal mix of debt to total value will seat at 30.5% of debt to value, which in turn implies a debt-to-equity ratio of 44%. According to our model, we expect Albemarle to reach this mix relatively fast - in 2022 -, as their increase their debt levels in order to fund growth of the lithium unit. Albemarle will have a net debt value of \$2.8 billion vs a \$9.2 Bn of Value; by 2030, this value is expected to evolve to \$4.8 billion in net debt and \$15.5 Bn in Value.

▪ Transactions with shareholders

Graph 16, Source: Analyst Estimates



ALB has paid \$173 million in dividends as of 09-30-2021, making a 27th consecutive year of dividend increases, making them one of the only 65 companies to be part of the Dividend Aristocrat ETF which includes 65 companies that have increased their dividend payment for at least 25 straight years. It is ALB's intention to keep rewarding their shareholders by keeping their dividend hikes in the foreseeable future. We expect the dividend to keep growing and share buybacks to be part of the equation in the future. We have reason to believe that Albemarle will increase their dividends for the 28th consecutive year in 2022 as we predict a total of \$191 million in dividends. In 2021, Albemarle has issued \$1.5 Billion worth of their own stock in order to fund growth in their Lithium business unit. We do not expect Albemarle to start buying back their own stock until free cash flow is positive.

▪ Non-core Business

In July 2021, ALB has concluded the sale to W.R. Grace of their Fine Chemistry Services (FCS) segment, one of their non-core businesses, for a sum of \$570M (\$300M in cash and \$270M funded through the issuance to ALB of

ALB sold their Fine Chemistry Services (FCS) segment to W.R. Grace for \$570M - \$300M cash & \$270M preferred equity

non-participating preferred equity of a newly create W.R. Grace Subsidiary). ALB used these proceeds to further fund their CapEx. Furthermore, ALB has recently gone through a review of their Catalysts unit. The review was brought upon driven by concerns about whether the catalysts business unit was in line with Albemarle’s goal of seeking high growth opportunities. Ultimately, Albemarle decided not to go through with the sale, as the Company believed that the Catalysts unit will grow above GDP in the foreseeable future, and this extra growth will be able to enhance its FCF, which will then be used to fund further growth opportunities. Based on our model, the Catalysts unit sales should grow at a CAGR of 3.93% from 2022 until 2028, above the long-term GDP growth rate.

Projections and Financial Analysis

We make our projections having in consideration the three business units of Albemarle. Due to their differences in nature, their core drivers naturally differ. It is expected **the segment that will contribute the most for the growth of Albemarle will be the lithium business unit** and, therefore, it will represent the most significant contribution to the overall valuation of Albemarle. When projecting each line going forward, we based our estimates on the main drivers that influence each figure for each of the units.

When forecasting the lithium revenues for the fourth quarter of 2021, we used the average value of the previous 3 quarters, to which we applied our drivers that will be explained below in order to arrive to Q4 earnings of \$441M and year ending sales for the lithium unit of \$1.4Bn. For the Bromine and Catalyst units, we assumed that the quarter 4 earnings would be equal to their previous 3 quarters average as both these units in the past have showed extremely steady earnings throughout all 4 quarters. With this we arrive at a Q4 sales value for Bromine of \$279,300,000 and a value of \$187,367,000 for Catalysts, which translate into 2021-year-end sales of \$1,117,200,000 and \$749,467,000 respectively. Sales from the All-other division were already set in Q2, where the company sold the unit, meaning that all sales since then will be zero, as the unit ceased to exist, translating into a 2021 sales value of \$751,000

Lithium revenues expected to be \$441M in Q4 2021, totalling \$1.4Bn for the year.

Lithium

Plant capacity is perhaps the most important factor when it comes to understand if Albemarle can fully capitalize on the increased demand for lithium worldwide. Albemarle is currently the second largest provider of lithium for EV’s in the world with 60% of their sales being directed related to energy storage solutions, which represents around 50 ktpa of Lithium. If Albemarle can keep this

Table 4, Source:
Company Financials

Increased Capacity by Plant (ktpa)	ktpa
La Negra III/IV	40
Kemerton I/II	100
Guangxi Tianyuan	50
Yangtze River	50
Sichuan Pengshan	50

market position, we can confidently assume that their revenues will be heavily impacted by the increase in EV demand expected in the future, which is expected to grow at a CAGR of 20% from 2021 to Albemarle operates two raw material resource extraction plants based on brine. One located in the Salar de Atacama (Chile) and the other one in Clayton Valley in Nevada (USA). In addition to these, Albemarle also holds a 49% share in the spodumene mine of Talison Lithium in Australia. The company also owns a spodumene mine in Kings Mountain, North Carolina (USA). With these mines, Albemarle will be able to extract the natural resources that are needed in order to treat and convert into lithium ready to be applied into lithium-ion batteries. By the beginning of 2021 Albemarle owned and operated several conversion plants that allowed them to produce 85 Kilotons of lithium per annum (ktpa). The company has two Wave 2 projects coming online, La Negra III/ IV which is a low-cost, high-quality Chilean brine plant which will add 40 ktpa of lithium carbonate capacity. It is also worth mentioning that this plant is 100% owned by Albemarle. The other Wave 2 projects are Kemerton I / II, with Albemarle prioritizing Kemerton I to mitigate risks related to labour shortages and pandemic related travel restrictions in Western Australia. Both these plants will add 50 ktpa of capacity to Albemarle by the end of 2022.

Wave 3 projects are also on the horizon for Albemarle having an agreement to Acquire Guangxi Tianyuan New Energy Materials which has a production plant designed to produce 25 ktpa but Albemarle expects to expand to 50 ktpa in the future. Albemarle also has two investment agreements for two sites in China, them being Yangtze River Chemical Industrial Park, and Sichuan Pengshan Economic Development Park, with initials plans to build 50 ktpa conversion plants in each site. All these projects are in line with the company's long-term strategy with the company trying to aggressively accelerate the growth of conversion capacity through acquisitions, looking into expansion potential in current plants, and increasing their investment in low-cost jurisdictions in order to reduce capital intensity and improve margins.

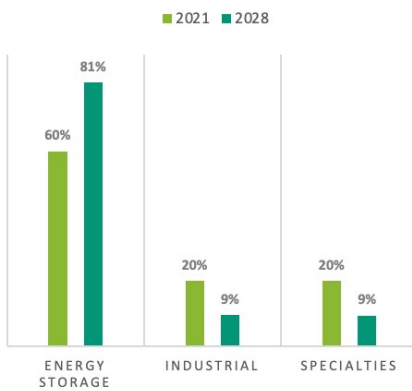
With all these expansions and acquisitions, Albemarle is expected to reach 175 ktpa capacity by 2022, once all the wave 3 projects are concluded they are expected to add another 150 of ktpa, adding potential wave 4 projects down the line would put Albemarle's capacity up to 500ktpa, hence placing them in an extremely good position to benefit from the increased demand in the lithium market, further boosted by the also increased demand on the EV market. Due to the highly concentrated industry with only a few players controlling the market,

we can confidently assume that Albemarle will be able to run at full capacity due to the supply cap that is predicted to exist in the lithium market.

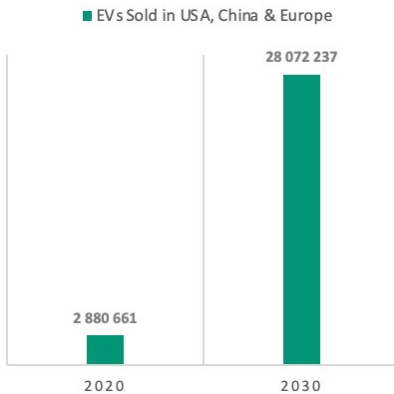
Lithium Applications

When estimating the revenues of the lithium business unit going forward, we broke down lithium sales by application. The company’s primary end markets can be split within the following three applications:

Graph 17, Source: Analyst Estimates



Graph 18, Source: Bloomberg



Albemarle’s lithium segment will strongly benefit from the expected rise in EV sales.

▪ Energy Storage⁵

In the lithium segment, its main application is **Energy Storage**, which accounts for ~60% of lithium sales. We expect this value to increase to ~80% in 2028 and will represent almost 90% of Albemarle’s lithium sales by 2040. The primary end markets for this **application are the automotive industry, grid storage and electronics**, with the first forecasted to largely become the main market for energy storage (93% by 2030), hence, our **main driver for energy storage is electric vehicle** sales in the USA, China and Europe, as Albemarle’s lithium sales for this segment are predominantly directed at automotive batteries. Furthermore, based on our previous analysis of the EV market industry, we are confident that the values obtained on the EV Sales forecasts are an accurate estimate of what this industry will deliver. In 2020 the number of EV sold in China, USA and Europe was 2.880.661, and this value is expected to raise to a roughly 10 times bigger 28.072.237 by 2030. This represents a CAGR of 26%⁴ which is in the confidence range of most research reports on this topic. From 2030 to 2035 we expect a CAGR of 8% which will then stabilize at 4.9% going forward, as most car manufactures have already pledged to have their sales to come entirely from electric vehicles sales. Additionally, the CAGR of the automotive industry as a whole is historically between 3 and 4% (4% in the last 10 years), we assume that as the EV market reaches its first period of stabilization it justifies a premium over the historical CAGR of the industry as a whole, as it is still a fairly recent and still developing part of the industry even in 2035, where it will be roughly 15 years old which is still considered recent in industry terms, we believe that the industry will fully mature by 2050, which at this time the electric car market is expected to represent roughly 80%⁶ of the total automotive industry.

However, we are aware that these values are estimates and are subject to changes as we move in time. As such, we accounted for three different scenarios – Base case, optimistic, and pessimistic and we will discuss their impacts further in the repor. Because the market is already very optimistic on the EV market, the

probability of the actual values surpassing these estimates is considerably smaller than the market experiencing some underperformance. In order to achieve higher results, the output of lithium production would also have to improve which is another factor that will be hard to. Furthermore, the absolute value of a negative impact in the market will be greater than that of a positive one, which means the market is more sensitive to negative impacts compared to positive ones, our predicted share price under a pessimistic state would be 67% lower to our base case share price, this contrasts to a 25% premium under a optimistic scenario. A lack of lithium supply will put a full-stop on the EV market's fast advancement and would have a severe negative impact, not only on the automotive industry but also on the lithium producers which Albemarle is a part of.

▪ Industrial

Secondly, lithium has Industrial applications on the **specialty glass, lubricants, and health markets**, which represent 20% of total lithium sales. We expect this value to be just shy of 10% in 2028 and according to our model should represent just below 6% of total lithium sales in 2040. The difference in weights is mostly originated from the abnormal growth in the energy storage applications, which outpaces the growth of the specialty glass, lubricants and health applications. We decided to use as a **driver for this portion of sales the total industrial production growth⁷ from China, USA and Europe**, as these applications belong to industries that show long term growth correlation to industrial production output.

Industrial production to move with GDP

Over the last two decades, global industrial production has been experiencing very large volatilities, with these being caused mainly by the several recent financial crises. In fact, during the 2008 financial crisis, industrial production in advanced economies had fallen the most since WW II. A decrease in production has happened every time there is a recession, thus clearly displaying a high level of correlation. This shows that the industrial production is highly dependent on the overall state of the economy. In the USA the average growth has been 3.58% from 1920 until today. In our model we consider 2023 to be the first year where the impacts of Covid-19 are fully behind us with China having a big jump in production. The Industrial production output is expected to grow 9.2% in 2024, in 2030 this value is expected to be 5.1% which represents an average decrease in growth of -8.1% per year. We assume that this decrease in growth will continue until the historical average is reached. Which we expect to happen in 2034, at which point we model the industrial production to remain steady, in line with its historical average around 3.6%

**Specialties applications
driven by consumer
behaviour**

Specialties

Lastly, when it comes to the last 20% of lithium sales split, these involve applications which are referred to as **Specialties** applications on the Tires, Pharmaceutical and Agriculture industries. We expect these to represent roughly 10% of sales by 2028 this portion of sales will be driven by the consumer expenditure growth in China, USA and Europe again we believe that these are industries that will grow alongside consumer expenditure as they are dependent on the populations consumption in order to grow. We expect that these will represent solely 6% of lithium total sales by 2040.

At the end of 2020, personal savings rate saw a major increase to almost double the values of 2019, while Personal Consumer Expenditure (PCE) fell 3.9%, as the Covid pandemic hit the economy and generated general fear. However, as vaccination started to pace up, consumer anxiety dropped, as consumers became less worried to go outside, with tourism also experiencing a boost, which ultimately led to an increase in the PCE. On top of this, as the labour market rebounds, household's personal income is expected to increase, with this forecast being exponentiated by the increase in consumer savings during the pandemic. Finally, the International Institute for Sustainable Development (IISD) expects the global population to rise to 9.9 Bn by 2050, which amounts to a 0.78% CAGR increase, which will also boost consumer spending year over year. Quantifying these forecasts, and according to Euromonitor, the weighted average PCE among USA, China and Europe in 2021 is expected to increase 12.8% in 2021, with this value being reduced to 7.23% in 2022 and then slowly decreasing to an average of approximately 5% from 2023 until 2032. We then expect this value to keep decreasing linearly towards the average expected value before covid-19 placed a full stop on consumer expenditure in 2020, which was 2.8%. ⁸