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Albemarle: Riding the EV Revolution – All in on Lithium

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Abstract

This report corresponds to an Equity Report and comprises the valuation of Albemarle Corporation (Ticker:ALB) as of December 2021. The valuation was done through a DCF model whose objective is to accurately estimate the intrinsic value of the Company and the share price of ALB stock at the end of 2022. This report will analyze and forecast the Company's financials, namely its Income Statement, Balance sheet and Free Cash Flow Map until 2040. Lastly, in order to obtain more accurate results, both a scenario and multiple analysis were conducted as a way to account for the sensitivity of the variables that affect the Company's results.

Keywords: Valuation, Albemarle, Lithium, Electric Vehicles

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This report is part of the Albemarle report and should be read has an integral part of it.

ALBEMARLE CORPORATION

COMPANY REPORT

SPECIALTY CHEMICALS

17 DECEMBER 2021

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Albemarle: Riding the EV Revolution

Is Lithium the Future?

- Given our FY2022 share price of $272.54 dollars and an expected return of 18.62% we recommend a BUY position on Albemarle Corporation.
- Albemarle is showing that they are committed to their lithium business unit by having invested a more than $2 billion from 2017-2020, bringing their capacity to 85 ktpa.
- Lithium pricing as more than doubled in 2021, showing the importance that this chemical is for today's electrification of the automotive industry which has grown 77% in 2020 and is set to grow 54% in 2021.
- Bromine margins (33.5%) have remained constant through the covid pandemic showing the resilience of this unit, in contrast the Catalyst unit as suffered the biggest cut in their margin which its now 16.3%.
- Past months share price performance was impacted by uncertainties over the omicron variant of Covid-19, which has spread fears of further lockdowns which would heavily impact the EV market, and therefore have material impact in Albemarle's growth prospects.

Company description

Albemarle Corporation is a largescale specialty chemicals company, with market leading positions in lithium, bromine and refining catalysts. They serve a multitude of industries by developing value-added, customized solutions.

Recommendation:	**BUY**
Price Target FY21:	**$ 277.02**
Price (as of 4-Feb-22)	**$ 230.92**

Reuters: alb, Bloomberg: ALB

52-week range ($)	140.69 - 283.80
Market Cap ($)	$ 27.01B
Outstanding Shares (m)	116

Source: Bloomberg

Source: Bloomberg

(Values in € millions)	2019	2020E	2021F
Revenues	3,589	3,129	3,341
Adj. EBITDA	1,037	0.818	0.887
Adj. EBITDA Margin	29%	26%	27%
Core Result	0.570	0.445	0.300

Source: Bloomberg

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Projections and Financial Analysis

Lithium Market Specificities

Supply and Demand Mechanics

Albemarle will strongly benefit from an increase in lithium prices.

The Net Zero Emissions by 2050 goal assumes that by 2030 there will be around 300M electric vehicles and that those will represent roughly 60% of new cars sold in the same year.[1] Additionally, demand for lithium is expected to reach 1793kt, a ~465% increase compared to 2020. As such, an exponential increase in growth like the one expected raises a lot of other concerns. The main obstacle for the lithium industry will be the difficulty to match the raw material demands that the lithium batteries will require. Based on current estimations, the supply of lithium will just barely exceed the demand for it, meaning it will be an extremely tight market. In fact, this issue has already transpired, as the players in this market become more anxious and start competing more fiercely for lithium extraction locations. This ultimately resulted in spot prices soaring; in China, the biggest EV market shareholder, prices rose 170% this year. These price increases benefit Albemarle: as the average extraction cost is expected to not suffer any significant changes, and with a boom in revenues driven by both demand and the lithium price increase, this will ultimately result in an improvement in ALB's margins. However, with companies ramping up production just like Albemarle – who has plans for heavy investments in the following years -, we can safely assume that the demand for lithium will never far exceed its supply. On the other hand, such event would mean that the EV adoption would slowdown, thus having a negative impact not only on Albemarle, but the industry as a whole.

While the supply for lithium seems to be solved, the charging infrastructure needed to accommodate the increase in EV's is still not present. In 2020, 80 percent of EV buyers in Europe had access to private charging. If mass adoption is desired, a solution needs to be found for the people that do not have a way of charging their vehicles in their homes. People who depend on public parking for their cars, which account for the majority in urban canters, need a reliable and cheap alternative to charging their vehicles. As of now, owning an electric vehicle without owning a garage can become extremely expensive and not practical. It is expected that, in the near future, 50 percent of European EV buyers will not have access to private chargers. This can only become true if public chargers become widely available.

- Government Incentives

EV adoption is consumer-driven in China and driven by regulation in Europe

Regulatory weight and consumer pull toward EVs depend greatly on region. Europe is mainly driven by regulation when it comes to EVs, while in China the consumer pull is extremely strong, despite incentives being very low. On the other hand, the United States EV sales have been facing slower growth due to both limited regulatory pressure towards adoption as well as low consumer interest. It is expected that the Biden administration will increase the regulatory pressure towards EV adoption, therefore increasing the sales growth in the USA.

Out of these three markets (which are the most important when it comes to lithium demand) the European one being a regulatory-driven market with positive consumer demand trends is expected to electrify the fastest and is expected to remain the global leader in electrification in terms of EV market share. Many countries have already announced the end of ICE sales by 2030. Furthermore, seven manufacturers have committed to 100 percent of electric sales by 2030. Ultimately this goes in line with the European Union announced target of zero-emission for new cars by 2035.

China will also continue to experience strong growth in electrification and will remain the biggest EV market in absolute terms, despite the low EV subsidies and the Chinese government not having any target regarding EV sales. One of the biggest drivers for growth in the Chinese market however might be the government's dual-credit policy

USA expecting lower growth, while China continues to soar.

The USA is perhaps the market with the biggest upside potential due to its size but is also the one with the lowest expected growth, mainly due to the consumer reluctance towards EVs. Besides that, the Biden administration has been pushing towards a more electric future, with strong investments in charging infrastructure, and more stringent fleet emissions targets. The increase in electric sales in the USA will be mostly fuelled by regulatory support in California and other states that follow its CARB ZEV regulation. Automotive manufacturers support electrification targets and have declared ICE bans by 2035, meaning the USA will be lagged when compared with the EU and China; nevertheless, it is headed in the same direction.

Regulation and government incentives to be strong drivers of EV adoption.

Regulation will play a key role in the EV mass adoption around the world. More Governments and cities adopt more incentives to accelerate the shift for green mobility, this obviously impacts the demand for EV's, which are one of the best alternatives when it comes to sustainable mobility. Moving forward, regulators around the world are defining stricter emission targets, trying to accelerate as much as possible the transition to electric cars. The European Union presented its program called "Fit for 55" program, which aims to align climate, energy, land

use, transport, and taxation policies to reduce net greenhouse gas emission by at least 55% by 2030. On the other side of the Globe, President Biden as introduced a 50 percent electric vehicle target for 2030, which might be over optimistic, but nevertheless shows that that his administration is committed to the adoption of more electric vehicles. Both in Europe and in the USA, most governments are offering EV subsidies in order to boost the adoption of these vehicles. Cities around the globe are also implementing "electric vehicle only roads" as a way to incentivize once again the acquisition of these vehicles.

- Consumer Behaviour

Consumer behaviour and awareness are shifting as more people accept and incorporate alternative and sustainable mobility options. E-bikes and e-scooters are among the favourites of consumers for short commutes. When it comes to electric vehicles, it is expected that their demand will vastly increase, as their price (when compared to ICE) decreases. This will be mostly achieved by the expected decrease in the cost of production of ion-batteries. The other big factor that will contribute to the increase in consumer demand in EV's is the increased range expected for these vehicles in the coming years. Lastly as EV's present themselves as a more sustainable alternative to ICE's consumers in the market for a new car will be more inclined to buy an EV over an ICE vehicle. It is also important to mention that the financial incentives from many governments for the acquisition of EV's is accelerating their adoption as they are making the acquisition of EV's at par with ICE vehicles.

As EVs become more affordable, demand is expected to increase.

- Technology

This is perhaps one of the most important factors when it comes to the EV market, and that will ultimately impact Albemarle's revenues going forward. Albemarle is totally dependent on the technology evolution of the industry, as the Company is just a supplier of lithium and does not play a role in the technological advances in the lithium batteries space. As of now, industry players are accelerating the speed of innovation when it comes to creating new concepts of electric, connected, and autonomous mobility. In the last decade the industry has attracted more than $400 billion in investments. Out of those, $100 billion have been invested since the beginning of 2020. If these investments prove to be successful, they will help to reduce the current costs associated to EVs and make electric shared mobility a realistic alternative to owning a car to many more consumers. As in any industry, the more players are in the market, the faster the market evolves and becomes more "complete" - this is crucial for the evolution of the EV industry. As more and more car manufacturers shift their focus to EVs, the more capital will be employed in R&D in the industry, which will naturally only

Technology will play a crucial role in the success of EV's in the next decade

As more players enter the market and as more capital is employed, the EV industry becomes more developed.

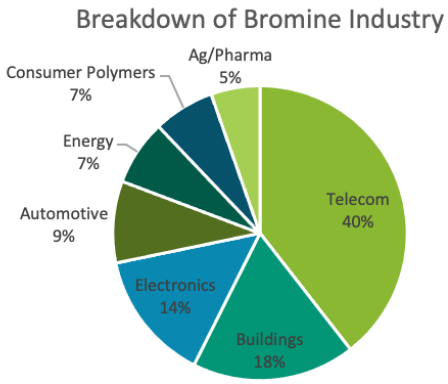
benefit Albemarle, who sits at the bottom of the supply chain. Many car manufacturers have already stated their intentions to stop investing in new ICE platforms and models so that they can fully focus on the electrification of their fleet. It is expected that by 2035 the largest automotive makers will go fully electric.

Bromine

Expected bromine growth at 3.5% in next five years.

Bromine is fundamental to our day to day lives as an essential chemical in many industries mostly due to its fire-retardant properties Bromine sales are expected to be affected by several industries. The industry with the biggest addressable market for bromine currently is the telecom industry with an **addressable market of $2.2Bn.** One of the biggest reasons for the large addressable market in this industry is the rollover of 5G technologies around the globe which require new infrastructures, more specifically the wiring, connectors, and new circuit boards. The expected growth for this market in the next 5 years is expected to be 3.5%. Buildings are expected to have an addressable market of $1 billion and are expected to grow at 4% in the next 5 years bromine is utilized mostly in the insulation, wiring and connectors for this market. Electronics are expected to have an addressable market of $800 million with an expected growth of 5% yearly. This is followed by the automotive industry more specifically related to its tires, seats and wiring with an addressable market of $500 million and it is expected to grow at around 4% per year. The energy industry has a $400 million addressable market on its oilfield, and completion fluids and it is expected to grow at 3% per year. Consumer polymers with an addressable market of $375 million with an expected growth of 5% fuelled by the textiles and packaging needs of the bromine solutions. Lastly the pharma industry with a total addressable market of $300 million and expected growth of 2.5%. This amounts to a total addressable market for bromine in today's world of $5.6 billion and expected average growth of 3.86%. We expect this growth to remain steady all the way until 2026 and then to slowly decay in direction to the average long term GDP growth rate of 2% which we expect to be reached by 2035 as the industry fully matures. We then model it to remain steady at these levels, as we believe that bromine, being an essential part of many industries will always be dependent on the overall shape of the economy in order to grow.

Graph 1, Source: Company Financials



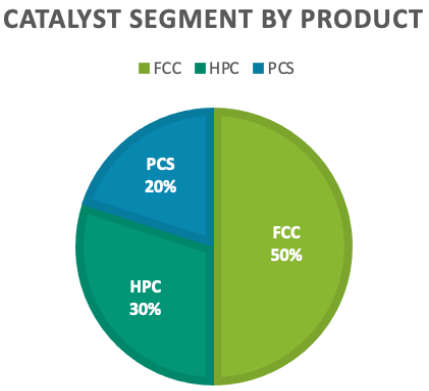
Catalysts

Catalyst segment expected a CAGR of 3.9% from 2022 to 2028

The Catalyst's business is subdivided into three categories: the FCC (50% of catalyst sales), HPC (30%) and PCS (20%). Because the first two catalysts are mainly used in oil refineries – the former used in increasing efficiency in refineries

and the latter used to upgrade oil fractions into clean fuels. As such, we used **total miles driven as the main sales driver for both FCC and HPC catalysts.** According to data from FRED (Federal Reserve Economic Data), total miles driven in the U.S has been increasing at an average pace of 1.06% p.a. from 2010-2019. We decided to exclude values from 2020 and 2021 due to the abnormal impact the Covid pandemic had, which deviates from normality and would negatively impact the accuracy of the model. Additionally, suffer little variations on a year-on-year basis, which goes in line with the idea of a steady increase of this driver. Furthermore, and supporting this rationale, a study conducted by the FHWA (Federal Highway Administration) in the Spring 2021 provides a baseline economic growth outlook for the projected CAGR in Vehicle Miles Travelled (VMT) of 1.0% from 2019-2039 (next 20 years). Regarding the PCS catalysts, because these are heavily linked with the use of polyutherane, we used the **demand for polyutherane as the main driver for PCS products.** A study conducted by Raw Material, Polyols, Product, Application, and Geography, estimates that this market will reach ~ $102Bn by 2028, mainly caused increasing demand from durable and lightweight materials; ultimately, this result translates in a CAGR of 3.9% from 2021 until 2028.

Graph 2, Source: Company Financials



Because the FCC and HPC catalysts share the same driver, the VMT growth will initially be responsible for 80% of the catalyst's sector sales (50% of FCC and 30% of HPC), while polyurethane demand will account for the remaining 20%. However, because the growth on polyurethane demand is higher than that of the VMT, the weight on the former will keep increasing, and the polyurethane demand will eventually be responsible for 31.67% of total catalyst sales. From that point onwards, the sector's y-o-y growth rate will linearly decrease towards the long-term growth rate, i.e., 2%.

Cost drivers

- COGS

Due to data unavailability with regards to the breakdown of costs of goods sold (COGS) per business unit, we decided to estimate those COGS based on the estimated EBITDA margin going forward.

Table 1, Source: Bloomberg

Lithium Price Increase	
Current vs Avg. 2017-20	
Asia	48%
Europe	52%
N. America	46%

By looking into Albemarle's margins, we clearly identify that there are no abnormal changes from one year to another in any of its segments, nor is it changing towards a trend (i.e., the margins bounce back and forth with little variation). Additionally, it was observed that the COGS move along with revenues in all of Albemarle's segments, which leads us to the assumption that the COGS will mainly depend on quantities produced. As such, and because the Company

does not have any plans for efficiency improvements in its operations, there is no reason to believe that these costs will suffer significant changes going forward. On the other hand, while Bromine and Catalyst prices are expected to remain somewhat steady, Lithium prices have seen a major increase during 2021. In fact, when compared to the average September prices of the last 4 years, prices in Asia, EU and US have increased, respectively, by 34%, 49% and 42%. Note that the decision of choosing September prices comes from the fact that most contracts regarding lithium are done during Q4 and the use of the average price calculated with the last 4 years comes from the fact that Albemarle's lithium contracts range from 2-5 years. We then calculated the weighted average increase in lithium prices based on the price increase by region and sales breakdown by region (48%, 24%, 26% and 2% in Asia, EU, US and RoW, respectively), which resulted in a 30% price increase. Lastly, this value was adjusted to reflect the impact only on the Lithium margins, which lead to a result of a 23% improvement in the lithium EBITDA margin. This approach is supported by the fact that the extraction costs on lithium mainly depend on the flow rate of that lithium extraction, which is to say that COGS will be mainly driven by quantity extracted.

Table 2, Source: Bloomberg

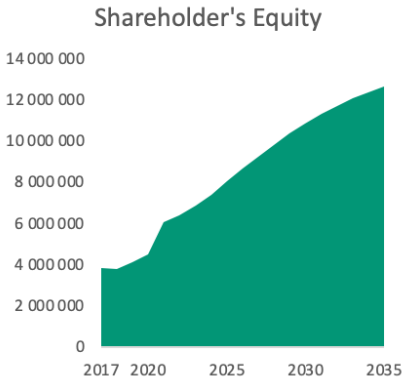
% ALB Sales by Region	
Asia	49%
EU	25%
USA	27%
RoW	2%

There are cost risks associated with lithium extraction, being potential increases in labour costs and lithium impurities the main ones.

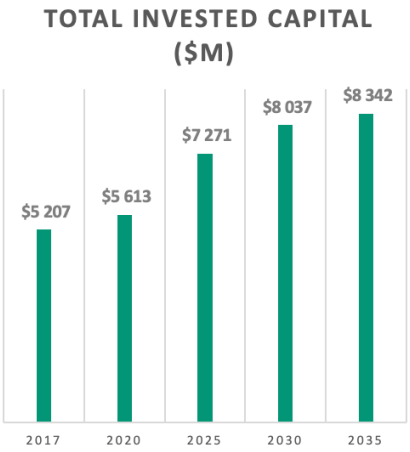
However, both lithium brine and hard rock from which the lithium chloride or hydroxide is extracted may contain certain impurities, some of which can complicate the extraction process and may require additional steps (such as first extracting those impurities and only then extract the lithium) that can lead to further costs; additionally, these impurities also impact the price of lithium sold, which may also influence ALB's revenues. Furthermore, there are still other cost risks associated, such as changes in labor costs or royalty rates, we estimate that as Albemarle opens more plants, their experience and knowledge will allow them to streamline processes and make their plants more efficient, effectively offsetting any increase in potential labor cost in the long term which is expected to grow at the inflation rate. Considering SG&A, we believe it will remain constant at ~12% of total sales, as most SG&A costs are shared across business units, we estimate them together rather than allocating them to each business unit. The same reasoning applies when estimating Albemarle's R&D costs, which we believe will remain at a low ~2% of sales. As discussed previously, R&D costs should remain low, as Albemarle is simply a provider of specialty chemicals then used in industries responsible for developing technologies i.e., the technology needed in order to compact lithium batteries while raising the quantity of lithium these hold at the same time.

Balance Sheet

Graph 3, Source: Analyst Estimates



Graph 4, Source: Analyst Estimates



The corporate division is responsible for the shared costs between all units

When reformulating our balance sheet, we decided to use an operating cash of 10% because Albemarle is in a capital-intensive industry, and after reviewing the company's quarterly statements we believe that a 10% operating cash is realistic, since it will be enough to cover the cash fluctuations it has throughout the year, we left our working capital as a % of revenues as we believe that as revenues grow so will these line items. We have no reason to believe that inventories (which is the biggest line item in the working capital segment) will differ much more from the actual 37% of revenues. Some fluctuations are expected but such can't be modelled as they are non-material, we believe it will remain around the 40% of revenues going forward. On the core invested capital segment is where we focus most of our research in order to understand effectively what amount of investment Albemarle's willing to spend in order to grow their business. Albemarle has a long-term plan regarding capex of the Lithium business, and we base our model on Albemarle's expectations to when will cash be deployed. Starting with 2022 where we added the median value expected for capex expense $1.15 billion, which is based on the purchase of Guangxi Tianyuan, and other lithium related investments, going forward past 2022 until 2026 we will base our model on Albemarle's guidance for Capex which is $900 million in 2023 and 2024, $1.1 billion in 2025 and 2026, past 2026, as the industry matures the capex is expected to decrease until it reaches the levels that Albemarle had pre high growth phase which in 2036 we expect to be $850 Million which translates in an increase of $315 million in total invested capital after having into consideration depreciation. Other Assets are mostly operating leases which have a value $220 million, which we expect to increase with sales in the foreseeable future as these consist mostly of office space, which Albemarle will have to increase as their plant capacity increases specially in plants that they are opening in new jurisdictions such as China. Other noncurrent liabilities consist almost entirely in non-current payables and therefore we model it as being a percentage of revenues since we believe that as revenues increase these payables will increase with them, making their value

When it comes to Albemarle's all other unit, we model it until 2021, per company reports all other was a non-core unit that was sold during the year of 2021 and will therefore cease to exist going forward.

The company accounts for the corporate division in a separate account, corporate is basically the companies head offices, and offices spread around the world, they are not a core division, but they are also not a non-core division, they

are not a forgoing profit division and their only function is to support each of the units in their operations and corporate activities.

OTHER VARIABLES

ESG

Albemarle is considered "High risk" on the ESG Risk Rating

As of now, Albemarle scores 37.2 on the Sustainalytics ESG Risk Rating (range 0 – 40+), which measures a company's exposure to industry-specific material ESG risks and how well a company is managing those risks. This score makes ALB the 312 / 465 of the Chemicals Industry and 11,927 / 14,633, making it "High Risk".

▪ Electric Vehicles' Role on ESG

EV cars are 0-CO_2 emissions and are thus much more eco-friendly compared to ICE vehicles. In fact, and according to International Council on Clean Transportation (ICCT), the CO_2 lifecycle is reduced by 65% in the current state in Europe and can ultimately reach 83% if all electricity is green. However, EVs have a serious problem in hand when it comes to production, as **producing an electric vehicle generates almost higher emissions intensity by 80%**, according to a McKinsey study, due to its higher share in aluminium. With that being said, there are two possible ways to tackle this issue. Firstly, using **recycled materials** as primary, i.e., materials not subject to chemical changes after being extracted can significantly reduce the share of emissions associated with the initial generation of raw materials. However, doing so has two main constraints: the first being that the materials' end of life recycling is still far from optimal, and the second being the increasing prices in these materials, as several industries increase their demand for them, thus creating supply bottlenecks, which lead to increasing prices. Secondly, industries can also move into using **green raw materials** (with low/no CO_2 emissions). In fact, as technology advances, it is expected that "**80-90% of today's material emissions can be eliminated with 2030 technologies**" (McKinsey study). On the other hand, while changing resources may be a relatively simple process, changing the whole manufacturing process will require significant CapEx investments, as companies will most likely have to make changes in the machinery of the whole plants altogether. Although this is a scenario that Albemarle will probably have to face, there are still no plans from the Company to engage in these investments.

In the end, all factors combined cause a **two-way effect** on the EV sales forecast: while **electric vehicles producers are now trying to decrease prices** in order to increase demand, the process of shifting towards greener energy

should drive EV prices upwards, thus decreasing demand. If that is the case, lithium demand will almost definitely plunge, thus negatively impacting ALB's lithium sales.

Role of Regulation on ALB Products

Albemarle is under tight scrutiny from regulators due to the potential effects their chemicals might have on the environment

Because ALB is involved in the chemicals sector, many of its products are under scrutiny from Regulatory Authorities across several countries (an example of this are the brominated flame retardants produced by the Company). As such, products that may raise concerns regarding the environment or the people's general safety and well-being may result in **regulation** against these products. This results in increased risks for the Company, depending on the enforcement and severity of these regulations. The simple threat of regulation could hurt the company, as the market is likely to react to those types of news. Furthermore, if regulation is in fact enforced, this may result in limitations - or, if too severe, a product/segment ban - on some of the Company's products, thus decreasing sales and forcing the Company to revise its business strategy and operations.

Additionally, ALB must comply with several requirements under the European Community Regulation for the Registration, Evaluation, Authorization and Restriction of Chemicals ("REACH"), which requires European Union (EU) manufacturers and importers of chemicals and other products into the EU to file comprehensive reports, with "substances of high concern" being subject to an authorization process, which might ultimately result in limitations to the use of the product or even banning it. Additionally, the tracking and reporting of these issues comprises additional costs to the Company, including not only monitoring and reporting, but also extending to increased raw materials costs, which may lead to increased selling prices and resulting in decreased demand for said products.

Last, but not least, lithium extraction has a significant negative environmental impact: it uses approximately 500,000 gallons per metric ton of lithium, it harms the soil and causes air contamination. As such, populations might fight against lithium mines, as it happened, for example, in Covas do Barroso (Portugal), where the largest estimated deposits of lithium in Western Europe lies, and where the population is rising against the lithium mines exploration. In the end, this might result in drag-backs on lithium extraction which may result in projects being delayed or even cancelled.

Arbitration

The arbitration decision came as surprise to Albemarle's top management

On its Q3 Earnings Report, Albemarle reported an expense of $657M under "Legal Accrual", relative to the Huntsman-Rockwood dispute, where a subsidiary of Huntsman Corporation filed a lawsuit in NY State against Rockwood Holdings, Inc., Rockwood Specialties, Inc., certain former executives of Rockwood and its subsidiaries, and Albemarle. Huntsman had acquired certain Rockwood subsidiaries through a stock purchase agreement (SPA). Note that this transaction closed on Oct. 1, 2014. Huntsman's claim asserts on the basis that some technology acquired by Huntsman to Rockwood for a production facility in Augusta, Georgia, which comprised the assets acquired through said SPA, did not work, and that there was an intentional misguidance by Rockwood and the defendant executives regarding that technology. Before the SPA, Albemarle had begun conversations with Rockwood for a purchase of all outstanding equity of Rockwood, transaction that closed later on Jan. 12, 2015. However, because ALB had acquired Rockwood, Huntsman alleges that ALB is also liable for the damages.

The $657 million unexpected cost might delay Albemarle's lithium expansions

The accrued expense registered on ALB's Income Statement is based on the decision of the AAA arbitration panel, which the company considers to be the best estimate available on this case.

Scott Tozier, Albemarle's CFO, has reported that this arbitration occurrence could have a negative impact on the Company's growth opportunities, both on the organic side, as it slows ALB's ability to accelerate its projects, as well as on the inorganic side, as the Company would have less cash available for possible acquisitions, saying that in order to do so "would need some sort of more creative type of financing to do".

Valuation Model

Cost of Equity

In order to estimate our Beta with the CAPM we regressed the stock returns of Albemarle with those of the MSCI world index, we regressed the returns for the past 3 years and arrived at a Beta of 1.7865. We decided to regress for 3 years rather than the standard 5 because Albemarle has experienced a shift in their business that has happened in the last 3 years with the revolution in the EV market which heavily impacted Albemarle's Lithium business unit, and therefore the company's idiosyncratic risk. Based on the premise that in the long-term equity betas revert to the mean of 1 we smoothed our beta with the Blume's

adjustment arriving at an adjusted beta of 1.524 which should partly offset the error in the estimate arrived due to the low number of observations (36) in the regression model. This value contrasts with the average of Albemarle´s peers of 1.37 Albemarle's unlevered beta of 1.13 is above its lithium peers at 0.98. Tianqi (0.68), Ganfeng (0.85), SQM (0.82), Pilbara (1.41). This puts Albemarle's unlevered beta as the second highest among its lithium peers. We believe that the reason for this difference is due to the fact that Albemarle is only recently redirecting their strategy towards lithium, and the market might be putting a premium on their lack of experience in this market when compared to pure lithium players. It is important to mention that all regressions show an extremely low R^2 due to the recent nature of the lithium boom, making the results hard to analyse. In order to calculate our cost of equity we used the data available by Damodaran related to the current equity risk premium in the USA (4.72%). We then arrived at a cost of equity of 8.69% using the CAPM by multiplying the Equity Risk-Premium by our Beta, and then adding the 10-year risk free rate of the United States is currently 1.42%.

Cost of Debt

In order to accurately calculate the opportunity cost of Albemarle's debt we would need to calculate the YTM of option free bonds, however Albemarle does not have any option free bonds on the market. Therefore, we decided to find what the average yield to maturity of option free bonds with a Moody's rating of Baa3 were, since Albemarle's debt is considered investment grade the YTM is considered a good proxy. We then found that the default spread for such bonds is 1.71%, to this we added the yield of bonds with the identical credit rating to arrive at the total weighted average cost of debt 3.16%, which results in an after-tax cost of debt of 2.49%. In our opinion this is an accurate way of estimating their average cost of debt in the long term as we have reason to believe they will always converge to the average YTM of companies with the same credit rating.

WACC

We arrive at a WACC of 6.8% which will remain constant throughout our model as the mix of equity and debt will stabilize from 2022 onwards.

Table 3, Source: Analyst Estimates

Risk Free Rate Sensitivity				
1.25%	1.44%	1.75%	2%	3%
293	277	254	237	208

The valuation model incorporates two different stages of growth

Terminal Value

We calculate our terminal value in 2040, as this is the time period at which our results achieve their stage of constant growth.

Albemarle is highly dependent on their lithium business unit, which belongs to a relatively new industry that we believe will only converge with long term GDP

past 2050. As such, we used a **two-stage growth model in order to calculate our terminal value in 2040**. The first stage of growth will be in line with the steady value achieved in the years of 2036-2040 of 3.91%. We then expect this value to converge to 2% in 10 years' time. We assume that our RONIC will carry the values achieved in the years of 2036-2040 of 32.6% and based on the sustainable growth formula we predict this value to then decrease to 23.3% in perpetuity. We estimate that the first 10 years of our terminal value will represent $7.6 billion in present value, and our perpetuity from 2050 forward will be worth $15 billion in present value terms.

Scenario/Sensitivity Analysis

As we discussed throughout the report, there are many unknowns in regards with many variables, whether it is differences in the price of lithium going forward, or regulation affecting demand, or any other variable. With this in mind, we performed a sensitivity analysis where we assume three cases, base, optimistic, and pessimistic.

In our optimistic scenario we started by assuming that the price of lithium would be 5% higher in China, and 10% higher in both Europe and the USA as these two have more room to grow in order to catch up with the prices in China. This contrasts to our pessimistic case where we assumed lithium prices lower by 15% in China and 10% in Europe and USA. Then we assumed that the demand for electric cars in China would increase 15%, in Europe it would increase 10%, and in the USA it would increase 25% as we believe this is the market where the EV market has the biggest upside potential. On the pessimistic side we assumed decrease in demand of 25% in China, 10% in the USA, and 15% in Europe. Based on these parameters we expect the number of EV's sold in these 3 regions to be 32,428,145 in 2028 compared to 28,072,237 in our base case, and 20,056,885 in our pessimistic which represents an overall growth in sales of EV's of 15.5% in the optimistic case, and a decrease of 28.5% in the pessimistic. For both the consumer expenditure and industrial production we assumed growth would be 15% greater in the optimistic case and 25% lower in the pessimistic compared to the base case. We also assumed that the growth rate at which they stabilize will also be 15% higher and 25% lower respectively. This will all translate into an adjusted EBITDA of almost $3 billion in 2030 and $5.5 billion in 2040 in the lithium unit, compared to $2.7 billion and $4.8 billion respectively for the base case, and $1.6 billion and $2.5 billion in the pessimistic. When it comes to Bromine we assumed that the growth rate that sales will grow at 5% until 2026 vs 3.86% in the base case and 2% in the pessimistic case, we then assume that the long term gdp growth rate to be 2.5% vs the base case one of 2%, and 1.5%

Table 4, Source: Analyst Estimates

	17 Dec. 2021
Tax Rate	21%
Market Cap	$27.1Bn
D/EV	0.25
D/E	0.38
Adjusted Beta Levered	1.52
Raw Beta	1.79
SE of Raw Data	0.35
Beta Unlevered	1.13
Risk Free rate	1.44%
MRP	4.72%
Cost of Debt	3.15%
Cost of Equity	8.63%
Unlevered Cost of Capital	6.76%

in the pessimistic. The Bromine unit is a more stable business then lithium and we do not expect the upside nor the downside to be quite as extreme as the lithium business unit. Based on our model Bromine would experience an adjusted EBITDA of $581 million in 2030 vs $530 million in the base case and $460 million in the pessimistic, in 2040 the values are expected to be $765 million, $660 million, and $561 million respectivily. For the Catalysts unit we assumed an increase of 5% in the increase of miles driven per year, and and increase of 2.5% of the demand for polyurethane in the upside scenario, on the downside we assume a decrease in the demand for polyurethane of 40% and a decrease of the miles driven by 5%. This will translate in a cagr of sales growth until 2028 of 3.95% vs 3.93% vs 1.78%, all our scenarios assume that this value will linearly decrease until it reaches our projected long term gdp growth of 2.5%/2.0%/2.5%, this will represent an adjusted EBITDA of $211 million in 2040 vs 201 million in the base case vs $177 million in the pessimistic. The total adjusted EBITDA in 2040 in the optimistic case is $5.9 billion vs the $5.2 billion in the base case vs $3 billion in the pessimistic case.

Table 5, Source: Analyst Estimates

	Adjusted	Unlevered
Albemarle	1.52	1.13
Tianqi	1.34	0.68
Ganfeng	0.99	0.85
SQM	1.30	0.82
Pilbara	1.69	1.41
Average	1.37	0.98

- Share Price

Under our base case scenario we arrive at a core enterprise value of $36,377,112,000 to which we add the non-operational assets totalling $51,280,000, and then subtrating the net debt of the company in 2022 which totals $2,739,760,000, arriving at an equity value of $33,688,633,000 which translates into a share price of $293.07. While we are confident of our base assumptions we know that Albemarle faces many different risks and that is why we also calculated a share price under a pessimistic scenario which equates to $94.81 assuming the changes previously discussed. On the optimistic side we arrived at a share price of $365.71. In our opinion the probablity of an upside scenario is inferior to that of an pessimistic, therefore we assume that the probability of an upside scenario to be 5% while the probability of a pessimistic scenario is 10%. Using this weights we arrived at a final share price of $277.02, which currently represents a buy recommendation, as we expect a return of 19.96% from capital gains and 0.59% in the form of dividends.

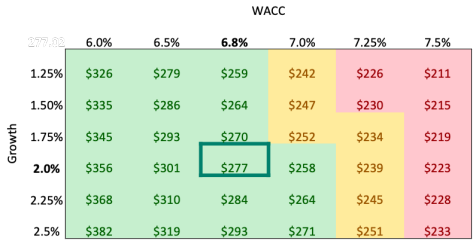
Table 6, Source: Analyst Estimates

	Pessimistic	Base	Optimistic
Share Price	$96.25	$293.07	$365.71
Probability	10%	85%	5%

- Sensitivity Analysis

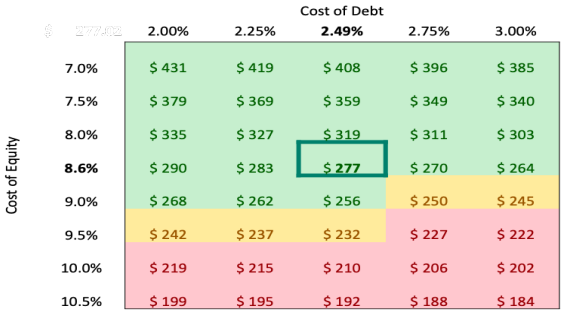
Our model as many variables that are sensitive to slight changes. We performed a sensitivity analysis on different variables in order to understand their effect on the share price of the company. The natural first variable to change is the WACC, in table 11 we can see that our share price is extremely sensible to changes in the WACC. With a WACC of 7.5% we would be recommending a sell position on Albemarle, and everything below a 7% would be considered a buy.

Table 7, Source: Analyst Estimates



We can also see that in terms of the long-term growth rate, our recommendation remains the same within all possible long-term growth rates tested.

Table 8, Source: Analyst Estimates



We also did a sensitivity analysis to see how our share price would behave to changes of either the cost of equity or/and cost of debt. We can see that our recommendation holds under all tested costs of debt and that only a cost of equity above 9.5% would turn our recommendation into a sell. Lastly, we tested our share price against changes in the risk-free rate and concluded that a sharp increase in the risk-free rate would turn our recommendation into sell territory.

- Multiple and Ratio Analysis

Running a multiple and ratio analysis is crucial to understand how Albemarle is ranking against its peers when it comes to current valuation. We will be looking at the P/E ratio and the EV/EBITDA. Analysing these two together can indicate whether Albemarle is over/under valued compared to its peers. When we first look at the P/E ratio we can see the Albemarle is trading at the average of its peers (P/E of 55.21 vs 56.24 of average). We decided to exclude tianqi from the average calculations as its values are way too extreme and would be distorting the average values. Regarding the EV/EBITDA we can see that Albemarle and SQM trade at a similar multiple, 23.16 and 21.9 respectively, while Ganfeng and Tianqi trade at a much higher one. The same can be observed in the EV/EBIT ratio where Albemarle trades at 30, which again is close to SQM's value at 30.35

When looking at the ratios we can see that Albemarle's ROA is 3.7% vs SQM's of 3.46%. It is interesting to see that Albemarle can achieve a higher ROE then SQM, 9.16% vs 7.82% this can be explained due to the fact that Albemarle has more debt in their structure then SQM effectively leveraging their ROE.

Appendix

Financial Statements

Appendix 1 - Income Statement

Revenues	2017	2018	2019	2020	2021	2022	2023	2024	2025	2040
Lithium	1 018 885	1 228 171	1 358 170	1 144 778	1 399 132	1 783 105	2 117 122	2 550 671	3 111 942	10 842 638
Bromine Specialties	855 143	917 880	1 004 216	964 962	1 117 200	1 160 335	1 205 135	1 251 665	1 299 992	1 915 622
Catalysts	1 067 572	1 101 554	1 061 817	797 914	749 467	769 103	790 862	814 120	839 007	1 246 884
All Other	128 914	127 186	165 224	221 255	75 095	0	0		0	0
Total	3 070 514	3 374 791	3 589 427	3 128 909	3 340 894	3 712 542	4 113 119	4 616 456	5 250 941	14 005 143
COGS	1 965 700	2 157 694	2 331 649	2 134 056	2 212 494	2 407 574	2 600 948	2 831 360	3 109 413	7 331 334
Gross Profit	1 104 814	1 217 097	1 257 778	994 853	1 128 400	1 304 968	1 512 172	1 785 096	2 141 528	6 673 809
Selling, general and administrative expenses (as % of revenue)	347 451	461 629	424 749	392 967	412 492	458 379	507 837	569 983	648 321	1 729 181
Research and development expenses (as % of revenue)	84 330	70 054	58 287	59 214	69 646	77 393	85 744	96 237	109 464	291 958
Core Result before Taxes and OCI	673 033	685 414	774 742	542 672	646 262	769 196	918 591	1 118 876	1 383 743	4 652 670
Taxes and OCI Core	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2040**
Statutory Taxes Core	236 073	143 970	162 696	113 961	135 715	161 531	192 904	234 964	290 586	977 061
Tax Adjustments Core	-60 318	-2 384	-20 829	-31 376	0	0	0	0	0	0
Foreign Currency Translation	227 439	-150 388	-62 031	100 389	28 852	28 852	28 852	28 852	28 852	28 852
Total Core Result	724 716	393 440	570 844	560 475	539 399	636 517	754 539	912 764	1 122 009	3 704 461
NON CORE OPERATIONS	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2040**
Gain on sale of business		210 428	0	0	428 424					
Other Non Core Costs		10 254	-53 531	-77 528	-40 268	-40 268	-40 268	-40 268	-40 268	-40 268
Other expenses, net		-59 149	-18 508	-18 509	-32 055	-32 055	-32 055	-32 055	-32 055	-32 055
Litigation					-657 412					
Non Core Result before Taxes and OCI	0	161 533	-72 039	-96 037	-301 312	-72 324	-72 324	-72 324	-72 324	-72 324
Statutory Taxes Non Core	-39 321	33 922	-32 360	-20 168	-63 275	-15 188	-15 188	-15 188	-15 188	-15 188
Tax Adjustments Non Core	335 545	-19 868	-9 007	7 470	0	0	0	0	0	0
Other Non Core Income	-39 808	25 063	16 511	-30 539	0	0	0	0	0	0
Equity in net income of unconsolidated investments (net of tax)	84 487	89 264	129 568	127 521	107 710	107 710	107 710	107 710	107 710	107 710
Non Core Result	-251 545	261 806	115 408	13 642	-130 326	50 574	50 574	50 574	50 574	50 574
FINANCIAL OPERATIONS	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2040**
Financial Costs	-115 350	-52 405	-57 695	-73 116	-63 696	-115 908	-123 997	-134 054	-145 611	-254 393
Cost of debt	8.30%	2.83%	1.82%	2.05%	3.15%	3.15%	3.15%	3.15%	3.15%	3.15%
Financial Result Before Taxes and OCI	-115 350	-52 405	-57 695	-73 116	-63 696	-115 908	-123 997	-134 054	-145 611	-254 393
Statutory Taxes Financial	-40 373	-11 005	-12 116	-15 354	-13376	-24341	-26039	-28151	-30578	-53423
Less: Comprehensive income (loss) attributable to noncontrolling interests	45 505	45 396	70 662	71 098	58 165	61 330	65 314	63 977	62 197	63 266
Financial Result	-120 483	-86 796	-116 241	-128 860	-108 485	-152 898	-163 271	-169 879	-177 229	-264 237
Total Company	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2040**
Core Result	724 716	393 440	570 844	560 475	539 399	636 517	754 539	912 764	1 122 009	3 704 461
Non Core Result	-251 545	261 806	115 408	13 642	-130 326	50 574	50 574	50 574	50 574	50 574
Financial Result	-120 483	-86 796	-116 241	-128 860	-108 485	-152 898	-163 271	-169 879	-177 229	-264 237
TOTAL	352 689	568 449	570 011	445 258	300 588	534 194	641 842	793 459	995 355	3 490 799

Appendix 2 - Consolidated Balance Sheet

Consolidated Balance Sheet	2017	2018	2019	2020	2021	2022	2023	2024	2025	2040
Invested Capital										
Current assets:										
Operating Cash	$ 307 051.40	$ 337 479.10	$ 358 942.70	$ 312 890.90	$ 334 089.38	$ 371 254.25	$ 411 311.95	$ 461 645.61	$ 525 094.11	$ 1 400 514.29
Trade accounts receivable,	$ 534 326.00	$ 605 712.00	$ 612 651.00	$ 530 838.00	$ 579 509.62	$ 643 456.79	$ 706 548.81	$ 794 277.91	$ 906 590.84	$ 2 414 003.74
Other accounts receivable	$ 37 937.00	$ 52 059.00	$ 67 551.00	$ 61 958.00	$ 55 460.79	$ 65 570.61	$ 74 944.87	$ 83 425.39	$ 92 619.69	$ 250 509.91
Other current assets	$ 136 064.00	$ 84 790.00	$ 162 813.00	$ 116 427.00	$ 131 654.24	$ 153 091.74	$ 188 542.09	$ 212 381.30	$ 249 792.34	$ 786 374.85
Growth %										
Inventories	$ 592 781.00	$ 700 540.00	$ 768 984.00	$ 750 237.00	$ 755 078.27	$ 927 330.94	$ 1 079 351.28	$ 1 269 893.50	$ 1 462 326.94	$ 4 605 536.42
Growth %										
Accounts payable	$ (418 537.00)	$ (522 516.00)	$ (574 138.00)	$ (483 221.00)	$ (505 750.92)	$ (576 002.03)	$ (638 481.89)	$ (711 165.44)	$ (808 399.27)	$ (2 161 792.66)
Accrued expenses	$ (268 336.00)	$ (257 323.00)	$ (576 297.00)	$ (440 763.00)	$ (388 430.52)	$ (458 439.60)	$ (556 475.70)	$ (595 419.28)	$ (661 644.68)	$ (1 799 641.06)
Income taxes payable	$ (54 937.00)	$ (60 871.00)	$ (32 461.00)	$ (32 251.00)	$ (46 170.90)	$ (47 527.80)	$ (47 272.92)	$ (55 885.10)	$ (65 926.50)	$ (171 325.23)
Working Capital	$ 866 349.40	$ 939 870.10	$ 788 045.70	$ 816 115.90	$ 915 439.96	$ 1 078 734.89	$ 1 218 468.49	$ 1 459 153.90	$ 1 700 453.48	$ 5 324 180.27
Net property, plant and equipment	$ 2 493 310.00	$ 3 021 084.00	$ 4 909 473.00	$ 5 354 625.00	$ 5 655 477.00	$ 6 355 173.99	$ 7 018 576.92	$ 7 696 810.96	$ 8 504 422.92	$ 15 425 190.09
Growth %		21.2%	62.5%	9.1%	5.6%	12.4%	10.4%	9.7%	10.5%	2.2%
Goodwill	$ 1 610 355.00	$ 1 567 169.00	$ 1 578 785.00	$ 1 665 520.00	$ 1 623 471.00	$ 1 623 471.00	$ 1 623 471.00	$ 1 623 471.00	$ 1 623 471.00	$ 1 623 471.00
Other intangibles, net of amortization	$ 421 503.00	$ 386 143.00	$ 354 622.00	$ 349 105.00	$ 352 596.05	$ 356 122.01	$ 359 683.23	$ 363 280.06	$ 366 912.86	$ 425 974.44
Growth %										
Other assets	$ 74 164.00	$ 80 135.00	$ 213 061.00	$ 219 268.00	$ 220 730.15	$ 238 426.74	$ 258 391.33	$ 273 967.12	$ 288 724.65	$ 582 351.00
Growth %										
Joint Ventures	$ 499 756.00	$ 486 032.00	$ 534 430.00	$ 604 964.00	$ 598 135.52	$ 599 233.92	$ 600 348.80	$ 601 480.40	$ 602 628.97	$ 622 077.07
Growth %										
Other noncurrent liabilities	$ (599 174.00)	$ (526 942.00)	$ (754 536.00)	$ (629 377.00)	$ (621 147.12)	$ (621 147.12)	$ (621 147.12)	$ (621 147.12)	$ (621 147.12)	$ (621 147.12)
% revenues	-20%	-16%	-21%	-20%						
Deferred income taxes	$ (370 389.00)	$ (382 982.00)	$ (397 858.00)	$ (394 852.00)	$ (453 630.70)	$ (482 238.33)	$ (668 056.43)	$ (809 104.75)	$ (960 329.17)	$ (3 243 436.98)
Total Core Invested Capital	$ 4 995 874.40	$ 5 570 509.10	$ 7 226 022.70	$ 7 985 368.90	$ 8 291 071.86	$ 9 147 777.10	$ 9 789 736.21	$ 10 587 911.56	$ 11 505 137.60	$ 20 138 659.77
Nonmarketable Securities	$ 3 655.00	$ 9 177.00	$ 11 746.00	$ 14 171.00	$ 14 171.00	$ 14 171.00	$ 14 171.00	$ 14 171.00	$ 14 171.00	$ 14 171.00
as % core invested Capital										
Marketable equity securities	$ 30 653.00	$ 33 513.00	$ 33 637.00	$ 37 109.00	$ 37 109.00	$ 37 109.00	$ 37 109.00	$ 37 109.00	$ 37 109.00	$ 37 109.00
as % core invested Capital										
Assets held for sale	$ 39 152.00	$ -	$ -	$ -						
Noncurrent assets held for sales	$ 139 813.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Liabilities held for sale	$ (1 938.00)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Noncurrent liabilities held for sale	$ (614.00)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Non Core Invested Capital	$ 210 721.00	$ 42 690.00	$ 45 383.00	$ 51 280.00	$ 51 280.00	$ 51 280.00	$ 51 280.00	$ 51 280.00	$ 51 280.00	$ 51 280.00
Total Invested Capital	$ 5 206 595.40	$ 5 613 199.10	$ 7 271 405.70	$ 8 036 648.90	$ 8 342 351.86	$ 9 199 057.10	$ 9 841 016.21	$ 10 639 191.56	$ 11 556 417.60	$ 20 189 939.77
Financial	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2040**
Postretirement benefits	$ (52 003)	$ (46 157)	$ (50 899)	$ (48 075)	$ (48 075)	$ (48 075)	$ (48 075)	$ (48 075)	$ (48 075)	$ (48 075)
Pension benefits	$ (294 611)	$ (285 396)	$ (292 073)	$ (340 818)	$ (340 818)	$ (340 818)	$ (340 818)	$ (340 818)	$ (340 818)	$ (340 818)
Dividends payable	-35 165	-35 169	-38 764	-40 937	-40 937	-40 937	-40 937	-40 937	-40 937	-40 937
Debt (excluding pension liabilities)	-1 837 372	-1 705 210	-3 050 257	-3 572 058	-2 022 098	-3 679 623	-3 936 406	-4 255 677	-4 622 567	-8 075 976
as % of Core Invested Capital	-35%	-30%	-42%	-44%	-37%	-40%	-40%	-40%	-40%	-40%
Excess Cash	830 105	217 825	254 167	433 833	159 646	1 303 740	1 364 727	1 440 553	1 527 690	2 347 874
Net Debt	-1 389 046	-1 854 107	-3 177 826	-3 568 055	-2 292 282	-2 805 712	-3 001 510	-3 244 953	-3 524 707	-6 157 932
Common Equity	3 817 696.00	3 759 108.00	4 093 580.00	4 468 594.00	6 050 069.74	6 393 344.68	6 839 506.27	7 394 238.14	8 031 710.23	14 032 008.14

Appendix 3 – FCF Map

CF MAP	2017	2018	2019	2020	2021	2022	2023	2024	2025	2040
CORE										
Core Result	724 716	393 440	570 844	560 475	539 399	636 517	754 539	912 764	1 122 009	3 704 461
Invested Capital Core Business	5 206 595	5 613 199	7 271 406	8 036 649	8 342 352	9 199 057	9 841 016	10 639 192	11 556 418	20 189 940
Change in Core Invested Capital		406 604	1 658 207	765 243	305 703	856 705	641 959	798 175	917 226	430 125
Core FCF		-13 164	-1 087 362	-204 768	233 696	-220 188	112 580	114 589	204 783	3 274 336
NON CORE										
Non Core FCF	-251 545	261 806	115 408	13 642	-130 326	50 574	50 574	50 574	50 574	50 574
Core + Non Core FCF (Unlevered free cash flow)		248 642	-971 955	-191 125	103 370	-169 614	163 154	165 163	255 358	3 324 911
FINANCIAL										
Financial Result	-120 483	-86 796	-116 241	-128 860	-108 485	-152 898	-163 271	-169 879	-177 229	-264 237
Net Debt	1 389 046	1 854 107	3 177 826	3 568 055	2 292 282	2 805 712	3 001 510	3 244 953	3 524 707	6 157 932
Change in Net Debt		465 061	1 323 719	390 229	-1 275 773	513 430	195 798	243 443	279 754	131 188
Net Debt & other claims										
Debt Cash Flows		378 265	1 207 478	261 370	-1 384 258	360 533	32 526	73 564	102 525	-133 049
Cash-Flow to/from Equity Shareholders	0	-627 037	-235 539	-70 244	1 280 888	-190 919	-195 680	-238 728	-357 883	-3 191 862
Financing FCF		**-248 772**	**971 939**	**191 125**	**-103 370**	**169 614**	**-163 154**	**-165 163**	**-255 358**	**-3 324 911**

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Report Recommendations

Buy	Expected total return (including expected capital gains and expected dividend yield) of more than 10% over a 12-month period.
Hold	Expected total return (including expected capital gains and expected dividend yield) between 0% and 10% over a 12-month period.
Sell	Expected negative total return (including expected capital gains and expected dividend yield) over a 12-month period.

This report was prepared by *António Sabugueiro and João Faria*, a Master in Finance student of Nova School of Business and Economics ("Nova SBE"), within the context of the Field Lab – Equity Research.

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