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**Evaluation of the Current State of the Lithium Commodity Sector and the Valuation of a
Selected Lithium Mining Company Using Several Approaches**

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A research study submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in partial fulfilment of the requirement for the degree Masters in Engineering.

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ABSTRACT

Lithium demand has historically been predominantly driven by its use in lithium-ion (Li-ion) batteries in consumer electronics. However, the lithium market has undergone a paradigm shift over the past two years, with its future supply and demand dynamics being inextricably linked to the seemingly unstoppable adoption of Battery Electric Vehicles (BEVs) by global auto-manufacturers. Numerous factors are driving the rapid commitment to the development of BEVs by many major auto manufacturers, including environmental considerations, technological progress, consumer experiences, and political mandates.

Driven by the continuing positive rhetoric from major auto-manufactures, lithium prices increased sharply between 2016 and 2018, with the commonly quoted Lithium Carbonate Equivalent (LCE) price climbing by as much as 240% (for delivery in China) over the period. Consequently, many lithium-focused mining and project development companies have experienced significant growth in their share price and market capitalisation as interest around lithium and BEVs intensified.

The aim of this research study is twofold. Firstly, the current state of the lithium commodity market is analysed, with a particular focus on the demand and supply dynamics and the consequent impact the relationship between these two factors have on the lithium price. Evaluating and understanding the fundamentals behind the lithium price is critical, as the price is one of the key drivers to which the intrinsic value of a lithium mining company is very sensitive. Secondly, this research study aims to calculate the intrinsic value of a specific market participant, namely, Galaxy Resource Ltd (Galaxy or GXY), by conducting a fundamental Discounted Cash Flow (DCF) valuation using both a deterministic (i.e., static valuation) and a probabilistic (i.e., Monte Carlo Simulation) approach. The robustness of the valuation is improved by using Real Options Analysis (ROA) to account for Galaxy's one undeveloped asset, while the use of scenario analyses tests the sensitivity of the deterministic valuation to changes in key variables. Galaxy is used as a proxy for the lithium market as the company has a diverse portfolio of assets that provides a robust understanding of the primary types of lithium resources. For example, Galaxy owns an operating Australian-based hard-rock mine; a Definitive Feasibility Study (DFS) stage brine operation located in Argentina; and, a Pre-Feasibility Study (PFS) stage hard-rock project in Canada. The outcome of the valuation is used to discuss whether investment in the lithium market currently offers acceptable risk-adjusted returns considering the share price volatility experienced in 2018. The volatility is primarily due to bearish views published by many market participants of an impending lithium oversupply and a consequent long-term commodity price weakness.

The base case valuation output indicates that the decline in share prices in 2018 has resulted in a market that appears to be undervalued, assuming the valuation inputs are correct. However, the valuation proves to be extremely sensitive to the potential materialisation of a 'bear case' long-term

lithium price scenario, which may result in significant share price downside compared to current levels. Furthermore, the utilisation of a discount rate that caters for the contribution from cash flows originating in riskier jurisdictions, such as Galaxy's Argentinian brine asset, has a significant impact on the valuation and suggests Galaxy is at best fairly valued compared to its August 2018 share price.

However, the commodity price weakness experienced in 2018, driven primarily by fears of an impending lithium oversupply, and the consequent decline in lithium mining company share prices, has resulted in attractive valuations for companies such as Galaxy Resources, depending on the validity of the so-called lithium bear case proposed by many market participants. The potential for long-term share price outperformance within the lithium market remains an appetising prospect, with many factors suggesting lithium commodity demand may surprise to the upside while the success rate of bringing new lithium supply online may disappoint, resulting in the potential for attractive returns for investors patient enough to wait for the market to develop. However, a clearer view of the long-term lithium price and the validity of a bear case scenario is required and therefore needs further investigation. Furthermore, the utilisation of a weighted average cost of equity that considers the relative contribution to Galaxy Resources' cash flows from riskier jurisdictions, such as Argentina, has a significant impact on the valuation when compared to using a simpler static cost of equity that considers only cash flows from Galaxy's country of incorporation, namely Australia. The use of such a weighted approach appears uncommon, despite the inclusion of riskier cash flows into the calculation of a discount rate being intuitively correct.

Section 1 of the research study provides an introduction to the volatility the lithium market has experienced over the past two years and highlights the significant valuation increases that many market participants have exhibited, despite the recent fears surrounding the sustainability of the currently high LCE price. Furthermore, the primary aim and purpose of the research study are discussed.

Section 2 explores the dominance and importance of lithium-ion within the battery market and provides an introduction to the fundamentals of the lithium commodity market, such as how lithium is mined and processed, its geology and the critical demand and supply drivers.

Section 3 discusses the validity of using an income-based valuation approach, and more specifically a DCF valuation methodology, to determine the intrinsic value of the selected mining company. The common difficulties encountered when valuing a cyclical commodity company is also addressed. The key valuation inputs utilised in a DCF model are introduced with a focus on typical mistakes made in their definition and calculation.

Section 4 introduces Galaxy Resources and the company's various projects, with Section 5 outlining the valuation methodology employed, namely, a deterministic Net Present Value (NPV) calculation,

scenario analyses, a probabilistic Monte Carlo Simulation, as well as a Real Options Analysis (ROA) for the one long-dated project.

Section 6 presents the valuation outputs and discussion, with Section 7 providing a conclusion and recommendations for further research.

GLOSSARY

ALB:	Albemarle
BEV:	Battery Electric Vehicle
BNEF:	Bloomberg New Energy Finance
BSM:	Black, Scholes and Merton
CAGR:	Compound Annual Growth Rate
CAPEX:	Capital Expenditure
CAPM:	Capital Asset Pricing Model
CO₂:	Carbon Dioxide
Corfo:	Chilean Economic Development Agency
Cyest:	Cyest Corporation
DCF:	Discounted Cash Flow
DFS:	Definitive Feasibility Study
DMS:	Dense Media Separation
DSO:	Direct Shipped Ore
EBIT:	Earnings Before Interest and Tax
ERP:	Equity Risk Premium
EU:	European Union
EV:	Electric Vehicle
EVI:	Electric Vehicle Initiative
FCF:	Free Cash Flow
FMC:	FMC Corporation
Ganfeng:	Ganfeng Lithium

GDP:	Gross Domestic Product
GWh:	Gigawatt-Hour
GXY/Galaxy:	Galaxy Resources
ICE:	Internal Combustion Engine
IFE:	International Fisher Effect
IRR:	Internal Rate of Return
LCE:	Lithium Carbonate Equivalent
LCO:	Lithium Cobalt Oxide
LFP:	Lithium Ferro Phosphate
Li₂CO₃:	Lithium Carbonate
Li-ion:	Lithium-Ion
LiOH:	Lithium Hydroxide
LMO:	Lithium Manganese Oxide
LTO:	Lithium Titanate
MCS:	Monte Carlo Simulation
MWh:	Megawatt-Hour
NCA:	Lithium Nickel Cobalt Aluminium
NMC:	Lithium Nickel Manganese Cobalt
NO_x:	Nitrogen Oxides
NPV:	Net Present Value
OEM:	Original Equipment Manufacturer
PFS:	Pre-Feasibility Study
PHEV:	Plug-In Hybrid Electric Vehicle

ROA:	Real Options Analysis
RoM:	Run-of-Mine
SQM:	Sociedad Química y Minera de Chile
Tianqi:	Tianqi Lithium
USA:	United States of America
WACC:	Weighted Average Cost of Capital

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1. INTRODUCTION

1.1. Background

Lithium's historical use has been in two primary sectors, namely the electronics and industrial sectors, with lithium demand traditionally driven primarily by its use in Li-ion batteries in consumer electronics such as smartphones and tablets. However, the future of lithium demand is inextricably linked to the BEV.

The automotive industry's quest to limit its impact on the environment and transform the BEV into a sustainable mode of transport has gathered pace over the last few years and continues to progress at high intensity. The rapid commitment to the development of BEVs by many major auto-manufacturers has mostly surprised the industry but various catalysts are driving the push towards BEVs (Glencore, 2017; Morgan Stanley, 2018), namely:

- Environmental considerations: Momentum to decarbonise the economy is gathering speed with Bloomberg New Energy Finance (BNEF) forecasting investment in zero-carbon energy at approximately US\$8.7 trillion by 2040 with an estimated 530 million Electric Vehicles (EVs) on the road by the same date;
- Technological progress: Technology is advancing rapidly across the EV supply chain, including improvements in power generation, storage, charging infrastructure and vehicle design. Technological advances drive cost efficiencies and enhanced performance, resulting in BEVs that can compete with Internal Combustion Engines (ICEs) on key performance metrics;
- Consumer experience: Although BEVs are in their infancy, existing BEV models, as well as those under development, are beginning to demonstrate performance comparable to, or exceeding, that of equivalent ICEs. Average BEV range, acceleration, and speed is increasing, while charging times and costs are decreasing, enhancing the consumer experience; and,
- Political mandate: Tightening emissions regulations are expected to drive up the cost of producing ICEs, resulting in their future economic viability being questionable. Some estimates suggest, depending on the severity of future ICE focused legislation, that BEV drivetrain costs will be equivalent to that of ICEs by between 2022 and 2024, as depicted in Figure 1 (Morgan Stanley, 2017). The figure showcases the forecasted decline in the manufacturing cost of BEVs versus the increase in cost for ICEs when considering the various environmental and social constraints currently developing for the ICE market. The original cost assumption for an ICE drivetrain is impacted by: 'Add NOx' – the cost to comply with new European NOx tests; 'Add SUV' – the global preference for larger and higher emission generating SUVs; 'Add RDE' – the requirement to adhere to real-world driving emissions

testing; and, 'Add Diesel Decline' – the gradual decline of lower CO₂ emitting diesel vehicles, as depicted in Figure 1. Furthermore, multi-government policy initiatives such as the Electric Vehicle Initiative (EVI), which comprises 16 major global economies (including China, United States of America and the United Kingdom), seeks to facilitate the global deployment of at least 20 million EVs by 2020. A further campaign announced in 2017, led by China, targets at least 30% new electric vehicle sales by 2030 collectively across all EVI countries.

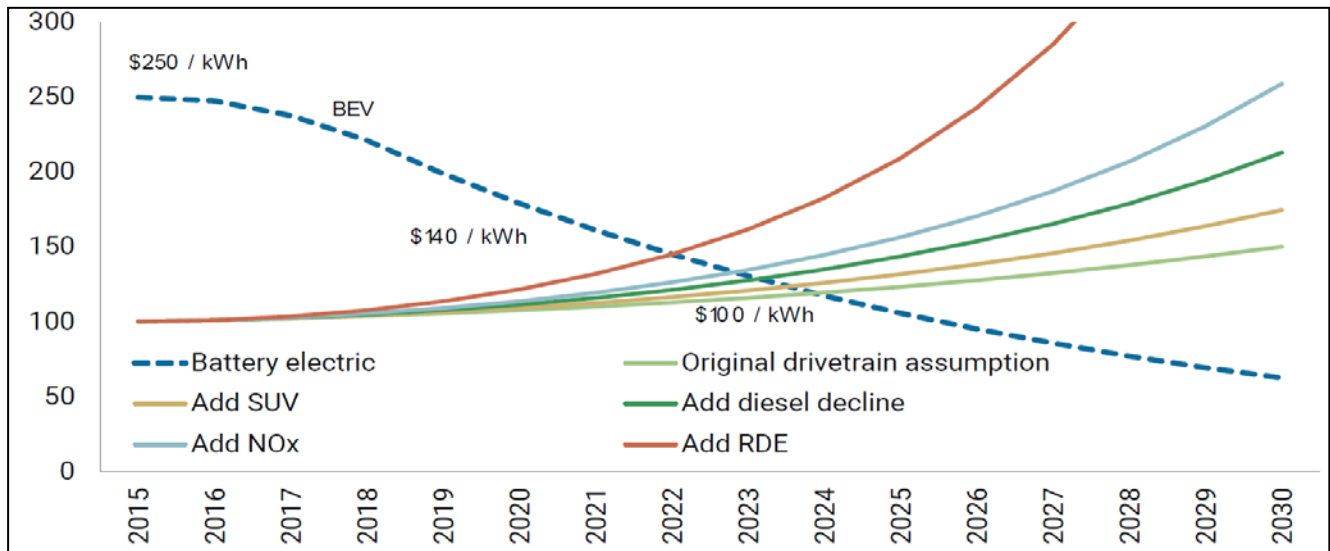


Figure 1: Rising Cost of ICE versus Falling BEV Drivetrain Costs (Morgan Stanley, 2017)

The adoption of BEVs is exemplified by many established Original Equipment Manufacturers (OEMs) announcing the target to launch more than 100 new BEV models by 2024, further accelerating automotive and mobility trends and potentially growing EVs' share of total passenger-vehicle sales to approximately 35 percent in major markets like China, Europe, and the United States by 2030. There will also be a sizable share of midsize and volume-segment vehicles among the many new BEV models, with EVs thus moving away from previous "niche roles" such as high-performance sports or midrange city cars. A prominent and recently launched example is Tesla's new Model 3, with more than 450,000 pre-orders in 2018 (Chatelain, et al., 2018).

The clear majority of current battery technology employed in BEVs utilises Li-ion based batteries and fears exist that a supply deficit is rapidly evolving as auto-manufacturers aggressively commit to the adoption and integration of BEVs into their fleets (The Boston Consulting Group, 2017). The projected increase in Li-ion battery demand is depicted in Figure 2 (Eckhouse, et al., 2018), which indicates that EVs overtook consumer electronics as the dominant lithium consumer in 2015, and is forecasted to grow rapidly as adoption in the automotive market increases.

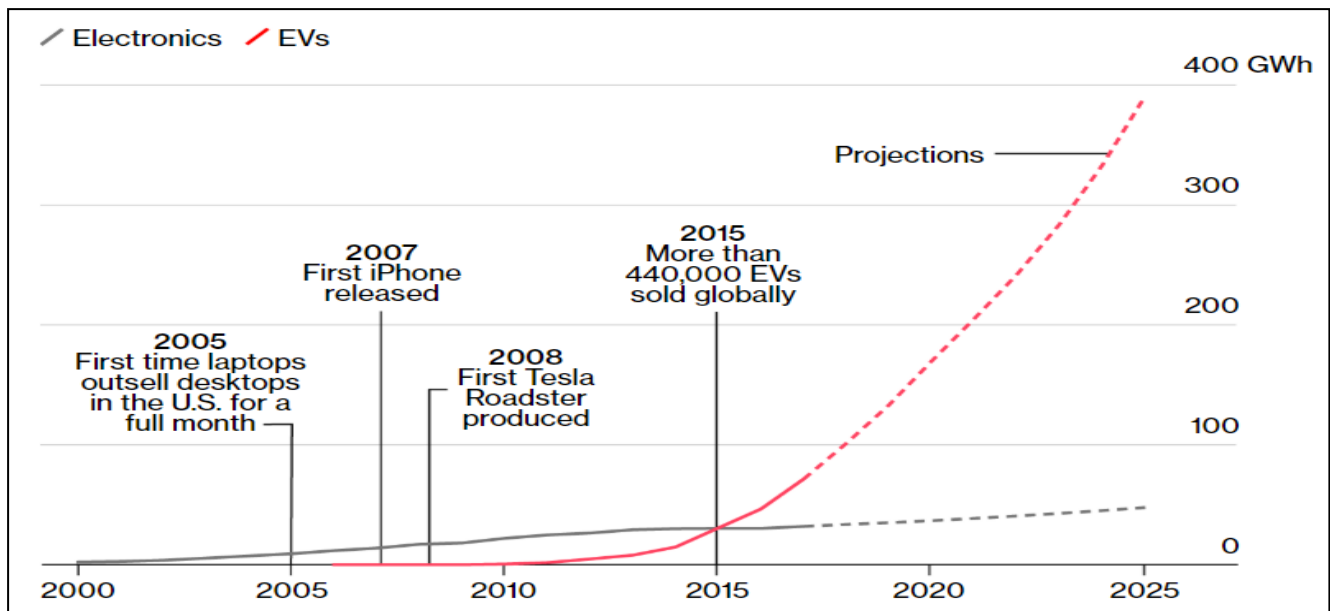


Figure 2: Estimated Global Demand for Lithium-Ion Batteries in GWh (Eckhouse, et al., 2018)

1.2. Purpose of Study and Research Motivation

Driven by the continuing positive rhetoric from auto-manufactures, lithium prices increased sharply between 2016 and 2018, with the commonly quoted LCE price climbing 240% (for delivery in China) over the period (Lithium Americas, 2018). It is not only the lithium price that has experienced robust increases but an increase in the number of junior mining companies dedicated to exploring and developing lithium ore bodies has also been observed. Some of these junior miners have experienced staggering growth rates in their share price as interest around lithium and BEVs has intensified. The fundamentals behind the improving valuations of many lithium companies are robust, with supporting factors including (Morgan Stanley, 2017):

- Lithium is abundant within the earth's crust but forecasted demand is expected to outstrip supply due to the difficulty of extracting and processing lithium into battery-grade materials;
- Adoption rates committed to by auto-manufacturers have been more aggressive than anticipated and the capital investment required to develop lithium mines to meet demand has been lagging. Financing a lithium mine is also difficult because lithium prices cannot be hedged like traded commodities such as copper via futures as no active exchanges are trading lithium-based products; and,
- Some forecasts indicate that total lithium supply needs to increase from 229kt LCE in 2017 to as much as 750kt LCE by 2025, equating to a Compound Annual Growth Rate (CAGR) of 16%.

Market analysts agree that real-world demand factors underpin the soaring EV related commodity prices. However, this should not automatically translate into higher company valuations as the development of a new mine faces many challenges (such as construction delays and production ramp-up difficulties, low lithium recoveries, etc.) and the lithium market is still in its infancy (Mathews,

2017). Despite this, recent share price increases for many companies has been considerable, as presented in Table 1 (Company Data).

Table 1: Company Information (As per Company Website)

Company Name	Lithium Americas Corp. (LAC)	Galaxy Resources Ltd (GXY)	Pilbara Minerals Ltd (PLS)
Listing	TSX	ASX	ASX
Market Capitalisation	CAD 468 million (USD 360 million)	AUD 1,120 million (USD 829 million)	AUD 1,570 million (USD 1,162 million)
1 Jan 2016 Share Price	CAD 1.52	AUD 0.57	AUD 0.32
Current Share Price ¹	CAD 5.13	AUD 2.84	AUD 0.90
% Change	338%	498%	282%
Primary Country of Operation	Argentina	Australia (Hard-Rock) and Argentina (Brine)	Australia
Asset Type	Brine	Hard-Rock and Brine	Hard-Rock
Status	Production Target of H2 2019	Production (Hard-Rock) and in Development (Brine)	Production Target of Q1 2018
Design Production Capacity (ktpa LCE)	Phase 1: 25 Phase 2: Increase to 50	30 (Hard-Rock) and 25 (Brine)	44

¹Share price at the time of writing

The share price and market capitalisation of the lithium companies described in Table 1 declined quite sharply in 2018 as investment banks such as Morgan Stanley hypothesised a relatively quick and significant decline in lithium prices by 2021 due to the potential for a theorised oversupply, as described in Section 2.3.4. However, despite the correction in the share price in 2018, the significant valuation gains that the abovementioned companies experienced since 2016 may still indicate a strong degree of overvaluation driven by the currently high lithium commodity prices.

The purpose of this research study is two-fold. Firstly, the rapid growth in market capitalisations experienced by many lithium mining companies has primarily been due to the significant increase in the lithium price. The current state of the lithium commodity market is consequently analysed, with a particular focus on the supply and demand dynamics and how these two drivers influence the lithium price, and whether the high-price environment experienced in 2018 is sustainable. Secondly, a fundamental DCF valuation is conducted for one representative company, namely, Galaxy Resources Ltd (Galaxy or GXY). The outcome of the valuation is used to discuss whether an investment in the lithium market currently offers acceptable risk-adjusted returns considering the share price volatility experienced 2018 and the bearish views published by many market participants of impending lithium oversupply and consequent long-term commodity price weakness. GXY is selected as a proxy for the lithium market as it has both an operating hard-rock mine, as well as a brine operation currently in development, allowing analysis of the two primary sources of lithium production.

2. LITHIUM INDUSTRY OVERVIEW

The information presented in Section 2.1 is not explicitly required to conduct a valuation of a lithium mining company. However, it is critical to understand the fundamentals of lithium and why it is the dominant commodity within the BEV market. Section 2.1 aims to address this by discussing lithium's market position, geology, global resource and reserve allocation, the supply chain and chemical forms of lithium utilised and the extraction and processing techniques employed. Sections 2.2 and 2.3 discuss the demand and supply dynamics of the lithium industry and the consequent impact the relationship between these two factors have on the lithium price, which is one of the key drivers of the intrinsic value of a lithium mining company, as discussed in Sections 6.2 and 6.3.

2.1. Introduction to Lithium

2.1.1. Why does Lithium-Ion Dominate the Battery Market?

2.1.1.1. Early Batteries

Batteries are so universal today that their contribution to modern-day comforts is almost invisible, yet they have a long history and arguably an even brighter future. The Italian physicist Alessandro Volta invented the first true battery in 1800. Volta stacked discs of copper and zinc, separated by a cloth soaked in saltwater, with a wire connected to each end, which resulted in the generation of continuous and stable current (Alarco & Talbot, 2015).

Volta's initial discovery catalysed the development of a variety of battery technologies, with one of the most enduring batteries being the lead-acid battery which is still the most widely used today in ICE vehicles. However, modern technologies demanded batteries to be more compact, safer and with higher capacities and faster recharging capabilities. The advent of a new type of Li-ion battery in 1980 that met these requirements heralded the beginning of lithium's dominance of modern-day battery technology, culminating in the technology's exclusive use in cell phones and laptop computers (Deng, 2015). Despite being the subject of intensive research to identify the flaws and potentially improve battery design through substitutes, the Li-ion battery remains the industry standard due to it being light, energy-dense and capable of holding its charge effectively.

Some of the first BEVs developed used the traditional lead-acid battery but these vehicles typically suffered from poor performance and the need for regular battery replacements due to their low cyclability. Lead-acid batteries also suffer from relatively low specific energy and poor cold-temperature performance, hence the development of alternative technologies, such as the Li-ion battery (Fogarty, 2018).

2.1.1.2. Use of Lithium-Ion for BEVs

Lithium is the lightest known metal and the least dense solid element with the highest electrochemical potential (a measure of its willingness to transfer electrons). This suggested to technology developers that it should have excellent energy-to-weight properties, an essential requirement for use in automotive vehicles (Deutsche Bank, 2016). Although Li-ion has dominated the consumer electronics market since the early 2000s, its prevalence in current BEV cathode technology is primarily due to its early adoption by Tesla. Tesla has been using Li-ion batteries to develop and produce its vehicles and stationary storage products for over a decade (Hotter, 2018).

Lithium is the only active material involved in electron transfer in the battery; consequently, increasing the lithium content increases the battery's energy density. The high reactivity of lithium requires the inclusion of various other materials in the battery to ensure its stability, safety, and to maximise battery life expectancy (Deutsche Bank, 2016). There are consequently many variants of the Li-ion battery with the six predominant batteries currently in use being: Lithium Ferro Phosphate (LFP), Lithium Nickel Manganese Cobalt (NMC), Lithium Nickel Cobalt Aluminium (NCA), Lithium Manganese Oxide (LMO), Lithium Titanate (LTO) and Lithium Cobalt Oxide (LCO), which contain varying quantities of lithium in the cathode and electrolyte (Morgan Stanley, 2017). However, LCO, which is most prevalent in consumer electronics, is generally considered unsuitable for automotive applications because of its inherent safety risks (BCG, 2009).

The comparison of competing Li-ion technologies occur along six dimensions, namely: safety; lifespan (measured in terms of number of charge-and-discharge cycles and the overall battery age); performance (peak power at low temperatures and thermal management); specific energy (quantity of energy the battery can store per kilogram of mass); specific power (quantity of power the battery can store per kilogram of mass); and, cost. Figure 3 (BCG, 2009) highlights these key characteristics.

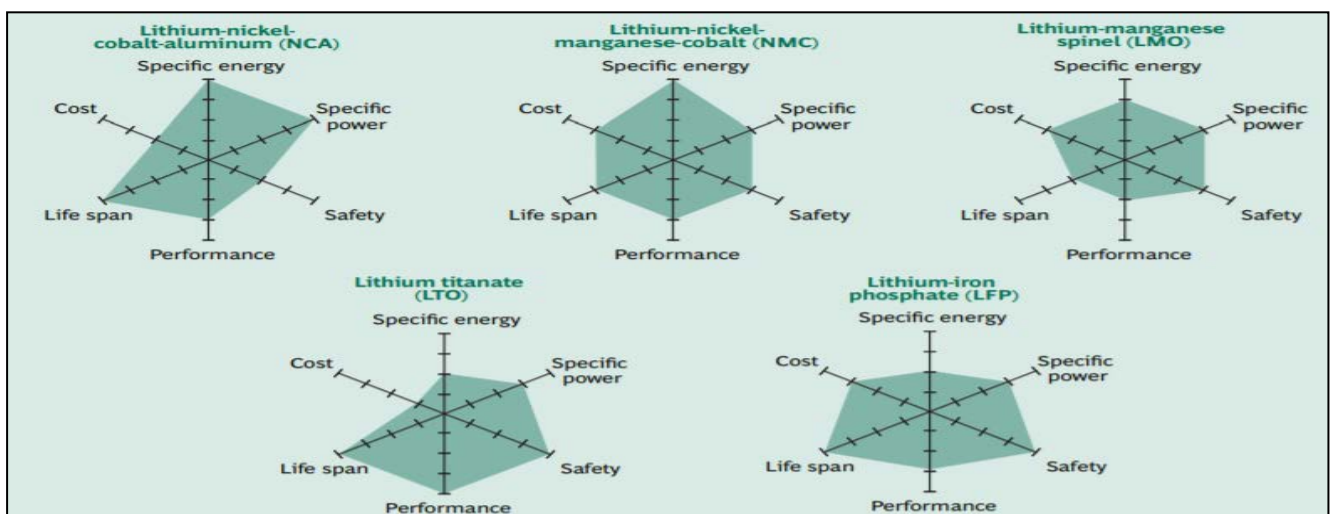


Figure 3: Key Characteristics and Trade-Offs Among the Five Principal Li-Ion Battery Technologies (BCG, 2009).

Figure 3 indicates that the various battery technologies offer a relatively diverse set of performance characteristics. However, NCA and NMC cathodes are the two leading technologies used in the BEV industry due to their strong overall performance in all six categories, with Tesla employing the NCA technology for its Model S vehicle (Hotter, 2018).

Battery technology will continue to develop with a particular focus on reducing cost. Supply-demand fundamentals of the competing EV battery materials, and their relative properties and suitability will be an important determinant for a battery that will dominate future market share. Therefore, technology development is expected to focus on the supplementary battery metals as this is where the real trade-off and competitive advantages in performance are realised. Although substitution of lithium through future technology development remains a risk, Li-ion is anticipated to remain the battery of choice in the short to medium term for several reasons, namely (Battery University, 2011):

- The batteries have a high energy per unit mass relative to other electrical energy storage systems;
- High power-to-weight ratio;
- High energy efficiency; and,
- Good high-temperature performance.

The most significant threat to the demand and supply fundamentals of lithium's use in battery technology is the ongoing focus on the development of solid-state batteries. This battery technology utilises a solid-state glass or ceramic electrolyte, instead of the current liquid lithium-carrying electrolyte, and could improve energy density by up to 40%, reducing the size of batteries required in BEVs, and consequently the amount of lithium required. However, there are several electrochemical and manufacturing hurdles the solid-state battery technology needs to overcome and the early adoption of solid-state batteries may take another ten years to be realised (Fogarty, 2018).

2.1.2. Lithium Production, Geology and World Reserves

2.1.2.1. Historical Production

Brine and hard-rock operations are the primary sources of lithium with brine traditionally dominating market supply, as depicted in Figure 4 (Deutsche Bank, 2016). The figure presents the strong growth in supply exhibited by lithium since the increase in adoption of laptops in 2005 and the advent of the smartphone in 2007, both primary users of Li-ion batteries, with the CAGR of supply equating to 6.6% between 1995 and 2015. However, subsequent sections highlight the potential need for the lithium market to grow at an accelerated rate of up to 16% per annum to meet growing demand and the requirement for both new hard-rock and brine operations to meet the forecasted demand.

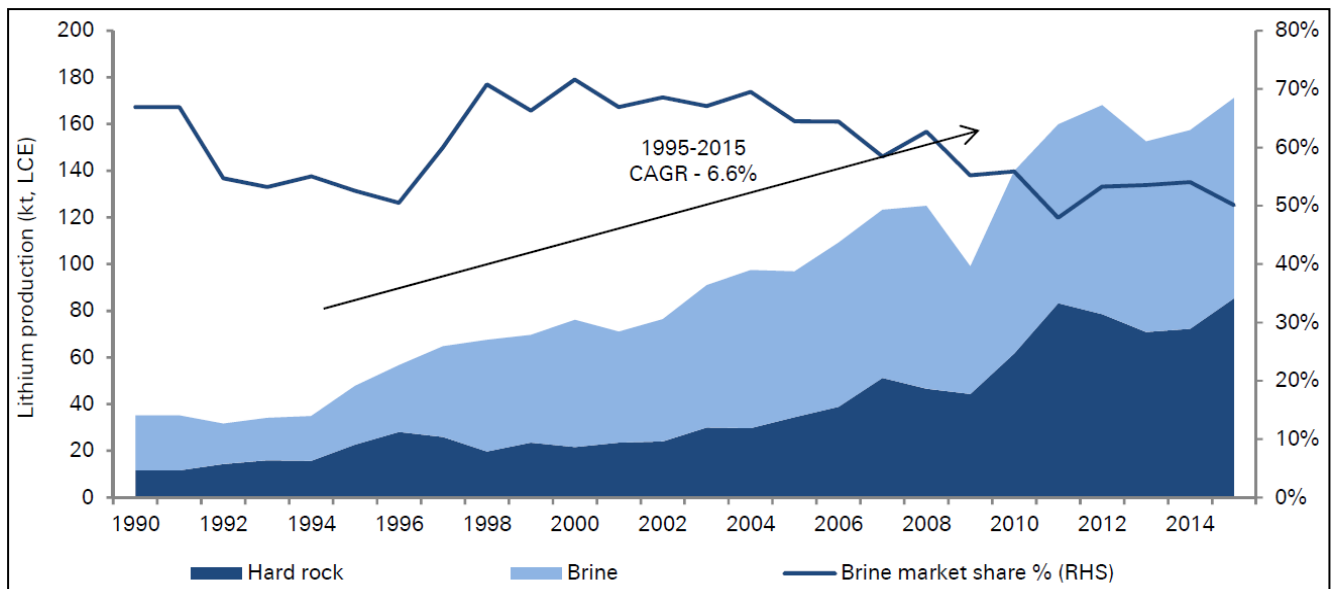


Figure 4: Historical Global Lithium Output (LCE Basis) (Deutsche Bank, 2016)

2.1.2.2. Brine Resources

Brine resources are primarily located in South American countries, such as Chile, Argentina, and Bolivia, in an area commonly known as the "Lithium Triangle". Lower quality brine deposits do also exist in the United States and China but the economics of these are less favourable due to lower grades and higher levels of impurities (Deutsche Bank, 2016).

Lithium brine deposits are lithium enriched accumulations of saline groundwater. All lithium brine operations share a number of ore deposit characteristics, namely: arid climate; closed basin containing a playa or salar (i.e. a dry lakebed or salt flat in an arid basin); tectonically driven subsidence; associated igneous or geothermal activity; suitable lithium source-rocks; one or more adequate aquifers; and, sufficient time to concentrate a brine. All of these factors interact to allow dissolved lithium derived from the weathering and leaching of various source rocks, or from hydrothermal fluids or volcanic activity, to collect in a closed basin.

Lithium is highly soluble and, unlike sodium (Na), potassium (K) and calcium (Ca), does not readily produce minerals when concentrated by evaporation. Instead, the lithium ends up in residual brines in the shallow subsurface. Economic brines have Li concentrations in the range of 200 to 4,000 milligrams per litre (mg/L). Other elements in solution such as boron and potassium may be recovered as by-products or co-products. However, brines can also contain undesirable elements that create problems in processing such as magnesium (USGS, 2013).

2.1.2.3. Hard-Rock Resources

Hard-rock derived lithium is recovered from the mineral spodumene, found in economic quantities within pegmatite intrusions, primarily in Canada, Australia, Brazil, Portugal, Zimbabwe and China.

Pegmatites are an intrusive igneous rock composed of large crystals formed during the slow cooling of the source magma (ScienceViews, 2010). Pegmatites are hard ores that require significant crushing and grinding before producing a lithium-rich spodumene concentrate.

Other less significant hard-rock lithium sources include petalite (extracted at the Bikita Mine in Zimbabwe), lepidolite (several mines in China) and a lithium-clay mineral called hectorite (deposits identified in the United States of America (USA), Mexico, and Morocco) (Deutsche Bank, 2016).

2.1.2.4. Lithium Resources and Reserves

The identifiable global lithium resources and reserves, as per 2017 data, are depicted in Figure 5 (USGS, 2018) and indicates that on a resource basis the global split of identifiable lithium deposits is quite diverse. However, in terms of economically extractable reserves, future lithium production appears to be relatively concentrated and dominated by Chilean and Argentinian brine deposits and Australian and Chinese hard-rock deposits, as is the case in 2018 as well. This is an important consideration when analysing the market's ability to respond to increasing demand. The countries that host the largest economically extractable reserves are mining-friendly jurisdictions which will help facilitate the development of new mines required to meet future demand.

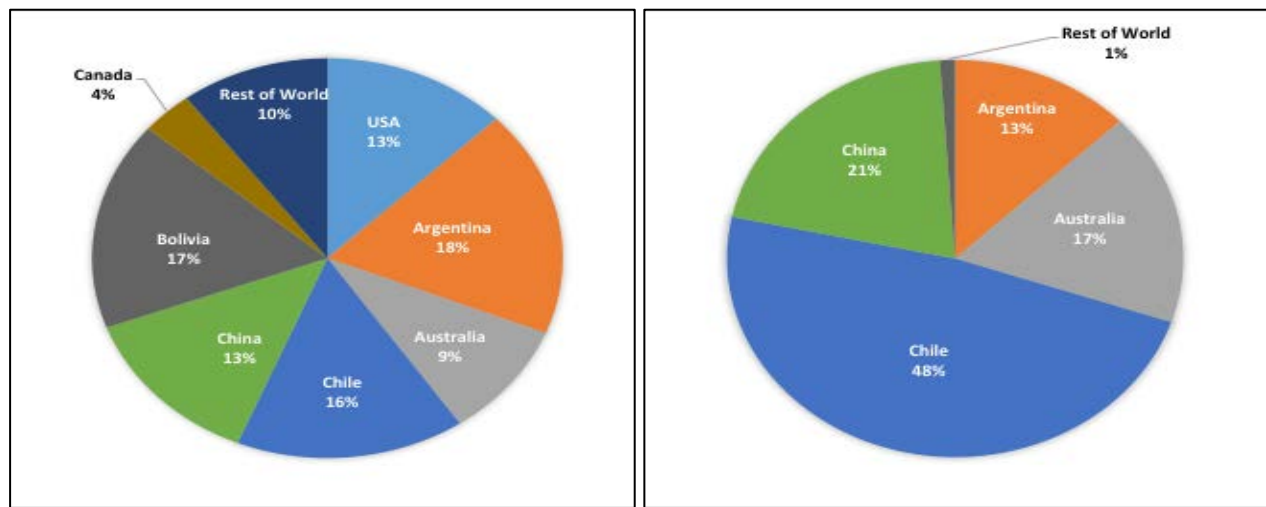


Figure 5: Global Lithium Resources - 284 Mt LCE (Left) and Reserves – 83 Mt LCE (Right) (USGS, 2018)

2.1.3. Lithium Chemical Forms

Lithium sales occur in several forms, with lithium carbonate (Li_2CO_3) contributing the largest market share at 50% in 2015 based on volumes sold, followed by lithium hydroxide (LiOH) at 20% in 2015. Technical grade lithium concentrate (derived from spodumene and used for glass and ceramics manufacturing) contributes 14% of sales volumes, while the remainder is shared amongst several other end-products, as depicted in Figure 6 (Deutsche Bank, 2016).

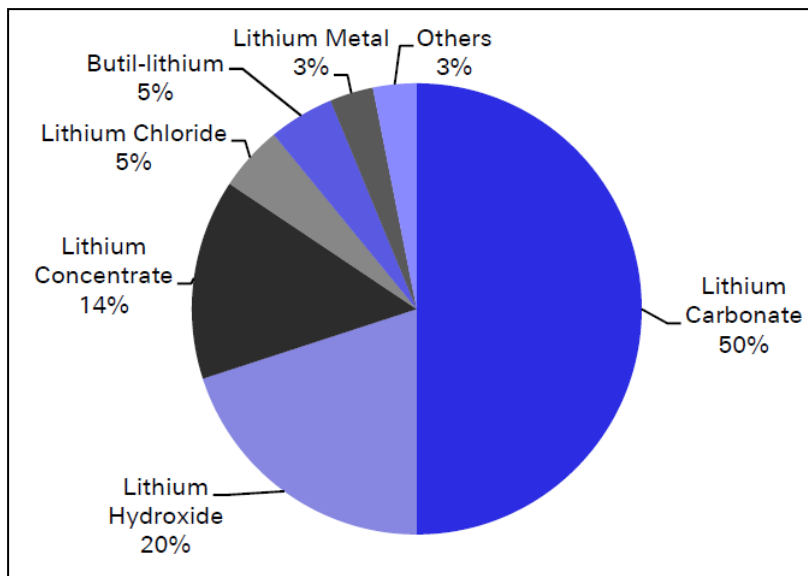


Figure 6: 2015 Global Lithium Product Market (Deutsche Bank, 2016)

2.1.4. Lithium Supply Chain

Figure 7 (UBS Global Research, 2018) depicts the high-level lithium supply-chain. Lithium carbonate and hydroxide are the primary lithium feedstocks required for the production of cathode materials used in battery electric vehicles.

Lithium carbonate and lithium hydroxide are each produced via the brine or spodumene mining and processing route. However, brine and spodumene as a primary source of supply each have their competitive advantage with the specific chemistries resulting in brine being a more cost-effective source for lithium carbonate and spodumene for lithium hydroxide. Typically, the lithium carbonate or hydroxide produced from brine operations and the spodumene concentrate produced from hard-rock operations are considered intermediate lithium products and require further upgrading at chemical conversion plants. Direct-shipped-ore (DSO) is another intermediate feed source to conversion plants and refers to the mining of spodumene run-of-mine material and its shipment to an offsite concentrator for further beneficiation (Miller & Moores, 2018).

Figure 7 highlights the relative complexity of the lithium value chain, with the likely bottlenecks identified as follows (Miller & Moores, 2018):

- Direct shipped ore: No further on-site processing required, with the raw ore shipped directly to third-party processing facilities. No bottlenecks and low barriers to entry;
- Spodumene concentrate: No bottlenecks due to relatively quick ramp-up time and limited production complexity;
- Brine based operations: Operational complexity and historically slow ramp-up due to operational and technical difficulties. Many economically viable reserves identified, but the timely exploitation of these are uncertain;

- Battery-grade lithium chemicals: Bottleneck due to constrained conversion capacity; and,
- Battery components (cathode and anode materials): Bottleneck due to sizeable fixed asset base required and production complexity.

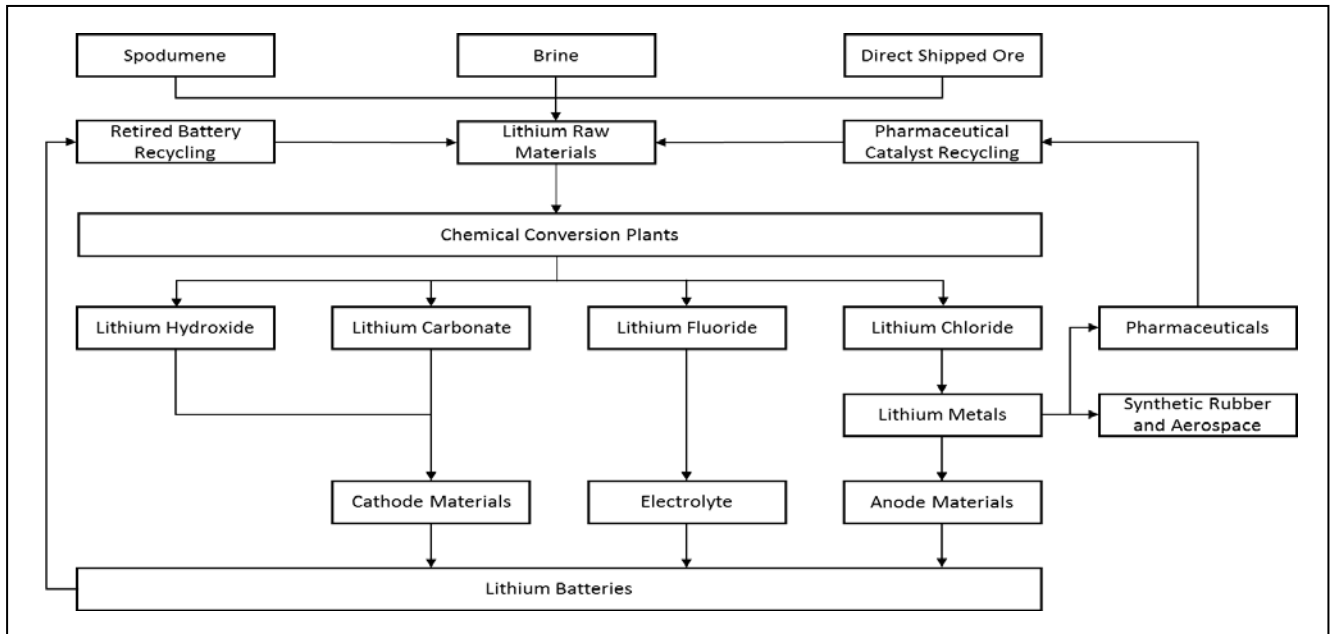


Figure 7: Lithium Supply Chain (UBS Global Research, 2018)

Despite the wide variety of lithium chemicals produced, the most common unit of measurement when referring to the size of the lithium market is Lithium Carbonate Equivalent (LCE) or Li_2CO_3 . However, products exist in various forms and Table 2 (Deutsche Bank, 2016) provides the conversion factors required to translate volumes of different lithium products to an LCE basis to make effective comparisons.

Table 2: Lithium Compound Conversion Factors (Deutsche Bank, 2016)

Lithium Compound	Formula	Li	Li_2O	Li_2CO_3
Lithium Metal	Li	1.000	2.152	5.322
Lithium Carbonate	Li_2CO_3	0.188	0.404	1.000
Lithium Oxide	Li_2O	0.465	1.000	2.473
Lithium Hydroxide	LiOH	0.290	0.624	1.542
Spodumene	$\text{LiAlSi}_2\text{O}_6$	0.037	0.080	0.199
Petalite	$\text{LiAlSi}_4\text{O}_{10}$	0.023	0.049	0.121
Lepidolite	$\text{KLi}_2\text{AlSi}_3\text{O}_{10}(\text{OH},\text{F})_2$	0.019	0.041	0.102
Lithium Chloride	LiCl	0.164	0.352	0.871
Lithium Bromide	LiBr	0.080	0.172	0.425
Butyllithium	$\text{C}_4\text{H}_9\text{Li}$	0.108	0.233	0.577

2.1.5. Extraction and Processing Methods

2.1.5.1. Brine Processing

Brine-based operations extract the brine from a salar, or salt-lake, via a series of pumping wells. The brine is deposited and stored in a sizeable evaporative pond system over a 9 to 12-month period, during which lime is added to facilitate the precipitation of impurities such as magnesium. Evaporation assists in concentrating the brine for further processing. The processing plant configuration varies depending on the asset, capital available, and the desired end-product. Figure 8 (Deutsche Bank, 2016) depicts a standardised flowsheet. The inherent complexity in extracting, processing and purifying the brine into a high purity Li_2CO_3 or LiOH intermediate product is evident and is also a key consideration when analysing whether the robust pipeline of lithium projects slated for development are likely to achieve their stated ramp-up dates, as discussed in Section 2.3.4.1.

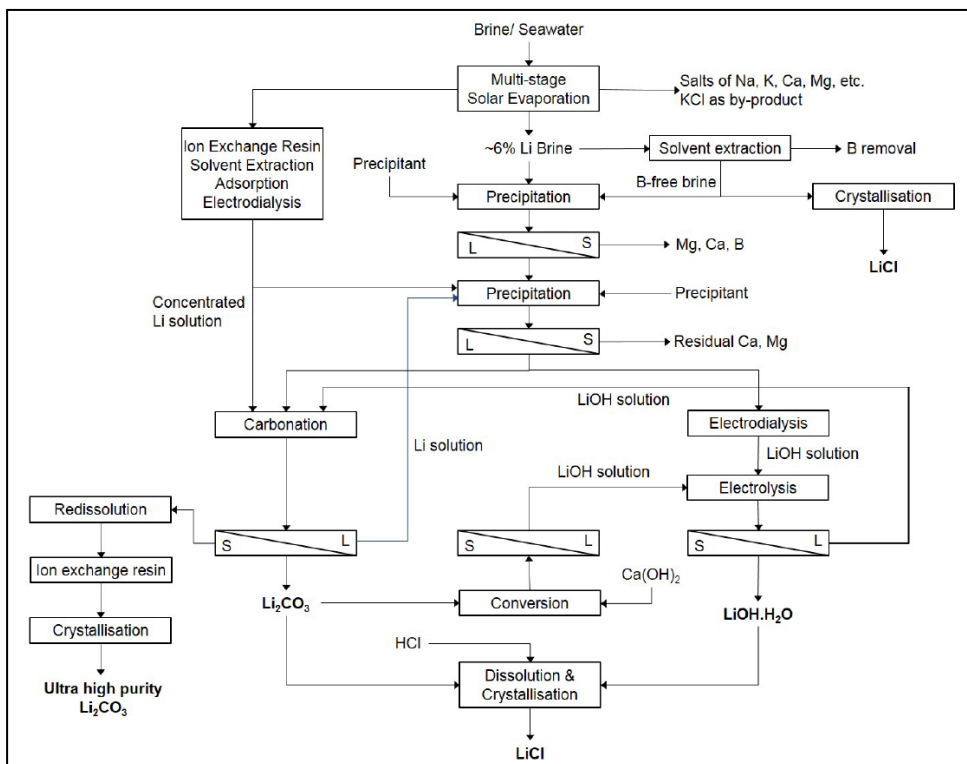


Figure 8: Process Flow Diagram of a Typical Brine Processing Operation (Deutsche Bank, 2016)

2.1.5.2. Spodumene Processing

The processing route for hard-rock lithium ores is more conventional with drill and blast methods producing Run-of-Mine (RoM) material that is trucked to a central processing facility. The ore subsequently undergoes several stages of crushing to reduce the material to the desired size fraction. Lithium-bearing minerals such as spodumene can be liberated from gangue material via Dense Media Separation (DMS), using either spirals or hydro-cyclones, to separate particles based on their density. Some ores may require further processing and upgrading through the use of

flotation, which selectively suppresses the gangue material while concentrating the lithium-bearing minerals. Magnetic separation may also be employed to eliminate any magnetite present. The final wet concentrate is filtered and prepared for transportation as an approximately 6% spodumene concentrate. Figure 9 (Deutsche Bank, 2016) depicts a standardised flowsheet, and the relative lack of complexity compared to brine processing is a crucial determinant in spodumene projects ability to be constructed and ramped-up reasonably quickly.

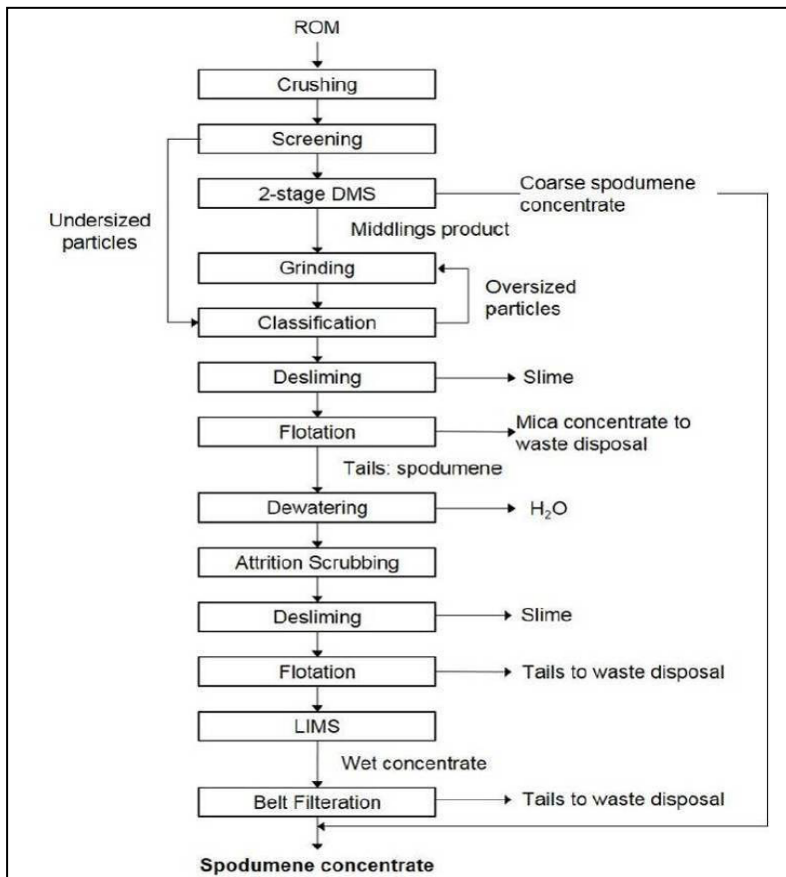


Figure 9: Process Flow Diagram of a Typical Hard-rock Processing Operation (Deutsche Bank, 2016)

2.1.5.3. Downstream Lithium Concentrate Processing

As discussed in Section 2.1.5.1, brine operations are capable of producing high-grade lithium carbonate or hydroxide chemicals from brine solutions utilising a hydrometallurgical approach. However, the intermediate lithium concentrate produced at a hard-rock operation requires further refinement into higher purity lithium products before use in the battery supply chain. The chemical conversion plants used to conduct the refinement are mostly situated in China as this is the largest market for battery-grade lithium products. Consequently, Australia and other jurisdictions producing spodumene concentrate ship the product to China for further processing.

At the conversion plants, the lithium concentrate undergoes additional comminution to reduce the particle size further before roasting of the material in the presence of various acids. The roasted material is subsequently leached to produce a lithium sulphate or chloride solution. The leachate is

then purified using hydroxide precipitation to remove impurities such as aluminium, iron, and calcium. Ion exchange is utilised next to further purify the solution before the use of sodium carbonate in a carbonation step to produce the final battery-grade of 99.5% lithium carbonate material. The conversion plants are also capable of producing lithium hydroxide, as depicted in the standardised flowsheet presented in Figure 10 (Deutsche Bank, 2016).

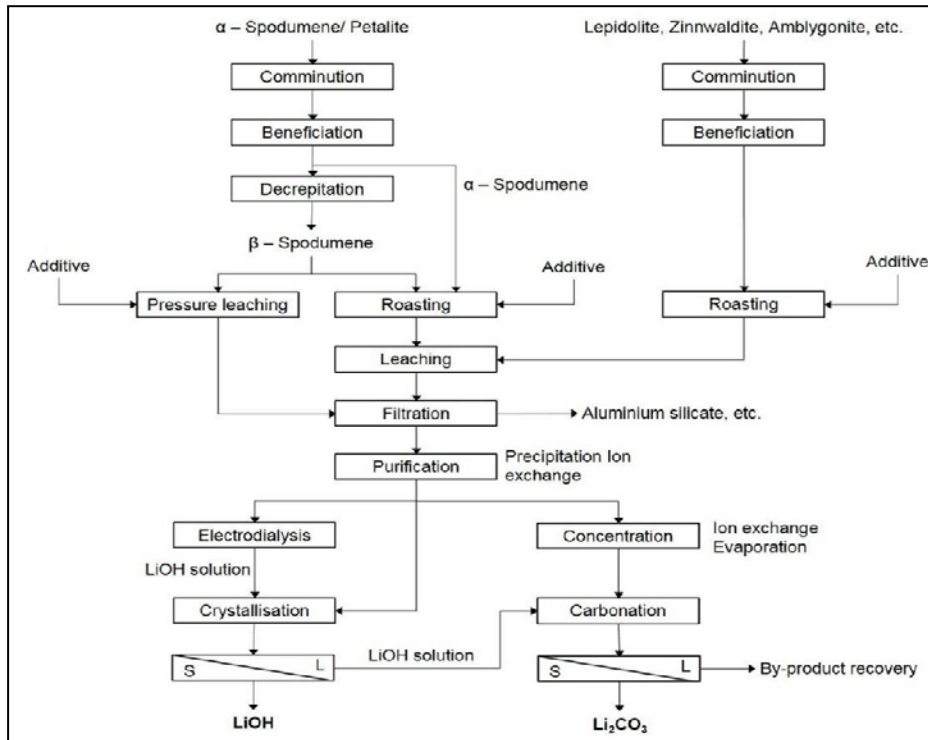


Figure 10: Process Flow Diagram of a Typical Spodumene Conversion Plant (Deutsche Bank, 2016)

2.1.6. Economic Difference Between Brine and Hard-Rock Operations

Lithium brine deposits typically generate better economics due to the lithium already being isolated and in solution within the deposit, negating the requirement for drilling, blasting, crushing and physical separation, as required in hard-rock operations. However, brine operations are more capital intensive and incur significant lead times to achieve nameplate production capacity due to technical and geographical challenges, such as low extraction rates and the reliance on evaporation which is easily affected by adverse weather conditions. These operations require large economies-of-scale and have a long resonance time due to the need for solar evaporation to achieve purification.

For example, Orocobre Limited's Olaroz brine project in Argentina has a nameplate production capacity of 17,500 tpa LCE, at a capital cost of US\$230m, equating to a capital cost intensity of US\$13,143/t LCE. Olaroz is yet to achieve its nameplate production capacity with the project experiencing numerous commissioning and design issues such as low lithium extraction and poor evaporation rates. These issues have led to an actual operating cost of approximately US\$4,000/t LCE, compared to a design cost of US\$2,500/t LCE.

Comparatively, the Australian hard-rock projects have a considerably lower capital cost intensity of between approximately US\$3,500/t LCE and US\$6,000/t LCE. Furthermore, these projects are capable of successfully achieving a 12-month construction, commissioning and ramp-up target, as showcased at the Mt Marion project in Australia. However, the key differentiating factor between brine and hard-rock is that the latter produces an intermediate spodumene concentrate that requires significant processing and upgrading to produce battery-grade lithium carbonate or hydroxide product. The additional capital intensity of constructing a conversion facility is estimated to be between US\$10,000 and US\$15,000/t LCE, which somewhat normalises the capital intensity between the two production routes (Deutsche Bank, 2016). Table 3 (Company Reports) highlights the critical operating and capital cost metrics discussed above for several projects currently under development, or that have recently entered the production phase. The table indicates that hard-rock projects are consistently less capital intensive than brine projects while the latter have higher operating margins due to their favourable geology. However, Nemaska Lithium's hard-rock project capital intensity is higher than most brine projects as they are constructing an integrated operation, consisting of the mine, spodumene concentrator facility, and a conversion plant to produce battery-grade lithium hydroxide.

Table 3: Capital and Operating Cost Comparison of Brine and Hard-rock Projects (Company Reports)

Company/Project	Status	Location	Design Production (ktpa LCE)	CAPEX (US\$m)	Capital Intensity (US\$/t LCE)	EBITDA Margin (%)	Cash Operating Cost (US\$/t LCE for Brine, US\$/t Concentrate for Hardrock)
Brine Projects							
Orocobre	Operating	Argentina	17.5	230	13143	59%	3946
LAC	Development	Argentina	25	425	17000	78%	2495
Galaxy Resources / SDV	Study Phase	Argentina	25	474	18960	75%	3410
Hardrock Projects							
Neometals / Mt Marion	Operating	Australia	27	158	5852	32%	271
Nemaska Lithium	Development	Canada	33	616	18667	-	219
Altura Mining	Development	Australia	30	103	3433	51%	238
Pilbara Minerals (Stage 1)	Development	Australia	45	209	4644	-	277

2.2. Demand Dynamics

As previously mentioned, Lithium has historically been used in two primary sectors, namely, the electronics and industrial sectors. Its use in the electronics sector has been dominated by the demand for Li-ion batteries in consumer electronics such as smartphones and tablets. In the industrial sector, it is primarily used in glass and ceramics production to reduce the melting point and lower the energy consumption required for manufacturing (Morgan Stanley, 2018). Although these sectors will continue to provide a strong base of demand, with historical growth rates being relatively stable and predictable, the future of lithium demand is inextricably linked to the battery electric vehicle. Therefore, the fundamental BEV market dynamics are briefly investigated and highlighted in the following sections.

2.2.1. Demand for Battery Electric Vehicles

Lithium has been the established metal used in global battery technology for many years but the demand for lithium has been transformed by the surge in popularity of Li-ion batteries over the last two decades. This segment expanded from 6% of global demand in 2000 to 44% in 2017, driven by the increased use of consumer electronics (Morgan Stanley, 2017).

However, there has been a paradigm shift over the past two years in the forecasted supply and demand dynamics expected to unfold within the Li-ion battery market, and the primary driver behind this is the growing demand for BEVs. Some forecasts estimate Li-ion batteries share of the global lithium end-use market to reach 73% by 2025 (Morgan Stanley, 2018). One simple indication of the forecasted mass rollout of electric vehicles is the 26 battery ‘mega factories’¹ currently either in production or slated for production by 2021, compared to only three factories in 2014. Majority of these new factories are purpose-built to exclusively service the growing BEV market (Ferris, 2017).

The rapid rise in BEV popularity is tentatively attributable to the auto-manufacturer Tesla and its Chief Executive, Elon Musk, who has aggressively marketed his vision of electrifying the global automobile industry. Although Tesla may perhaps solely be attributed with bringing BEVs into the mainstream, it is the consequent rapid commitment to electrification from established carmakers that are going to primarily determine their adoption rate from a supply perspective. Global auto-manufacturers have pledged a combined total of US\$90 billion to design new models, adapt manufacturing plants and develop new technologies (Lienert, 2018), with the combined aim of launching approximately 340 BEV and Plug-In Hybrid Electric Vehicle (PHEV) models in the next three years (Hertzke, et al., 2018). These larger auto brands have several advantages relating to the rapid launch of EVs, namely: stronger distribution networks; they can successfully scale manufacturing; and, they host a more robust global market presence. Furthermore, they are incentivised to electrify for several reasons, including increasing pressure from regulators to meet stricter emission standards; the potential threat of complete ICE vehicle bans in some cities; and, the falling price of batteries (Muller, 2018). The drivers behind BEV adoption are discussed in the below sub-sections.

2.2.1.1. Health Issues, Rising Emission Standards, and Regulatory Requirements

There is an ever-increasing global focus on various ICE pollutants such as Nitrogen Oxides (NO_x) and Carbon Dioxide (CO₂), evidenced in new legislation such as the Paris Climate Agreements and the Euro 6b emission limits. These will make future compliance for ICEs increasingly difficult and costly.

¹The term “megafactories” was introduced by Benchmark Minerals to describe factories that plan to produce more than one gigawatt-hour of total capacity annually.

For example, recent studies in the United Kingdom have indicated that an illegally high level of air pollution is causing approximately 40,000 early deaths a year. Renewable energy policies and the closure of many coal-fired power plants have alleviated the problem somewhat. However, despite the improvement, London still breached its annual air quality limits by the end of January 2018. To combat the problem, British lawmakers have suggested implementing the establishment of a "polluter pays" principle, which requires auto-manufacturers to pay a levy into a clean air fund. Lawmakers have also proposed escalating the current 2040 deadline for manufacturers to end the sale of petrol and diesel cars in the UK (Hodges, 2018).

China, the world's largest vehicle market, has suffered from notoriously serious air pollution problems, with smog responsible for 1.6 million additional deaths in 2015 (Hodges, 2018). In response to the declining air quality, the Chinese government defined a 'New Energy Vehicles' development plan in 2012. The plan introduced measures and subsidies to accelerate the development of the electric and hybrid vehicle industry and encourage consumers to purchase these classes of vehicles. The plan aims to impose minimum production and sales quotas for BEVs on both domestic and foreign auto-manufacturers in 2019. For consumers, it has introduced subsidies on green-car purchases and removed the restrictions on the number of new car licenses allowed for green vehicle purchases. Metropolitans like Beijing hope the impact of these measures will be significant, with the city anticipating an increase in green vehicle sales from approximately 580,000 in 2017 to 7 million by 2025 (Takeshita, 2018).

Considering the regulatory pressure many governments are facing it is unlikely that the focus of auto-manufacturers will shift away from cleaner automotive technologies given the deteriorating air quality and related health issues experienced in many major metropolitan areas (Morgan Stanley, 2017).

2.2.1.2. Potential ICE Vehicle Ban in Cities

Pressure on auto-manufacturers to overhaul their vehicle line-up escalated in September 2015 after Volkswagen were involved in a diesel-emission testing scandal that severely damaged the reputation diesel vehicles garnered for being relatively more CO₂ emission friendly compared to its petrol alternative (Reiter & Rauwald, 2018). Furthermore, a German court ruling passed in early 2018 may force as many as 66 German cities to remove older diesel vehicles from their inner-city districts in order to comply with European Union (EU) regulations relating to NOx emissions. These cities have failed to meet EU standards that required compliance by 2010 with large cities like Stuttgart achieving average levels double that allowed.

The potential impact on the diesel market is considered to be two-fold, namely: the regulations may disincentivise future customers from purchasing diesel vehicles due to fears of stricter regulations and the possible imposition of further bans. Secondly, it may incentivise auto-manufacturers to accelerate diversifying their vehicle offerings in an attempt to mitigate the risk of further penalties or

bans negatively affecting sales. The impact on the diesel market is evident with diesel vehicles contributing 45% of the total Western European vehicle sales in 2017, versus 51% in 2015 (Matussek, 2018).

2.2.1.3. Electric Buses

A study by BNEF forecasts that the number of electric buses in service is going to more than triple in the next seven years from about 386,000 in 2017 to nearly 1.2 million in 2025, equalling approximately 47% of the worldwide municipal bus fleet. Public buses are considered ideal for electrification as they travel fixed routes and cover a predictable distance. Consequently, most major metropolises in China have committed to electrified bus targets, with Western cities such as London, Los Angeles, and Paris committing to only buying zero-emission public transport vehicles by 2025 (Hodges, 2018). Although the upfront cost of an electric bus is still higher than diesel or petrol powered versions, they do offer a lower total cost of ownership when considering fuel and maintenance expenses. The lower total cost and the decreasing cost of batteries will provide incentives for cities to increasingly adopt electric buses (Chediak, 2018).

2.2.1.4. Stationary Storage

Renewable energy, especially solar and wind power, is fast becoming the focal point of new electricity generation investment. The Bloomberg 2017 New Energy Outlook predicts that US\$10.2 trillion will be spent on new power generation worldwide through 2040, with 72% of this being invested in new wind and solar plants (Bloomberg New Energy Finance, 2017). This growing reliance on renewable energy can cause electrical grids to become unstable due to the fluctuating nature of the renewable power supply with the near 48-hour blackout in South Australia in 2016 evidence of the potential impacts of unreliable supply. The traditional solution to this problem has been the maintenance of 'spinning reserves' or 'peaking power' supplied by a backup network of fossil-fuel-powered generators. However, the ultimate expectation is that energy storage, in the form of advanced battery technology, will provide a more efficient solution for future renewable-dominant grids due to their ability to inject power into grids rapidly and in the precise amount needed to interdict and smooth-out fluctuations (Campion, 2018).

It is argued that Li-ion batteries are unlikely to be the technology of choice for the stationary storage sector as the requirement for low-weight batteries (a feature of Li-ion) is not a pre-requisite, and there is also perhaps a more established group of alternative battery technologies available when compared to the BEV sector. It is consequently predicted that the Li-ion stationary storage market will experience a mild CAGR of approximately 3% between now and 2025 (Morgan Stanley, 2018). However, industry case-studies seem to refute this with two large Li-ion stationary battery installations recently completed. For example, a 343 MWh installation was completed in California in 8 months during 2016 and the South Australian government enlisted Tesla in 2017 to install a 129

MWh battery farm, with completion achieved in less than 100 days. The successful installation of batteries at these two sites has increased the confidence in using Li-ion batteries for energy storage due to the completed projects' relatively low cost, the speed of installation, and their large scale.

2.2.1.5. Falling Battery Prices and Increasing Range

BEVs are currently only capable of competing with traditional ICE vehicles at the upper-end or luxury vehicle price bracket due to prohibitively expensive input costs, specifically the batteries itself. Figure 11 (Hodges, 2018) depicts that the cost of a BEV is substantially higher than a mid-range ICE vehicle, with the battery contributing 49% of the total cost in 2016. The left-hand axis presents the total manufacturing cost in US\$'000, with the percentage contribution from the battery indicated.

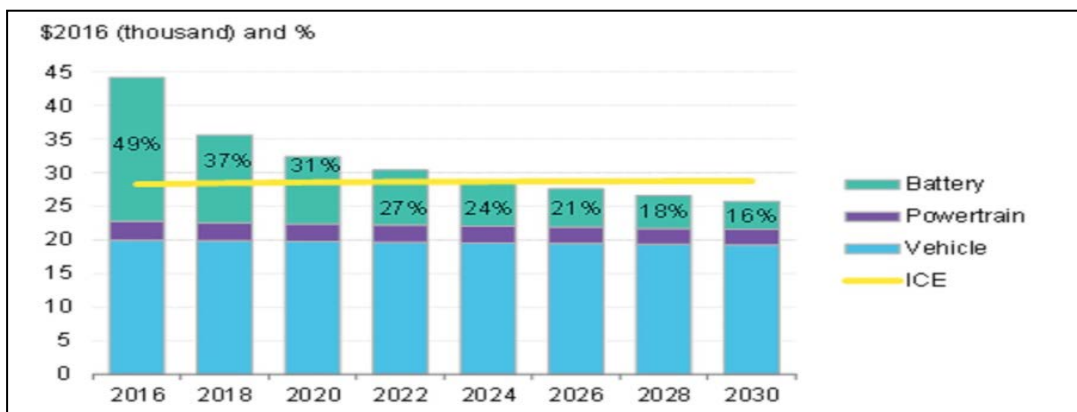


Figure 11: U.S. Medium Price-Range BEV Price Breakdown Compared to Similar Range ICE Vehicle (Hodges, 2018)

However, battery prices have exhibited a declining trend due to technology developments and the benefit of economies of scale, which may be allocated to the construction of so-called battery mega factories. BNEF forecasts a battery price of US\$70/kWh in 2030, compared to the average 2017 price of US\$208/kWh. Figure 12 (BNEF, 2017) depicts the declining trend the cost curve has exhibited since 2010.

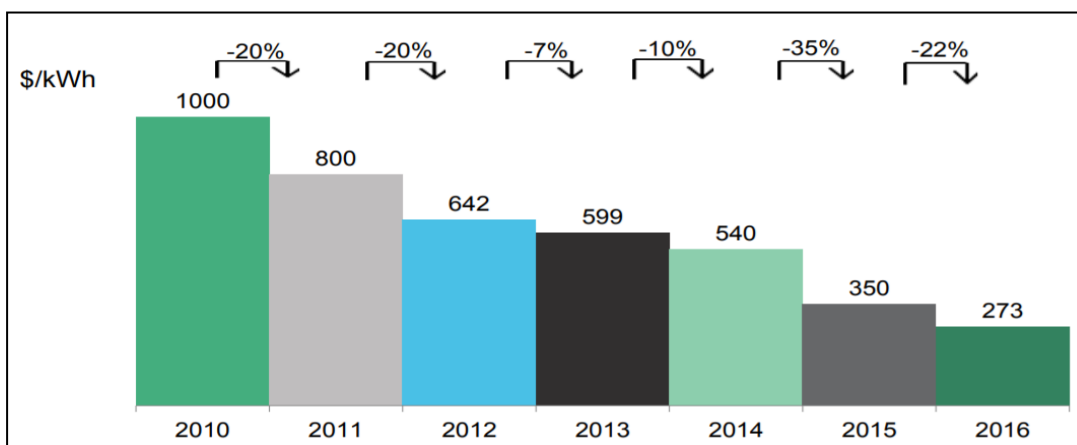


Figure 12: Li-Ion Battery Historical Cost of Production (BNEF, 2017)

The impact of the price decline is forecasted to result in BEVs reaching cost parity with ICEs by 2024, where the battery component is expected to only contribute 24% of total costs (see Figure 11). Some forecasts, however, estimate cost parity to be reached by 2020 if battery technology development continues at current rates, as measured by the number of new battery-related patents filed per annum (Spector, 2017). Analysts have posited that the required battery cost for BEVs to achieve parity with ICE vehicles is between US\$125 and US\$150/kWh (UCSUSA, 2017). The decline in input costs is expected to occur despite the rising price of commodities critical to the manufacture of the batteries (Hodges, 2018).

Importantly, an increase in BEV range, similarly driven by technology improvements, has accompanied the decrease in battery prices. Figure 13 (Chatelain, et al., 2018) indicates that pre-2017 BEV models struggled with the trade-off between range and price while recent models have started achieving a stronger balance that will help drive BEV market penetration (Chatelain, et al., 2018).

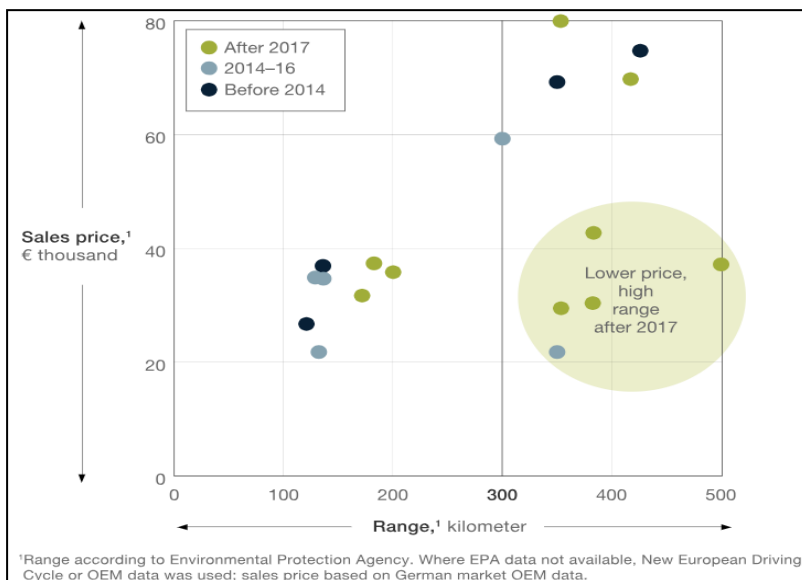


Figure 13: Electric Vehicle Price and Range by Year of Launch (Chatelain, et al., 2018)

2.2.1.6. BEV Commitments from Global Auto-Manufacturers

The aforementioned demand drivers have already started incentivising many of the globally dominant car manufacturers to plan for the long term and consequently pivot their strategies towards BEVs, as indicated in Table 4 (Edelstein, 2017; Madrigal, 2017; Zhang, 2018). Critically, most of the major manufacturers such as VW and Toyota have committed to a fairly aggressive adoption timeline, aiming for the mass roll-out of BEV and hybrid vehicles before 2030.

Table 4: Planned Electric Vehicle Adoption Rate by Major Manufacturers (Edelstein, 2017; Madrigal, 2017; Zhang, 2018).

Company	Adoption Plan	Key Date
General Motors	Plans to phase out gas-powered vehicles for an "all-electric future". Plans to release 20 all-electric vehicles by 2023.	2023
Ford Motor Company	Created the EV-dedicated "Team Edison" to focus on the development of all-electric cars. The auto-manufacturer pledged to invest US\$11 billion by 2022 on new all-electric and hybrid vehicles, with 16 BEV cars and 24 hybrids or plug-in hybrids slated for release by 2023.	2022
Porsche	Porsche has committed to spending US\$7.4 billion on electric mobility by 2022. The investment doubles the company's previously announced commitment. The funding will go towards the development of the Porsche Mission E, electrification of existing models, charging infrastructure, and facility updates, with a target of all sales being 50% BEV by 2023.	2022
Toyota and Mazda Motor Company	Toyota and Mazda recently announced that they are teaming up with auto-parts manufacturer Senso to create a new company to develop necessary EV technology for use across multiple vehicle types and models, expanding beyond Toyota's Prius line. The two Japanese carmakers also pledged to build a US\$1.6 billion U.S.-based plant by 2021, where they will work on electric and hybrid vehicles.	2021
Daimler (parent company of Mercedes Benz)	Investing US\$1 billion in a plant to produce all-electric SUVs and build a battery facility. Overall commitment of US\$10 billion to EV development. Mercedes-Benz outlined a plan to electrify its "entire portfolio" by 2022, offering 50 electric and hybrid models.	2022
Renault, Nissan, and Mitsubishi	These manufacturers have entered into an alliance and committed to developing new systems to use across their vehicle lines, with a focus on "purely electric" EVs like the Nissan Leaf. The auto-manufacturers plan to release 12 all-electric models by 2022.	2022
Jaguar Land Rover	Aiming to electrify its entire vehicle line-up by 2020, with new powertrains ranging from mild hybrid vehicles to all-electric systems.	2020
Volvo	Aims to electrify its entire vehicle line by 2019, with five all-electric models planned between 2019 to 2021. The auto-manufacturer hopes to sell one million of the electric and hybrid cars by 2025.	2025
VW Group (parent to Volkswagen, Audi, and Porsche)	Investing US\$84 billion in EV development, with approximately US\$60 billion dedicated to battery production. The company plans to offer electric and hybrid versions of 300 vehicles by 2030, with a plan to produce 3 million BEVs a year by 2025.	2030

2.2.1.7. Adoption Rates

Section 2.2.1.6, Table 4 shows that car manufacturers have announced significant shifts towards electrification, undeterred by the fact that consumers are not currently gravitating towards BEV purchases. Although global EV sales increased by 57% to 1.3 million in 2017, overall penetration is still low, with BEVs like the Chevrolet Bolt, Nissan Leaf and Tesla Model S representing only 0.5% of new vehicles sales in the USA in 2017. Sales were stronger in other regions, with Norway achieving an adoption rate of 32% and Europe registering a 40% growth in sales volumes in 2017. However, the USA and China (which registered an adoption rate of 2% in 2017) are the critical markets that auto-manufacturers need to target to accelerate the penetration of BEV sales (Hertzke, et al., 2018). Figure 14 (Hertzke, et al., 2017) highlights the recent trend and accelerated uptick in BEV and PHEV sales between 2014 and 2016, as discussed above.

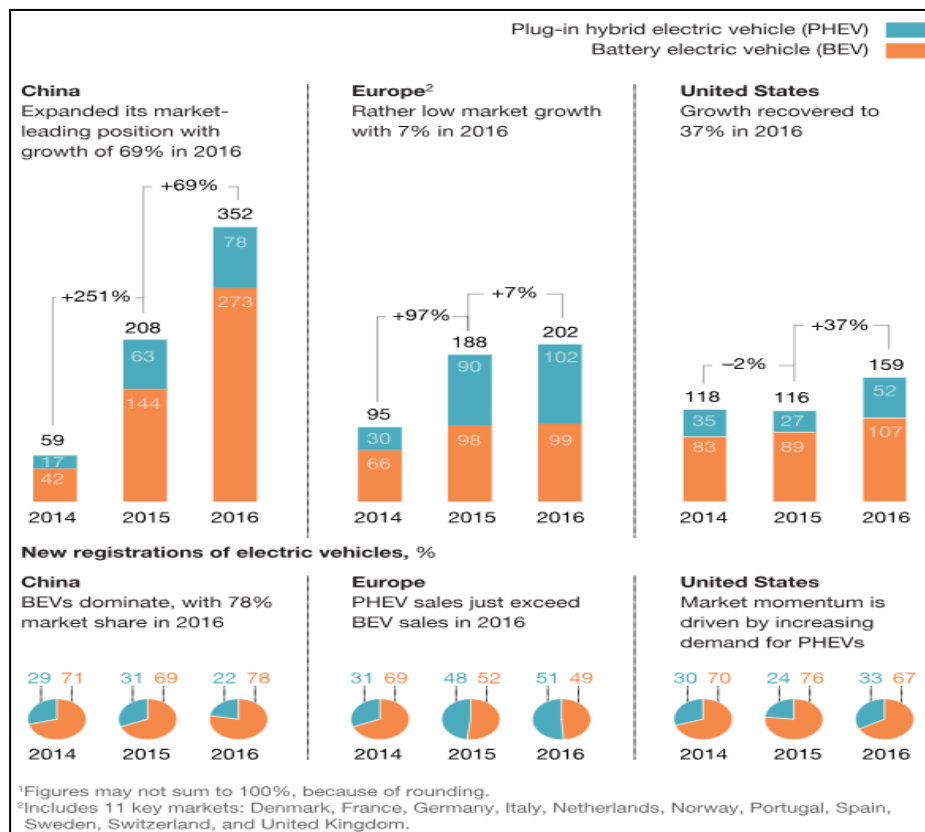


Figure 14: New Registration of Electric Vehicles in Key Markets in Thousands of Units (Hertzke, et al., 2017)

Despite the BEV market being in its infancy, auto-manufacturers are betting that more relevant models with longer range and lower prices, along with the availability of more charging stations, will drive consumers towards BEVs (Muller, 2018). The consequent aggressive adoption rates committed to by many manufacturers is one of the drivers behind institutions like Morgan Stanley modelling a base case scenario of EVs reaching 80% of global sales by 2050. An upside scenario of 90% of sales exists if the deployment of stricter regulations continue and technology develops faster than Morgan

Stanley anticipates. This results in the total number of EVs on the road reaching equilibrium with ICEs by approximately 2047 and an estimate of over one billion EVs before 2050, as depicted in Figure 15 (Morgan Stanley, 2017).

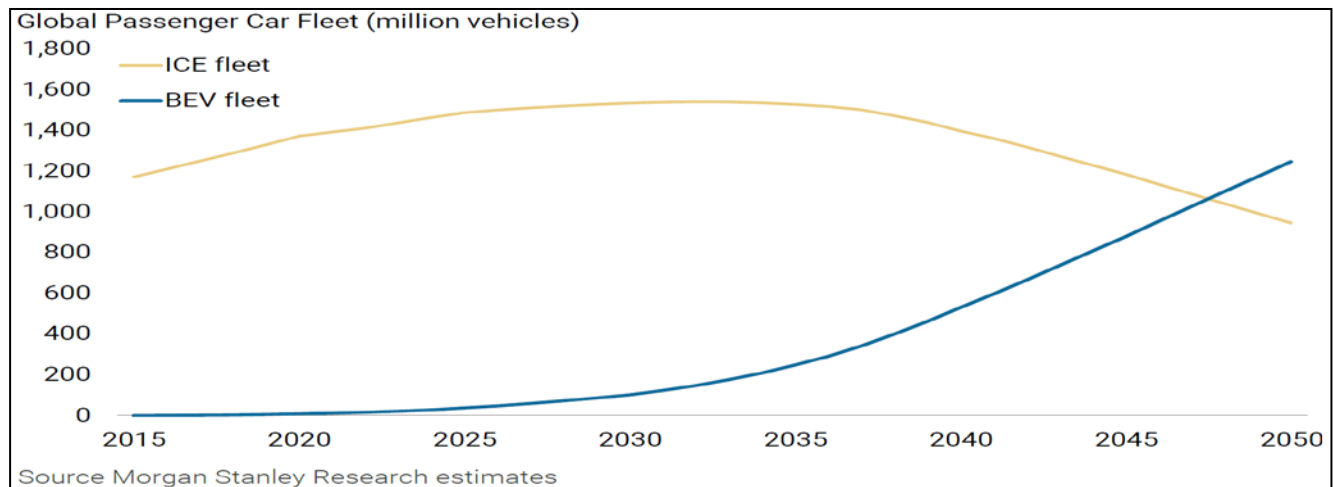


Figure 15: Global Passenger Car Fleet Forecast (Morgan Stanley, 2017)

The apparent universal move towards embracing BEVs by the large auto-manufacturers has precipitated a diverse range of forecasted BEV adoption rates and associated LCE demand numbers. These are the two primary drivers influencing the lithium commodity price and a summary of future penetration rates and demand estimates is provided in Figure 16 (Albemarle, 2018). The figure represents the forecasts from a variety of institutions such as Roskill, BMO Capital Markets, Citi Investment Research, Deutsche Bank, Goldman Sachs, Numora, Morgan Stanley, UBS, Oppenheimer, SQM, and FMC. Figure 16 highlights that the majority of the forecasts expect a BEV penetration rate of 10% or higher, and an average estimated LCE demand of at least 800 kt LCE per annum by 2025.

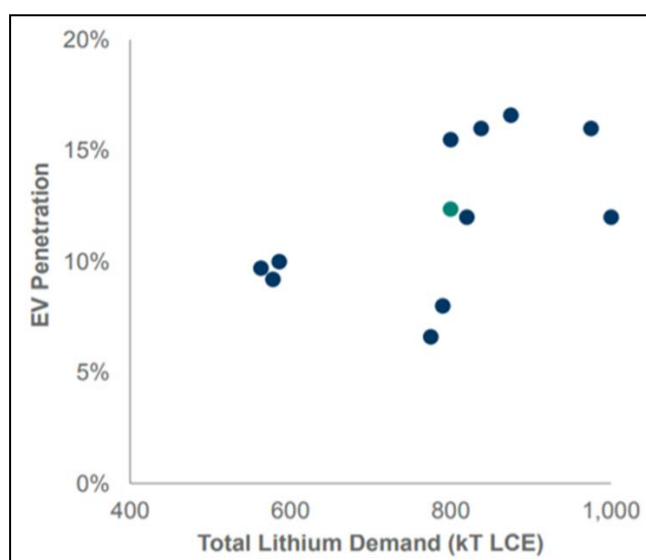


Figure 16: 2025 BEV Penetration Rate Forecasts and Total LCE Demand (Albemarle, 2018)

2.2.2. Challenges to Increasing Demand

2.2.2.1. High Vehicle Production Costs and Elimination of Subsidies

The economics of producing an EV battery will be a crucial determinant for its successful adoption. The battery cost currently accounts for between 40% – 50% of the total BEV cost, while in the widely adopted smartphone the battery cost is less prohibitive and only accounts for a mere 1% - 2% of the total cost (Hodges, 2018). Consequently, BEVs are currently heavily reliant on supportive government policies in order to provide a competitive price alternative to ICE vehicles. Subsidies for the purchase of electric vehicles and buses, along with reduced or waived taxation, free parking, and other perks supports the purchase of BEVs at current prices. As battery technology improves and economies of scale take effect, the cost of batteries will reduce. Consequently, the cost of BEVs will decrease which will likely result in the withdrawal of subsidies and other incentives. Analysts expect many subsidies to be repealed, or at least pared-back, by 2022 in the United States and as early as 2020 in China and Europe (Hotter, 2018) which may impact the affordability of BEVs relative to ICEs if battery costs have not decreased sufficiently by then.

Table 5 (UCSUSA, 2017) provides an example of the beneficial subsidies currently helping drive BEV adoption in the United States. Purchasers of a qualifying BEV receive a tax credit of up to US\$7,500 enabling BEVs to compete with their ICE equivalents. Conversely, EV sales suffer in the absence of supportive policies at current prices. For example, the state of Georgia offered a tax credit of up to US\$5,000 for EVs sold. However, state lawmakers abruptly repealed the tax credit in 2015, with sales consequently declining from 1,338 in June 2015 to only 148 two months later, and they have yet to recover (UCSUSA, 2017).

Table 5: Impact of Incentives on BEV Sales Prices (UCSUSA, 2017)

	Ford Focus EV	Ford Focus Titanium	Toyota Prius Prime Plus	Toyota Prius One	VW eGolf	VW Golf S
Powertrain	Plug-in EV	Gasoline	Plug-in EV	Hybrid	Plug-in EV	Gasoline
Market Price (US\$)	31,075	24,075	27,100	23,475	28,995	19,895
Federal Incentive (US\$)	7,500	-	4,502	-	7,500	-
Price After Federal Incentive (US\$)	23,575	24,075	22,598	23,475	21,495	19,895

2.2.2.2. Prohibitive Capital Cost of Charging Infrastructure

A potentially key limitation to the forecasted rapid adoption of BEVs is the current lack of charging infrastructure and the substantial capital investments required to provide sufficient geographic coverage to allay customer 'range anxiety'. For example, fast-charging stations capable of fully charging a family-sized car in 25 minutes costs up to US\$150,000 (Knupfer, et al., 2018). To meet forecasted BEV sales targets, institutions such as Morgan Stanley estimate a global charging infrastructure investment requirement of US\$2.7trn by 2040 and they are dubious whether this is

feasible without massive government support (Morgan Stanley, 2017). Conversely, UBS has estimated that US\$360bn in charging infrastructure investment is required to be spent over the next eight years to keep pace with BEV sales (Steitz, 2018). The large discrepancy in capital investment required highlights the uncertainty present within the industry.

Furthermore, research by Goldman Sachs indicates that 75% of driving trips are less than 80km in distance. This infers that the infrastructure investment required to capture the majority of the market may not be as significant as expected since charging at home overnight will be sufficient in most cases. Therefore, it may not be required to ensure that charging stations are located country-wide at regular intervals to match the mileage achievable in BEVs (The Lithium Spot, 2018).

However, car manufacturers have started committing the capital required to meet infrastructure demands with several vital investments (EVRater, 2017), for example:

- Mercedes, BMW, and Ford entered a joint venture in 2016 to develop 400 charging stations across Europe, with the project completed in 2018;
- Volkswagen pledged US\$2bn in charging infrastructure to be invested over the next ten years (up to the end of the 2020's) in the United States;
- Tesla has over 5,000 superchargers installed at 800 locations worldwide; and,
- Uber has committed to establishing an unknown number of chargers in London to support their relationship with Nissan.

The infrastructure limitations are not only being addressed by BEV manufacturers but also by oil giants such as BP and Shell, who are attempting to diversify their business offerings by investing in charging stations and renewable energy developments. BP committed in January 2018 to start adding rapid charging points for electric cars at some of its UK petrol stations while Shell started deploying charging points at its petrol stations towards the end of 2017. Furthermore, both firms have started investing heavily in renewable energy and low-carbon technology, for example: BP invested US\$200m for a 43% stake in Europe's largest solar developer, Lightsource; and, Shell acquired NewMotion in 2017, a Dutch firm with over 30,000 private charging points at homes and offices in Europe (Vaughan, 2017).

The preliminary capital investments in charging stations by oil companies are minuscule relative to their annual capital expenditure budgets, for example, BP invested US\$1bn into charging infrastructure in 2017 versus a US\$17bn budget for oil exploration and CAPEX. However, it does provide an indication of the progress being made in the BEV space (Vaughan, 2018) and its potential impact on oil companies. Wood Mackenzie forecasts that BEV growth along with the influence from more efficient ICE technology will result in global petrol demand within the transport sector peaking by 2030 (Wood Mackenzie, 2017), indicating the prudence of oil companies in diversifying their asset base.

Despite the increase in investment, there is, for example, only 16,000 public charging stations in the United States and fewer than 2,000 of these charging stations are fast-charging, while there are still seven times as many gas stations. It is a typical chicken-or-egg situation; consumers are reluctant to invest in a BEV due to 'range anxiety', but only an increase in BEV sales will incentivise further investment in charging infrastructure (Knupfer, et al., 2018).

2.2.2.3. Large Financing Requirements for New Supply and Lack of Investment Appetite

Industry experts have forecasted that lithium companies will need to invest at least US\$12bn by 2025 to increase LCE output fivefold, which equates to the production output required to keep pace with the world's increasing appetite for Li-ion batteries. However, the lithium industry is in its infancy and its current small scale, opaque market dynamics and relatively poor track record in delivering projects as per schedule, limits financial institutions' desire to provide funding. It traditionally takes between two and three years to construct a lithium mine and processing plant, and up to five years to repay a project loan. Lenders, therefore, need to take a seven-year view on the lithium price, which is at a strongly contentious point. Some investment banks, such as Morgan Stanley and Citigroup, have forecasted that lithium prices may halve through 2021 due to rising output entering the market from projects currently in development (which is discussed further in Section 2.3.4). This hesitation from banks to invest results in mining companies seeking alternative forms of funding, such as private equity, which carries a much higher cost of funding compared to what banks typically charge and can consequently diminish the economic viability of projects (Stringer & Ishikawa, 2018).

Without further investment supplies of lithium may remain tight, sustaining a price boom that has already seen prices triple since 2015 which will continue to drive short-term profits at currently established projects. However, this will have an overall negative impact on the adoption rate of BEVs and therefore hinder the long-term viability of the lithium boom. For example, Nemaska Lithium spent 18 months negotiating a US\$830m funding package for their Quebec, Canada based mine and processing plant, a significant period of time. This inability to rapidly access traditional funds has delayed the development of the sector and may influence the supply/demand dynamics if funding does not become more readily available, as depicted in Figure 17 (Stringer & Ishikawa, 2018). Figure 17 presents elemental lithium demand, which needs to be divided by 0.188 to convert to LCE, versus the feasible supply rate, depending on the level of successful project funding. The figure highlights the significant supply shortfall if only 50% of current pipeline projects are successfully funded.

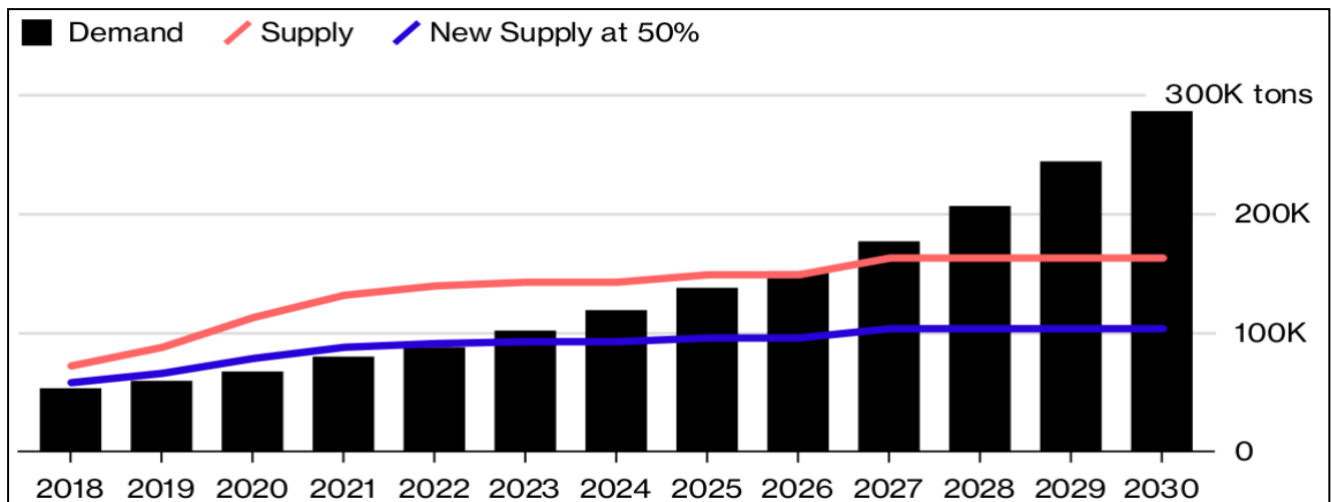


Figure 17: Lithium Demand versus Supply Assuming Lack of Funding Results in a Project Development Success Rate of 50% (Stringer & Ishikawa, 2018)

2.2.3. Impact of BEVs on Commodity Demand

Commodities such as lithium, cobalt, manganese, and nickel are used in the manufacturing of the battery cathode, while the extensive wiring required in the vehicle utilises copper. In 2017 an additional 153 GWh of battery manufacturing capacity was added to the planned output, bringing the total investment pipeline to 372 GWh. However, analysts forecast a requirement of 750 GWh of battery manufacturing capacity by 2025. This increased requirement for raw materials is creating a demand driver for many commodities that did not previously exist (Lazenby, 2017). The increasing prevalence of BEVs and the strong forecasted growth in future sales is expected to dramatically affect the demand/supply dynamics of several commodities, with particular emphasis on lithium and cobalt due to the forecasted increase in supply required relative to their current production base.

The demand potential for a number of the critical base metal BEV commodities was illustrated by modelling the metal requirements across the BEV supply chain to achieve a BEV market share of 30% by 2030. The modelling approximated that an additional 4.1Mt of copper (18% of 2017 supply), 1.1Mt of nickel (55% of 2017 supply) and 314kt of cobalt (332% of 2017 supply) will be required to enable the forecasted penetration (Glencore, 2017). While the increase in copper and nickel demand is in-line with typical global GDP growth rates (1.4% and 3.7% CAGR, respectively), the increase in cobalt required is substantial, equating to a CAGR of 11%. The impact on LCE demand is similarly significant, with most consensus forecasts indicating a demand of between 700 and 1,000 kt by 2030, equating to a CAGR of between 11% and 15% compared to 2017's production output of approximately 200 kt (Morgan Stanley, 2018).

Figure 18 (IRESS Data) and Figure 19 (Lithium Americas, 2018) highlights the impact on commodity prices of the forecasted increase in BEV demand. The recent gains in copper, manganese, and aluminium have been relatively small and are likely due to a more positive global economic outlook

over the past 12 to 18 months, rather than the forecasted growth in the BEV market. However, the noticeable gains in cobalt and lithium are due to their currently small production base and the forecasted increase in supply required compared to this (Sanderson, 2017).

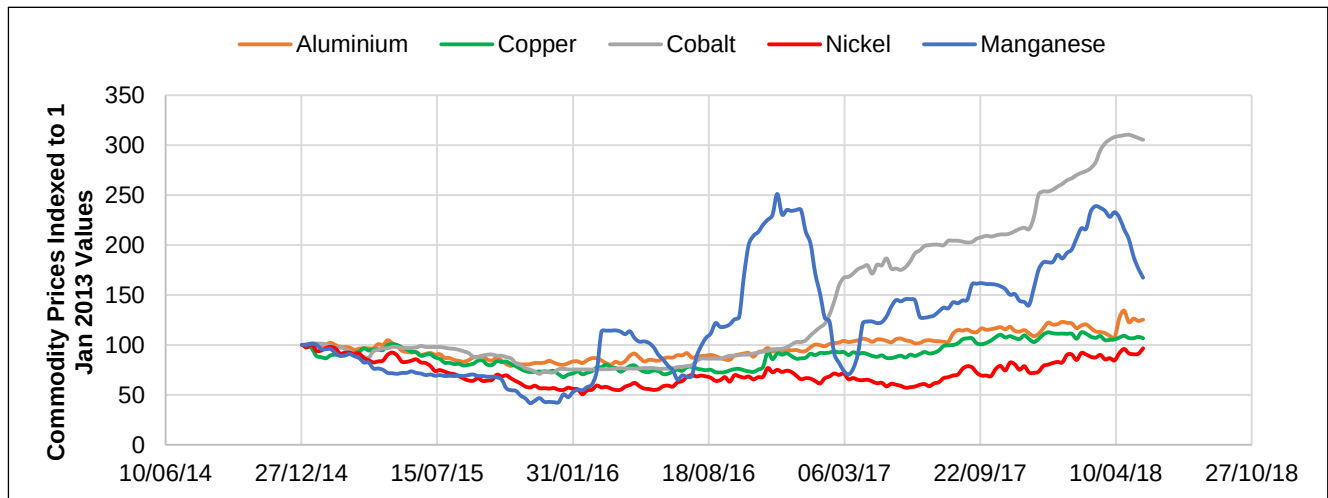


Figure 18: Commodities Used in BEV Production, Indexed to 100 as at January 2013 (IRESS Data)

Lithium carbonate and hydroxide spot prices in China have softened in 2018, but remained high compared to prices in 2015, as presented in Figure 19. On the contrary, the contracted offtake prices received by two market participants, namely, Orocobre and SQM (both of which are South American lithium carbonate brine producers) continue to increase year-on-year since December 2016. The discrepancy in Chinese spot prices and contracted prices is primarily due to the recent significant increase in low-quality brine production from the Qinghai province in China, along with some financially constrained Chinese chemical conversion plants clearing stocks quickly and at lower prices to generate early cash flows (Lowry, 2018).

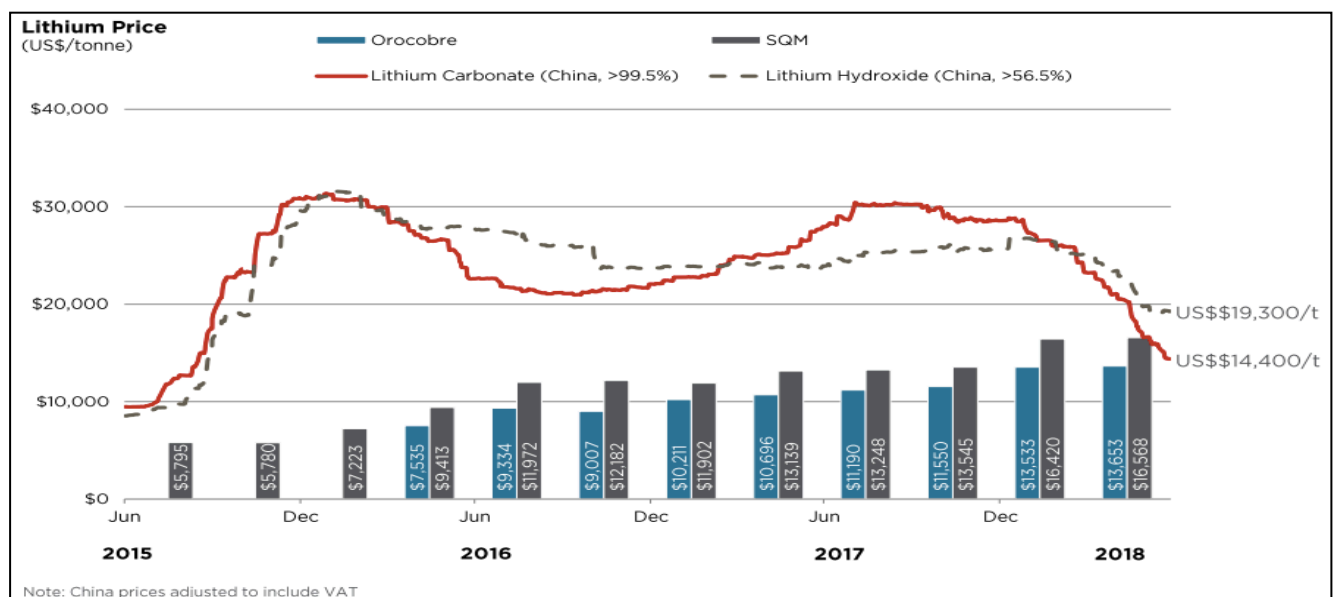


Figure 19: Lithium Carbonate and Hydroxide Spot Prices in China versus Contracted Prices Received by Two Lithium Mining Companies (Lithium Americas, 2018)

The supply of other commodities used in Li-ion batteries, such as cobalt, is arguably more constrained than lithium due to its geographical scarcity, the political risk within the operating jurisdictions, and the nature of the geology such that cobalt is predominantly a by-product originating from copper mines. However, it is the lithium market that has seen the sharpest increase in interest (Behrmann, et al., 2018), primarily due to the following reasons:

- Substitution risk is far higher for cobalt due to the relatively wide variety of battery cathode technologies already available, all of which are dependent on lithium, but do offer alternatives to cobalt, as depicted in Table 6 (Desjardins, 2016). Despite the variety of cathode technologies available, analysts expect NCA and NCM, both of which contain cobalt, to dominate the BEV market as the cathodes of choice for at least the next ten years. Instead, substitution will focus on reducing the amount of cobalt relative to the other cathode materials used in the NCA and NCM batteries, with future NCM batteries expected to contain only 10% cobalt, versus between 20% and 30% currently (Benchmark Mineral Intelligence, 2018); and, *Table 6: Different Lithium Battery Chemistries (Desjardins, 2016)*

Cathode Type	Chemistry	Example Metal Portions
NCA	LiNiCoAlO_2	80% Nickel, 15% Cobalt, 5% Aluminium
LCO	LiCoO_2	100% Cobalt
LMO	LiMn_2O_4	100% Manganese
NMC	LiNiMnCoO_2	Nickel 33.3%, Manganese 33.3%, Cobalt 33.3%
LFP	LiFePO_4	100% Iron

- The lithium market is forecasted to require upwards of US\$9bn of investment by 2022, from US\$1.2bn in 2017, if future demand develops as forecasted (Lazenby, 2017). However, the lithium mining industry is relatively small and undeveloped, with a greater reliance on junior miners entering the market compared to many other mined commodities. Some of the world's largest mining companies, namely, Anglo American and Glencore, supply majority of base metals such as copper, nickel, and cobalt. These companies have the scale, capital and expertise to develop new projects focusing on the supply of these metals, while the smaller junior lithium miners are unable to respond to demand drivers as rapidly. For example, Glencore aims to increase its production of cobalt from the Democratic Republic of the Congo (which supplies 60% of the world's cobalt) by 67% over the next three years (Sanderson, 2018).

Therefore, although lithium is not the most significant contributor to cathode production costs or exhibits the tightest demand and supply dynamics, it is lithium that is going to attract the most capital investment relative to its current supply base.

2.3. Supply Dynamics

As discussed in Section 2.1.4, the lithium supply chain is relatively complex. Consequently, the entire lithium supply chain is critical when analysing the supply-side dynamics as there is the potential for price-determining bottlenecks to form at many different points. Furthermore, chronic underinvestment in a market that has been relatively stagnant for many years has resulted in under capacity developing in both the mine supply sector as well as the battery conversion sector. However, the lithium supply dynamics are rapidly evolving with critical factors discussed below.

2.3.1. Primary Supply

Primary mined lithium supply has traditionally been dominated by a handful of suppliers, namely: Sociedad Química y Minera de Chile (SQM), Albemarle (ALB), FMC Corporation (FMC), and more recently Tianqi Lithium (Tianqi) and Ganfeng Lithium (Ganfeng) as well. Together, these lithium majors have historically accounted for close to 90% of global lithium supply (The Lithium Spot, 2018). Global lithium production rates are depicted in Figure 20 (USGS, 2018), which highlights the recent increase in output. The figure does not include production from the USA, as the USGS withholds this data; however, USA's contribution is relatively small at between 4,000 and 6,000 t LCE per annum, based on the production data from the only operating lithium mine in the USA.

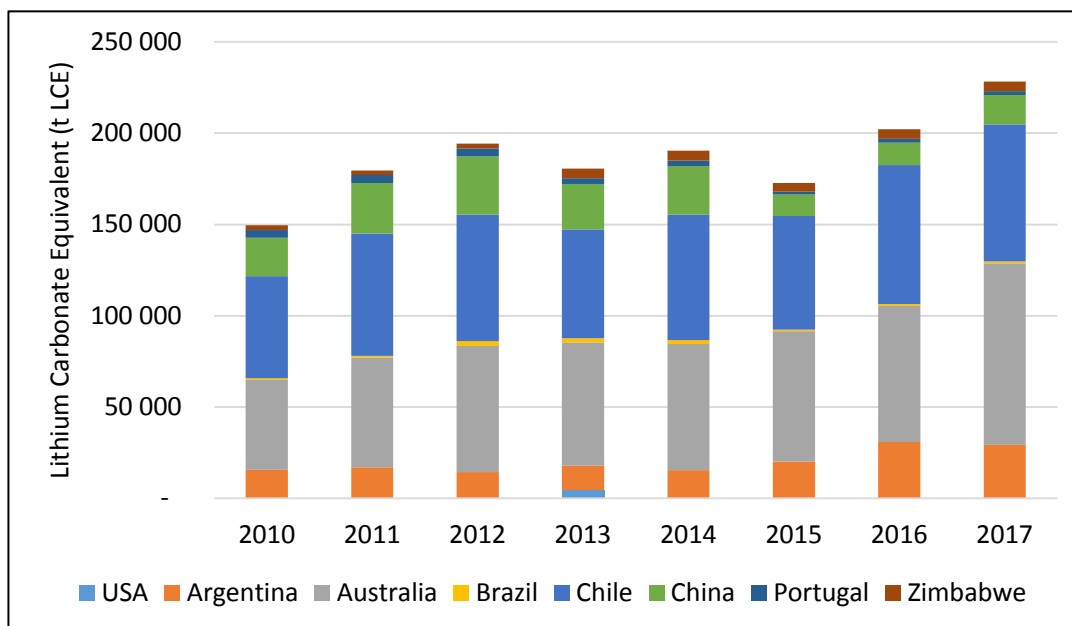


Figure 20: Global Lithium Production per Country (USGS, 2018)

The faster than expected commitment to the adoption of BEVs by large auto-manufacturers and the resulting surge in both current and forecasted demand has surprised many of the industry majors. Underinvestment by the abovementioned companies in pipeline projects capable of being implemented quickly has allowed junior and mid-tier miners to establish somewhat of a foothold in the market by bringing several projects on-line in a relatively short period.

Despite the entry of many smaller players, the major producers are still forecasted to supply approximately 80% of total 2019 production and will remain a dominant force in the industry due to the high-quality and low-cost nature of their asset portfolio. Figure 21 (Morgan Stanley, 2018) depicts the global cost curve with SQM, ALB, and FMC dominating the low-cost Chilean and Argentinian brine operations, which contribute a combined 68% of the world's lithium reserves (USGS, 2018). The dominance of the South American brine reserves has helped cement the position of the major miners as the primary source of lithium. Junior and mid-tier miners are the primary contributors to Australia's hard-rock lithium supply, many of whom have entered into joint ventures with specific lithium majors such as SQM, Ganfeng and Albemarle. Although higher cost, the Australian hard-rock operations are quicker to construct and commission, easier to operate and less capital intensive.

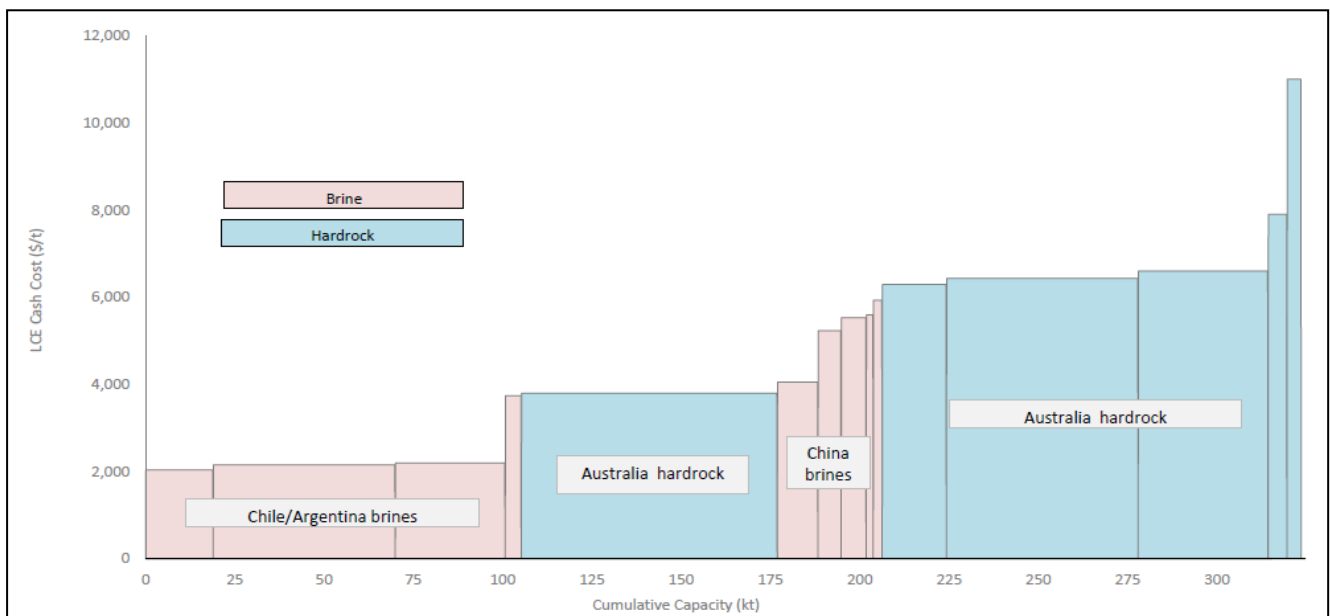


Figure 21: 2017 Lithium Production Cash Costs (Ex-Royalty), US\$/t LCE (Morgan Stanley, 2018)

2.3.2. Changing Supply Dynamics

The most significant potential disruption to the lithium supply and demand dynamics is the recently announced amendments by the Chilean Economic Development Agency (Corfo) to the production quota granted to SQM and Albemarle. Lithium is classified as a strategic metal in Chile due to its historical importance in the production of nuclear weapons. The strict Chilean production quotas reflected this with allowable production, relative to its potential capacity, constrained. The Chilean policy had not adapted to cater for the demand shock that materialised with the advent of Li-ion batteries, and Chile's market share of global production consequently fell from 75% in 2000 to 24% by 2017.

However, Chile aims to rectify this with the new quotas introduced. The quota agreed with SQM is summarised in Table 7 (Morgan Stanley, 2018). The quota indicates the current allowable cumulative production remaining at 345 kt LCE up to 2017, as well as the agreed-upon increase of 1,861

cumulative kt of LCE production up until 2030. Furthermore, SQM's annual maximum production limit increased from 60 ktpa LCE to 216 ktpa LCE. Although these increases are significant, the likelihood of SQM ramping up production to maximise output up to the quota limit is unlikely, as discussed in Section 2.3.4. Furthermore, Chile's second major lithium producer, Albermarle, signed a similarly relaxed quota agreement with Corfo in 2017, allowing them to increase their annual production rate to 140 ktpa LCE from the currently approved rate of 80 ktpa LCE, contingent on the development of a new extraction process by ALB (Reuters, 2018).

Table 7: Salient Features of the New SQM-CORFO Quota Agreement (Morgan Stanley, 2018)

SQM-Corfo Agreement	kt LCE	Condition for Expansion
Existing Quota	345	Cumulative Production Remaining at end-2017
Expansion 1	989	2 x 25 ktpa LCE Battery-Grade Processing Plants to be Constructed
Additional Quota	600	4 x 25 ktpa LCE Battery-Grade Plants to Be Constructed
Efficiency Quota	272	Allowance for Future Expansions/Efficiency Gains
Total	2,206	

Table 8 (Morgan Stanley, 2018) indicates the progressive tax rates applicable under the new quota regime. For example, considering a price of US\$12,600/t LCE (which is similar to the average price experienced by SQM in the third quarter of 2017), the effective tax rate under the tax regime would equate to 19.14% (Sociedad Química y Minera de Chile S.A., 2017).

Table 8: New Royalty Regime Applicable to SQM-CORFO Quota Agreement (Morgan Stanley, 2018)

Sale Price (US\$/t Lithium Carbonate)	Royalty Rate
US\$ 0 - 4,000 / t	6.8%
US\$ 4,000 - 5,000 / t	8.0%
US\$ 5,000 - 6,000 / t	10.0%
US\$ 6,000 - 7,000 / t	17.0%
US\$ 7,000 - 10,000 / t	25.0%
> US\$ 10,000 / t	40.0%

Chile's reserves are significant in terms of their size and quality; however, they are not the primary determinant of future supply with additional expansion expected from Argentina and Australia. Argentina recently relaxed mining legislation with the aim of attracting foreign investment by removing the ban on exporting lithium and by capping royalties as well. Australia has seen a rapid increase in prominence with many hard-rock projects successfully financed and entering the construction and commissioning phase within a short space of time. The potential impact of the increase in new production capacity from these jurisdictions is discussed in the following sections.

2.3.3. Conversion to Battery Grade Material

China houses the majority of the conversion capacity required to produce battery-grade material, with the premier converters being Ganfeng and Tianqi. The increase in production of battery-grade lithium carbonate equivalent over the past two years has been due to China securing more spodumene feedstock from new operations based in Western Australia. Although output has increased, market

commentators highlight the constrained capacity at converters that are capable of producing battery-grade specification lithium products as the most significant potential bottleneck to increased supply, hence the most likely influencer of the lithium price as well. Ganfeng and Tianqi are planning significant expansions domestically and abroad, and the ability of conversion capacity to maintain pace with the planned increase in mining output is a crucial consideration. Furthermore, the ability of new conversion capacity to produce battery-grade specification material, which has historically been difficult, will play a significant role (Miller & Moores, 2018).

Benchmark Minerals highlights the risk of a price divergence occurring between the feedstock material supplying converters and the final battery-grade material produced. A divergence can occur if new supply ramps-up rapidly and outstrips the pace of new converter capacity. This may result in some stockpiling of feedstock material which may cause a decrease in the spodumene price while the further beneficiated material maintains a high price level (Miller & Moores, 2018).

2.3.4. Bear Case for Lithium – Flood of New Supply

There is little negative sentiment regarding the speed of adoption of BEVs or lithium's dominance in the BEV market for the foreseeable future. Consequently, the demand fundamentals for lithium are robust with few bear-case viewpoints or scenarios predicted. However, rising demand for Li-ion batteries for BEV use has seen lithium prices triple since 2015, which has the potential of attracting new suppliers into the market due to the high profit margins achieved. The possibility of a significant increase in supply by producers in an attempt to benefit from the rising prices forms the premise of the bear-case scenario outlined by Morgan Stanley in their report "The Long-Term Pain of New Supply" (Morgan Stanley, 2018). This report is perhaps the direst bear-case scenario published by research institutions to-date and predicts a 45% decline in LCE prices by 2021. However, other market participants such as Wood Mackenzie have also predicted a sharp decline in prices, estimating a similarly severe 41% decrease by 2022 (Els, 2018).

Recently announced projects and expansion plans together with the easing of production quotas by the Chilean government have resulted in Morgan Stanley estimating that as much as 500ktpa of additional lithium supply may be added to the global market by 2025, equating to a CAGR of 16%, versus their forecasted demand growth rate of 12% over the same period (Morgan Stanley, 2018). Table 6 (Morgan Stanley, 2018 and The Lithium Spot, 2018) presents a summary of the significant lithium projects currently in the development pipeline. Morgan Stanley estimates that 70% of the 707 ktpa of LCE pipeline projects will be successfully financed, constructed and commissioned by 2025, hence their forecast of approximately 500 ktpa of new supply.

Table 9: Pipeline of Lithium Projects (Morgan Stanley, 2018 and The Lithium Spot, 2018)

Project Name	Operator	Location	Type	Financed	Permits	2025 Planned Production (ktpa LCE)
Development / Ramp-Up						321
Pilangoora	Altura Mining	Australia	Spodumene	✓	✓	28
Pilangoora	Pilbara Minerals	Australia	Spodumene	✓	✓	39
Whabouchi	Nemaska Lithium	Canada	Spodumene	✓	✓	31
Olaroz	Orocobre (66.5%)	Argentina	Brine	✓	✓	25
Cauchari - Olaroz	LAC (50%) / SQM (50%)	Argentina	Brine	✓	✓	25
Salar de Atacama Expansion	SQM	Chile	Brine	✓	✓	149
La Negra 3 Expansion	Albemarle	Chile	Brine	✓	✓	24
Feasibility Stage						286
Greenbushes Expansion	Talison Lithium	Australia	Spodumene	✗	✓	63
Mibra	AMG	Brazil	Spodumene	✗	✓	10
Wodgina	Mineral Resources	Australia	Spodumene	✗	✓	92
Jiangxi Tezhong	Yichun Expansion	China	Spodumene	✗	✓	10
East Taijina'er Expansion	Lithium Natural Resources	China	Spodumene	✗	✓	9
Cauchari - Olaroz Expansion	LAC (50%) / SQM (50%)	Argentina	Brine	✗	✓	25
La Negra 4 Expansion	Albemarle	Chile	Brine	✗	✓	36
Sal de Vida	Galaxy Resources	Argentina	Brine	✗	✓	25
Salar de Rincon	Enirgi Group	Argentina	Brine	✗	✗	15
PEA / PFS / Pilot Plant Stage						100
Sal de Los Angeles	Lithium X (80%)	Argentina	Brine	✗	✗	10
Sonora	Bacanora Minerals	Mexico	Clay	✗	✗	35
Salar de Uyuni	YLB/K-UTEC	Bolivia	Brine	✗	✗	10
Qarhan Zangge	Zangge Holdings	China	Spodumene	✗	✗	16
Yiliping	China MinMetals	China	Spodumene	✗	✗	9
Bald Hill	Tawana Resources	Australia	Spodumene	✗	✗	20

BEV penetration rates, as well as forecasted demand and supply figures, as supplied by prominent market contributors, are presented in Table 10 with the Morgan Stanley bear-case highlighted. It indicates why, based on Morgan Stanley's forecasts, they are negative about future lithium price movements with supply growth significantly outstripping their demand forecast. However, Morgan Stanley's demand forecast does appear to be an outlier and is approximately 25% lower than Deutsche Bank's forecast, which is the second lowest.

Table 10: BEV Penetration Rates, Lithium Demand, and Supply Forecasts

Source	EV Penetration Rate and Proposed Date	LCE Demand (kt) and Proposed Date	LCE Supply (kt) and Proposed Date	Comments
Morgan Stanley	9% / 2025	578 / 2025	727 / 2025	102 million vehicle sales by 2025. LCE demand equates to CAGR of 12%.
Deutsche Bank	N/A	775 / 2025	889 / 2025	N/A
UBS	N/A	1,047 / 2025	607 / 2025	CAGR of 17% between 2015 - 2025 for LCE demand
Matt Bohlson	15% / 2025	1,150 / 2025	N/A	Prominent market commentator
Roskill	N/A	800 / 2025	N/A	Demand increasing to 1,000 kt in 2026
Albemarle	12% / 2025	800 / 2025	N/A	Lithium Producer
J.P. Morgan	12% / 2030	1,000 / 2025	N/A	N/A
Boston Consulting Group	6% / 2025	N/A	N/A	6% BEV, 2% PHEV, and 16% HEV penetration and total vehicle sales of 105 million.
Wood Mackenzie	10% / 2030	N/A	N/A	N/A
McKinsey	5% / 2020	N/A	N/A	N/A

The drivers behind Morgan Stanley's forecasted flood of new supply, as well as the relevant counterarguments, where applicable, are summarised in Table 11 (Morgan Stanley, 2018).

Table 11: Morgan Stanley Bear-Case Drivers and Counterarguments (Morgan Stanley, 2018 and The Lithium Spot, 2018)

New Supply Driver	Counterargument
Relaxing of Chilean production quota: The world's largest and lowest-cost producer, SQM, was granted an additional production quota by the Chilean Government. Albemarle has been granted an increase in its quota as well. Overall this equates to a potential 200 ktpa increase in low-cost supply by 2025. Chilean producers may be further incentivised to increase output and lower prices by Chile's new royalty structure which reduces the marginal royalty rate from 40% for sales prices above US\$10,000/t to as low as 17% for prices between US\$6,000 and US\$7,000/t.	Legislation and royalties: There is a lack of visibility regarding Chile's quota policy beyond 2030 which may deter the significant CAPEX investments required to realise the forecasted production expansions. The agreement currently stipulates that the Chilean government has the right to purchase SQM's assets post-2030. Profitability: Furthermore, SQM and Albemarle will not necessarily increase production to squeeze out higher-cost producers and steal market share as this will lower the marginal cost of production, decrease commodity prices and consequently reduce their margins. SQM has stated that it aims to implement supply discipline and maintain its current market share of 25%, indicating that a rapid expansion to the full quota approved by Corfo is unlikely to happen (J.P. Morgan, 2018). Lastly, SQM and Albemarle's ability to influence price is also declining due to growing output from the domestic Chinese market (The Lithium Spot, 2018).
New project supply: Quota related expansions from Chile, as well as new brine and hard-rock developments in South America and Australia, have the potential to add 500 ktpa of new supply by 2025. Flattening of the cost curve: The additional supply potentially coming online in Chile from SQM and Albemarle is situated in the first quartile of the cost curve. The new supply is anticipated to flatten the cost curve, with the marginal cost of production required to meet Morgan Stanley's 2025 demand forecast to decrease significantly.	Ramp-up difficulties: Lithium projects can be complicated, especially brine projects, and can take significant time to ramp-up to full capacity. There are several examples showcasing this, as discussed in Section 2.3.5.1 below.
BEV sales penetration rates: Morgan Stanley currently forecasts a penetration rate of 9% by 2025, with an adoption rate of 13.7% required to balance their supply forecast. The current lack, and the high cost, of charging infrastructure, as well as the continued need for government subsidies to assist in making BEVs cost-competitive, currently constrains their penetration rate.	Conflicting forecasts: Morgan Stanley's demand forecast is substantially lower than the majority of market participants listed in Table 7, with an average demand forecast of 930 ktpa LCE by 2025. However, their market balancing BEV penetration rate of 13.7% is also within the consensus market forecast range of 10% or more, as previously presented in Figure 16.

2.3.4.1. Historical Project Difficulties

The crux of Morgan Stanley's bear-case scenario is the speed at which they anticipate new supply to enter the market; however, the lithium industry has a relatively poor track record of ramping up new supply and achieving the designed production rates. Figure 22 (Morgan Stanley, 2018) indicates the proposed increase in supply that producers committed to in 2012 versus the actual expansion rates achieved in 2016. It highlights the severe under-delivery of promised supply, with the failure attributed to a variety of reasons, including funding concerns and technical difficulties. For example, approximately 145 ktpa of new supply by 2016 was announced in 2012; however, only approximately 10 ktpa of this materialised with Orocobre Limited's Olaroz brine project in Argentina the only new contributor. As discussed in Section 2.1.6, the Olaroz project is producing below its design capacity of 17.5 ktpa and has experienced numerous commissioning and design issues.

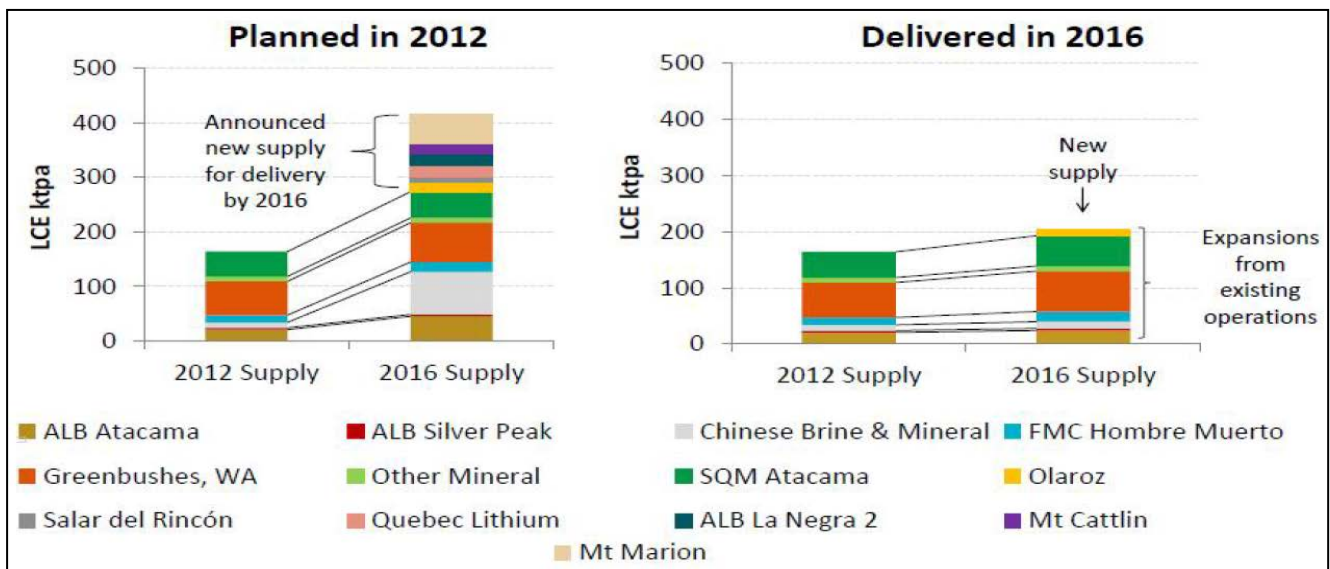


Figure 22: Planned Production in 2012 versus Actual Capacity Delivered by 2016 (Morgan Stanley, 2018)

Furthermore, brine project developers rarely achieve the quoted design capacity as indicated in Figure 23 (UBS Global Research, 2018), which depicts the actual utilisation rates as a percentage of design capacity. For example, the average plant utilisation rates in Argentina in 2016 was approximately 75% of their full design capacity. The low utilisation rates are attributable to the operational complexity of the brine supply.

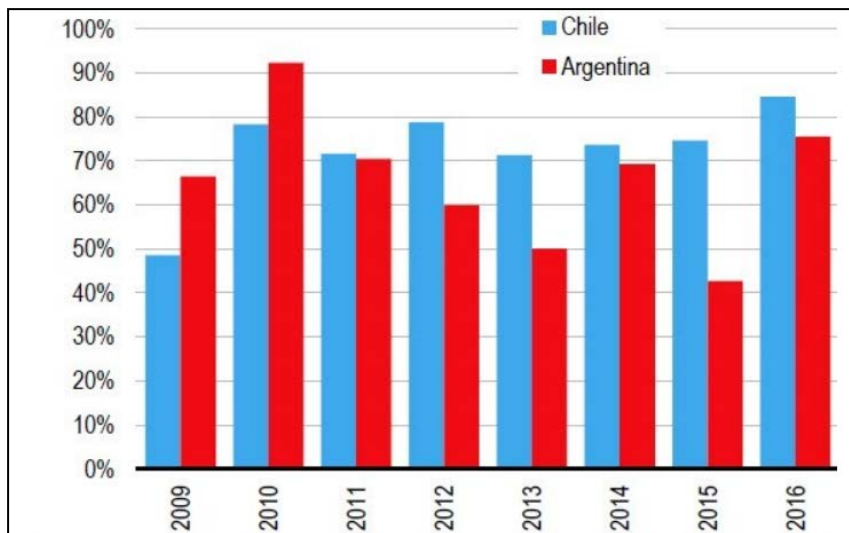


Figure 23: Brine Processing Facilities Utilisation Rates in Chile and Argentina as a Percentage of Design Capacity (UBS Global Research, 2018)

It has historically taken between seven and ten years to advance a brine project from the feasibility study stage to operational efficiency, while hard-rock projects average closer to five years (Albemarle, 2018). However, the five-year timeline assumes that projects receive timely funding and that the junior or mid-tier owner of the project partners with an experienced market participant who is capable of executing new projects (Bohlsen, 2018). These timelines are in stark contrast to the that provided by project management teams in Table 9 and used by Morgan Stanley in their price forecast, which indicates fully ramped-up production by 2025 for numerous projects that are currently unfunded and in the early study-stage of development. The successful construction of a project does also not guarantee that it will achieve its design production output, as observable in Figure 22 and Figure 23.

Potential also exists for battery-grade material producers and battery manufacturers to absorb any excess feedstock supply to willingly build inventories for use in the future production of battery components, therefore sustaining demand for feedstock materials and hence their price. The concept of price stickiness is vindicated by many junior miners agreeing to 5-year offtake contracts with battery suppliers for 100% of their production capacity. These offtake agreements also commonly have a price ceiling and floor set, which prevents them from participating in upside but also brings a degree of stability to the range in which lithium will trade.

Finally, if pricing does start to feel pressure and prices do retreat, it will consequently also affect the investment and funding decisions for many pipeline projects that may want to retain the optionality of delaying the project (The Lithium Spot, 2018).

3. TRADITIONAL VALUATION TECHNIQUES

3.1. Overview of Valuation Techniques

The value of a mineral project can be determined using a variety of valuation techniques and associated methodologies. Three broad valuation categories exist, namely: market-based, income-based, and cost-based.

The market-based approach relies on historical mineral property transactions in order to provide the best estimate for the current value of a property. The market-based approach is formally defined as, 'Any approach to value based upon the use of data that reflects market transactions and reasoning that corresponds to the thinking of market participants' (IVS, 2001). The most widely accepted valuation methodologies within this approach include the following: the value per unit method, such as the US\$ per hectare or ounce approaches; the Kilburn method; the market capitalization per ounce method; and, the comparable asset valuation method. For example, the US\$ per unit of commodity method uses the commodity content of a property as estimated from the resource and reserve statements or from interpolated information from adjacent properties. A US\$ per unit of commodity value is attributed to the property by using recently concluded transactions on similar deposits in the same country as a proxy for the value (Lilford & Minnitt, 2005).

The cost-based approach is relatively simple and it relies on the premise that the value of a property must be worth at least that amount expended on the property to achieve a certain level of geological understanding. The cost-based approach is formally defined as, 'A comparative approach to the value of property or another asset, that considers as a substitute for the purchase of a given property, the possibility of constructing another property that is a replica of the original or one that could furnish equal utility with no undue cost due to delay' (IVS, 2001). The multiples of exploration expenditure is a commonly applied cost-approach method and it focusses on the significance of the exploration, namely: only past expenditures that are considered reasonable and productive contributors to value. Therefore, the cost approach method assumes that the amount of exploration expenditure justified and justifiable on a mineral property is related to that property's value (Lilford & Minnitt, 2005).

The income-based approach presents the most widely used and understood valuation methodology available to valuers. The income-based approach is formally defined as, 'A comparative approach to the value that considers income and expense data relating to the property being valued and estimates value through a capitalization process. Capitalization relates income (usually net income) and a defined value type by converting an income amount into a value estimate. This process may consider direct relationships, yield or discount rates applied to a series of incomes over a projected period, or both. The income approach reflects the principle of anticipation' (IVS, 2001). The income-based approach includes techniques such as the Discounted Cash Flow (DCF) methodology, tail

margin analysis and option pricing. In terms of cash flow analysis, the DCF valuation technique is the most commonly used valuation tool, with alternative approaches such as tail margin analysis being extensions thereof (Lilford & Minnitt, 2005). The merits of the DCF and option pricing technique are discussed in subsequent sections as these techniques form the basis for the valuation conducted in this study.

3.2. Selection of the Discounted Cash Flow Methodology as Primary Valuation Technique

Cost-based valuations fail to recognize the worth of the real asset in a resource project, namely, the mineral deposit, and is consequently primarily applicable to new projects in the early exploration phase (Kyle, 1983). Only the income and market-based approaches are therefore useful for development or production stage companies, such as the lithium miner selected for this study.

Although it is always preferable to use a minimum of two valuation methods to validate both the assumptions used and the resultant valuation generated (Berry & Thomas, 2016), the market-based approach is considered inappropriate for use in this research study as it will merely reinforce the depressed or inflated prices, depending on the phase of the commodity cycle, that market participants are willing to pay for lithium mining companies.

In contrast to the other two methodologies mentioned, the income-based approach and more specifically the calculation of Net Present Value (NPV) using the DCF technique, has certain unique features and advantages not always exhibited by the other methods. Consequently, it forms the foundation of the valuation conducted in this study. The advantageous features include (Kyle, 1983):

- Recognition of the time value of money and is prospective in focus, not historical;
- Sensitivity to variable cash flow patterns that may be driven by cyclical swings in production, sales and commodity prices over time;
- Ability to use real or nominal values;
- Suitable for projects with a finite time horizon;
- Develops a logical relationship between key variables; and,
- Facilitates sensitivity analysis and can quantify the effective range of the valuation.

However, the NPV/DCF method is not without its pitfalls. The selection of the following key input variables is of particular importance due to their potential uncertainty and the material impact they have on the valuation (Kyle, 1983):

- Functional currency and the potential need for exchange rate assumptions if the functional currency or commodity prices quoted are in a different currency to that utilised in the valuation;

- Inflation and real escalation rate assumptions and their appropriate linkage to nominal rates using the Fisher Equation;
- The discount rate used which is equivalent to the opportunity cost of the capital invested and reflects the return which could be earned elsewhere from a similar investment of comparable risk;
- The project's estimated resource life should determine the appropriate time horizon of the DCF model, with a shorter time span of 20 years frequently selected for very long-life mining operations; and,
- Future commodity prices and the approaches to forecasting them can vary from simple statistical regression analysis to more complex econometric equations of supply and demand.

Several forms of the DCF valuation model exist with each relying on a variation of Free Cash Flow (FCF). However, the Enterprise DCF methodology, as defined in Table 12 (McKinsey & Company, 2000), remains one of the most commonly utilised amongst practitioners and academics as it solely relies on company cash flows, rather than on accounting-based earnings (McKinsey & Company, 2000). It is consequently selected as the DCF methodology of choice for this study. Table 12 also highlights some of the lesser-used, or more specialised, DCF valuation techniques available; however, the Enterprise DCF methodology is most applicable for projects and thus selected for use.

Table 12: Frameworks for DCF-Based Valuation (McKinsey & Company, 2000)

Model	Measure	Discount Factor	Assessment
Enterprise Discounted Cash Flow	Free Cash Flow	Weighted Average Cost of Capital	Works best for projects, business units, and companies that manage their capital structure to a target level.
Discounted Economic Profit	Economic Profit	Weighted Average Cost of Capital	Explicitly highlights when a company creates value.
Adjusted Present Value	Free Cash Flow	Unlevered Cost of Equity	Highlights changing capital structure more easily than WACC-based models.
Capital Cash Flow	Capital Cash Flow	Unlevered Cost of Equity	Compresses free cash flow and the interest tax shield in one number, making it difficult to compare operating performance among companies over time.
Equity Cash Flow	Cash Flow to Equity	Levered Cost of Equity	Difficult to implement correctly because capital structure is embedded within the cash flow. Best used when valuing financial institutions.

The Enterprise DCF model determines the enterprise value of the company by discounting FCF at the corporate cost of capital. FCF, as defined in Equation 1, includes the cash flow available to all investors, namely: equity holders, debt holders, and any other non-equity holders.

Free Cash Flow =

$$\text{Earnings Before Interest and Tax} \times (1 - t) + \text{Depreciation} \pm \text{Change in Working Capital} - \text{Capital Expenditure} \quad (1)$$

The classical DCF equation utilized to calculate the present value of future cash flows discounted at an appropriate rate is shown in Equation 2:

$$\text{Present Value} = \sum_{t=0}^n \frac{\text{Free Cash Flow}_t}{(1 + \text{Discount Rate})^t} \quad (2)$$

Rearranging the simplified enterprise value equation allows calculation of the value to equity holders, as presented in Equation 3:

Enterprise Value =

$$\text{Market Value of Equity} + \text{Market Value of Debt} - \text{Cash and Cash Equivalents} \quad (3)$$

Section 3.4 provides further detail regarding the determination of the key input variables and their use in the valuation model.

3.3. Valuing Cyclical Mining Companies

Cyclical and commodity companies, such as mining companies, have a unique feature in that their value is frequently more dependent on the movement of a macroeconomic variable, such as the commodity price, than on firm-specific characteristics. Commodity prices tend to move in cycles and the most significant challenge often faced with valuing a mining company is that the most recent earnings and cash flows reported in financial statements are dependent on the current phase of the commodity cycle, and extrapolating those numbers into the future is consequently a key input assumption (Damodaran, 2009). Valuing a cyclical company presents many unique challenges, some of which are explored in more detail below.

3.3.1. Base-Year Fixation

Base-year fixation refers to the fact that current-year financial statements, which subsequently form the base year in the valuation, are often overemphasised with little cognisance given to the firm's operational history or the performance of the overall sector. Depending on the phase of the commodity cycle, extrapolation of these base-year results can lead to a gross over- or undervaluation.

It is not just earnings that are skewed by the phase of the commodity cycle, with various other valuation inputs affected, namely (Damodaran, 2009):

- Profitability measures: Any ratios derived from earnings, such as the EBIT margin and days of sales outstanding are both a function of revenue and hence the phase of the commodity cycle;
- Capital expenditure: A company's ability and willingness to spend CAPEX will also vary in conjunction with earnings; and,
- Discount rate: Market debt ratios and the cost of debt and equity are essential inputs used in calculating the Weighted Average Cost of Capital (WACC) and these inputs fluctuate as the commodity and overall economic cycle changes. During an economic slowdown, the risk-free rate typically decreases while the equity risk premium increases and the relative preference for debt and equity funding are also influenced, which can ultimately result in the cost of financing changing through a commodity cycle.

3.3.2. Forecasting Cycles versus Selective and Adaptive Normalisation Methods

The valuation of an inherently cyclical commodity company can be broadly addressed by either attempting to forecast both the current phase of the commodity cycle and the timing of future cycles or alternatively adopting a 'selective normalisation' approach (Damodaran, 2009). Attempting to forecast the fluctuation of the commodity cycle over the time horizon of a mining operation will require an underlying macroeconomic forecast, generated using a substantial number of assumed inputs, adding another level of complexity to the valuation. Given the unpredictability of future commodity cycles and the complex interplay between the various assumptions used, the merit of forecasting cycles accurately is questionable.

Instead, the selective normalisation approach argues that the opportunity cost, referring to the time and effort expended attempting to forecast economic and commodity cycles, should be better spent researching and analysing the company more thoroughly and using normalised inputs for the valuation. Selective normalisation for a cyclical company refers to utilising values representing the mid-point of the cycle, where the values are neither unduly inflated or depressed due to a swing in the commodity cycle. However, such a mid-point or normal value inherently refers to the intrinsic value of the commodity which reflects the underlying fundamental demand and supply dynamics. This definition of normalisation consequently has a subjective component to it, with a 'normal' value potentially having a variety of interpretations. Selective normalisation is thus also susceptible to valuation errors, such as (Damodaran, 2009):

- Subjectivity: As discussed above, the interpretation of what is a reasonable value for a specific commodity price is subjective and dependent on the valuer's conclusions regarding the current phase of the commodity cycle and the true intrinsic value of a commodity;
- Incomplete normalisation: Refers to only normalising cash flows, which is typically the key value driver, while maintaining other inputs such as capital expenditure and cost of financing, in-line with the base-year financial numbers; and,

- Inconsistent growth: If the perception is that the base-year financial results reflect a depressed commodity cycle, then both the company earnings and the future revenue growth rate may be revised upwards, resulting in an effective double-accounting of growth in earnings.

In the case of a mining company, key inputs such as production volumes, recovery rates, commodity prices, capital expenditure, and discount rates are amenable to the use of selective normalisation. The use of this approach is common for company valuations, leading to the application of constant discount rates and short-term (3 to 5 year) forecasts of commodity prices, followed by a constant long-term real commodity price (Macquarie Wealth Management, 2016).

One of the perils of selective normalisation is the replacement of current financial results and input parameters with what is perceived to be normalised numbers if a mid-point in the commodity cycle is assumed. However, cycles can last for many years resulting in the selective normalisation approach either under- or overvaluing a company for extended periods. A partial resolution of this dilemma is to assume normalisation in the long-term while allowing earnings to follow the current cycle in the short to medium term; with this approach termed 'adaptive normalisation'.

Figure 24 (McKinsey & Company, 2000) presents a hypothetical rolling DCF valuation and compares it to the underlying cash flows used to generate it. It is apparent that the DCF values exhibit lower volatility than the cash flows; this is due to the DCF methodology reducing future expected cash flows to a single value. Consequently, any volatility in a single-year proves to be relatively unimportant. Therefore, it appears that for a cyclical commodity company only the long-term trend is significant as the cyclical cash flows can cancel one another out; however, it is essential that the valuation period is long enough to capture the full commodity cycle (McKinsey & Company, 2000). This conclusion provides a degree of credence to using an adaptive normalisation approach instead of expending the time and effort to formulate a detailed commodity cycle forecast.

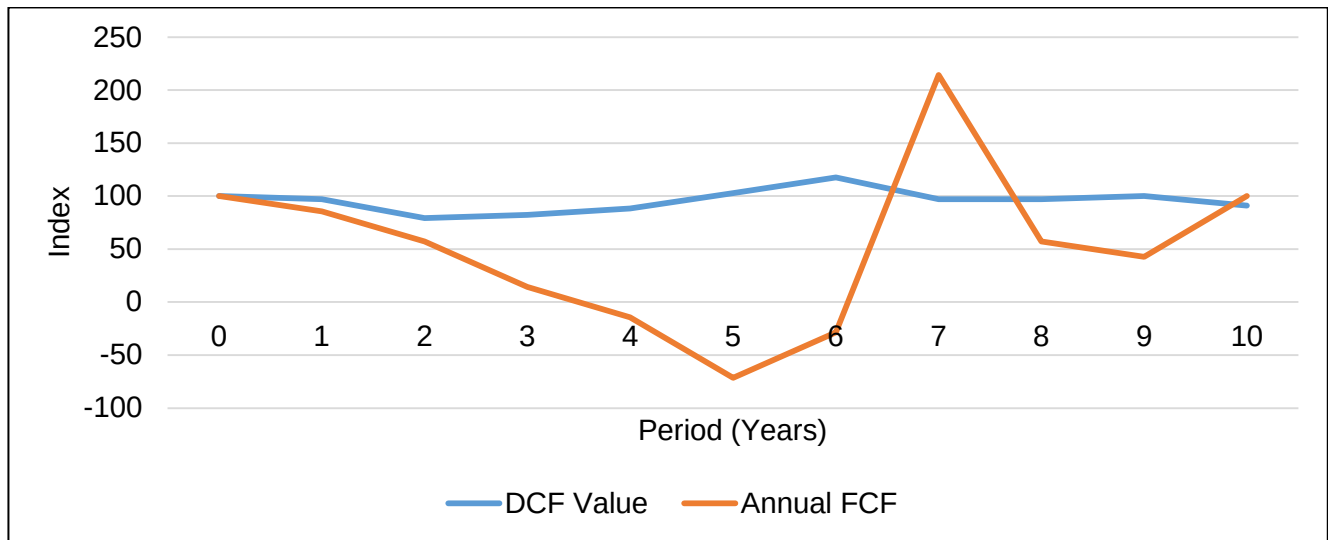


Figure 24: The Long-Term View: Free Cash Flow and DCF Volatility (McKinsey & Company, 2000)

3.3.3. Probabilistic Approaches

Section 3.3.2 suggests that a single perfect technique does not exist when valuing a cyclical commodity company, with both cycle forecasts, selective and adaptive normalisation techniques exhibiting inefficiencies. However, the complexity of generating a detailed macroeconomic forecast and its consequent impact on the lithium commodity cycle is beyond the scope of this research study. Therefore, a hybrid methodology will be employed which uses the adaptive normalisation technique and combines this with a quantitative risk model, namely, a Monte Carlo Simulation (MCS). This methodology attempts to address some of the inherent variability, uncertainty, and subjectivity present in selecting input values (Lane, et al., 2012).

Deterministic valuations generate a single point-in-time solution and, therefore, have the potential to understate the true project risk. Cyst Corporation (Cyst) describes a case study where a deterministic valuation generated a robust positive NPV. Subsequently, Cyst conducted an audit using a probabilistic approach, which generated a distribution of possible outcomes. The probabilistic approach indicated that the project showcased a 44% probability of an NPV less than zero (Lane, et al., 2012), highlighting the benefit of employing this approach.

The two most common probabilistic approaches are:

Scenario analysis, which allows for the categorisation of the commodity cycle into discrete phases, such as a 'bull' or 'bear' market, and also enables the testing of more specific scenarios on a company level by adjusting key inputs such as production rates, plant recoveries or the cost of capital. Investment banks commonly present three discrete scenarios, namely a base, bear and bull market, where the bear and bull markets represent scenarios of lower and higher than expected commodity price forecasts, respectively (Macquarie Wealth Management, 2016). Calculating the discrete value under each scenario determines the firm's value for a range of plausible outcomes

(Damodaran, 2009). The technique is valuable in assessing the different valuations based on management choices and decisions, but the assumption is that the scenario tested is correct (Lane, et al., 2012); and,

Secondly, quantitative risk modelling, also called stochastic modelling or Monte Carlo Simulation (MCS), is a mathematical method for conducting a quantitative risk analysis. MCS methods rely on the repeated random sampling from a probability distribution, where different inputs are used in a mathematical model to calculate an outcome for each sample run. It is equivalent to conducting thousands of 'what-if' scenarios (Lane, et al., 2012).

The probability distributions required to define the operational inputs necessary to conduct an MCS should ideally originate from an analysis of historical operational performance data relating to actual achievements in mining rates and costs, processing rates, and recoveries. In the absence of such historical data, alternative sources of information are used, such as the performance of competitor companies exploiting similar orebodies, test work results, results obtained during initial ramp-up phases, and/or industry-accepted limits of possible minimum and maximum results (Lane, et al., 2012).

3.3.4. Real Options Analysis

A common critique of conventional valuation approaches such as DCF is their failure to consider the interrelationship between the commodity price and the ability of a company to make the appropriate investment and financing decisions based on the future price level. Management has the luxury of observing and analyzing the prevailing commodity price and cycle before committing to an investment decision. Arguably, conventional valuation methodologies need to reflect this optionality by attributing an option premium to the currently undeveloped resource base, highlighting a company's right, but not the obligation, to proceed with a project. Failure to include this premium results in DCF valuations underestimating the value of natural resource companies (Damodaran, 2009).

If the assumption that an undeveloped resource has an element of optionality is considered valid, then a technique such as a Real Options Analysis (ROA) is applicable. ROA accounts explicitly for the uncertainty in cash flows arising from a resource or investment decision. ROA draws on an analogy with financial options, such as call and put options, which have found widespread acceptance. A call option is a right, but not the obligation, to purchase an asset at a given price. If the owner chooses to exercise the option, the owner forfeits the option but gains the asset. Specific investment opportunities have a similar structure. For example, a mining company that has spent money to develop a feasibility study for a resource has the right, but not the obligation (with the potential consequence of losing the mining license), to implement the design and construct a mine. If the company decides to invest in the mine, then it has exercised its option, and this type of option is called a real option (Crundwell, 2008).

Black, Scholes and Merton (BSM) developed a set of equations that are frequently applied to solve for the value of a real call and put option. The equation for a call option, which is primarily of relevance to mining valuations, is outlined in Equation 4. The inputs used in Equation 4 are defined in Table 13 (Crundwell, 2008 and Damodaran, 2009) and the table also provides techniques used for estimating the inputs as applied to mineral resource assets.

$$\text{Call Option} = S e^{-\delta(T-t)} N(d_1) - K e^{-r(T-t)} N(d_2) \quad (4)$$

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left((r - \delta) + \frac{\sigma^2}{2}\right)(T - t)}{\sigma\sqrt{T - t}} \quad (4.1)$$

$$d_2 = d_1 - \sigma\sqrt{T - t} \quad (4.2)$$

Table 13: Definition of Inputs for Use in Black, Scholes & Merton Real Options Analysis Equation (Crundwell, 2008 and Damodaran, 2009)

Input	Estimation procedure
Value of Underlying Asset (S)	Usually estimated as the quantity of recoverable resource times the current price, less the cost of production.
Development Lag	Since the resources are not instantaneously extractable, a time lag must be allowed between the decision to extract the resources and the actual extraction. A simple adjustment for this lag is to adjust the value of the developed reserve for the loss of cash flows during the development period. Thus, if there is a one-year lag in development, the current value of the undeveloped reserve will be discounted back one year at the cost of delay (which equates to the percentage of potential cash flows lost due to the lag).
Strike Price (K)	Capital investment to develop the reserve. Generally assumed to be known and fixed.
Life of the Option (T - t)	Can be defined in one of two ways: a. If rights to the mineral reserve are for a finite period, use that period. b. The number of years of production it would take to exhaust the estimated reserve.
Variance in Value of Underlying Asset (σ)	The quantity of the resource is assumed to be known; therefore, σ refers to the variance in the price of the natural resource.
Dividend Yield or Cost of Delay (δ)	Annual cash flow as a percent of the value of the underlying asset. Once the reserve becomes viable, this is what the firm is losing by not developing the reserve.

ROA applies to a commodity company housing multiple independent and undeveloped reserves; each reserve is considered separately as an option, and the derived values are aggregated to generate the overall option value for the firm. This methodology is simple enough for small and

medium-sized firms with limited independent reserve tenements. However, the complexity increases for large corporations that potentially have hundreds of undeveloped reserves (Damodaran, 2009). Application of option pricing theory to the undeveloped reserves allows the calculation of the total firm value using Equation 5.

$$\begin{aligned} \text{Value of Operating Assets} = \\ \text{Value of Developed Reserves} + \text{Option Value of Undeveloped Reserves} \end{aligned} \quad (5)$$

3.4. Discussion of Key Valuation Input Variables

As discussed in Section 3.2, the income approach, and more specifically the DCF methodology, to valuing mineral properties relies on the calculation of the free cash flow derived from the production of a commodity from the mineral property. The free cash flow is dependent on the revenues estimated from the sale of the commodity as well as on the operating expenses, working capital, capital expenditure, taxation and royalties. The resultant cash flows are then used to derive the NPV of the operation at a predetermined discount rate, or at a range of discount rates. The determination of these components of the free cash flow and NPV calculation requires several economic and valuation inputs to be assumed. Section 3.4 discusses and analyses some of the key input assumptions required to conduct the valuation presented in this research study.

3.4.1. Macroeconomic Assumptions

3.4.1.1. Inflation, Escalation and Exchange Rates

Cash flows can either be expressed in nominal or in real terms. Nominal cash flows incorporate changes in the purchasing power of money by considering inflation in the valuation, while real cash flows only consider real increases in prices and costs over time and hence ignores inflation driven increases. Using either nominal or real cash flows will provide the same valuation outcome, granted that the correct adjustments are made consistently throughout the valuation model (Kyle, 1983).

Inflation adjustment of real escalation rates to equivalent nominal rates can be done utilising the widely accepted International Fisher Effect (IFE), expressed in Equation 6. The forecasting of exchange rates is similarly based on the IFE, which suggests that currencies with a higher nominal interest rate will depreciate because the higher rate reflects higher expected inflation rates (since real interest rates are assumed to be equal across different countries, as per the IFE assumption). Consequently, Equation 7 represents the expected percentage change in the future spot exchange rate (XR) (Crundwell, 2008).

$$(1 + \text{Nominal Growth Rate}) = (1 + \text{Real Escalation Rate})(1 + \text{Inflation Rate}) \quad (6)$$

$$XR_{A/B} = \frac{(1 + \text{Nominal Interest Rate of A})}{(1 + \text{Nominal Interest Rate of B})} \approx \text{Nominal Interest Rate of A} - \text{Nominal Interest Rate of B} \quad (7)$$

The decision to conduct a valuation in either nominal or real terms is an important one with the respective advantages and disadvantages of a real approach highlighted in Table 14 (Smith, n.d.).

Table 14: Comparison of the Advantages and Disadvantages of Using a Real Approach in Valuations (Smith, n.d.)

Real Approach	
Advantages	Disadvantages
Assumptions: No inflation assumptions or forecasts required.	Internal Rate of Return (IRR): Calculated IRR is lower when excluding inflation.
Simplified Model: Capital costs, operating costs, and revenues for the project are only subject to real escalation, if applicable. Consequently, the valuation is free of the accumulating effect imposed by compounding inflation rates, allowing for easier troubleshooting and trend identification.	Discount Rate: Requirement to use real (excluding inflation) discount rates; an often-overlooked adjustment as quoted debt interest rates inherently account for expected inflation rates.
	Tax: Understatement of taxes since inflation typically reduces the relative tax shield provided by depreciation expenses. Furthermore, tax rates are calculated using nominal earnings (not real earnings), and the application of tax rates to real models consequently become more difficult.

3.4.2. Selection of an Appropriate Discount Rate

There are two primary considerations when determining the appropriate methodology to calculate a suitable discount rate. Firstly, economic and finance theory proposes the use of the corporate cost of capital as a discount rate. This discount rate reflects the opportunity cost of capital, that is, the return that could be earned elsewhere from a similar investment with a comparable risk profile (Kyle, 1983). The alternative method proposes a project-specific discount rate that relies on industry expectations of an appropriate rate of return and that directly accounts for risk factors specifically associated with the mining project considered, such as those encountered during the mineral exploration and project development phases (Smith, n.d.).

The primary difference between the two methodologies is where risk is reflected. The corporate cost of capital, typically used for the valuation of public companies, considers the project and company-specific risks in cash flows via the use of scenario analysis or probabilistic simulations. The discount rate, conversely, is only adjusted for company risk relative to market risk and country risk, via the beta measure and country risk premium, respectively (Damodaran, 2016).

Conversely, the project-specific discount rate incorporates additional risk premiums, such as technical, economic, and political risks, directly into the discount rate. The incorporation of these additional premiums can be achieved through various techniques, including the use of a quantitative rating scale, as described by Matunhire & Park (2011). In practice, both methodologies described

have their uses and limitations, with a critical consideration being that risk is not double accounted by, for example, adjusting both the cash flows and the discount rate to reflect company-specific risks (Damodaran, 2016).

The valuation conducted in Section 6 uses the corporate cost of capital approach where the discount rate only reflects macroeconomic or market risks, while the use of MCS considers the company or project-specific risks. The determination of an appropriate discount rate is covered in Section 5.1.6; however, this is not to ensure the calculation of a precisely accurate discount rate, but rather to address some common misconceptions and mistakes that are made when calculating the discount rate. Figure 25 (Damodaran, 2016) highlights why attempting to calculate a precisely accurate discount rate is not explicitly required. The figure presents the cost of capital for USA publicly listed companies in January 2016 and indicates that 50% of all discount rates at the time were between 6.6% and 9.2%. The spread of discount rates are surprisingly small and the impact of a calculation error in determining the discount rate is therefore often muted.

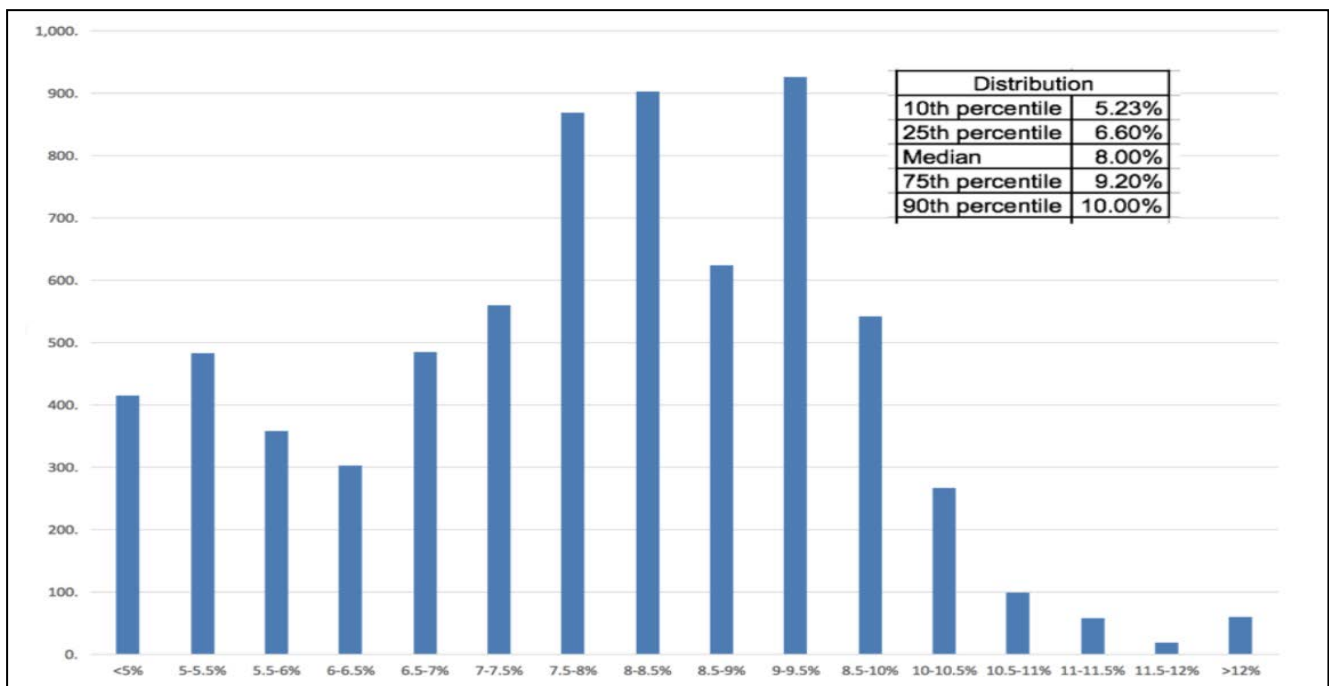


Figure 25: Cost of Capital for USA Publicly Listed Companies in January 2016 (Damodaran, 2016)

3.4.3. Weighted Average Cost of Capital

The Enterprise DCF model introduced in Section 3.2 calculates a free cash flow available to all investors, and consequently needs to be discounted at the firm's corporate cost of capital, which reflects the risk faced by all investors (McKinsey & Company, 2000). The corporate cost of capital, in its most basic form, is a weighted average of the costs of raising debt and equity funding for an investment or a business. The cost of equity reflects the perceived risk for equity investors while the

cost of debt reflects the default risk envisioned by lenders (Damodaran, 2016). These considerations are represented in the firms WACC, as defined in Equation 8.

$$WACC = (We \times Ke) + (Wd \times Kd) \quad (8)$$

Where:

Ke = Proportional cost of equity

Kd = Proportional after-tax cost of debt

We = Proportion that equity contributes to the corporate capital structure on market value basis

Wd = Proportion that debt contributes to the corporate capital structure on market value basis

The application of WACC is intuitive and relatively straightforward once the various inputs are defined. However, it does have drawbacks, namely, the calculation of its various components introduces significant subjectivity. Furthermore, it discounts the future cash flows using a constant cost of capital, which implicitly assumes the company keeps its capital structure constant at a target ratio of debt to equity. The valuation conducted in Section 6 attempts to mitigate these risks by using the previously defined 'adaptive normalisation' technique, in conjunction with a probabilistic valuation approach.

Table 15 (McKinsey & Company, 2000) identifies the methodology and data required for estimating each component of the WACC. These input components are explored further in Section 5.1.6.

Table 15: WACC Input Components (McKinsey & Company, 2000)

Component	Methodology	Data Requirements	Considerations
Cost of Equity	Capital asset pricing model (CAPM)	- Risk-free rate - Market risk premium - Company beta	- Use a long-term government rate denominated in the same currency as cash flows. - The market risk premium is difficult to measure. Various models point to a risk premium between 4.5% and 5.5%. - To estimate beta, lever the company's industry beta to the company's target debt-to-equity ratio.
After-tax Cost of Debt	Expected return proxied by yield to maturity on long-term debt	- Risk-free rate - Default spread - Marginal tax rate	- Use a long-term government rate denominated in the same currency as cash flows. - Default spread is determined by the company's bond rating and amount of physical collateral. - In most situations, use the company's

			statutory tax rate. The marginal tax rate should match marginal tax rate used to forecast net operating profit less adjusted taxes (NOPLAT).
Capital Structure	The proportion of debt and equity to enterprise value	-	Measure debt and equity on a market, not book, basis. Use a forward-looking target capital structure.

3.4.3.1. Cost of Equity and Market Value of Equity

The cost of equity is the input component most susceptible to scrutiny and subjectivity due to the variety of methodologies available to calculate it, some of which include the Capital Asset Pricing Model (CAPM), the Fama-French Three-Factor Model, and the Arbitrage Pricing Theory Model, the merits and disadvantages of which are extensively covered in other texts, such as McKinsey & Company (2000).

The CAPM is the most widely used and provides one of the more objective methodologies for determining a discount rate, as the risk-free rate and market risk premium are common to all companies, with only beta varying across individual companies. The CAPM is presented in Equation 9:

$$E(R) = R_f + \beta \times (R_m - R_f) \quad (9)$$

Where:

$E(R)$ = Expected return of security

R_f = Risk-free rate

β = Beta of the company, which adjusts for company-specific risk

R_m = Market's cost of equity

$R_m - R_f$ = Market equity risk premium

Although the CAPM is used extensively, the model theory provides minimal guidance for its use in valuation. Consequently, valuation specific best-practices for determining the various CAPM inputs are discussed below, with detailed calculation methodologies provided in reference texts, such as McKinsey & Company (2000). Furthermore, the determination of the appropriate discount rate applied in Section 5 extensively uses open source CAPM model inputs that are calculated by industry practitioners such as Damodaran (Damodaran, 2018).

Risk-Free Rate

The risk-free rate is the rate of return one can expect to receive from an investment with guaranteed returns, implying that the entity invested in is default-free. The interest rate on an appropriately selected government bond almost exclusively reflects the risk-free rate. Vital valuation-specific considerations regarding the use of the risk-free rate within the CAPM include:

- **Tenor:** Ideally, each future cash flow should be discounted using a government bond with the same maturity, but this contributes to unnecessary complexity. Therefore, practitioners typically select a bond tenor that best matches the valuation period. Conservatively, it is suggested to use a higher long-term interest rate, such as a 10 or 30-year bond, regardless of the valuation period (McKinsey & Company, 2000);
- **Default-free rate:** The default-free rate can be estimated using the interest rate on deep investment-grade entities for the currency used in the valuation. The investment-grade entity can either be the local government rating or a suitable investment grade corporate entity. If no investment-grade counterparty exists in the relevant jurisdiction, then the appropriate government bond can be used with the default spread subtracted to arrive at the risk-free rate. Furthermore, it is recommended to use the interest rate of a zero-coupon government bond as the payment of interim coupons effectively reduces the maturity (McKinsey & Company, 2000); and,
- **Inflation and currency:** Nominal risk-free rates in different countries will vary due to the incorporation of expected inflation relating to the local currency. This variation can be corrected for by either conducting the valuation in real terms and using a real risk-free rate, or by ensuring the currency of the cash flows matches the currency of the nominal risk-free rate used (Damodaran, 2016).

Equity Risk Premium (ERP)

The ERP is the premium that investors require to invest in equities as an asset class, relative to what they could earn on a risk-free investment, and the correct calculation methodology to employ is widely debated (Damodaran, 2016). No single, universally-accepted model exists; however, there are three generally accepted methodologies employed to calculate the ERP, discussed in more detail in reference texts such as those produced by Aswath Damodaran (2016). Briefly, the three methodologies are:

- Estimating the future risk premium by measuring and extrapolating the difference between historical stock returns and the risk-free rate;
- Using regression analysis to link current market variables to project the expected market risk premium; and,
- Using a DCF valuation in conjunction with estimates of return on market investment and growth to reverse engineer the market's cost of capital and thus calculate a forward-looking premium.

Although all three methodologies have their flaws, the forward-looking estimate is preferred as it is less susceptible to manipulation (Damodaran, 2016). Vital valuation-specific considerations for calculating the ERP include:

- ERP in varying markets: Instead of blanketly applying the ERP of developed markets, such as the USA, a market-specific ERP should be calculated to capture country-specific risks;
- Company ERP: The ERP of the country of the company's incorporation is frequently incorrectly adopted as the company-specific ERP. Instead, the ERP should arguably be calculated using a weighted average of the country ERP's where the company generates its revenues; and,
- Inflation consistency: Regardless of the calculation methodology employed, it is important to remain consistent in the use of nominal or real rates. Calculation of a real market return consequently requires the subtraction of a real risk-free rate to calculate the ERP.

Importantly, the above methodology assumes that the ERP varies across countries, with a higher ERP applying to riskier countries, reflecting the investors need to earn a higher rate of return for assuming a higher country risk. However, a common approach amongst many practitioners is to attach a flat ERP to a company based upon its country of incorporation, consequently ignoring the fact that a significant portion of the company's cash flows may be generated in riskier jurisdictions. The valuation in Section 6 considers both scenarios, namely, both a constant country of incorporation ERP as well as a weighted varying ERP based on the company's revenue-generating jurisdictions.

Beta

Beta measures a stock's co-movement relative to that of the aggregate stock market, which implies that beta measures the risk added to a diversified market portfolio, and not the total risk of the security or project. Therefore, it is possible for an individual investment to be high risk but to be low risk relative to the diversified market. Beta measures the relative risk of an asset and is therefore standardised around 1. Consequently, a low-risk investment relative to the market, such as that described in the preceding example, has a beta close to 1. Conversely, a relatively risky asset has a beta greater than 1, while a negatively correlated asset has a beta of less than 1 (Damodaran, n.d.). Beta is not directly observable, and its value, therefore, needs to be estimated using regression, with a common regression model defined in Equation 10:

$$R_i = \alpha + \beta R_m + \varepsilon \quad (10)$$

Where:

R_i = Stock's return

α = Model intercept

β = beta of the company, which adjusts for company-specific risk

R_m = Market return

ε = *Residual error term*

Equation 10 determines a raw, unadjusted beta for the specific stock, the accuracy of which improves if other complementary adjustments are made to the estimated raw beta. The primary adjustment made is the calculation of an unlevered industry beta, which is subsequently corrected for the company's specific level of leverage. The use of an industry beta has shown to decrease the standard error relative to the calculation of a company-specific raw beta. Companies in the same industry typically face the same operating risks, so they should have similar operating betas. However, to compare companies with similar operating risks, the effect that leverage has on beta needs to be eliminated by calculating an unlevered industry beta. Unlevering the industry beta is required since companies also face financial risk when raising debt, which consequently heavily influences beta. Equation 11 indicates the relationship between the levered and unlevered beta:

$$\beta_e = \beta_u \times \left(1 + \frac{D}{E}\right) \quad (11)$$

Where:

β_e = *Levered equity beta*

β_u = *Unlevered industry beta*

D/E = *Company's ratio of debt to equity, i.e., its capital structure*

Key valuation-specific considerations relating to the calculation of the beta include:

- Measurement period and frequency for beta calculation: The measurement period should include at least 60 data points, with 5-years of monthly returns typically employed by practitioners. Increasing the frequency to weekly or daily returns has shown to introduce systematic biases. For example, if a stock is illiquid then using daily or weekly data points may result in many reported returns being equal to zero, biasing the beta calculation downwards; and (Damodaran, 2016),
- Benchmark portfolio used for regression: In theory, it is required to use a value-weighted market portfolio that includes all traded (both bonds and stocks) and untraded (such as private companies) assets. However, this theoretical portfolio is unobservable and consequently, a diversified proxy such as the S&P 500 or MSCI World Index, should be used. Importantly, avoid using a local market index as many local markets are small and/or heavily weighted to a specific industry, eliminating the diversification required.

Market Value of Equity

The market value of equity and its percentage contribution to the capital structure is one of the more straightforward inputs required as a publicly listed company's market value of equity is equivalent to its market capitalisation.

3.4.3.2. Cost of Debt and Market Value of Debt

Cost of Debt

Investors in the bond market assess default risk when evaluating and pricing bonds and are compensated for assuming this default risk by charging a default spread over the risk-free rate to entice them to invest. The default spread is company-specific and widens as the credit or default risk increases. The default spread can be calculated in several ways, namely (Damodaran, 2016):

- Using the yield to maturity on a bond previously issued by a company;
- Using a credit rating issued for the company by rating agencies, such as S&P and Moody's, and applying the credit rating specific spread to the long-term risk-free rate; or,
- If the company is not rated, a synthetic rating is required, derived using certain income, balance sheet and cash flow statement metrics.

Calculation of the cost of debt requires adjustment of the long-term risk-free rate through the addition of the company-specific default spread. The current default risk of the company, reflected by credit ratings or the spread applied to recently issued debt, is to be used in determining the default spread. Avoid using a historic default risk associated with previous debt issuances that the company may have on their balance sheet. This requirement implies that using a balance sheet interest rate, obtained by dividing the interest expense a company paid by the book value of its debt, may result in an over- or underestimation of the cost of debt, depending on the company's current credit quality (Damodaran, 2009).

Market Value of Debt

Relative to the market value of equity, calculating the market value of debt is more difficult, as banks may supply a large proportion of a company's debt through loans, which are not tradeable debt instruments. Therefore, the loans do not reflect a current market price. In this scenario, it is assumed that either the market value of debt is equal to its book value or the market value is calculated by discounting future cash flows at the appropriate yield to maturity (McKinsey & Company, 2000). The former assumption suffices in cases where the bank debt is recent, or the cost of debt for the company, as reflected by a credit rating, for example, has remained relatively constant since the debt issuance.

The simplified WACC formula does not require the explicit calculation of the market value of debt and equity as the equation only reflects the proportions of debt and equity within the capital structure. The cost of capital should rely on the target weights since the current capital structure, if different from the target, may merely reflect a temporary short-term swing that is yet to be rebalanced by management. A combination of the following three approaches can be used (McKinsey & Company, 2000):

- Determine the current market-value-based capital structure;

- Review and compare the capital structure of peer companies; and,
- Review management's implicit or explicit approach to financing and its implications for the capital structure.

3.4.4. Future Commodity Prices

As discussed in Section 3.2, the determination of future commodity prices can vary significantly in complexity, with a few methods outlined below (Damodaran, 2009):

Averages over time: The use of long-term real price averages can be employed, with a time-frame of either 3, 5 or 10 years, typically considered to ensure coverage of an entire commodity cycle. However, Lithium is not exchange-traded like many other commodities, with prices often negotiated on a per-contract basis, making it difficult to obtain average historical prices. Furthermore, a paradigm shift in demand and supply dynamics has arguably occurred over the past 18 months due to the EV boom, resulting in historical prices being unrepresentative.

Sector averages: The use of sector averages bypasses the problem of commodities or companies that do not have a long operating track record as it instead uses current, or at least very recent, market prices derived from industry peers. However, prices derived using this approach is still susceptible to influences from the current phase of the commodity cycle.

Forward curves: Using a normalised commodity price to value a mining company does expose the valuation to subjectivity. For example, the method of normalisation and the final normalised price selected is still dependent on the valuer's opinion of the current phase of the commodity cycle. Using consensus market-based prices, derived from forward or futures markets, removes the valuer's subjectivity. However, as previously mentioned, lithium is not exchange-traded, voiding the use of this methodology.

Management and analyst estimates: Although subjective, the use of consensus estimates provided by market analysts, as well as management's opinion of future prices, is a valuable tool in determining and analysing the future outlook for a specific commodity.

More complex methods: Considerable evidence has been produced to demonstrate that in a highly competitive and organised market, price changes will be close to random and can consequently be modelled using a random walk technique such as the geometric Brownian model (Lane, et al., 2012). However, unlike a commodity such as gold, the lithium market is still in its infancy with prices determined via short to medium term offtake contracts. Furthermore, the lack of a regulated metals exchange and the consequent lack of empirical evidence prevents the use of such a technique to model the lithium commodity price.

3.4.5. Time Horizon, Production Profile, and Capital and Operating Expenses

The project's life of mine schedule is used to determine the appropriate time horizon of the DCF model. Where the project life is significantly long, it is not uncommon to shorten the time horizon and consequently the valuation horizon. Although arbitrary, 20 years is a commonly accepted valuation horizon as the impact of cash flows past this point has a rapidly diminishing impact on the calculated NPV due to the significant discount factor applied to cash flows so far into the future (Kyle, 1983). The remaining asset-specific input parameters, such as production profiles, capital and operating expenses are to be determined from current operating data as well as completed definitive feasibility studies for any undeveloped projects.

4. GALAXY RESOURCES LTD

Galaxy Resources Ltd (Galaxy or GXY) is an Australian Securities Exchange listed lithium-focused miner. Galaxy is the 100% owner of three projects, namely: their primary operating project, Mt Cattlin, situated in Western Australia; Sal de Vida, a brine project currently in the DFS stage, located in the salt flats of Argentina; and, James Bay, a sizeable hard-rock resource situated in Quebec, Canada, which is in the PFS stage.

Galaxy is a prime case study candidate to assess the lithium price and project completion certainty that the market is currently building into valuations as it has a hard-rock asset currently in production (Mt Cattlin), a brine project seeking financing such that development can commence (Sal de Vida), and a longer-dated hard-rock project (James Bay). A brief outline of the three projects is provided in the following section, with detailed input parameters provided in Section 5.

4.1. Market Valuation

GXY's share price and market capitalisation have experienced a significant increase since the start of 2016, driven by the recommencement of operations at Mt Cattlin, in conjunction with rising demand and a consequently strong spodumene concentrate price. The 660% market capitalisation increase in 2016 from A\$152m to A\$952m allowed Galaxy admittance to the S&P/ASX 200 All Ordinaries Index, joining established mining companies such as BHP Billiton Ltd, Iluka Resources and Fortescue Metals Group (ASX 200 List, 2018). This strong performance also made it the second-best performing stock on the index in 2016.

The strong performance continued in 2017, as depicted in Figure 26 (Bloomberg Data), and is one of the primary reasons for its selection as the valuation case study company. The significant increase in market capitalisation appears to indicate the assumption of strong future lithium prices and high development certainty for the Sal de Vida and James Bay projects. As mentioned in Section 1.2, the sharp decline in GXY's market capitalisation in 2018 year-to-date is due to several research institutions theorising an impending oversupply of lithium because of the ramp-up of several projects currently under development.



Figure 26: Galaxy Resources Ltd Market Capitalisation (A\$ Million) (Bloomberg Data)

4.2. Galaxy Resources' Mines and Projects

4.2.1. Mt Cattlin Mine

GXY wholly owns the Mt Cattlin spodumene project, located two kilometres north of the town of Ravensthorpe in Western Australia, as depicted in Figure 27 (Galaxy Resources Ltd, 2017).



Figure 27: Mt Cattlin Lithium Mine Location

The project was restarted in the last quarter of the 2016 financial year after it was placed on care and maintenance in 2012 due to sustained low commodity prices. Mt Cattlin operations transitioned into

commercial production with ramp-up and commissioning of the plant completed at the end of April 2017.

The Mt Cattlin mine operations include open-pit mining of a flat-lying pegmatite orebody. Upon uncovering the ore, the flat-lying nature of the orebody allows mining to proceed at a reasonably constant strip ratio. Mining is carried out using excavator and truck operations, delivering to a conventional crushing and DMS gravity recovery circuit.

The crushing plant consists of a 3-stage crushing circuit, producing a -6mm product from ROM ore at a treatment rate of 1.6 million tonnes per annum. The crushing plant provides feed to a fine ore bin, which feeds the concentrator on a continuous 24 hour per day basis.

The concentrator consists of a reflux classifier and two stages of DMS cyclones, with mechanical attrition of the intermediate sink product. Stacking of the final spodumene concentrate occurs on a pad adjacent to the plant area where it is drained and prepared for trucking to the nearby Esperance port.

4.2.1.1. Resources and Reserves

Table 13 (Galaxy Resources Ltd, 2017) presents Mt Cattlin's resources and reserves. Using Mt Cattlin's design production capacity of 1.5 Mtpa, and considering only reserves, results in a calculated Life of Mine of 5.1 years. However, significant upside is available based on the 11.62 Mt of resources currently identified and the ongoing geological drilling conducted at Mt Cattlin.

Table 16: Mt Cattlin Resources and Reserves (Galaxy Resources Ltd, 2017)

Category	Mt	Li ₂ O%
Reserves	7.64	1.05
Proven	1.95	1.03
Probable	5.69	1.06
Resources	11.62	1.20
Measured	1.88	1.19
Indicated	7.39	1.19
Inferred	2.35	1.25

4.2.1.2. Production Statistics

Table 17 (Galaxy Resources Ltd, 2017) provides a summary of Mt Cattlin's production and sales statistics for FY2017 and Q2 FY2018. These production statistics form the basis of the valuation conducted for Mt Cattlin and the key production highlights and trends are thus briefly discussed.

FY2017:

- Milled tonnes: Steady-state production was achieved in Q4 with crushed tonnes of 414,192 wmt for the quarter, or 1,656,768 wmt on an annualised basis, which is at the top-end of the crushing plant's capacity of 1,600,000 wmt;

- Plant recoveries: The concentrator plant achieved a recovery of 56%, which is marginally above the design target range of 50 – 55%. However, a technical and financial evaluation completed during FY2017 investigated the construction of an ultra-fines DMS circuit, a secondary float re-crush circuit and a final product optical sorter that will target further increases in recovery rates to between 70 – 75%. Construction and commissioning, scheduled for completion in Q3 2018, will result in an increase in annual concentrate production volumes to between 220,000 and 240,000 dmtpa; and,
- Product specification: The full 153,518 dmt of lithium concentrate shipped during the year was at the required product grade and specification, with no penalties consequently incurred.

1Q FY2018 and 2Q FY2018:

- Mining volumes and production costs: Total mining volumes increased by approximately 30% in FY2018 compared to 4Q FY2017, driven by a lower mined grade (1.01% in 1Q FY2018 and 1.11% in 2Q FY2018). This has resulted in production costs increasing to US\$415/dmt (4Q FY2017: US\$346/dmt).

Table 17: Mt Cattlin Production Statistics (Galaxy Resources Ltd, 2017 and 2018)

Metric	Units	Q1 FY2017	Q2 FY2017	Q3 FY2017	Q4 FY2017	FY2017	Q1 FY2018	Q2 FY2018
Total								
Total Material Mined	bcm	231,222	571,638	612,676	637,277	2,052,813	843,308	846,830
Waste Mined	bcm	143,300	460,850	472,732	499,288	1,576,170	-	-
Ore Mined	bcm	87,922	110,788	139,944	137,989	476,643	-	-
Strip Ratio	-	1.63	4.16	3.38	3.62	3.31	-	-
Ore								
Ore Mined	wmt	233,193	303,394	390,092	395,036	1,321,715	528,977	419,314
Ore Grade	% Li ₂ O	0.96	1.12	1.2	1.19	1.14	1.01	1.11
Ore Treated	wmt	253,156	334,036	369,981	414,192	1,371,365	430,398	435,296
Ore Plant Feed Grade	% Li ₂ O	1.02	1.15	1.30	1.27	1.20	1.11	1.17
Concentrate								
Concentrate Produced	dmt	23,467	32,998	47,075	52,139	155,679	43,852	47,901
Recovery	%	53	52	57	58	56	52	56
Concentrate Sold	dmt	23,455	30,135	41,834	58,094	153,518	44,258	45,761
Concentrate Grade	% Li ₂ O	5.38	5.77	5.74	5.75	5.69	5.70	5.83
Moisture Content	%	1.8	2.12	1.69	1.73	1.81	-	-
Mica Content	%	1.88	1.96	1.1	2.11	1.77	-	-
Costs and Sales								
Cash Costs	A\$/dmt	502	524	405	423	451	-	-
Cash Costs	US\$/dmt	380	393	320	325	346	415	-
Realised Selling Price	A\$/dmt	719	961	1,062	1,125	1,014	-	-
Realised Selling Price	US\$/dmt	542	722	843	868	783	-	-

4.2.1.3. Offtake Agreement

In February 2016, Galaxy announced that it had signed its initial 45,000 tonnes of lithium concentrate offtake agreement with two Chinese customers. The pricing of this offtake was US\$600/t (Free-On-Board (FOB), at 5.5% Li₂O content, with specifications of less than 5% mica content and 8% moisture) for delivery in 2016.

By December 2016, Galaxy announced that it had signed binding commitments with the two existing Chinese offtake customers for the sale of 120,000 tonnes of lithium concentrate from the Mt Cattlin

Project, for delivery in the calendar year 2017. Galaxy was able to achieve offtake prices of US\$830 per tonne (FOB, at 5.5% Li₂O content), with customers also agreeing to pay an additional US\$15/t for every 0.1% of Li₂O improvement in the product grade delivered, resulting in an agreed price of up to US\$905/t for a 6% grade lithium concentrate.

In November 2017, Galaxy entered into new binding long-term offtake contracts with multiple customers throughout Asia for 100% of the planned production of lithium concentrate from Mt Cattlin for five years commencing 2018. Pricing is on either a Cost Plus Insurance and Freight (CIF) or Cost Plus Freight (CFR) basis and will be subject to an annual pricing review between Galaxy and its customers in Q4 of each calendar year. The parties have agreed the pricing for FY2018 with the headline pricing achieved unknown, except that it is higher than FY2017 pricing.

4.2.2. Sal de Vida Project

The Sal de Vida salar project is located in north-west Argentina in what is known as the 'Lithium Triangle', home to more than 60% of the world's annual production of lithium from brines. The Salar lies approximately 1,400 kilometres north-west of Buenos Aires at an altitude of 4,025 metres, as depicted in Figure 28 (Galaxy Resources Ltd, 2017). The property is accessible from the city of Salta via an all-season road, and there is a major powerline 115 kilometres away. The development of Sal de Vida, when fully completed, will include evaporation ponds, a battery-grade lithium carbonate plant and a potash plant.



Figure 28: Sal de Vida Lithium Project Location (Galaxy Resources Ltd, 2017)

4.2.2.1. Project Details

In 2016, Galaxy engaged Techint, one of the largest engineering and construction firms in Argentina, to assist in the formal review on the economics for the DFS of the Sal de Vida project. The critical project metrics, based on the DFS, which are required to conduct the valuation presented in Section 6, is outlined in Table 18 (Galaxy Resources Ltd, 2017), with the resources and reserves statement presented in Table 19 (Galaxy Resources Ltd, 2017). Sal de Vida is a long-life, medium production output project when compared to other lithium pipeline projects presented in Table 9 in Section 2.3.4.

Table 18: Sal de Vida Definitive Feasibility Study Details (Galaxy Resources Ltd, 2017)

Sal de Vida: Key Project Details	Metrics
Reserves (kt)	LCE: 1,139 KCl/Potash Equivalent: 4,197
Production Guidance (ktpa)	Lithium Carbonate: 25 ktpa KCl/Potash: 94 ktpa
Operating Life (years)	40 (as per Table 19 and using the above production rates)
CAPEX (US\$m)	US\$474m (including US\$31m for the optional potash plant and US\$43m contingency allowance)
OPEX (US\$/t LCE)	Before Potash Credits: US\$3,410/t After Potash Credits: US\$3,144/t
Ramp-Up/Construction Period	Construction: 3 years to commissioning (2019 – 2021) Ramp-Up: 3 years to full production (2021 – 2023)
Tax Regime	Current Corporate Tax Rate: 35% 2020 Corporate Tax Rate: 25% Rebate on Gross Export Revenue: 2.5% Additional Rebate for Lithium Exports: 3.0%

Table 19: Sal de Vida Resource and Reserve Statement (Galaxy Resources Ltd, 2017)

Category	Lithium Carbonate Equivalent	KCl Equivalent
Reserves (kt)	1,139	4,197
Proven	181	633
Probable	958	3,564
Resources (kt)	7,232	28,833
Measured	3,005	11,902
Indicated	2,665	10,757
Inferred	1,562	6,174

4.2.3. James Bay Project

The James Bay lithium pegmatite project in Quebec, Canada contains an ore resource which stands at 40.8 Mt at 1.40% Li₂O, all classified as indicated resources. The project is located in north-west

Quebec, two kilometres south of the Eastmain River and 100 kilometres east of James Bay, as depicted in Figure 29 (Galaxy Resources Ltd, 2017).



Figure 29: James Bay Lithium Project Location (Galaxy Resources Ltd, 2017)

The James Bay deposit occurs at surface and it outcrops in some areas. It is comprised of several swarms of pegmatite dykes and resource modelling indicates that it is amenable to open-pit extraction. A 33,000-metre diamond drilling program commenced in 2017 with the aim of extending the existing resource contained in numerous outcropping spodumene-bearing pegmatites at James Bay. The drilling programme results will be utilised to complete a DFS. Table 20 (Galaxy Resources Ltd, 2017) presents the current resources identified at James Bay.

Table 20: James Bay Resource Statement (Galaxy Resources Ltd, 2017)

Category	Mt	Li ₂ O%
Resources	40.82	1.40
Measured	-	-
Indicated	40.82	1.40
Inferred	-	-

5. VALUATION METHODOLOGY

The various methods outlined in Section 3.3 were used to conduct the valuation for Galaxy Resources, with the following approach adopted:

1. Deterministic and adaptive normalisation valuation: A static, or point-in-time, valuation was conducted using the base-case scenario valuation inputs, as defined in subsequent sections, while applying the adaptive normalisation technique. Adaptive normalisation utilises input values relevant to the current phase of the commodity cycle, with, for example, normalised commodity prices and production figures utilised for longer-term inputs to reflect the long-term industry view;
2. Projects at different stages of their lifecycle and real options analysis: Mt Cattlin is an operating mine and therefore amenable to a DCF valuation technique. Similarly, Sal de Vida is at the DFS stage and nearing development, and there is sufficient information available to justify use of a DCF technique. The James Bay project is in the early stages of a PFS with minimal mining or processing information available, eliminating the use of a DCF technique unless significant assumptions are made. Consequently, the ROA technique is utilised to assign a valuation to the optionality of the resource base and the management team's decision to either progress the project or not. Investment banks frequently incorporate only a fraction of the value of a long-dated project given the long-term uncertainty regarding the lithium price and the inherent risks contained within progressing a new project into development. Consequently, the appropriateness of incorporating only a partial amount of the calculated Sal de Vida project value or the ROA value of James Bay is discussed;
3. Scenario analysis: A bull and bear case scenario for the lithium price was utilised to determine an upper and lower range for the static valuation. Furthermore, the long-term lithium price was varied such that the static valuation model output equalled the current market share price, thus determining the long-term lithium commodity price the market appears to be adopting. The crucial second variable tested using scenario analysis is the discount rate, with a focus on the relative impact of adopting a constant ERP or varying ERP approach, as discussed in Section 3.4.3.1; and,
4. Monte Carlo simulation: MCS applies probability distributions to critical input variables. The appropriate distributions were determined using actual historical production data (where available, such as with Mt Cattlin), management forecasts, and market consensus forecasts.

5.1. Key Valuation Input Variables

Table 21 provides a summary of the critical valuation inputs utilised for each valuation methodology employed, excluding real options analysis, which is discussed in Sections 5.1.7 and 6.1. The table indicates that the deterministic DCF valuation utilises all the key variables as they generate the revenues and operating expenses required to determine the NPV. The scenario analysis tests two of

the key determinants of value, namely, the assumed future commodity prices and the discount rate. Lastly, the MCS utilises probabilistic inputs for all variables except the macroeconomic assumptions and the project CAPEX, as discussed further in the subsequent sections.

Table 21: Key Valuation Inputs and the Methodology in Which They Are Utilised

Key Input	Valuation Methodology		
	Deterministic	Scenario Analysis	Monte Carlo Simulation
Macroeconomic Assumptions	✓ - Section 5.1.1	✗	✗
Production Profile and Time Horizon	✓ - Section 5.1.2.1	✗	✓ - Section 5.1.2.2
Operating Expenditures	✓ - Section 5.1.3.1	✗	✓ - Section 5.1.3.2
Capital Expenditures	✓ - Section 5.1.4.1	✗	✗
Future Commodity Prices	✓ - Section 5.1.5.1	✓ - Section 6.2.1	✓ - Section 5.1.5.2
Discount Rate / Cost of Capital	✓ - Section 5.1.6	✓ - Section 6.2.2	✓ - Section 5.1.6.5
Outputs Discussed in Section:	Section 6.1	Section 6.2	Section 6.3

5.1.1. Macroeconomic Assumptions

Conducting a valuation in real terms eliminates the need to generate assumptions regarding future inflation rates and allows for easier comparison of model inputs and outputs across different countries with different inflation rates. As such, the GXY valuation is conducted in real terms with the exchange rate being the only macroeconomic input required. Table 22 (Consensus Investment Bank Forecasts) presents the market consensus view of the US\$/A\$ exchange rate.

Table 22: Market Consensus US\$/A\$ Exchange Rate Forecast (Consensus Investment Bank Forecasts)

Input	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	Long-Term
Average Exchange Rate (US\$/A\$)	0.77	0.76	0.76	0.75	0.75	0.75	0.75	0.75	0.76
Credit Suisse	0.75	0.75	0.75	0.75	0.75	-	-	-	0.75
Macquarie	0.77	0.74	0.74	0.75	0.75	-	-	-	0.75
UBS	0.77	0.77	0.76	-	-	-	-	-	0.76
Baillieu Holst	0.76	0.75	0.75	-	-	-	-	-	0.75
Citi	0.78	0.81	0.81	-	-	-	-	-	0.81

The average exchange rate forecast, based on the above consensus investment bank forecast, is presented in Table 23 and depicts the base case forecast used in the valuation. The US\$/A\$ exchange rate was not selected as a variable to be used in the MCS as its historical volatility is relatively low, and the available forecasts suggest low future volatility as well.

Table 23: Base Case Valuation US\$/A\$ Exchange Rate Forecast

Input	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	Long-Term
Base Case Exchange Rate (US\$/A\$)	0.77	0.76	0.76	0.75	0.75	0.75	0.75	0.75	0.76

5.1.2. Production Profile and Time Horizon

5.1.2.1. Deterministic Valuation Inputs

The valuation is limited to 20 years, a typical time horizon used in valuations for large reserve and long-life mining projects, as discussed in Section 3.4.5 and 4.2. The production profile for GXY's currently operating Mt Cattlin mine, as well as the proposed Sal de Vida project, are presented in Figure 30. The production figures for Mt Cattlin are based on historical production statistics and management forecasts, as provided in the Annual Report (Galaxy Resources Ltd, 2017). The primary driver behind the increased spodumene production between 2018 and 2019 is the completion of the proposed processing plant upgrade, thus increasing lithium recoveries to between 70% and 75% from the current 55% to 60%. The definitive feasibility study (Galaxy Resources Ltd, 2018) outputs released to the market dictates the selected production output for LCE and KCl, or potash, at Sal de Vida. Although Galaxy does not explicitly define a construction and production ramp-up schedule for Sal de Vida, board approval and financing is currently outstanding with a decision expected by year-end 2018. Consequently, a three-year construction period (FY19 to FY21) is assumed, with production ramp-up occurring towards the end of FY22 and completed in FY23.

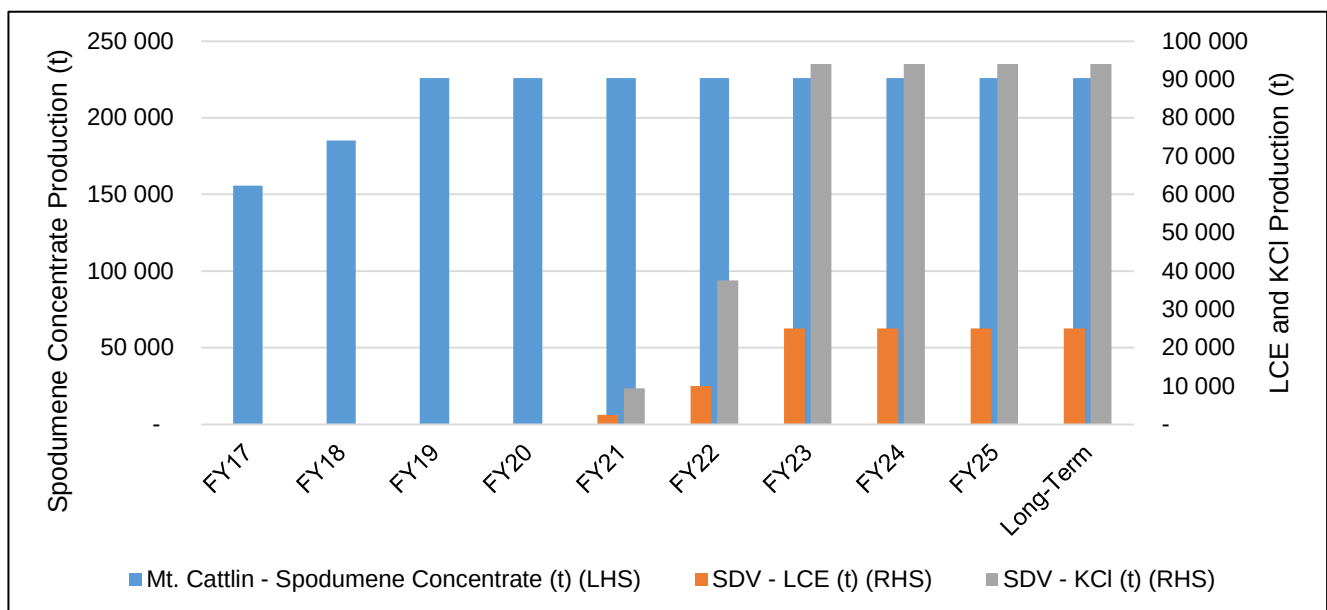


Figure 30: Mt Cattlin and Sal de Vida Base Case Production Profile

5.1.2.2. Monte Carlo Simulation Inputs

As outlined in Table 21, the production profile, operating expenses, future commodity prices and the discount rate were selected as the key variables applicable for use in the MCS. The selected variables are modelled by applying a triangular probability distribution. This distribution is selected as there is insufficient data available to conduct a statistical analysis of the key variables, which prohibits the selection and use of a more statistically appropriate probability distribution. Although the use of a

triangular distribution requires the application of subjective assumptions, it is considered the most prudent choice considering the above.

Production variability at Mt Cattlin is modelled by applying a probability distribution to both the run-of-mine ore produced and the plant recovery rate. The plant has a production capacity of 1.6 Mtpa, which is equivalent to 400 kt per quarter. However, the plant has a contingent capacity as indicated by the actual quarterly production rate in 1Q FY2018 of 430 kt and 435 kt in 2Q FY2018, equating to approximately 10% above the design capacity. These limits bound the triangular distribution assigned, as depicted in Figure 31, with a $\pm 10\%$ production range assigned. A negative correlation is assigned between the cost of production at Mt Cattlin and the production rate for the MCS, as an increase in production typically results in an improved unit cost of production.

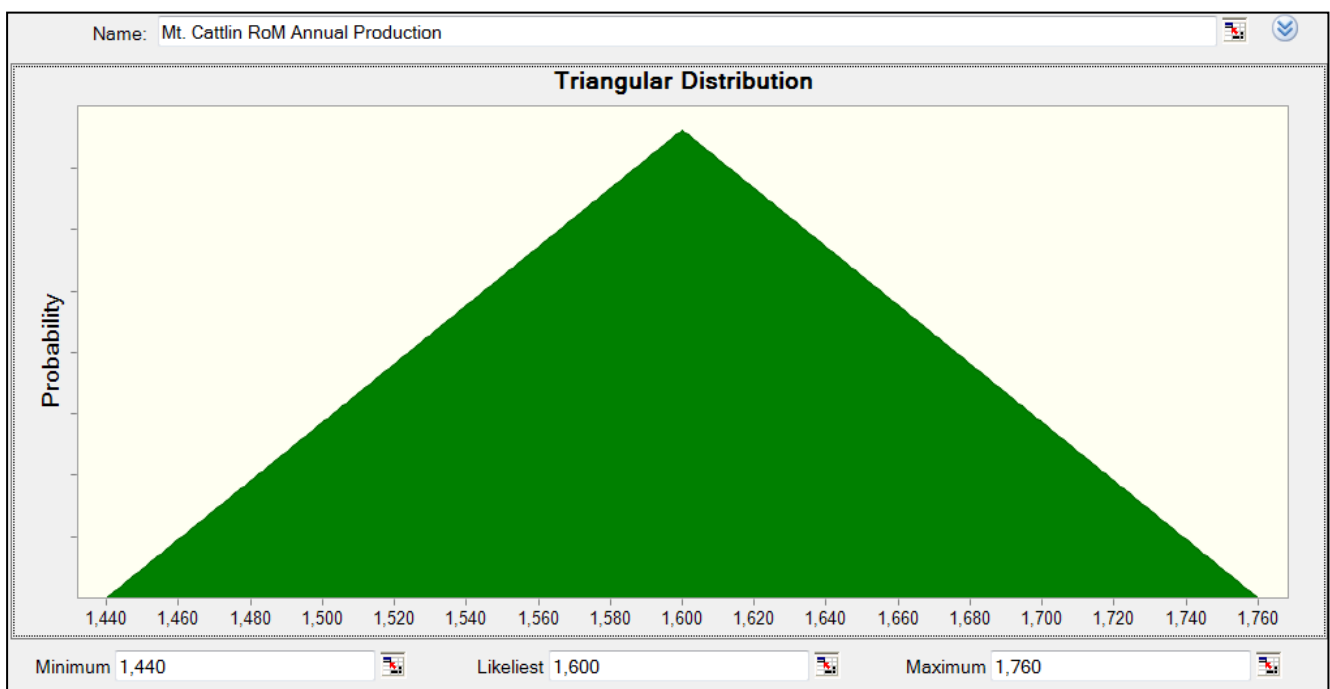


Figure 31: Mt Cattlin Run-Of-Mine Production Triangular Probability Distribution

The Mt Cattlin process plant upgrade, with a design recovery rate of 75%, is yet to be tested. However, Mt Cattlin's historical production statistics (see Table 17, Section 4.2.1.2) indicates a strong track record of achieving recovery rates within the design parameters. Consequently, the normalised recovery rate post the plant upgrade is assumed to only be marginally worse than the design value at 72.5%, with variability constrained in the triangular distribution between the design limit of 75% and a lower worst-case scenario of 65%, as depicted in Figure 32. The worst-case scenario may be punitive given Mt Cattlin's strong historical production track record, however, it is considered prudent as the plant upgrade is untested.

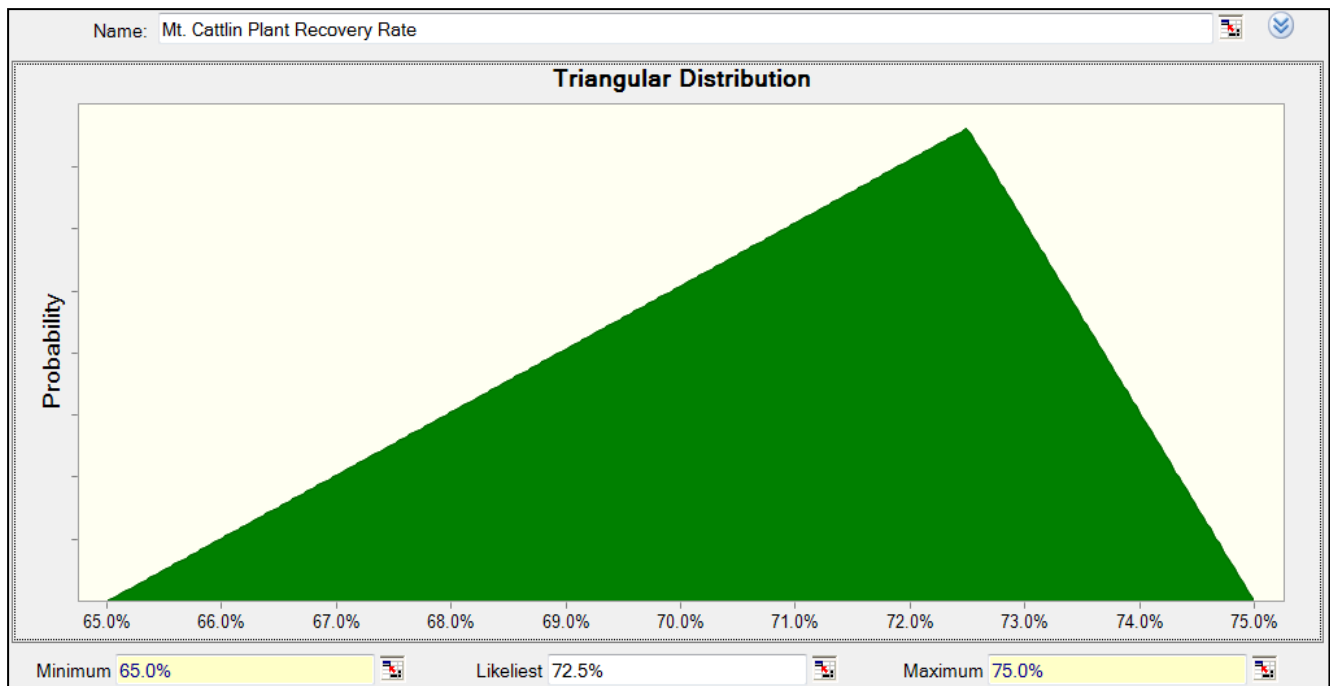


Figure 32: Mt Cattlin Plant Recovery Rate Triangular Probability Distribution

An asymmetric triangular distribution is utilised to model the production variability of Sal de Vida, as depicted in Figure 33 and Figure 34. An assumed extended lower tail of 80% of design production for both LCE and potash production caters for the historical difficulty brine operations have experienced during production ramp-up. The upper limit is assumed at 10% above design capacity to account for additional contingent capacity typically incorporated in plant design. The production of potash and LCE is assigned a correlation of one within the MCS as the same brine solution produces both products via solar evaporation and consequent further processing; their independent production is therefore not possible. Similar to the Mt Cattlin MCS, a negative correlation is assumed between the unit cost of production at Sal de Vida and the production rate.

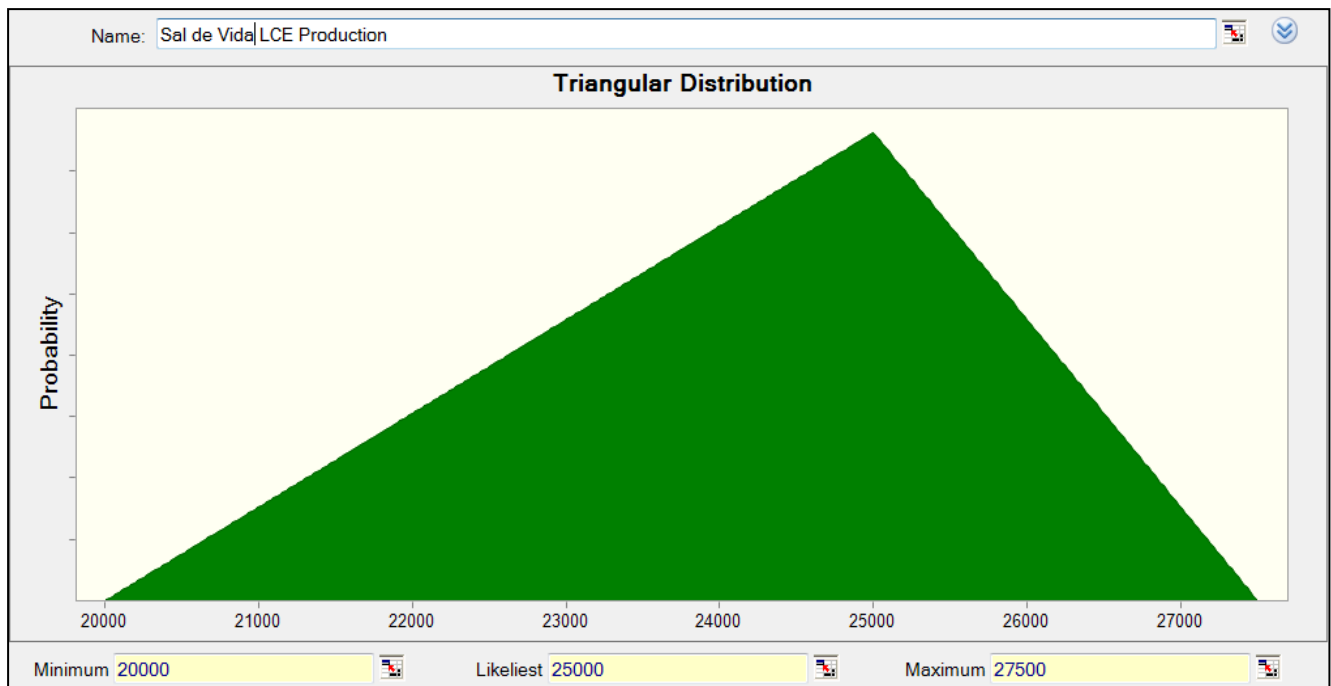


Figure 33: Sal de Vida LCE Production Triangular Probability Distribution

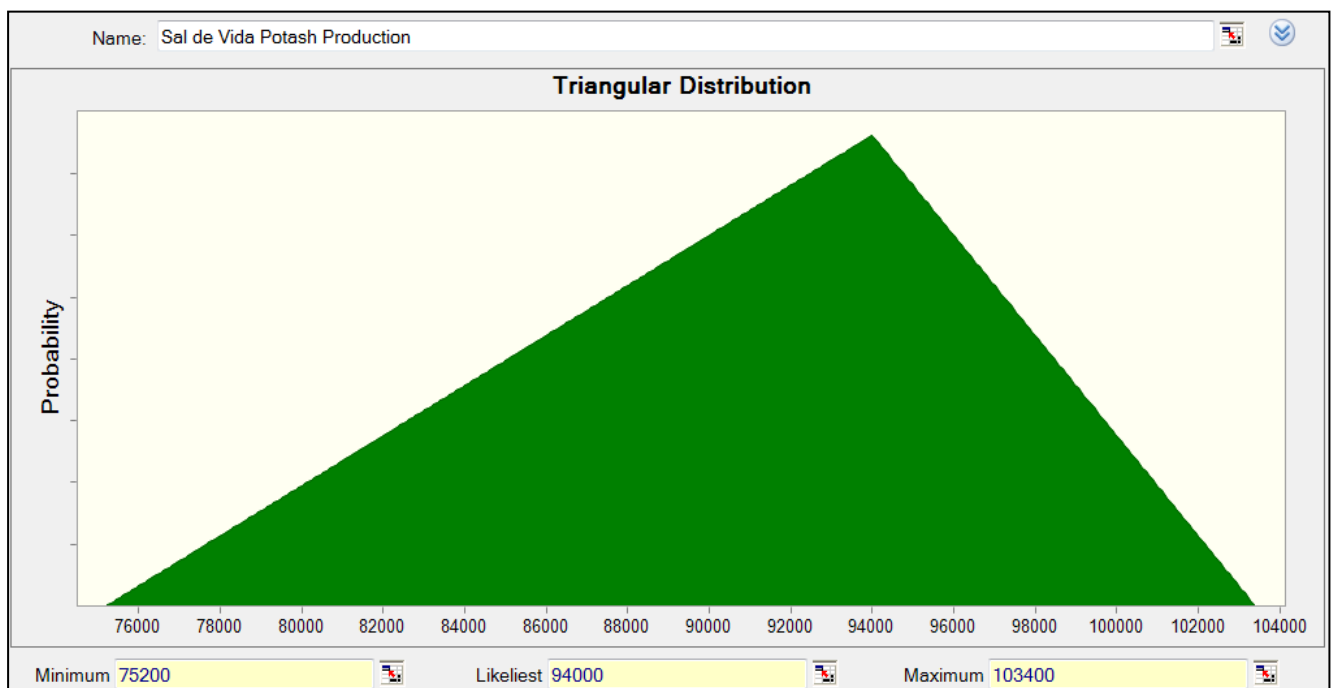


Figure 34: Sal de Vida Potash Production Triangular Probability Distribution

5.1.3. Operating Expenditures

5.1.3.1. Deterministic Valuation Inputs

The total cash operating cost, which includes royalties of 5% in Australia and 3.5% in Argentina, as well as marketing and sales costs of 3.5% of export revenue in both jurisdictions, is based on historical production statistics at Mt Cattlin and as per the definitive feasibility study for Sal de Vida

(Galaxy Resources Ltd, 2017 and Galaxy Resources Ltd, 2018). The forecasted operating costs at each operation for the base case spodumene and LCE price scenarios are depicted in Figure 35 (Galaxy Resources Ltd, 2017 and Broker Consensus). The spike in operating costs at Mt Cattlin in FY2018 is due to a lower than expected mined grade, and a consequently higher stripping ratio. However, the grade is assumed to normalise to that contained in the resources and reserve statement, hence the subsequent decrease in FY2019. The operating costs at Sal de Vida are high during the ramp-up phase (FY2021 to FY2023) but normalise to that presented in the DFS once production reaches steady-state.

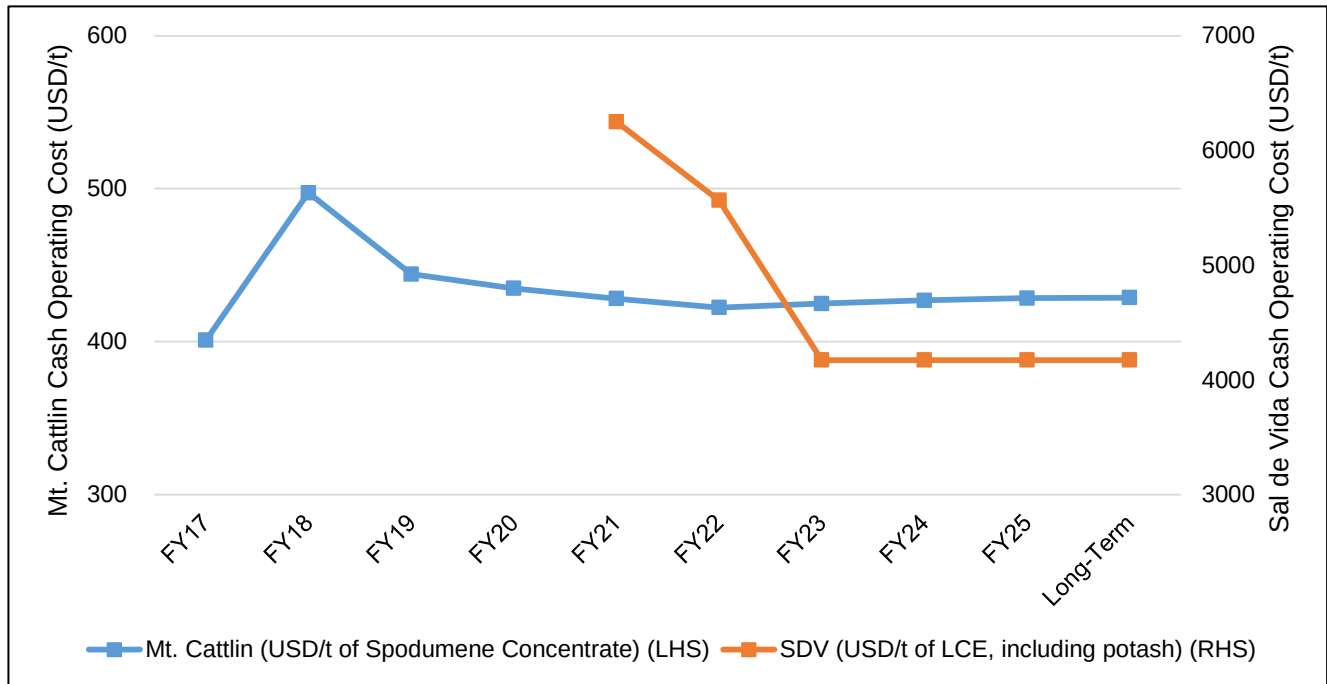


Figure 35: Total Cash Operating Cost, Including Royalties and Marketing, USD/t (Galaxy Resources Ltd, 2017 and Broker Consensus)

5.1.3.2. Monte Carlo Simulation Inputs

Limited historical production data is available for Mt Cattlin and Sal de Vida is still in the early development stage. Consequently, a simple $\pm 10\%$ symmetrical triangular distribution is applied to the operating costs at both operations, as presented in Figure 36 and Figure 37, to account for the intrinsic presence of operating cost variability. A negative correlation to production output is assigned, as previously discussed.

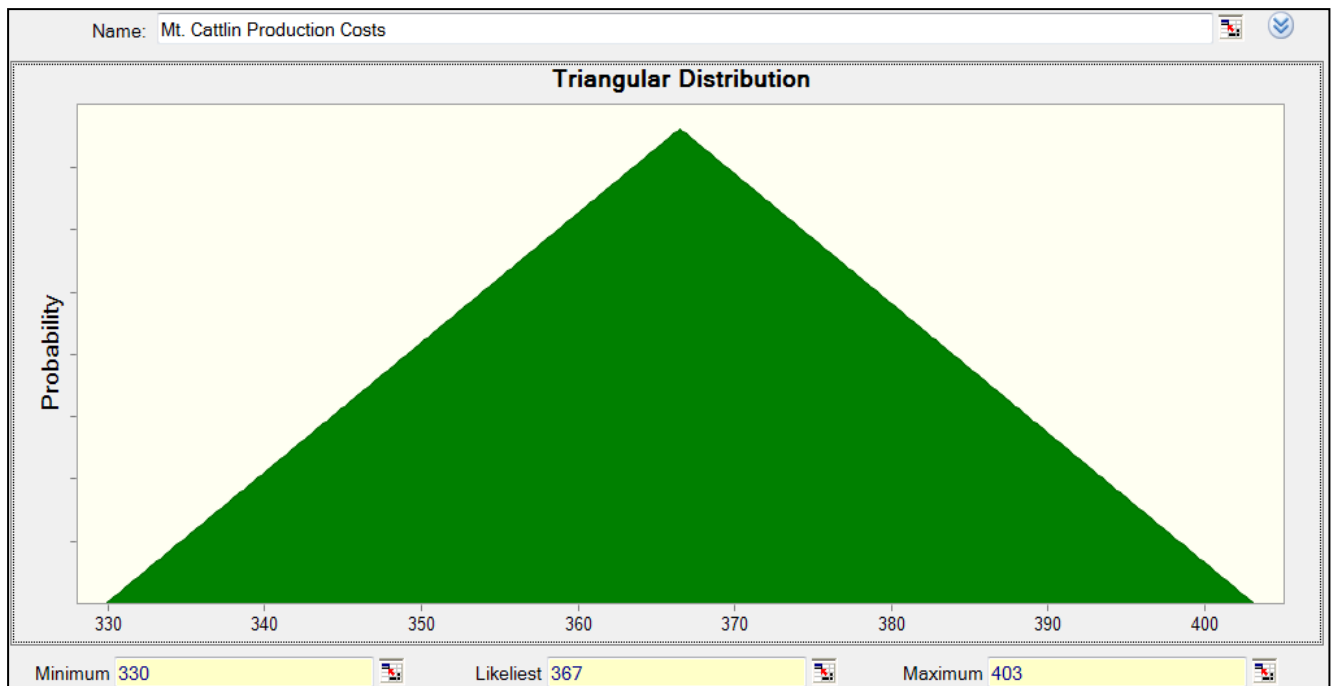


Figure 36: Mt Cattlin Production Costs Triangular Probability Distribution

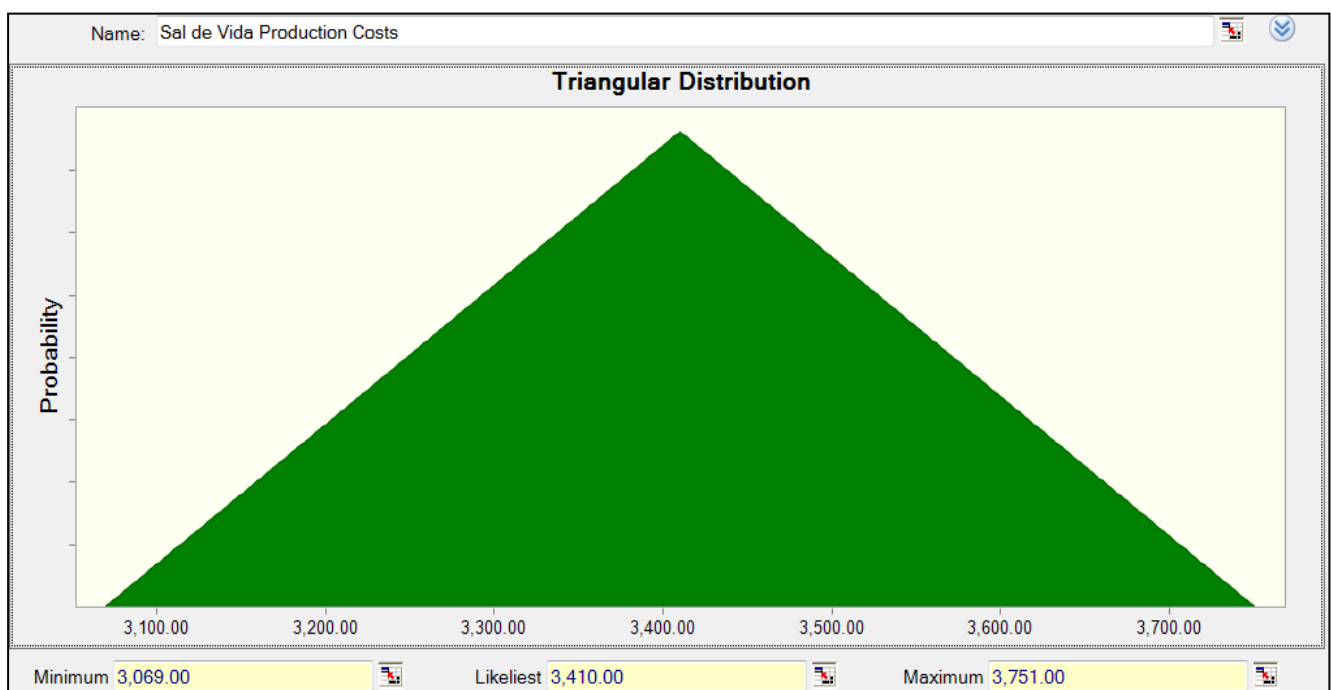


Figure 37: Sal de Vida Production Costs Triangular Probability Distribution

5.1.4. Capital Expenditures

5.1.4.1. Deterministic Valuation Inputs

Figure 38 and Figure 39 (Galaxy Resources Ltd, 2018 and Broker Consensus) depict the CAPEX profile at Mt Cattlin and Sal de Vida, respectively. The expansionary CAPEX at Mt Cattlin in FY2017 and FY2018 relates to the ramp-up of operations and the installation of the processing plant

upgrades required to achieve the forecasted recovery rates of between 70% and 75% while sustaining and exploration CAPEX is based on management's forecasts. Sal de Vida's US\$474m of CAPEX is assumed to be spent across three years, after which the project only requires sustaining CAPEX as the reserve base is currently sufficient to support production for more than 40 years, and hence there is no exploration expenditure.

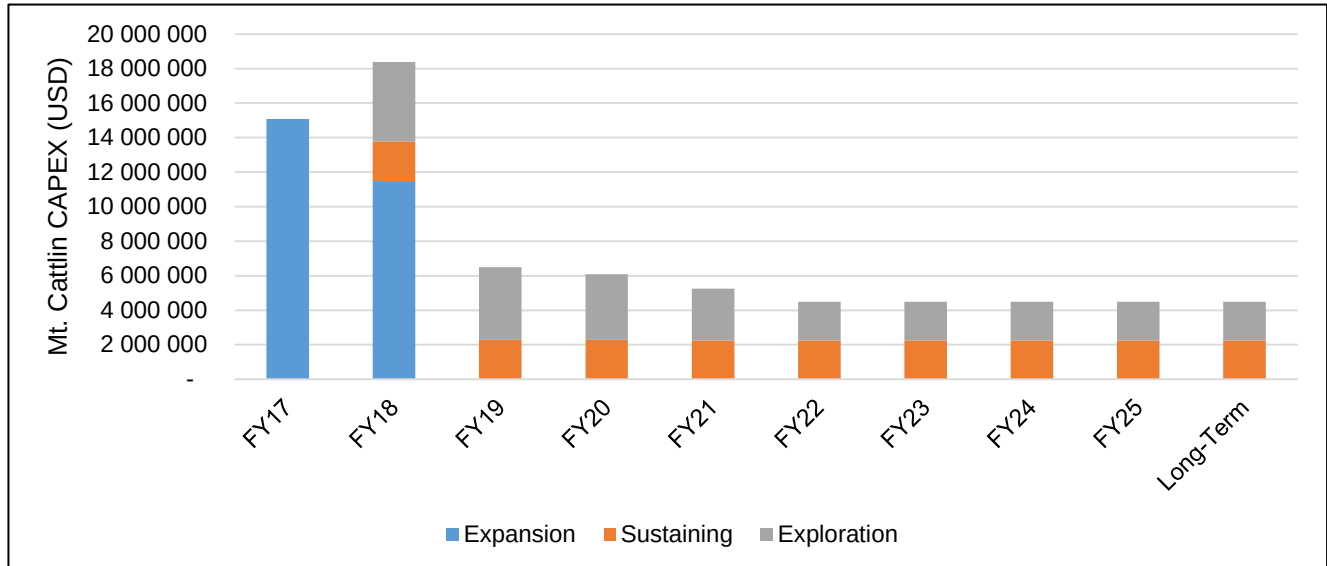


Figure 38: Mt Cattlin Ongoing CAPEX Requirement (Galaxy Resources Ltd, 2017 and Broker Consensus)

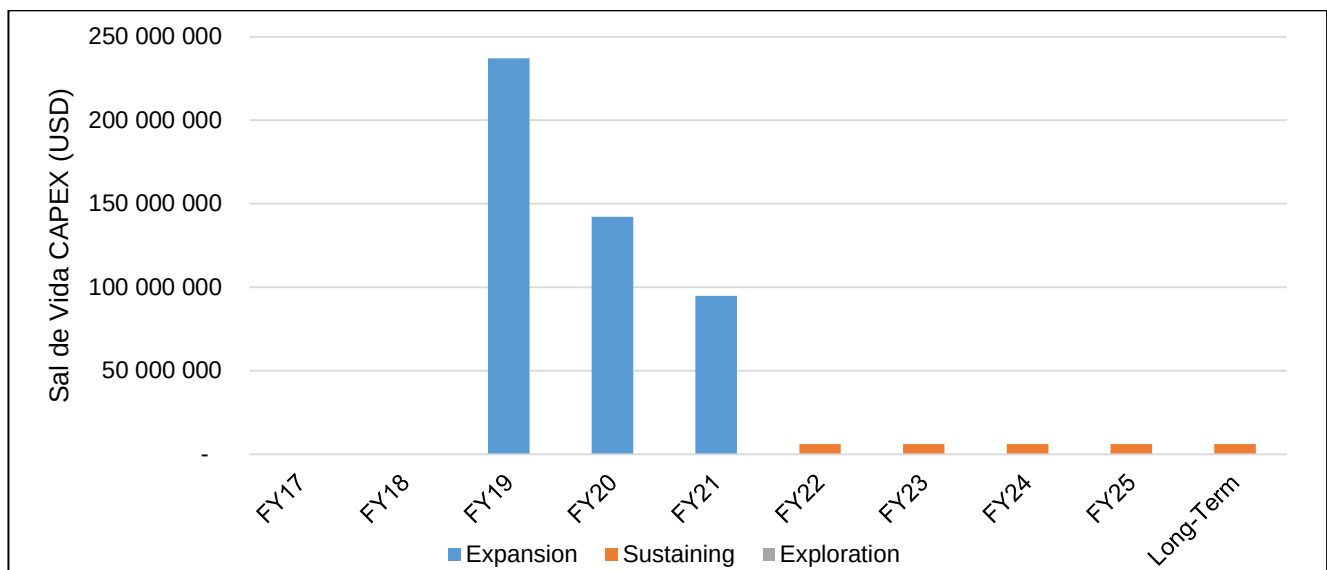


Figure 39: Sal de Vida Ongoing CAPEX Requirement (Galaxy Resources Ltd, 2018 and Broker Consensus)

5.1.5. Future Commodity Prices

5.1.5.1. Deterministic Valuation Inputs

The adaptive normalisation approach dictates the incorporation of the current spike in mined lithium product prices, namely, spodumene concentrate and lithium carbonate in the case of Galaxy. Table

25, which is based on the forecasts provided by leading investment banks and research institutions, presents the current spike in the commodity cycle and the potential future decline in prices. Prices are consequently assumed to remain robust throughout 2018 and 2019, after which the strong pipeline of projects currently under development (refer to Table 9 in Section 2.3.4) begin to equilibrate the supply and demand dynamics.

Table 24: Forecasted Spodumene Concentrate Prices

Spodumene Price	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	Long-Term
Average Spodumene Price (US\$/t)	955	858	751	675	607	637	662	679	630
Credit Suisse	-	850	750	675	575	600	650	675	700
UBS	940	939	864	793	606	660	660	660	660
Morgan Stanley	940	744	627	550	562	574	601	612	600
Canaccord	941	888	789	756	685	715	735	767	767
J.P. Morgan	-	825	675	600	-	-	-	-	500
Citi	1,000	900	800	-	-	-	-	-	550

Table 25: Forecasted LCE Price

LCE Price	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	Long-Term
Average LCE Price (US\$/t)	16,133	14,170	12,380	10,575	9,763	9,683	10,167	10,700	10,020
Credit Suisse	-	13,500	12,000	9,000	8,500	9,500	10,000	11,000	11,500
UBS	16,250	16,000	14,000	11,500	10,000	9,700	9,950	10,200	10,200
Canaccord	14,650	13,100	10,900	9,800	9,550	9,850	10,550	10,900	10,900
J.P. Morgan	-	14,250	13,000	12,000	11,000	-	-	-	10,000
Citi	17,500	14,000	12,000	-	-	-	-	-	7,500

The longer-term prices, from 2020 onwards, are assumed to decline quite sharply due to the commencement and ramp-up from several projects currently in the early stages of development. As discussed in Section 2.3.4, it is this author's opinion that the decline in lithium prices depicted is overstated. This is due to the historical difficulties project developers have experienced in ramping-up projects to their designed production specifications and the reasonably aggressive construction and commissioning timelines reported by many developers. However, the base case maintains the forecasted sharp decline in prices. The bull and bear case presents the possibility of supply potentially surprising to the downside and demand to either outstrip forecasts or surprise to the downside, as depicted in Table 26 and Table 27, respectively. The values in the below tables are derived from the consensus forecasts presented in Table 24 and Table 25.

Table 26: Spodumene Concentrate Price Bear, Bull and Bear Case Scenarios

Spodumene Price (US\$/t)	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	Long-Term
Base Case	911	858	751	675	607	637	662	679	682
Bull Case	1000	939	864	793	685	715	735	767	767
Bear Case	900	744	627	550	562	574	601	612	500

Table 27: LCE Price Bear, Bull and Bear Case Scenarios

LCE Price (US\$/t)	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	Long-Term
Base Case	16,133	14,170	12,380	10,575	9,763	9,683	10,167	10,700	10,020
Bull Case	17,500	16,000	14,000	12,000	11,000	9,850	10,550	11,000	11,500
Bear Case	14,650	13,100	10,900	9,000	8,500	9,500	9,950	10,200	7,500

5.1.5.2. Monte Carlo Simulation Inputs

Probability distributions assigned to the long-term spodumene and LCE prices are based on the above consensus forecasts. An asymmetrical triangular distribution is used to capture the potential for negative skewness represented by the relatively severe bear case scenarios for both spodumene and LCE, as forecasted by Morgan Stanley (2018). The bear case forecasts a 27% and 25% downside for spodumene and LCE from 2018 prices, respectively, while the bull case forecasts a 12.5% and 15% increase for spodumene and LCE, respectively. Figure 40 is thus constrained by the long-term spodumene bull case price of US\$767/t and the bear case price of US\$500/t, while Figure 41 is similarly constrained by the bull case LCE price of US\$11,500/t and the bear case price of US\$7,500/t. A strong positive correlation between spodumene and LCE prices is assumed for the MCS as each product effectively has the same demand and supply drivers.

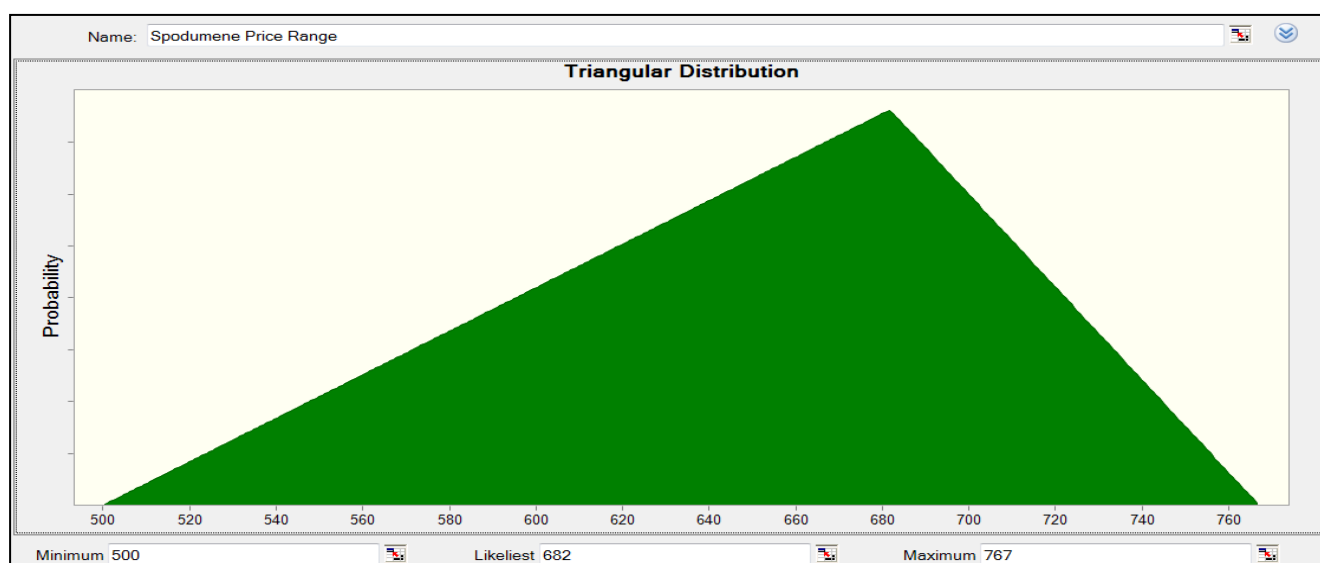


Figure 40: Spodumene Commodity Price Triangular Probability Distribution

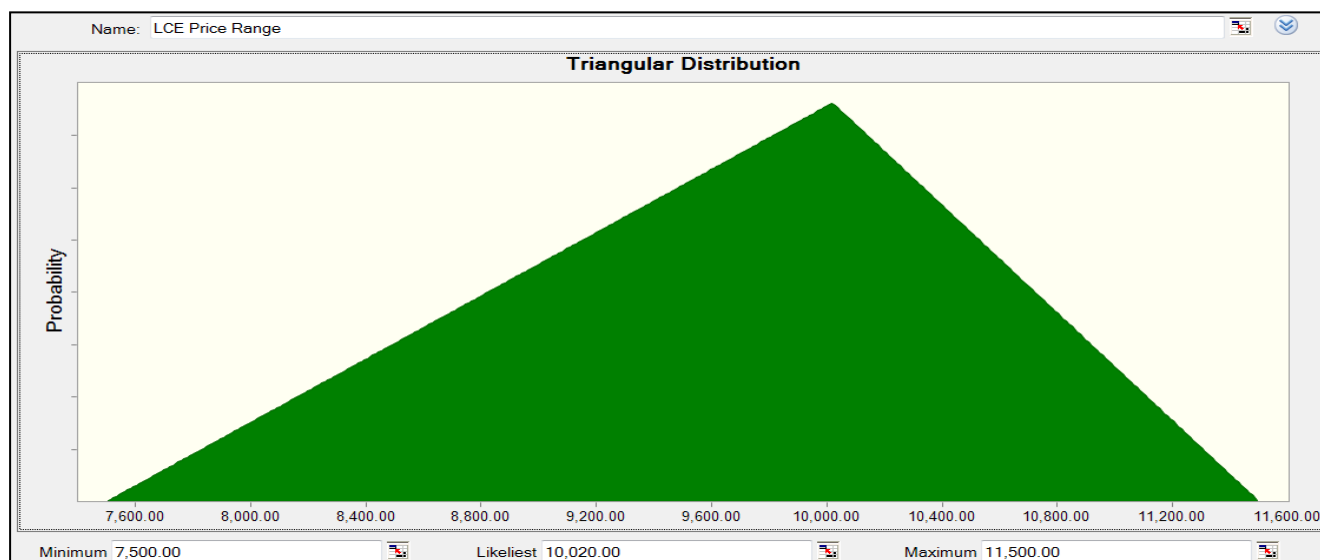


Figure 41: LCE Commodity Price Triangular Probability Distribution

5.1.6. Discount Rate / Cost of Capital

5.1.6.1. Capital Structure: Debt and Equity Contribution

GXY currently has zero interest-bearing debt on their balance sheet; however, it is unlikely that a corporate entity will maintain an unleveraged balance sheet indefinitely as gearing provides numerous benefits, some of which include (McKinsey & Company, 2000):

- Providing a readily available source of liquidity for working capital management;
- Debt can lower the WACC;
- Debt is a means of risk mitigation by sharing risk with the banks extending the funds; and,
- Entities typically do not have sufficient cash reserves available and do not generate strong enough free cash flows, to fund significant capital expenditures, such as those required during new project development.

As per the adaptive normalisation approach discussed, GXY's short-term cost of capital will be calculated assuming 100% equity funding. However, an assumed debt ratio of 20%, which falls within the range of 20% and 50% commonly found in industry (Smith, n.d.), is applied to GXY over the medium to long-term to reflect the likelihood of the company to raise funds through debt for the further development of the Sal de Vida and James Bay projects. Table 28 (Company Reports) presents the debt and equity ratios for various mining companies included in the ASX200 composite index. The data indicates that companies in the early stages of development, such as Kidman Resources and Altura Mining, primarily rely on equity funding while more established companies such as Rio Tinto and Newcrest Mining have a relatively higher capacity and appetite for debt funding. However, the generally low level of on-balance sheet debt is a testament to the de-leveraging strategy most mining companies adopted in the wake of the low commodity price environment that persisted up until early 2016.

Table 28: Capital Structure for Selected ASX200 Mining Companies (Company Reports)

Company	Commodity	Debt		Equity
		% Capital Structure Contribution	Interest Rate	% Capital Structure Contribution
Kidman Resources	Lithium	4%	N/A	96%
Altura Mining	Lithium	2%	N/A	98%
AVZ Minerals	Lithium	8%	12.0%	92%
Orocobre	Lithium	0%	19.0%	100%
Pilbara Minerals	Lithium	18%	12.0%	82%
Mineral Resources	Lithium	12%	4.1%	88%
Evolution Mining	Gold	10%	8.1%	90%
Northern Star	Gold	0%	23.9%	100%
Resolute Mining	Gold	4%	9.6%	96%
Newcrest Mining	Gold	11%	6.1%	89%
Iluka Resources	Rare Earths	6%	13.9%	94%
Lynas Corporation	Rare Earths	40%	9.6%	60%
South32	Diversified	7%	7.1%	93%
Rio Tinto	Diversified	15%	5.6%	85%

5.1.6.2. Cost of Debt

Based on Table 28, the average nominal cost of debt funding for a lithium, gold, rare earths and diversified miner, is 11.8% (9.3% real), 7.9% (5.4% real), 11.8% (9.3% real), and 6.3% (3.8% real), respectively. The real rates are determined using a long-term inflation forecast for Australia of 2.5% (Reserve Bank of Australia, 2018).

Galaxy is currently debt-free and its actual market-related interest rate is unavailable. The company's real cost of debt funding is consequently assumed based on the industry interest rates quoted above. A relatively high real interest rate of 9% is assumed until FY2021, as depicted in Figure 42, reflecting the ramp-up risk present at Mt Cattlin and the project risk associated with the construction of Sal de Vida. As the project completion and construction risk associated with Sal de Vida diminishes, so does Galaxy's risk of default, hence the assumed step down in interest rates in FY2021 to 7.0% (construction completion) and to 5% in FY2024 (steady-state production), both of which are in-line with the market-related interest rates depicted in Table 28.

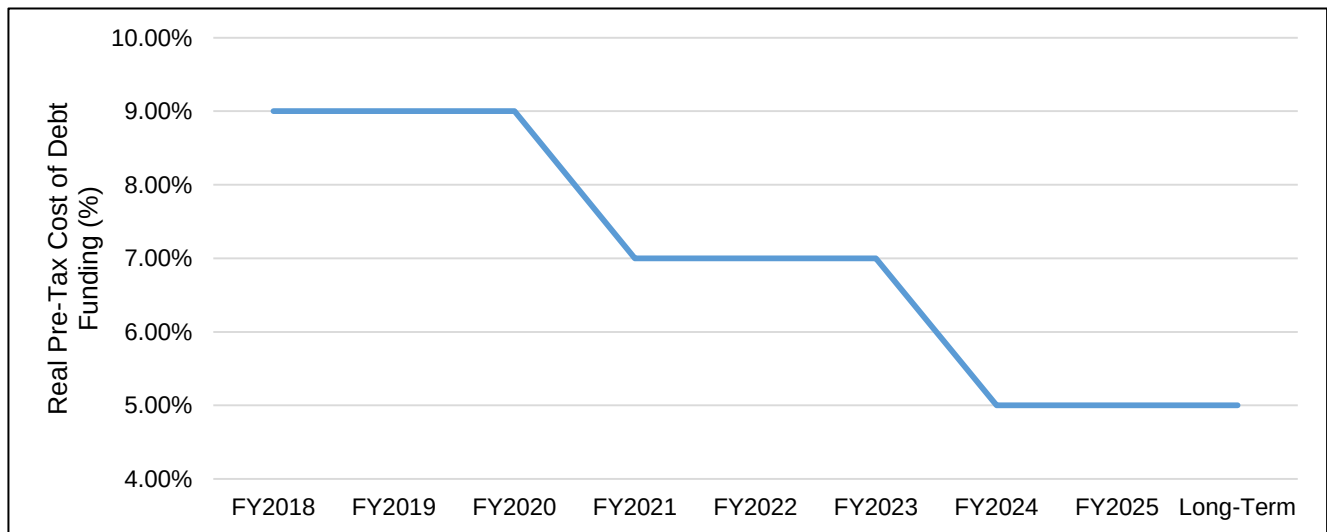


Figure 42: Galaxy's Assumed Real Cost of Debt Funding

5.1.6.3. Cost of Equity

Galaxy's cost of equity is calculated using the CAPM methodology, with the various inputs calculated as described in Section 3.4.3.1. The unlevered industry beta, used to calculate the company-specific levered beta, as well as the ERP for Australia and Argentina (the locations of Mt Cattlin and Sal de Vida), are sourced from Damodaran Online (Damodaran, 2018).

The ERP, used in the CAPM model as part of the cost of equity, was derived using several different approaches, as indicated in Table 29. The requirement to calculate both a 'constant ERP' and a 'varying ERP' is discussed in Section 3.4.3.1. The constant ERP approach calculates the cost of equity when considering only Australia's relatively low ERP in the CAPM equation. However, the base, bull and bear scenarios, each assuming a different commodity price deck, as per Table 26 and

Table 27, indicates the significant effect the varying ERP approach has on the cost of equity relative to the constant ERP approach. The varying ERP approach calculates an ERP based on the relative contribution of revenues from the different jurisdictions in which the company operates. The higher ERP, and hence the higher cost of equity under this approach, is due to the significant contribution to company revenue from the Sal de Vida project from 2021 onwards, with Argentina carrying a substantially higher ERP than Australia.

The base case valuation scenario uses a constant Australian ERP as Mt Cattlin is currently Galaxy's only operating asset. However, Table 29 provides the range of cost of equities used to determine the probability distribution applied to the overall WACC, as discussed in Sections 5.1.6.4 and 5.1.6.5.

Table 29: Different Methodologies for Calculating the ERP

Cost of Equity	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	Long-Term
Constant ERP (100% Australia ERP)	7.0%	8.1%	8.1%	8.1%	8.1%	8.2%	8.1%	8.1%	8.1%
Varying ERP's									
Base Case Lithium Prices	7.0%	8.1%	8.1%	9.5%	12.0%	14.0%	14.0%	14.0%	13.9%
Bull Case Lithium Prices	7.0%	8.1%	8.1%	9.4%	12.0%	13.8%	13.9%	13.9%	14.0%
Bear Case Lithium Prices	7.0%	8.1%	8.1%	9.6%	11.9%	14.2%	14.2%	14.2%	14.6%

5.1.6.4. Weighted Average Cost of Capital

Table 30 (Galaxy Resources Ltd, 2017; Damodaran Online, 2018) presents the various inputs, and calculated WACC for each relevant year, using the base case lithium commodity prices presented in Table 24 and Table 25, and assuming a constant ERP based on Galaxy's country of incorporation, which is Australia (hence the assumed zero percent contribution to revenue from Argentina).

Table 30: Base Case WACC for Galaxy Resources Ltd (Assuming Base Case Lithium Prices and Constant ERP)

Input	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	Long-Term
Base Case WACC (%)	7.0%	7.7%	7.7%	7.4%	7.5%	7.5%	7.2%	7.2%	7.2%
Tax Rate	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Cost of Equity	7.0%	8.1%	8.1%	8.1%	8.1%	8.2%	8.1%	8.1%	8.1%
% Equity in Capital Structure	100%	80%	80%	80%	80%	80%	80%	80%	80%
Real Risk Free Rate (10 yr TIPS)	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%
Levered Beta Calculation	1.23	1.45	1.45	1.45	1.45	1.46	1.46	1.46	1.46
Weighted ERP	5.08%	5.08%	5.08%	5.08%	5.08%	5.08%	5.08%	5.08%	5.08%
% Revenue from Australia	100%	100%	100%	100%	100%	100%	100%	100%	100%
% Revenue from Argentina	0%	0%	0%	0%	0%	0%	0%	0%	0%
Cost of Debt	6.30%	6.30%	6.30%	4.90%	4.90%	4.90%	3.50%	3.50%	3.50%
% Debt in Capital Structure	0%	20%	20%	20%	20%	20%	20%	20%	20%
Pre Tax	9.00%	9.00%	9.00%	7.00%	7.00%	7.00%	5.00%	5.00%	5.00%
Post Tax	6.30%	6.30%	6.30%	4.90%	4.90%	4.90%	3.50%	3.50%	3.50%

The three different commodity price scenarios, i.e. base, bull and bear, impact the calculation of the WACC when adopting the constant or varying ERP approach, as presented in Table 31. As discussed in Section 3.4.2, the calculated WACC is robust with relatively minimal deviation when applying either the constant or varying ERP approach across the different lithium price scenarios. However, the difference in WACC when comparing the constant and varying ERP approaches are significant.

Table 31: Base, Bear and Bull Case WACC for Galaxy Resources Ltd

WACC	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	Long-Term
Constant ERP Approach									
Base Case Lithium Price WACC (%)	7.0%	7.7%	7.7%	7.4%	7.5%	7.5%	7.2%	7.2%	7.2%
Bull Case Lithium Price WACC (%)	7.0%	7.7%	7.7%	7.4%	7.5%	7.6%	7.3%	7.3%	7.3%
Bear Case Lithium Price WACC (%)	7.0%	7.7%	7.7%	7.6%	7.5%	7.6%	7.3%	7.3%	7.3%
Varying ERP Approach									
Base Case Lithium Price WACC (%)	7.0%	7.7%	7.7%	8.6%	10.6%	12.3%	12.0%	11.9%	11.9%
Bull Case Lithium Price WACC (%)	7.0%	7.7%	7.7%	8.5%	10.6%	12.1%	11.9%	11.8%	11.9%
Bear Case Lithium Price WACC (%)	7.0%	7.7%	7.7%	8.7%	10.6%	12.4%	12.1%	12.1%	12.4%

5.1.6.5. Monte Carlo Simulation Inputs

An asymmetrical triangular distribution is used to model the long-term WACC, with the upper limit constrained by the maximum varying ERP calculated WACC of 12.4%, the base case is 7.3%, and the lower limit is constrained by the minimum constant ERP calculated WACC of 7%, as depicted in Figure 43.

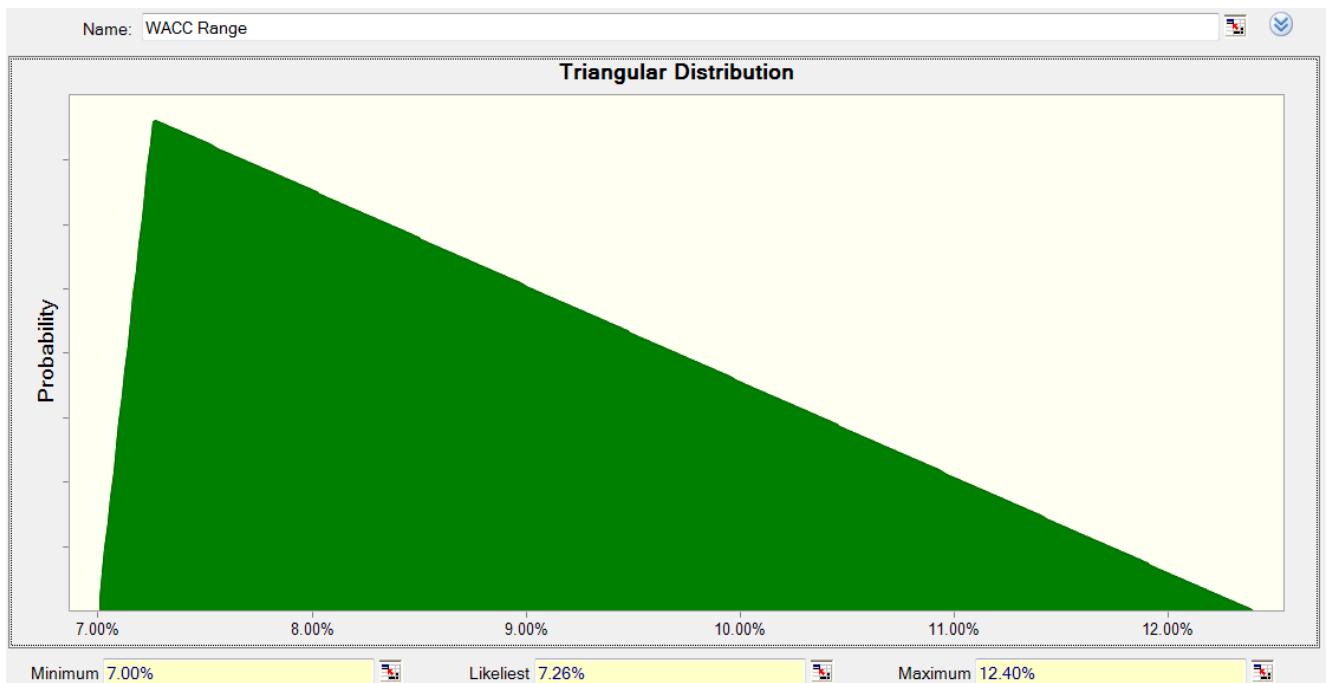


Figure 43: WACC Discount Rate Triangular Probability Distribution

5.1.7. Real Options Analysis Inputs

The ROA technique is employed to assign a value to the long-dated James Bay project, which is currently in the early stages of a PFS, with only a resource base and high-level costs assigned to the project. Although the decision by Galaxy to progress the project is potentially many years away, the availability of the resources, and the optionality to either exploit the project or not, depending on the prevailing market conditions, does contribute value. The relevant James Bay project characteristics (Galaxy Resources Ltd, 2018; Credit Suisse, 2018), as well as the inputs to the BSM equation, are presented in Table 32.

Table 32: James Bay Project Highlights and ROA Inputs

James Bay Project Assumptions	Input	Comments
Resource Size (Mt)	40	Company Information
Grade (% Li ₂ O)	1.40%	Company Information
ROM Production (Mtpa)	2	Company Information
LoM (Years)	15	Assumed Based on Valuation Timeline
LiO ₂ Recovery (%)	70%	Company Information
Spodumene Production (Kt/annum)	356	Calculated from Company Information
CAPEX (A\$m)	483	Credit Suisse
Cost of Production (A\$/t)		
Base	631	Company Information
Bull	639	Company Information
Bear	613	Company Information
Long-Term Spodumene Price (A\$/t)		
Base	890	Consensus Forecast, as per Table 26
Bull	1,001	Consensus Forecast, as per Table 26
Bear	653	Consensus Forecast, as per Table 26
James Bay - ROA Inputs	Input	Comments
Value of Underlying Asset (S) (A\$m)		Production x LoM x (Price - Costs)
Base Case Commodity Price Forecast	775	-
Bull Case Commodity Price Forecast	1,083	-
Bear Case Commodity Price Forecast	119	-
Development Lag Cost and Dividend Yield	6.7%	Annual Cash Flow/Value of Underlying Asset
Lag Time (Years)	9	Time Until Asset is Operational
Strike Price (K) (A\$m)	483	CAPEX Required
Life of Option (Years)	24	Lag Time plus LoM
Variance in Commodity Price (σ)	10.0%	Assumed
Dividend Yield (δ)	6.7%	-
Nominal Risk-Free Rate	2.5%	-

6. VALUATION OUTPUT AND DISCUSSION

6.1. Static Output and Real Options Analysis

The static DCF valuation output for the various lithium price scenarios, and incorporating the ROA value of the James Bay project, is presented in Table 33. Annexure A and B contain the detailed valuation of the Mt Cattlin and Sal de Vida projects, respectively. Key valuation assumptions include:

- Discount rate: As Table 31 in Section 5.1.6 indicates, the calculation of an appropriate WACC is fairly robust when varying valuation inputs such as the lithium price. Consequently, the outputs presented in Table 33 were determined using the 'base case lithium price WACC' under the 'constant ERP' approach for all three commodity price scenarios; and,
- Percent of value used: Only 75% of the DCF calculated Sal de Vida value is used to account for the uncertainty originating from the financing risk, licensing risk, construction, completion and commissioning risk still present. These risks will dissipate as the project progresses further. The full value of the James Bay project, as derived using the ROA methodology, is incorporated in the valuation since the ROA already accounts for optionality and uncertainty.

Table 33 indicates that Galaxy Resources provides marginal (13%) to strong (44%) upside potential, relative to the reference share price of A\$2.84 (as at July 2018), when considering the base and bull case commodity price scenario under a deterministic valuation methodology. However, the bear case commodity price scenario indicates the sizeable negative impact that an assumed long-term weakness in the commodity price has on Galaxy's valuation.

Table 33: Deterministic DCF and ROA Valuation for Galaxy Resources Ltd

Valuation Contributor	Methodology	% Used in Valuation	Base			Bull			Bear		
			100% Value (A\$m)	Adjusted Value (A\$m)	Per Share Value (A\$)	100% Value (A\$m)	Adjusted Value (A\$m)	Per Share Value (A\$)	100% Value (A\$m)	Adjusted Value (A\$m)	Per Share Value (A\$)
Mt Cattlin	DCF	100%	418	418	0.98	601	601	1.41	163	163	0.38
Sal de Vida	DCF	75%	623	467	1.09	818	614	1.43	304	228	0.53
James Bay	ROA	100%	66	66	0.16	105	105	0.24	4	4	0.01
Cash	-	100%	425	425	0.99	425	425	0.99	425	425	0.99
Valuation (A\$/share)			3.22			4.08			1.92		
Percent Premium/Discount to Current Share Price of A\$2.84			13%			44%			-32%		

6.2. Scenario Analysis

The discount rate and lithium prices are the critical variables used in the sensitivity analyses. The impact on the valuation of variable production rates, plant recovery rates, and operating costs is tested using the MCS approach, as discussed in Section 6.3.

6.2.1. Discount Rate

Two discount rate orientated sensitivity analyses were tested, with Table 34 indicating the outputs of a classical data table test, highlighting the sensitivity of the various lithium price scenario valuations to different discount rates. The green highlighted values indicate a valuation equal to, or above, the reference share price of A\$2.84/share. The table highlights GXY's sensitivity to a bear case price scenario where the calculated intrinsic value is less than the reference share price for all discount rates tested. The valuation is understandably more robust in the bull case scenario. However, the base case scenario can only accommodate a marginal increase in the discount rate to 8% (from the base case value of 7.2%) before the valuation falls below the reference share price.

Table 34: Discount Rate Sensitivity Analysis for Three Different Lithium Price Scenarios

Valuation (A\$/share)			
Discount Rate	Base	Bull	Bear
5%	3.95	4.98	2.32
6%	3.59	4.53	2.14
7%	3.29	4.14	1.98
8%	3.02	3.81	1.84
9%	2.79	3.51	1.71
10%	2.59	3.26	1.61
11%	2.42	3.03	1.51
12%	2.26	2.83	1.43
13%	2.13	2.66	1.36

The second sensitivity analysis, presented in Table 35, indicates the significant impact adopting the varying ERP approach has on the valuation. The varying ERP approach uses the revenue contribution from the two primary operations (i.e. Mt Cattlin (Australia) and Sal de Vida (Argentina)) to calculate a weighted discount rate based on the relative revenue contribution from each operation. The significant revenue contribution from Sal de Vida from 2025 onwards generates a relatively punitive long-term discount rate of approximately 12%. Under the varying ERP approach, Galaxy Resources appears to be, at best, fairly valued only when considering the Bull Case lithium price scenario.

Table 35: Valuation Sensitivity Using Two Different WACC Calculation Methodologies

Valuation (A\$/share)	Constant ERP	Varying ERP
Base	3.22	2.23
Bull	4.08	2.73
Bear	1.92	1.53

6.2.2. Commodity Price

Table 36 and Table 37 presents the valuation for a $\pm 30\%$ sensitivity in the long-term commodity price (from 2025 onwards) for each WACC calculation methodology tested (i.e., constant ERP and varying ERP). Although the price of spodumene and LCE feedstock have proved to be highly correlated, the

price movement can diverge as brine or hard-rock operations enter development at different stages, resulting in the one potentially increasing while the other decreases.

Table 36 indicates that a significant share price upside is present when using the constant ERP methodology. The base case price assumptions generate a valuation of A\$3.22/share (blue highlight), a 13% premium over the reference share price. Furthermore, the valuation can sustain between a 10% and 20% decrease in either the long-term spodumene or LCE prices, or a 10% decrease in both, before decreasing to, or below, the reference share price.

Table 36: Spodumene and LCE Price Sensitivity Analysis for the Constant ERP Approach

Valuation Sensitivity (A\$/share)		Spodumene Price (USD/t)						
		477	545	614	682 (Base Case)	750	818	886
LCE Price (USD/t)	7,014	2.13	2.29	2.44	2.60	2.75	2.91	3.06
	8,016	2.34	2.50	2.65	2.81	2.96	3.11	3.27
	9,018	2.55	2.70	2.86	3.01	3.17	3.32	3.48
	10,020 (Base Case)	2.75	2.91	3.06	3.22	3.37	3.53	3.68
	11,022	2.96	3.11	3.27	3.42	3.58	3.73	3.89
	12,024	3.17	3.32	3.48	3.63	3.79	3.94	4.10
	13,026	3.37	3.53	3.68	3.84	3.99	4.15	4.30

On the contrary, the varying ERP approach generates a vastly different set of valuations, as presented in Table 37. Utilising Argentina's country ERP in the calculation of the WACC has a substantial negative impact on the valuation, with only a 30% increase in both the long-term spodumene and LCE price generating an intrinsic value equal to the reference share price, as indicated by the green highlighted value.

Table 37: Spodumene and LCE Price Sensitivity Analysis for the Varying ERP Approach

Valuation Sensitivity (A\$/share)		Spodumene Price (USD/t)						
		477	545	614	682 (Base Case)	750	818	886
LCE Price (USD/t)	7,014	1.63	1.71	1.80	1.89	1.97	2.06	2.14
	8,016	1.74	1.83	1.91	2.00	2.09	2.17	2.26
	9,018	1.86	1.94	2.03	2.12	2.20	2.29	2.37
	10,020 (Base Case)	1.97	2.06	2.14	2.23	2.32	2.40	2.49
	11,022	2.09	2.17	2.26	2.35	2.43	2.52	2.60
	12,024	2.20	2.29	2.37	2.46	2.55	2.63	2.72
	13,026	2.32	2.40	2.49	2.58	2.66	2.75	2.83

6.3. Monte Carlo Simulation Output

An MCS utilising the previously described probability distributions and a 5000 simulation count was conducted, with the outputs depicted in Figure 44 and Figure 45, respectively. Figure 44 presents the probability distribution for Galaxy's valuation and highlights the 90% confidence interval, which represents the probability that Galaxy's true value will fall between A\$2.10/share and A\$3.32/share,

90% of the time, given that the assumptions on the inputs and probability distributions defined are correct.

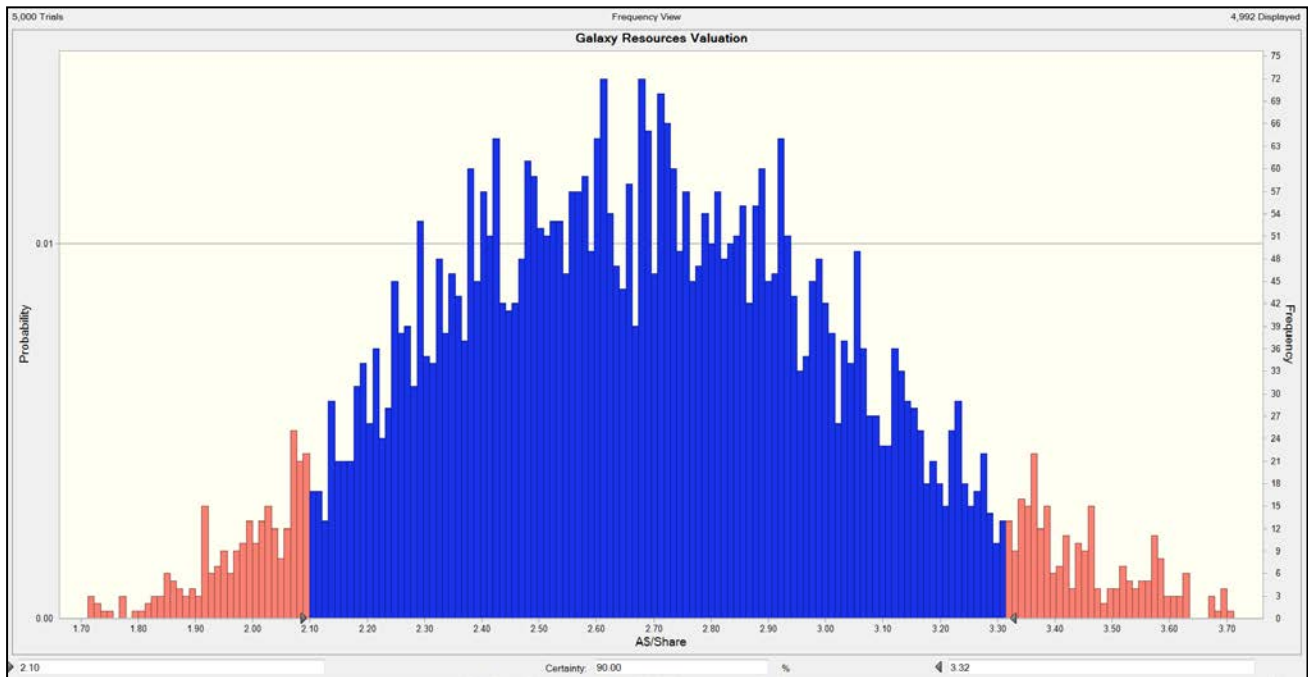


Figure 44: Probability Distribution for Galaxy Resources Ltd Valuation

Figure 45 depicts the cumulative probability distribution for Galaxy's valuation and highlights the risk that Galaxy's true value may be less than the July 2018 reference share price of A\$2.84/share 66.58% of the time (indicated by the blue highlighted area).

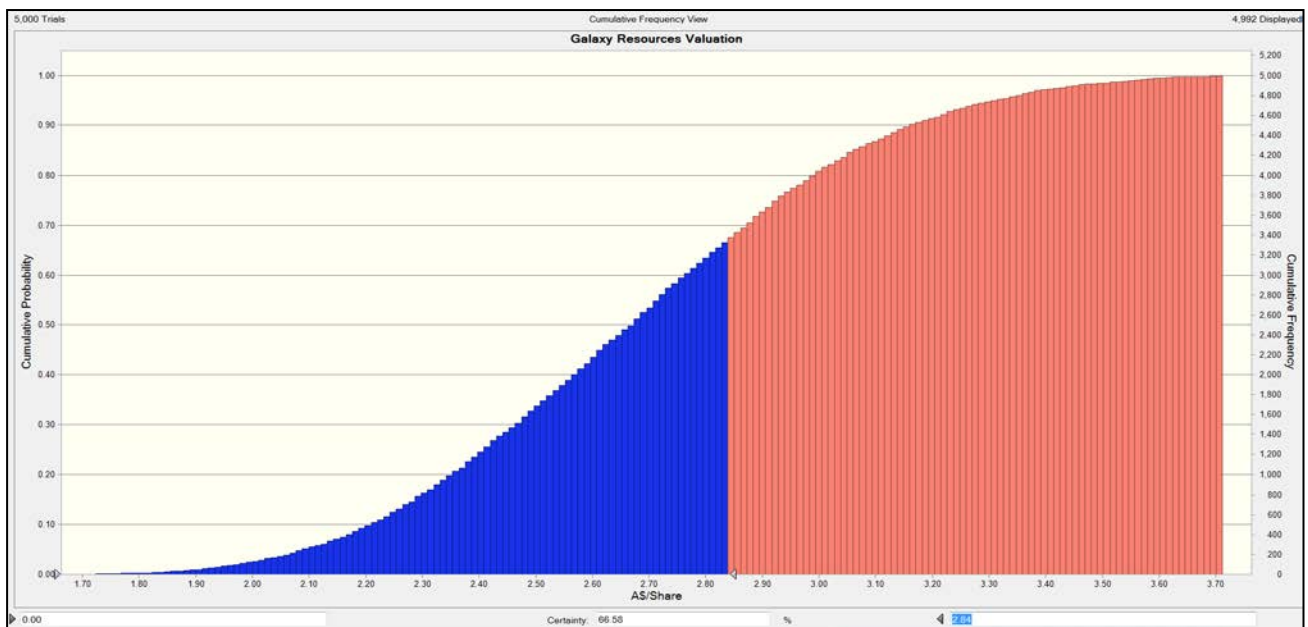


Figure 45: Cumulative Probability Distribution for Galaxy Resources Ltd Valuation

Figure 46 presents the Tornado Chart for Galaxy's valuation. The Tornado Chart assesses which input variable has the most significant impact on the valuation result by testing each input one at a

time and independently. The chart indicates that the long-term WACC, spodumene and LCE prices have the greatest impact on Galaxy's valuation.

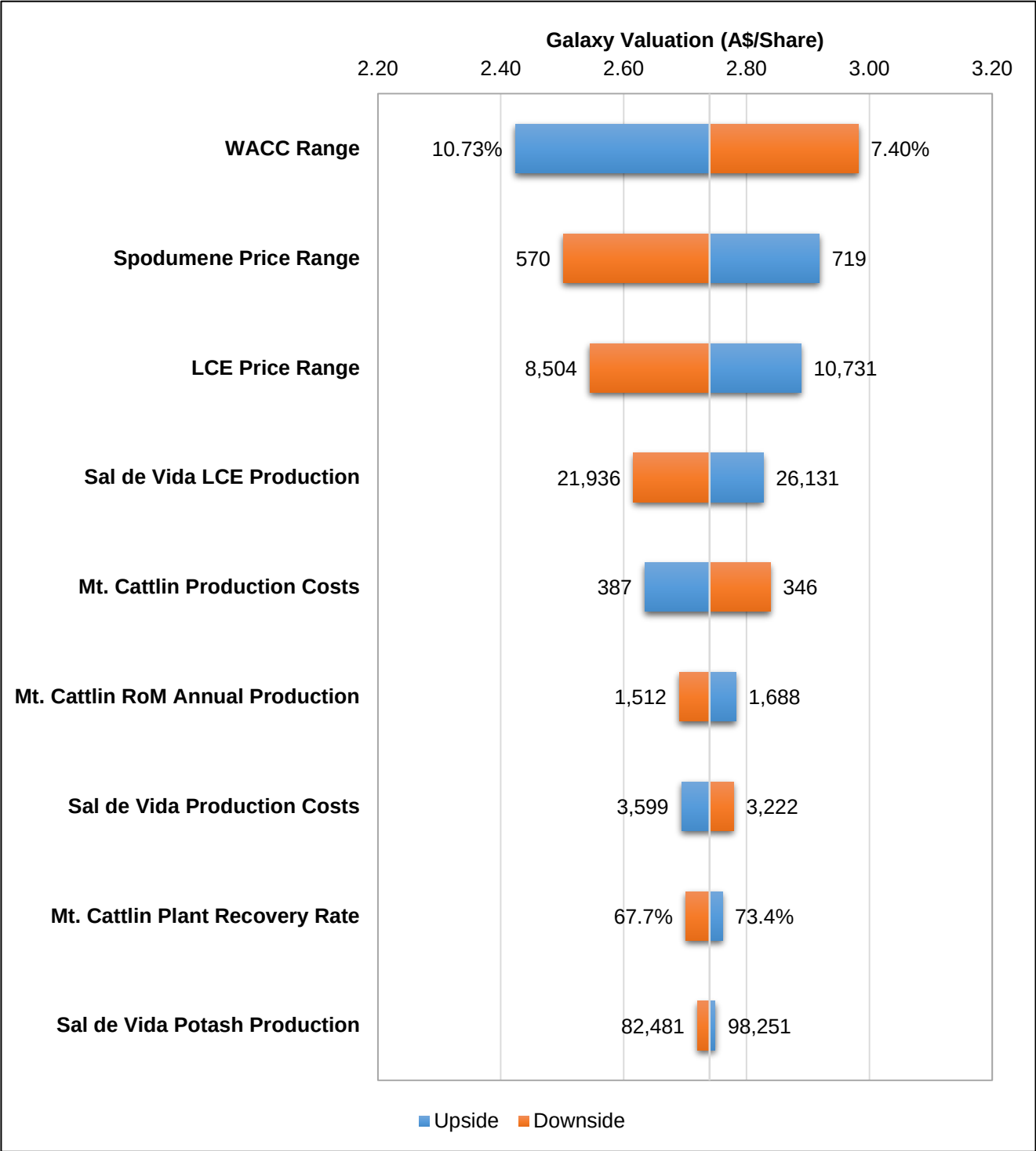


Figure 46: Galaxy Resources Ltd Valuation Tornado Chart

7. CONCLUSION AND FURTHER RESEARCH RECOMMENDATIONS

7.1. Lithium Market Boom and Bust over the Past 18 Months

The 250% increase in the lithium price between 2016 and 2018 attracted significant investment into the sector, with net inflows into the Global X Lithium and Battery Technology ETF (an investment fund that includes companies from across the lithium value chain) increasing from US\$50m in 2016 to nearly US\$1,000m by the middle of 2018. However, sharp increases in commodity prices and company market capitalisations frequently lead to a dose of anxiety and fear that the increase is unsustainable. The market's uneasiness, coupled with the bearish reports released by respected institutions such as Morgan Stanley and Citigroup, resulted in a sharp decline in the share price of many lithium mining companies. Galaxy Resources also suffered and their market capitalisation fell by 36.5% as of August 2018 from the all-time high achieved in January 2018.

7.2. Galaxy Resources as a Proxy for the Lithium Market

This apparent correction in the market leads to the intrinsic valuation conducted in Section 6 indicating marginal upside of 13% (A\$3.22) compared to the July 2018 reference share price of A\$2.84 under the base case/constant ERP scenario. The question thus arises whether this is a sufficient reward for assuming the relatively high level of risk inherent in an industry still in its infancy, such as the lithium market. The bull case/constant ERP scenario indicates a potential upside of 43% (A\$4.05), while the bear case/constant ERP valuation indicates a potential downside of 32% (A\$1.94). This highlights the significant negative impact an assumed long-term price weakness has on the valuation. Furthermore, the valuation showcases extreme sensitivity to the adoption of the varying ERP approach, which results in a best-case scenario valuation of A\$2.73 (a 4% downside to the reference share price) under the bull case/varying ERP valuation, and a severe downside scenario valuation of A\$1.53 (46% downside) under the bear case/varying ERP valuation. This significant sensitivity to the discount rate methodology applied, in conjunction with the MCS indicating a probability of the intrinsic value falling below the July 2018 reference share price 67% of the time, appears to indicate that the lithium market is, at best, fairly valued when using Galaxy Resources as a proxy for the industry as a whole and assuming the various assumptions applied are correct.

However, share price weakness in the lithium mining industry continued into September 2018, with Galaxy's share price deteriorating further to A\$2.40/share. This fall in share price was primarily driven by a softening in the spot lithium commodity price in China and the continued perception of strong new supply coming online in the short to medium term. The continued share price weakness does present a possible entry point into the lithium market for investors as the base case/constant ERP valuation of A\$3.22 represents an upside of 34% compared to the September 2018 share price of A\$2.40.

7.3. Varying Equity Risk Premium Methodology

Significantly, the appropriate selection and utilisation of the correct discount rate methodology have a material impact on the valuation outcome. The constant ERP approach, which calculates a cost of equity, and consequently a WACC, based purely on the equity risk premium of Galaxy's country of incorporation, namely, Australia, results in mostly strong valuations under various pricing scenarios. Conversely, the varying ERP approach, which utilises a weighted average cost of equity-based on the revenue contribution from the various jurisdictions in which Galaxy aims to operate, generates significantly weaker valuation outcomes. Intuitively, the varying ERP approach appears reasonable as it incorporates the higher risk associated with revenues and cash flows generated in riskier jurisdictions and the consequent need by investors for a higher risk-adjusted return. However, the use of a fixed WACC in the range of 8% to 10%, regardless of operating jurisdictions, appears frequently in valuations, which suggests that the varying ERP approach is not often employed.

7.4. Long-Term Pricing Assumptions

Furthermore, as indicated by the Tornado Charts presented, the long-term spodumene and LCE prices are the second and third largest drivers for the valuation, respectively. The previously mentioned bearish reports issued by Morgan Stanley and Citigroup postulate that a flood of new, low-cost supply will enter the market in the short to medium term and negatively impact prices, resulting in the bear case valuation presented materialising. However, although the lithium production cost curve is relatively flat and dominated by low-cost assets, this does not merely imply that the price can afford to dramatically decrease to the marginal cost of supply where the majority of the industry remains profitable, although at smaller margins. In order to meet the forecasted growth in demand, with estimates as high as 750 ktpa LCE by 2025, equating to a CAGR of 16%, the price will have to remain robust in order to incentivise new production. Companies are unlikely to commit hundreds of millions of dollars if the price declines to a point where the margins are thin, and only the lowest-cost producers are profitable. Consequently, although not considered in the bull case valuation conducted, certain respected market participants such as Benchmark Mineral Intelligence and Global Lithium LLC forecasts long-term LCE prices of between US\$12,500/t and US\$13,000/ t LCE, 13% higher than the bull case long-term price utilised.

7.5. Conclusion and Recommendation for Further Research

In conclusion, the long-term investment opportunity presented by lithium mining companies appears undeniable, with lithium demand driven by a combination of declining BEV costs, environmental benefits, and energy security. However, the exact degree of market growth and BEV penetration is contentious, and thus so is the outlook for long-term lithium prices. This uncertainty, coupled with the relatively small size of the market, its opaqueness concerning offtake agreements and commodity

pricing, and the riskiness of many of the jurisdictions in which new lithium projects are developed, has led to significant share price volatility for the majority of lithium producers.

Consequently, the potential for long-term share price outperformance within the lithium market remains an appetising prospect, with many factors suggesting demand may surprise to the upside while the success rate of bringing new supply online may disappoint, resulting in the potential for attractive returns for those investors patient enough to wait for the market to develop. However, a clearer view of the long-term lithium price is required and therefore needs further investigation. Furthermore, the utilisation of a weighted average cost of equity that considers the relative contribution to Galaxy Resources' cash flows from riskier jurisdictions, such as Argentina, has a significant impact on the valuation when compared to using a simpler static cost of equity that considers only cash flows from Galaxy's country of incorporation, namely Australia. The use of such a weighted approach appears uncommon, despite the inclusion of riskier cash flows into the calculation of a discount rate being intuitively correct. Additional research on the validity of applying a varying ERP discount rate methodology is therefore required.

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ANNEXURE A: MT CATTILIN VALUATION SHEET

Production Statistics - Mt Cattlin																
Drivers	Units	1Q FY17	2Q FY17	3Q FY17	4Q FY17	FY17	1Q FY18	2Q FY18	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25
Waste Material	BCM	143,300	460,850	472,732	499,288	1,576,170	654,136	696,875	2,138,061	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231
RoM Production	BCM	87,922	110,788	139,944	137,989	476,643	189,172	149,955	618,316	572,191	572,191	572,191	572,191	572,191	572,191	572,191
Strip Ratio	-	1.63	4.16	3.38	3.62	3.31	3.46	4.65	3.46	3.30	3.30	3.30	3.30	3.30	3.30	3.30
RoM Production	Kt	233	303	390	395	1,322	529	419	1,729	1,600	1,600	1,600	1,600	1,600	1,600	1,600
RoM Grade - LiO2	%	0.96%	1.12%	1.20%	1.19%	1.14%	1.01%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%
Ore Treated	Kt	253	334	370	414	1,371	430	435	1,729	1,600	1,600	1,600	1,600	1,600	1,600	1,600
Plant Feed Grade - LiO2	%	1.02%	1.15%	1.30%	1.27%	1.20%	1.11%	1.17%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%
Plant Recovery - LiO2	%	53%	52%	57%	58%	56%	52%	56%	55%	72.5%	73%	73%	73%	73%	73%	73%
Plant Mass Pull	%	9.3%	9.9%	12.7%	12.6%	11.4%	10.2%	11.0%	10.7%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%
Concentrate Production Grade - LiO2	%	5.38%	5.77%	5.74%	5.75%	5.69%	5.70%	5.83%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%
Concentrate Production	kt	23	33	47	52	156	44	48	185	226	226	226	226	226	226	226
Concentrate Sale Specifications																
LiO2 Grade	%	5.38%	5.77%	5.74%	5.75%	5.69%	5.70%	5.83%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%
Concentrate Sale Moisture Content	%	1.80%	2.12%	1.69%	1.73%	1.81%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%
Concentrate Sale Mica Content	%	1.88%	1.96%	1.10%	2.11%	1.77%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%
Concentrate Sales	kt	23	30	42	58	154	44	46	185	226	226	226	226	226	226	226
Offtake Prices - US\$/t	US\$/t	542	722	843	868	783	911	911	941	888	781	705	637	667	692	709
Offtake Prices - A\$/t	A\$/t	719	961	1,062	1,125	1,014	1,190	1,190	1,228	1,162	1,025	940	849	890	922	945
Cash Costs - US\$/t	US\$/t	380	393	320	325	401	497	497	497	444	435	428	422	425	427	429
Cash Costs - A\$/t	A\$/t	502	524	405	423	451	649	649	649	581	581	581	581	581	581	581

Production Statistics - Mt Cattlin														
Drivers	Units	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
Waste Material	BCM	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231	1,888,231
RoM Production	BCM	572,191	572,191	572,191	572,191	572,191	572,191	572,191	572,191	572,191	572,191	572,191	572,191	572,191
Strip Ratio	-	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30
RoM Production	Kt	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
RoM Grade - LiO2	%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%
Ore Treated	Kt	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
Plant Feed Grade - LiO2	%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%	1.11%
Plant Recovery - LiO2	%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%
Plant Mass Pull	%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%	14.1%
Concentrate Production Grade - LiO2	%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%
Concentrate Production	kt	226	226	226	226	226	226	226	226	226	226	226	226	226
Concentrate Sale Specifications														
LiO2 Grade	%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%	5.70%
Concentrate Sale Moisture Content	%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%
Concentrate Sale Mica Content	%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%	1.72%
Concentrate Sales	kt	226	226	226	226	226	226	226	226	226	226	226	226	226
Offtake Prices - US\$/t	US\$/t	712	712	712	712	712	712	712	712	712	712	712	712	712
Offtake Prices - A\$/t	A\$/t	949	949	949	949	949	949	949	949	949	949	949	949	949
Cash Costs - US\$/t	US\$/t	429	429	429	429	429	429	429	429	429	429	429	429	429
Cash Costs - A\$/t	A\$/t	581	581	581	581	581	581	581	581	581	581	581	581	581

Financial Information - Mt Cattlin												
Metrics	Units	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27
Total Revenue	A\$'000	125,603,000	227,489,252	262,459,723	231,477,874	212,280,814	191,859,930	200,971,018	208,274,947	213,395,228	214,374,105	214,374,105
Gross Sales Revenue	-	125,603,000	227,489,252	262,459,723	231,477,874	212,280,814	191,859,930	200,971,018	208,274,947	213,395,228	214,374,105	214,374,105
LiO2 Concentrate	-	125,603,000	227,489,252	262,459,723	231,477,874	212,280,814	191,859,930	200,971,018	208,274,947	213,395,228	214,374,105	214,374,105
KCl Concentrate	-	-	-	-	-	-	-	-	-	-	-	-
Other Income	-	-	-	-	-	-	-	-	-	-	-	-
Operating Cash Costs	A\$'000	(61,373,000)	(120,232,663)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)
Processing Costs	-	(22,807,000)	(44,680,011)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)
Mining Costs	-	(16,096,000)	(31,532,839)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)
Royalties	-	(7,703,000)	(15,090,548)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)
Agent Fees	-	(6,242,000)	(12,228,379)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)
Transport Costs	-	(5,546,000)	(10,864,881)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)
Admin and Other Site Costs	-	(2,979,000)	(5,836,004)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)
Corporate Expenses	A\$'000	(11,521,000)	(22,570,194)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)
Admin Expenses	-	(6,450,000)	(12,635,861)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)
Corporate Employment Expenses	-	(4,740,000)	(9,285,888)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)
Other	-	(331,000)	(648,445)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)
EBITDA	A\$'000	52,709,000	84,686,395	106,474,041	75,492,193	56,295,133	35,874,249	44,985,336	52,289,266	57,409,547	58,388,424	58,388,424
EBITDA Margin	%	42%	37%	41%	33%	27%	19%	22%	25%	27%	27%	27%
Depreciation and Amortisation	A\$'000	(28,020,000)	(36,816,252)	(35,349,269)	(32,276,028)	(29,497,327)	(26,922,222)	(24,527,407)	(22,406,709)	(20,528,753)	(18,865,752)	(17,393,103)
EBIT	A\$'000	24,689,000	47,870,143	71,124,773	43,216,165	26,797,806	8,952,027	20,457,929	29,882,557	36,880,794	39,522,672	40,995,321
EBIT Margin	%	20%	21%	27%	19%	13%	5%	10%	14%	17%	18%	19%
FCF Statement	Units	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27
EBIT	A\$'000	24,689,000	47,870,143	71,124,773	43,216,165	26,797,806	8,952,027	20,457,929	29,882,557	36,880,794	39,522,672	40,995,321
Income Tax	A\$'000	(7,406,700)	(14,361,043)	(21,337,432)	(12,964,850)	(8,039,342)	(2,685,608)	(6,137,379)	(8,964,767)	(11,064,238)	(11,856,802)	(12,298,596)
NOPAT	A\$'000	17,282,300	33,509,100	49,787,341	30,251,316	18,758,464	6,266,419	14,320,551	20,917,790	25,816,556	27,665,871	28,696,725
Change in WC	A\$'000	(1,696,000)	(38,470,566)	(5,284,514)	3,819,680	2,366,761	2,517,643	(1,123,285)	(900,484)	(631,267)	(120,683)	-
Total CAPEX	A\$'000	(35,839,000)	(24,000,000)	(8,500,000)	(8,000,000)	(7,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)
Depreciation and Amortisation	A\$'000	(28,020,000)	(36,816,252)	(35,349,269)	(32,276,028)	(29,497,327)	(26,922,222)	(24,527,407)	(22,406,709)	(20,528,753)	(18,865,752)	(17,393,103)
Free Cash Flow	A\$'000	7,767,300	7,854,786	71,352,096	58,347,024	43,622,552	29,706,284	31,724,673	36,424,015	39,714,041	40,410,939	40,089,828
Discount Factor	-	-	0.93	0.86	0.80	0.75	0.70	0.65	0.61	0.57	0.53	0.50
Discounted Free Cash Flow	A\$'000	-	7,341,718	61,485,078	46,672,729	32,730,920	20,688,815	20,486,251	22,299,748	22,670,092	21,511,329	19,896,502

Financial Information - Mt Cattlin												
Metrics	Units	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
Total Revenue	A\$'000	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105
Gross Sales Revenue	-	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105
LiO2 Concentrate	-	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105	214,374,105
KCl Concentrate	-	-	-	-	-	-	-	-	-	-	-	-
Other Income	-	-	-	-	-	-	-	-	-	-	-	-
Operating Cash Costs	A\$'000	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)	(131,331,923)
Processing Costs	-	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)	(48,804,640)
Mining Costs	-	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)	(34,443,789)
Royalties	-	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)	(16,483,630)
Agent Fees	-	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)	(13,357,240)
Transport Costs	-	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)	(11,867,871)
Admin and Other Site Costs	-	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)	(6,374,754)
Corporate Expenses	A\$'000	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)	(24,653,758)
Admin Expenses	-	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)	(13,802,338)
Corporate Employment Expenses	-	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)	(10,143,114)
Other	-	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)	(708,306)
EBITDA	A\$'000	58,388,424	58,388,424	58,388,424	58,388,424	58,388,424	58,388,424	58,388,424	58,388,424	58,388,424	58,388,424	58,388,424
EBITDA Margin	%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%
Depreciation and Amortisation	A\$'000	(16,089,017)	(14,934,200)	(13,911,567)	(13,005,988)	(12,204,063)	(11,493,929)	(10,865,079)	(10,308,209)	(9,815,079)	(9,378,395)	(8,991,695)
EBIT	A\$'000	42,299,407	43,454,224	44,476,857	45,382,436	46,184,361	46,894,495	47,523,345	48,080,215	48,573,345	49,010,029	49,396,729
EBIT Margin	%	20%	20%	21%	21%	22%	22%	22%	22%	23%	23%	23%
FCF Statement	Units	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
EBIT	A\$'000	42,299,407	43,454,224	44,476,857	45,382,436	46,184,361	46,894,495	47,523,345	48,080,215	48,573,345	49,010,029	49,396,729
Income Tax	A\$'000	(12,689,822)	(13,036,267)	(13,343,057)	(13,614,731)	(13,855,308)	(14,068,348)	(14,257,003)	(14,424,065)	(14,572,003)	(14,703,009)	(14,819,019)
NOPAT	A\$'000	29,609,585	30,417,957	31,133,800	31,767,705	32,329,053	32,826,146	33,266,341	33,656,151	34,001,341	34,307,020	34,577,711
Change in WC	A\$'000	-	-	-	-	-	-	-	-	-	-	-
Total CAPEX	A\$'000	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)	(6,000,000)
Depreciation and Amortisation	A\$'000	(16,089,017)	(14,934,200)	(13,911,567)	(13,005,988)	(12,204,063)	(11,493,929)	(10,865,079)	(10,308,209)	(9,815,079)	(9,378,395)	(8,991,695)
Free Cash Flow	A\$'000	39,698,602	39,352,157	39,045,367	38,773,693	38,533,116	38,320,076	38,131,421	37,964,360	37,816,421	37,685,415	37,569,405
Discount Factor	-	0.46	0.43	0.40	0.38	0.35	0.33	0.30	0.28	0.26	0.25	0.23
Discounted Free Cash Flow	A\$'000	18,369,275	16,976,947	15,704,887	14,540,413	13,472,492	12,491,495	11,588,983	10,757,532	9,990,593	9,282,360	8,627,673

ANNEXURE B: SAL DE VIDA VALUATION SHEET

Production Statistics - Sal de Vida											
Drivers	Units	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
LCE Production	t	-	-	2,500	10,000	25,000	25,000	25,000	25,000	25,000	25,000
KCl/Potash Production	t	-	-	9,400	37,600	94,000	94,000	94,000	94,000	94,000	94,000
Offtake Prices (US\$/t)	US\$/t	-	-	-	-	-	-	-	-	-	-
LCE	-	14,170	12,380	10,575	9,763	9,683	10,167	10,700	10,020	10,020	10,020
KCl	-	220	220	220	220	220	220	220	220	220	220
Cash Costs (US\$/t LCE - before Potash credits)	US\$/t	-	-	6,250	5,566	4,172	4,207	4,246	4,196	4,196	4,196
Financial Information - Sal de Vida											
Metrics	Units	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
Total Revenue	A\$'000	-	-	38,007,333	141,196,000	350,351,111	366,462,222	384,240,000	361,573,333	361,573,333	361,573,333
Gross Sales Revenue	-	-	-	38,007,333	141,196,000	350,351,111	366,462,222	384,240,000	361,573,333	361,573,333	361,573,333
LiO2 Concentrate	-	-	-	35,250,000	130,166,667	322,777,778	338,888,889	356,666,667	334,000,000	334,000,000	334,000,000
KCl Concentrate	-	-	-	2,757,333	11,029,333	27,573,333	27,573,333	27,573,333	27,573,333	27,573,333	27,573,333
Other Income	-	-	-	-	-	-	-	-	-	-	-
Operating Cash Costs	A\$'000	-	-	(20,834,258)	(74,207,586)	(139,067,122)	(140,235,178)	(141,524,067)	(139,880,733)	(139,880,733)	(139,880,733)
EBITDA	A\$'000	-	-	17,173,076	66,988,414	211,283,989	226,227,044	242,715,933	221,692,600	221,692,600	221,692,600
EBITDA Margin	%	-	-	45%	47%	60%	62%	63%	61%	61%	61%
Depreciation and Amortisation	A\$'000	-	-	(49,204,443)	(58,040,458)	(52,312,690)	(47,240,538)	(42,748,959)	(38,771,498)	(35,249,308)	(32,130,278)
EBIT	A\$'000	-	-	(32,031,367)	8,947,956	158,971,299	178,986,506	199,966,974	182,921,102	186,443,292	189,562,322
EBIT Margin	%	0%	0%	-84%	6%	45%	49%	52%	51%	52%	52%
FCF Statement	Units	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28
EBIT	A\$'000	-	-	(32,031,367)	8,947,956	158,971,299	178,986,506	199,966,974	182,921,102	186,443,292	189,562,322
Income Tax	A\$'000	-	-	8,007,842	(2,236,989)	(39,742,825)	(44,746,627)	(49,991,744)	(45,730,275)	(46,610,823)	(47,390,580)
Export Tax Rebates	A\$'000	-	-	(440,431)	123,034	2,185,855	2,461,064	2,749,546	2,515,165	2,563,595	2,606,482
NOPAT	A\$'000	-	-	(24,463,957)	6,834,001	121,414,330	136,700,944	152,724,777	139,705,992	142,396,064	144,778,223
Change in WC	A\$'000	-	-	(6,512,401)	(17,401,196)	(31,472,562)	(2,088,706)	(2,304,779)	2,938,594	-	-
Total CAPEX	A\$'000	(310,209,424)	(186,614,173)	(126,400,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)
Depreciation and Amortisation	A\$'000	-	-	(49,204,443)	(58,040,458)	(52,312,690)	(47,240,538)	(42,748,959)	(38,771,498)	(35,249,308)	(32,130,278)
Free Cash Flow	A\$'000	(310,209,424)	(186,614,173)	(108,171,914)	39,473,263	134,254,457	173,852,776	185,168,956	173,416,083	169,645,372	168,908,501
Discount Factor	-	0.86	0.80	0.75	0.70	0.65	0.61	0.57	0.53	0.50	0.46
Discounted Free Cash Flow	A\$'000	(267,311,709)	(149,275,701)	(81,163,666)	27,490,987	86,695,000	106,437,281	105,700,581	92,311,895	84,194,663	78,157,077

Production Statistics - Sal de Vida											
Drivers	Units	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
LCE Production	t	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
KCl/Potash Production	t	94,000	94,000	94,000	94,000	94,000	94,000	94,000	94,000	94,000	94,000
Offtake Prices (US\$/t)	US\$/t	-	-	-	-	-	-	-	-	-	-
LCE	-	10,020	10,020	10,020	10,020	10,020	10,020	10,020	10,020	10,020	10,020
KCl	-	220	220	220	220	220	220	220	220	220	220
Cash Costs (US\$/t LCE - before Potash credits)	US\$/t	4,196	4,196	4,196	4,196	4,196	4,196	4,196	4,196	4,196	4,196
Financial Information - Sal de Vida											
Metrics	Units	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
Total Revenue	A\$'000	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333
Gross Sales Revenue	-	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333	361,573,333
LiO2 Concentrate	-	334,000,000	334,000,000	334,000,000	334,000,000	334,000,000	334,000,000	334,000,000	334,000,000	334,000,000	334,000,000
KCl Concentrate	-	27,573,333	27,573,333	27,573,333	27,573,333	27,573,333	27,573,333	27,573,333	27,573,333	27,573,333	27,573,333
Other Income	-	-	-	-	-	-	-	-	-	-	-
Operating Cash Costs	A\$'000	(139,880,733)	(139,880,733)	(139,880,733)	(139,880,733)	(139,880,733)	(139,880,733)	(139,880,733)	(139,880,733)	(139,880,733)	(139,880,733)
EBITDA	A\$'000	221,692,600	221,692,600	221,692,600	221,692,600	221,692,600	221,692,600	221,692,600	221,692,600	221,692,600	221,692,600
EBITDA Margin	%	61%	61%	61%	61%	61%	61%	61%	61%	61%	61%
Depreciation and Amortisation	A\$'000	(29,368,260)	(26,922,391)	(24,756,482)	(22,838,490)	(21,140,035)	(19,635,991)	(18,304,104)	(17,124,668)	(16,080,233)	(15,155,348)
EBIT	A\$'000	192,324,340	194,770,209	196,936,118	198,854,110	200,552,565	202,056,609	203,388,496	204,567,932	205,612,367	206,537,252
EBIT Margin	%	53%	54%	54%	55%	55%	56%	56%	57%	57%	57%
FCF Statement	Units	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38
EBIT	A\$'000	192,324,340	194,770,209	196,936,118	198,854,110	200,552,565	202,056,609	203,388,496	204,567,932	205,612,367	206,537,252
Income Tax	A\$'000	(48,081,085)	(48,692,552)	(49,234,029)	(49,713,528)	(50,138,141)	(50,514,152)	(50,847,124)	(51,141,983)	(51,403,092)	(51,634,313)
Export Tax Rebates	A\$'000	2,644,460	2,678,090	2,707,872	2,734,244	2,757,598	2,778,278	2,796,592	2,812,809	2,827,170	2,839,887
NOPAT	A\$'000	146,887,714	148,755,747	150,409,960	151,874,827	153,172,021	154,320,735	155,337,964	156,238,758	157,036,445	157,742,826
Change in WC	A\$'000	-	-	-	-	-	-	-	-	-	-
Total CAPEX	A\$'000	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)	(8,000,000)
Depreciation and Amortisation	A\$'000	(29,368,260)	(26,922,391)	(24,756,482)	(22,838,490)	(21,140,035)	(19,635,991)	(18,304,104)	(17,124,668)	(16,080,233)	(15,155,348)
Free Cash Flow	A\$'000	168,255,975	167,678,138	167,166,442	166,713,316	166,312,057	165,956,726	165,642,068	165,363,426	165,116,678	164,898,174
Discount Factor	-	0.43	0.40	0.38	0.35	0.33	0.30	0.28	0.26	0.25	0.23
Discounted Free Cash Flow	A\$'000	72,587,452	67,443,757	62,688,614	58,288,665	54,214,045	50,437,922	46,936,125	43,686,807	40,670,175	37,868,247