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Speciality Mining & Metals

Source: Eikon Thomson Reuters

Market data

EPIC/TKR	**ILC**
Price (C$)	0.09
12m High (C$)	0.23
12m Low (C$)	0.07
Shares (FD m)	135.9
Mkt Cap (C$m)	12.2
EV (C$m)	16.8
Market	TSX

Description

International Lithium Corp. (ILC) is advancing three lithium exploration assets. Key issues for investors are the new management, the partnership with Ganfeng Lithium (Ganfeng), funding and the low valuation.

Company information

Chairman/ CEO	John Wisbey
CFO	Maurice Brooks
COO	Anthony Kovacs

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Key shareholders

John Wisbey	19.90%*
Ganfeng Lithium	11.35%*
TNR Gold Corp.	7.04%*
Other directors/mgt.	5.24%*

* incl. convertibles

Diary

Aug'18	2Q results
Nov'18	3Q results
Apr'19	Finals

Analyst

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International Lithium Corp.

Partnered with China's biggest lithium player

The turnaround of ILC has taken its first steps under the stewardship of a new Chairman/CEO appointed in March 2018. At the same time, the company continues to benefit from partnering with China's "lithium major", Ganfeng, which is providing support in terms of technology and capital. ILC's core asset in Argentina, the Mariana lithium salar (brine lake), is centrally located in South America's famous "Lithium Belt", and should take two key steps towards commissioning in the next six to nine months, with i) a Preliminary Economic Assessment this summer, and ii) a Pre-Feasibility Study in early 2019.

- **Strategy:** ILC's goal is to unlock value from its three brine and hard rock lithium projects, as it takes advantage of explosive demand growth for lithium used in batteries for electric vehicles (EVs). The global market share of EVs is expected to grow by a factor greater than 10, from 1% in 2017 to 12%-15% by 2026.

- **Strategic partner:** Ganfeng owns 11.35% of ILC and majority stakes in two of its lithium projects, which is in line with its strategy to ensure sufficient lithium supply in the future. It reiterated its commitment to Mariana in its recent Hong Kong IPO prospectus, with an ambitious target for commissioning in 2021.

- **ILC's core Mariana project (it has three) should "punch above its weight":** Size is far from everything when it comes to lithium salars. A productive salar is dependent on high transmissivity (i.e. rate of flow through the aquifer), specific yield (the ratio of extractable brine) and the uniformity of lithium grades.

- **Risks:** The new Chairman/CEO has resolved operational issues and, aside from the normal risks for a junior miner, his focus now is staying ahead of the funding curve – a further C$3.5m needs to be raised in 2018. A "funding feedback loop" is in play, where continued success should attract a fair valuation for ILC shares.

- **Investment summary:** Our DCF valuation for ILC is C$0.30-C$0.37/share, based on the Mariana project only. Using EV/resources multiples, ILC is valued at less than US$40/t LCE (lithium carbonate equivalent), compared with the average for its small-cap peers above US$45/t. The May 2018 sale of Galaxy Resources' non-core asset, Salar del Hombre Muerto (a lithium brine project with a resource estimate like Mariana), achieved an EV/resource price of US$110/t LCE.

Financial summary and valuation

Year-end Dec (C$m)	2015	2016	2017	2018E	2019E	2020E
Sales	0.000	0.000	0.000	0.000	0.000	0.000
Royalties	0.000	0.000	0.000	0.000	0.000	0.000
Underlying EBIT	-0.631	-0.796	-2.354	-0.720	-0.720	-0.720
Reported EBIT	-0.631	-0.796	-2.354	-0.720	-0.720	-0.720
Underlying PTP	-0.769	-1.033	-2.729	-1.463	-1.240	-1.554
Statutory PTP	-0.769	-1.033	-2.729	-1.463	-1.240	-1.554
Underlying EPS (C$)	-0.01	-0.01	-0.03	-0.01	-0.01	-0.01
Statutory EPS (C$)	-0.01	-0.01	-0.03	-0.01	-0.01	-0.01
Net (debt)/cash	-1.146	-2.932	-4.627	-6.275	-1.451	-13.171
Avg. shares (m)	77.13	83.70	89.33	102.75	193.78	305.4
P/E (x)	n/a	n/a	n/a	n/a	n/a	n/a
EV/sales (x)	n/a	n/a	n/a	n/a	n/a	n/a

Source: Hardman & Co Research

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Cash flow, earnings and valuation

PEA/PFS/FS for Mariana should support 2018-19 funding

Key milestones should support near-term funding

To unlock the value of its lithium exploration assets, the imperative for ILC's management is to remain ahead of the company's funding requirements, as Mariana progresses towards a preliminary economic assessment (PEA), pre-feasibility study (PSA) and feasibility study (FS) during the next two to three years.

In aggregate, ILC requires in the region of C$6.5m of external funding in 2018 to meet its funding commitments for the Mariana project, redeem convertible debentures, and pay staff and suppliers.

Of the C$6.5m figure, Mariana accounts for approximately C$3.75m (i.e. 17.246% x US$17.0m budget).

Having concluded a C$1.18m convertible debenture issue and a subsequent C$1.8m convertible debenture, ILC has raised C$2.98m, or nearly 45%, of the C$6.5m it needs this year. A positive PEA for Mariana, scheduled for this summer (see below), would be helpful in funding the balance. Our model currently assumes a C$3.52m equity raising at the end of the third quarter of 2018 at a price of C$0.10 per share.

PEA expected this summer, followed by PFS by late 2018/early 2019, and FS by end-2019/beginning of 2020

Assuming that ILC meets its 2018 milestones in terms of funding and a Mariana PEA, we expect the funding requirement to rise modestly, to about C$7.0m in 2019, and to be financed by a straight equity issue.

If exploration work at Mariana continues as expected, ILC's management anticipates a PFS by late 2018 or early 2019. We have no reason to doubt this time frame and are assuming an FS by the end of 2019 or the beginning of 2020.

Funding from 2020-21

The Mariana back-in option is potentially very significant for ILC's financial performance going forward. If ILC exercises its back-in option to acquire an additional 10% stake in Mariana, the 2020 funding requirement would be an additional ca. C$7.0m – equivalent to 10% of development costs at the date at which it is exercised. This is management's current intention and would increase ILC's ownership from 17.246% to 27.246%.

Our P&L and cashflow projections shown below assume a base case that the back-in option is not exercised (at this stage), but we comment on its potential impact and show the DCF valuations under both scenarios.

We are currently estimating that a potential lithium project at Mariana will have an annual production of 10,000 tonnes LCE p.a. However, ILC's management believes that successful testing of the membrane separation technology by Ganfeng (see below) could lead to a significantly higher production capacity.

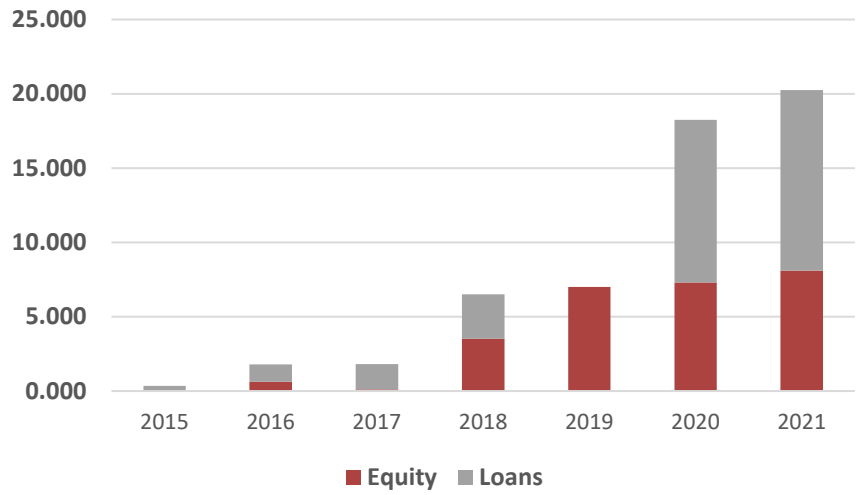
In the meantime, our assumptions for the advancement of Mariana include:

- construction of the project is green-lighted at the beginning of 2020; and
- the project is completed at the end of 2021, with commissioning beginning on 1 January 2022.

ILC's funding needs will obviously step up significantly from early 2020 to the end of 2021. The capital cost of a 10,000 tonne p.a. LCE project at US$13,000/t-US$15,000/t is US$130m-US$150m, or C$166m-C$192m, and we have conservatively assumed C$200m (100% basis) spent C$100m and C$100m, respectively, during 2020-21.

ILC's 17.246% share would amount to a capital spend of C$34.5m during those two years, or C$54.5m after the back-in. From a financing perspective, we have assumed that ILC funds this capital expenditure on a 60:40 basis in terms of debt to equity under both scenarios. Excluding the back-in, we estimate that ILC's funding requirement would peak at approximately C$20.0m in 2021.

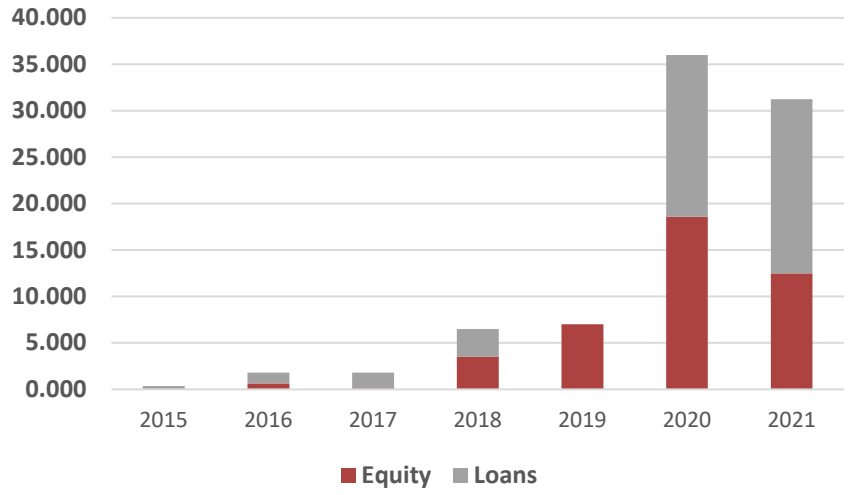
ILC funding excluding 10% back-in option on Mariana



Source: ILC, Hardman & Co. estimates

Including the approximately C$7.0m cost of exercising the back-in option and the additional share of capex, ILC's funding requirement would likely peak at almost C$36.0m in 2020.

ILC funding excluding 10% back-in option on Mariana



Source: ILC, Hardman & Co. estimates

Below are our cashflow projections through to end-2021, i.e. immediately prior to our expectation for the commissioning of Mariana.

ILC – cashflow statement					
Year-end Dec (C$m)	**2017**	**2018E**	**2019E**	**2020E**	**2021E**
Operating profit	-2.354	-0.720	-0.720	-0.720	-0.725
Non-cash items:					
Accrued interest	0.371	0.000	0.000	0.000	0.000
Forex	-0.204	0.200	0.000	0.000	0.000
Share-based payment	1.051	0.000	0.000	0.000	0.000
Dilution of Mariana	0.666	0.000	0.000	0.000	0.000
Other	0.010	0.000	0.000	0.000	0.000
Operating cashflow	**-0.460**	**-0.520**	**-0.720**	**-0.720**	**-0.725**
Change in receivables	0.074	0.000	0.000	0.000	0.000
Change in prepaids	-0.003	0.000	0.000	0.000	0.000
Change in payables	0.091	0.000	0.000	0.000	0.000
Cash from operations	**-0.297**	**-0.520**	**-0.720**	**-0.720**	**-0.725**
Tax paid	0.000	0.000	0.000	0.000	0.000
Net cash from ops.	**-0.297**	**-0.520**	**-0.720**	**-0.720**	**-0.720**
Exploration expenditure	-0.031	-3.800	-3.800	-17.246	-17.246
Equity inv. funding	-1.547	0.000	0.000	0.000	0.000
Recoveries on min. prop.	0.051	0.000	0.000	0.000	0.000
Other	0.157	0.000	0.000	0.000	0.000
Net cash for investing	**-1.369**	**-3.800**	**-3.800**	**-17.246**	**-17.246**
Increase in loans	0.000	0.000	0.000	10.948	12.148
Shares issued	0.113	3.520	7.000	7.298	8.098
Conv. debentures issued	1.694	2.980	0.000	0.000	0.000
Conv. debentures red.	0.000	-1.000	-0.700	0.000	0.000
Share issue costs	0.000	-0.106	-0.210	-0.219	-0.243
Net interest	-0.430	-0.743	-0.520	-0.834	-1.993
Other	0.249	0.000	0.000	0.000	0.000
Net cash for financing	**1.626**	**4.652**	**5.570**	**17.193**	**18.011**
Net change in cash	**-0.041**	**0.332**	**1.050**	**-0.773**	**0.040**
Cash: end of year	**0.004**	**0.335**	**1.386**	**0.613**	**0.653**
Debt: end of year	**-4.630**	**-6.610**	**-3.037**	**-13.984**	**-26.132**
Net debt: end of year	**-4.627**	**-6.275**	**-1.651**	**-13.371**	**-25.479**

Source: Hardman & Co.

Should ILC exercise the 10% back-in option, we estimate that end-2021 net debt would be C$38.548m, compared with our base case of C$25.479m.

ILC's management and Ganfeng are more optimistic on Mariana commissioning

We should reiterate that ILC's management and Ganfeng's IPO prospectus consider our 2022 assumption for Mariana's commissioning date as too cautious – with both believing 2021 is more likely. However, we prefer to be conservative at this stage and, in future, bring Mariana commissioning forward in our model if ILC is able to push ahead with the project more rapidly than we are currently assuming. Furthermore, a valuation case for ILC does not require support from an advancement of Mariana versus our current assumptions.

P&L projections prior to commissioning Mariana

Switching to the P&L account, our projections through to the end of 2021 are shown in the table below.

ILC – profit & loss account

Year-end Dec (C$m)	2017	2018E	2019E	2020E	2021E
Sales	0.000	0.000	0.000	0.000	0.000
Cost of sales	0.000	0.000	0.000	0.000	0.000
Gross profit	0.000	0.000	0.000	0.000	0.000
Margin (%)	n/a	n/a	n/a	n/a	n/a
Operator income	0.168	0.000	0.000	0.000	0.000
Operating expenses:					
Consulting fees	-0.574	-0.200	-0.200	-0.200	-0.200
Forex	0.182	0.000	0.000	0.000	0.000
Loss on equity inv.	-0.082	0.000	0.000	0.000	0.000
Office and misc.	-0.043	-0.050	-0.050	-0.050	-0.052
Professional fees	-0.170	-0.150	-0.150	-0.150	-0.150
Rent	-0.019	-0.015	-0.015	-0.015	-0.016
Shareholders' comms.	-0.077	-0.120	-0.120	-0.120	-0.120
Share-based payments	-1.051	0.000	0.000	0.000	0.000
Directors' fees	-0.070	-0.100	-0.100	-0.100	-0.100
Loss on Mariana dil.	-0.666	0.000	0.000	0.000	0.000
Other	0.048	-0.085	-0.085	-0.085	-0.087
EBIT	**-2.354**	**-0.720**	**-0.720**	**-0.720**	**-0.725**
Interest charges	-0.375	-0.743	-0.520	-0.834	-1.993
Pre-tax profit	**-2.729**	**-1.463**	**-1.240**	**-1.554**	**-2.718**
Taxation	0.000	0.000	0.000	0.000	0.000
Tax rate (%)	n/a	n/a	n/a	n/a	n/a
Attributable profit	**-2.729**	**-1.463**	**-1.240**	**-1.554**	**-2.718**
Basic no. of shares (m)	89.325	102.754	193.784	305.393	345.885
Basic EPS (C$)	**-0.03**	**-0.01**	**-0.01**	**-0.01**	**-0.01**

Source: Hardman & Co Research

Prior to commissioning of Mariana, assuming it goes ahead, we expect ILC to make operating losses in the range C$0.5m-C$1.0m, due mainly to corporate overheads and professional costs (and benefit from the elimination of share-based payments). Below the operating line, pre-tax losses are expected to rise – due mainly to interest costs – from slightly less than C$1.5m in the current year to almost C$3.0m in 2021.

By exercising the back-in option, there will be no change to our EBIT projections, but pre-tax losses will rise to C$3.7m due to higher interest charges. Losses per share will be little different despite the higher number of shares.

Swing to profits from losses as Mariana ramps up

Under both scenarios, ILC's losses should reverse into profits in 2022 with the initial ramp-up in Mariana production. We expect Mariana to reach full production of 10,000 tonnes p.a. of LCE in its third full year of operation in 2024.

Lithium price and unit cost estimates

The ramp-up in EV production has led to a surge in lithium carbonate and lithium hydroxide prices since 2015. While spot prices remain in the region of US$20,000/t in China, contact prices are in the region of US$13,000/t-US$14,000/t.

China spot lithium price, 2015-18 (US$/t)

Source: Lithium Americas

We have assumed that the lithium carbonate price will rise from US$11,000/t in 2022 to US$12,000/t in 2023, and US$12,700/t thereafter

Our long-term selling price assumption for lithium carbonate is US$12,700/t, which is in line with the average of estimates used by other small-cap lithium developers.

We have assumed that the price rises from US$11,000/t in 2022 to US$12,000/t in 2023, followed by US$12,700/t thereafter. Please note that our peer group for the lithium carbonate price consists of other developers of lithium brine projects, in addition to Bacanora Minerals, which is a clay lithium project.

Lithium carbonate price assumptions – other brine projects

US$/t	Project	Est. price
Advantage Lithium	Cauchari	>10,000
Neo Lithium	3Q	11,760
Lithium Americas	Cauchari-Olaroz	12,000
Pure Energy Minerals*	Clayton Valley	12,267
Lithium Power	Maricunga	13,584
Millennial Lithium	Pastos Grandes	13,862
Galaxy Resources	Sal de Vida	13,911
Bacanora	Sonora	14,300
Average		**12,711**

Hardman & Co Research, company reports
**Lithium hydroxide*

Offsetting issues at play in Mariana's production costs

In terms of unit production costs at Mariana, there are offsetting issues at play, as we explain later in the report.

The project has relatively lower lithium concentrations and higher concentrations of impurities (magnesium and sulphates) than other salars. On the positive side, Mariana's high transmissivity should make it more productive for its size, due to the flow rate. High concentrations of potash, a key by-product in brine, and favourable logistics, such as proximity to rail transport, will have a significantly positive effect on Mariana's unit production costs.

The production cost for other small explorers and developers is in the range of US$2,495/t-US$3,910/t of LCE, with an average of just over US$3,100/t.

Lithium carbonate production cost assumptions – other brine projects		
US$/t	**Project**	**Est. cost**
Lithium Americas	Cauchari-Olaroz	2,495
Neo Lithium	3Q	2,791
Lithium Power	Maricunga	2,938
Pure Energy Minerals	Clayton Valley	3,217
Millennial Lithium	Pastos Grandes	3,218
Galaxy Resources	Sal de Vida	3,410
Bacanora	Sonora	3,910
Average		**3,142**

Hardman & Co Research, company reports

We assume a production cost of US$3,300/t for Mariana for now

Until the PEA for Mariana is published, we can only make a guess at its unit production cost. At this stage, we are unsure whether potash will be accounted for in the revenue line or as a by-product credit offsetting production costs. For now, we will assume the latter. Taking into account the issues we noted above, including the likely significant benefit from potash, we are using an assumption of US$3,300/t for Mariana, until more guidance is forthcoming.

Under the recent tax reform, the Argentinian government issued Decree 1112/2017 on 29 December 2017. This lowered corporate income tax from 35% to 30% in 2018 and 2019, followed by a further reduction to 25% from 2020 onwards, which will be relevant to Mariana. In aggregate, royalty costs will only be 3.5%.

DCF assumptions in detail

Valuation – DCF and versus lithium peers

Our discounted cashflow valuation assumes a 40-year mine life for Mariana from 2023-62. The key assumptions, including sales volumes, selling prices and unit costs for our DCF valuation for ILC are summarised in the table below.

ILC – DCF model – key assumptions		
	Denominator	
Annual production capacity	tonnes	10,000
Time to achieve full production	years	3
Life of mine	years	40
Selling price LCE (long-term)	US$/t	12,700
Production cost LCE	US$/t	3,300
Royalty	% of revenue	3.5
Corporate tax rate	% of pre-tax profit	25.0
Maintenance capex	C$m	2.0
NPV discount rate	%	8.0
Fully diluted shares end-2021	million	345.9
US$/C$	ratio	0.76

Hardman & Co Research, company reports

Under the back-in option on Mariana, the only change in the assumptions above is that the fully diluted number of shares at the end of 2021 will be 430.3m, instead of 345.9m.

Below is a summary table for our DCF estimate for ILC from 2018-21 and the steady state for the Mariana project after it reaches full production from 2024-61

(obviously, the discounted value of free cashflows beyond 2024 continues to fall with time).

Our base-case DCF valuation is C$0.30

The lower segment of the table shows that our base-case valuation for ILC is C$0.30 per share. This compares with a current share price of C$0.09.

ILC – DCF estimate: base case					
Year-end Dec (C$m)	**2018E**	**2019E**	**2020E**	**2021E**	**2024-61E***
Sales					28.819
Royalties					-1.009
Production costs					-7.488
Less: tax					-5.080
NOPAT	**-1.463**	**-1.240**	**-1.554**	**-2.718**	**14.901**
Depreciation	0.000	0.000	0.000	0.000	1.216
Change in working capital	0.000	0.000	0.000	0.000	0.000
Less: capex	-3.800	-3.800	-17.246	-17.246	-0.345
Other	0.094	-0.210	-0.210	-0.243	0.000
Free cashflow	**-5.168**	**-5.250**	**-19.019**	**-20.206**	**16.112**
Discount rate (%)	8.0%	8.0%	8.0%	8.0%	8.0%
Discount factor	1.00	0.93	0.86	0.79	
NPV of free cashflow	-5.168	-4.861	-16.305	-16.041	
Valuation					
Cumulative free cashflow					616.3
NPV of free cashflow					107.0
Less: net debt (end-2017)					-4.6
Market cap.					102.4
No. shares (m)					345.9
Valuation per share (C$)					**0.30**

*Source: Hardman & Co Research *Mariana full production steady state*

DCF sensitivity analysis around base case

The next table shows the sensitivity analysis of the valuation of ILC's shares in the DCF model to different assumptions for the long-term price of lithium carbonate (rows) and the unit production cost (columns) excluding the Mariana back-in.

ILC – DCF sensitivity: base lithium carbon			
(US$/t)	**3,000**	**3,300**	**3,600**
11,000	0.24	0.23	0.21
12,000	0.28	0.27	0.25
12,700	0.31	**0.30**	0.28
13,000	0.32	0.31	0.29
14,000	0.36	0.35	0.33

Source: Hardman & Co Research

Our DCF valuation is C$0.37 assuming that the 10% back-in option is exercised

The following table shows that our DCF valuation for ILC is C$0.37 per share assuming that the 10% back-in option on Mariana is exercised on 1 January 2020.

ILC – DCF estimate					
Year-end Dec (C$m)	**2018E**	**2019E**	**2020E**	**2021E**	**2024-61E***
Sales					45.530
Royalties					-1.594
Production costs					-11.831
Less: tax					-8.026
NOPAT	**-1.463**	**-1.240**	**-1.876**	**-3.693**	**24.079**
Depreciation	0.000	0.000	0.000	0.000	1.921
Change in working capital	0.000	0.000	0.000	0.000	0.000
Less: capex	-3.800	-3.800	-34.246	-27.246	-0.545
Other	0.094	-0.110	-0.558	-0.375	0.000
Free cashflow	**-5.168**	**-5.250**	**-36.680**	**-31.313**	**25.455**
Discount rate (%)	8.0%	8.0%	8.0%	8.0%	8.0%
Discount factor	1.00	0.93	0.86	0.79	
NPV of free cashflow	-5.168	-4.861	-31.447	-24.858	
Valuation					
Cumulative free cashflow					965.5
NPV of free cashflow					164.2
Less: net debt (end-2017)					-4.6
Market cap.					159.6
No. shares (m)					430.3
Valuation per share (C$)					**0.37**

*Source: Hardman & Co Research *Mariana full production steady state*

DCF sensitivity analysis around base case

The next table shows the sensitivity analysis of the valuation of ILC's shares in the DCF model to different assumptions for the long-term price of lithium carbonate (rows) and the unit production cost (columns) including the Mariana back-in.

ILC – DCF sensitivity: lithium carbon			
(US$/t)	**3,000**	**3,300**	**3,600**
11,000	0.30	0.28	0.27
12,000	0.35	0.34	0.32
12,700	0.39	**0.37**	0.35
13,000	0.40	0.39	0.37
14,000	0.45	0.43	0.42

Source: Hardman & Co Research

Benchmarking ILC versus recent Galaxy Resources transaction

An alternative benchmark for valuing ILC, albeit on a takeout basis, was provided by the sale of Galaxy Resources' non-core asset, Salar del Hombre Muerto, in Argentina, on 29 May 2018. Like Mariana, it is a lithium-containing brine lake with a resource estimate, and is located near other producing salars. The sale price of US$280m compared with resources (measured, indicated and inferred) of 2.54m tonnes of LCE, equating to an EV/t LCE of US$110, or C$144.74. Applying a similar valuation to ILC's 1.866 million tonnes of LCE resources (admittedly indicated and inferred) gives a valuation for ILC of almost exactly C$0.30 per share.

Part of the reason for ILC's low valuation currently results from concerns regarding meeting funding needs. However, if ILC's new management team continues to be successful in raising money, either through issues of securities or by selling Mariana, or one of its other lithium assets, it would alleviate this factor.

This is the "funding feedback loop" we noted on the front page.

Comparing ILC on EV/resources

At the current ILC share price of C$0.09, ILC is trading on an EV/t in terms of LCE tonnes in the range US$38.72/t-39.42/t depending on whether the Mariana back-in option is activated. This is somewhat below ILC's peer group, which is trading on an average EV/t of US$45.46 as the table below illustrates.

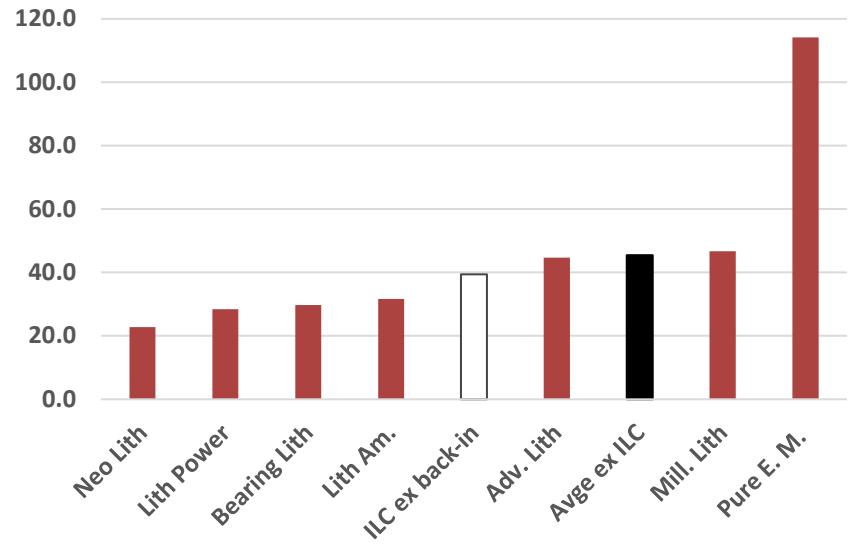
EV/resource valuation for lithium brine developers

US$/t	Project	EV/resources
Pure Energy Minerals	Clayton Valley	114.20
Millennial Lithium	Pastos Grandes	46.72
Advantage Lithium	Cauchari	44.70
Lithium Americas	Cauchari-Olaroz	31.61
Bearing Lithium	Maricunga	29.77
Lithium Power	Maricunga	28.46
Neo Lithium	3Q	22.80
Average		**45.46**
ILC excl. Mariana back-in		**39.42**
ILC incl. Mariana back-in		**38.72**

Source: Hardman & Co Research, company reports

Below, we present the data in chart form.

Brine EV/resources – developers, construction, production (May 2018)

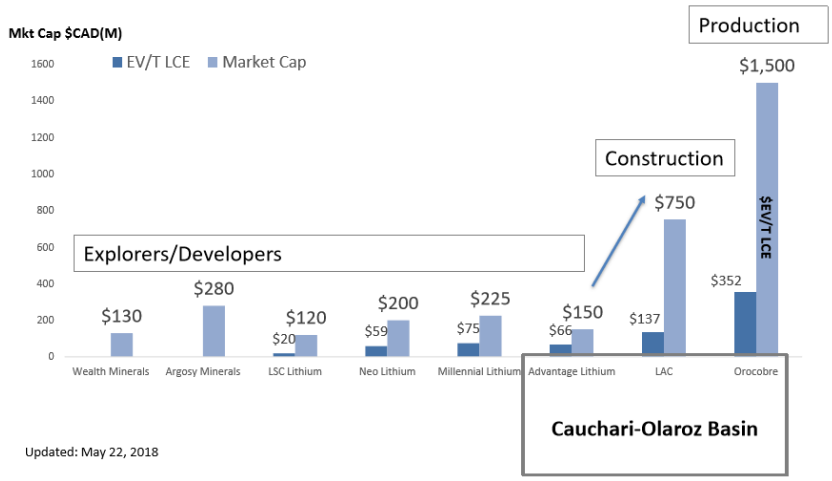


Source: Hardman & Co Research, company reports

Is there near-term value in the Avalonia project?

The next chart is more important from the perspective of advancing the Mariana project through construction and commissioning. The darker blue bars on the next chart from Advantage Lithium show the accretion to valuation in terms of EV/resources (LCE) that can be expected as developers successfully advance brine projects into the construction and production phases.

Brine EV/resources – developers, construction, production (May 2018)



Source: Advantage Lithium

In terms of one of ILC's "non-Mariana" assets, Ganfeng can increase its holding from 55% to 75% in the Avalonia lithium project in Ireland by making development expenditures of C$10m. However, this does not imply that a 20% interest in Avalonia is worth C$10m. For example, ILC is not currently in a position to make any significant expenditure to advance the project and is currently reliant on Ganfeng. That is not to say that there might not be significant value in Avalonia for Ganfeng. Indeed, monetising Avalonia could be an excellent way of de-risking the company for existing shareholders.

The focus of this report is, obviously, on ILC. However, explosive growth in lithium demand driven by EVs is obviously a critical part of the investment case. **We have given our slant on lithium prospects in the final section below**.

Backstory: IPO, Ganfeng and lithium

2011 IPO on Canada's TSX Venture Exchange

Spun off from TNR in Gold in 2011 – Ganfeng takes 9.9%

International Lithium Corporation (ILC) was created as a wholly-owned subsidiary of the Canadian metals exploration company, TNR Gold Corp., before it was spun off on the TSX Venture Exchange on 24 May 2011. The IPO was more than 20% oversubscribed and saw ILC raise C$3.06m from the sale of 12.244m new shares.

Ganfeng Lithium (Ganfeng) acquired a 9.9% stake in ILC in the 2011 IPO, which was subsequently increased via private placement and purchases from TNR Gold, to stand at 16.29% of the issued ordinary shares (11.35% after convertibles converted). Ganfeng is China's largest producer of lithium compounds, and the number three player worldwide after Albemarle and SQM. It is listed in Shenzhen with a market cap. of CNY 46.3bn (US$7.2bn) and is raising US$1.0bn via its Hong Kong IPO, which is scheduled for this year.

The shared vision remains in place for Ganfeng to support ILC with both capital and technology to facilitate lithium supply in line with its needs.

Ganfeng's operations in China

Source: Ganfeng

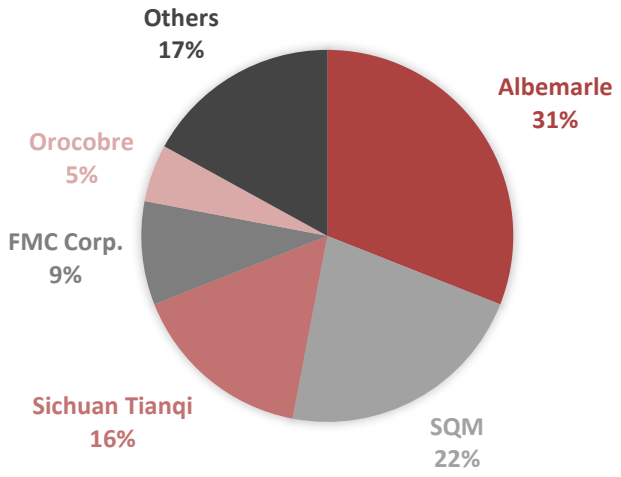
Ganfeng's midstream positioning left it exposed

Ganfeng began as a midstream lithium producer, but found it was exposed to changes in the supply of lithium raw materials in terms of their availability, swings in prices and the oligopolistic upstream structure of the lithium industry.

Oligopoly in upstream lithium

There are five companies – Albemarle, SQM, FMC, Sichuan Tianqi and Orocobre – accounting for more than 80% of global lithium mine production, as shown in the chart below.

Lithium mine production by company, 2017E



Source: Wood Mackenzie, Hardman & Co Research

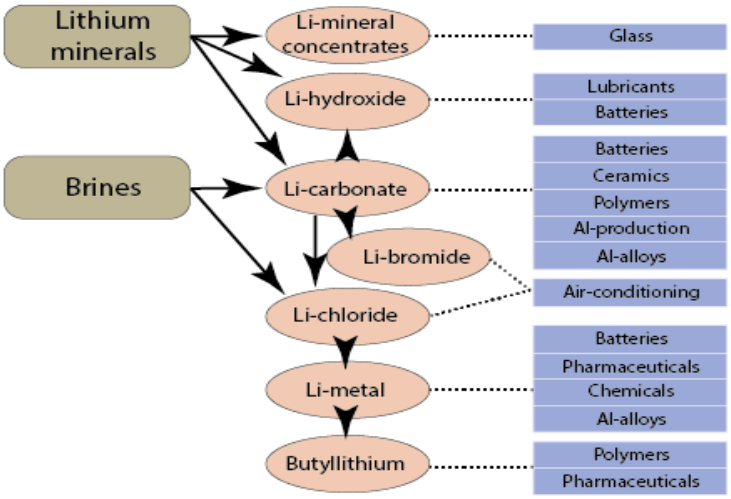
Lithium is sourced from brine lakes and hard rock ores

Briefly, the two major sources of lithium raw materials are brine lakes and minerals (hard rock ores).

- **Brine lakes:** these contain high concentrations of lithium salts in subsurface brine lakes, known as "salars", trapped in the earth's crust.
- **Minerals:** lithium concentrates are produced from spodumene, which is the primary hard rock lithium ore. Spodumene is a lithium aluminium inosilicate with the chemical formula $LiAl(SiO_3)_2$.

Lithium contained in brine or rocks is processed into concentrates that are converted into intermediate products, typically lithium carbonate, lithium hydroxide and lithium chloride, which are further refined/processed for end applications, EV batteries now being the most important. ILC is one of a small number of companies having exploration projects in both brine and hard rock, as we explain below.

Lithium mine production by company, 2017E



Source: Saltwork Consultants, Ziemann, S et al.

Ganfeng's "ecosystem"

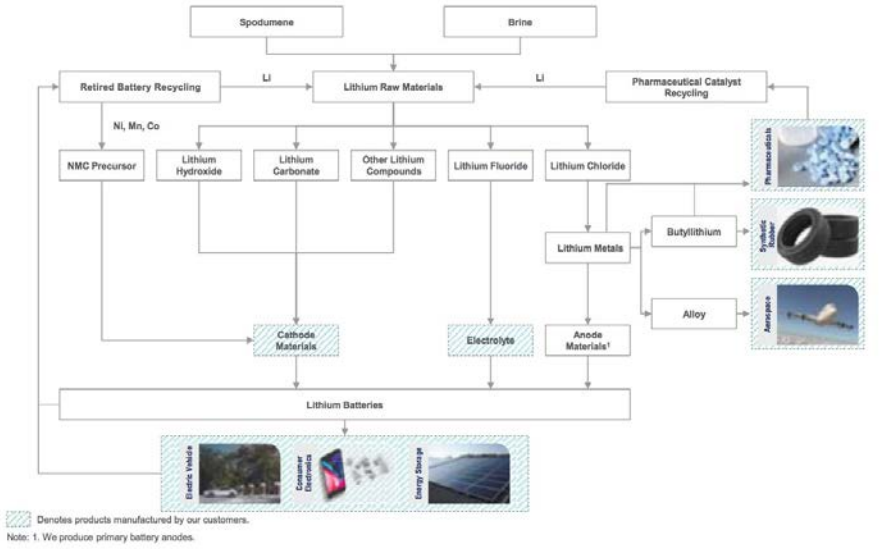
Ganfeng is becoming increasingly vertically integrated

In recent years, Ganfeng has purposely evolved into a vertically integrated player in the lithium industry, moving upstream and downstream, using lithium from both brine and hard rock sources. It focuses on:

- extraction of upstream lithium;
- processing of lithium compounds and production of lithium metals;
- production of lithium batteries; and
- recycling of lithium.

Ganfeng refers to its "ecosystem", shown below, which includes all aspects of lithium production, processing and refining through to production of lithium batteries.

The Ganfeng "ecosystem"



Source: Ganfeng

The ILC IPO in 2011 was Ganfeng's first strategic upstream move

In the February 2018 prospectus for its upcoming Hong Kong IPO, Ganfeng noted:

"Due to the scarcity of upstream lithium resources, access to an adequate high-quality supply of raw materials is crucial…We first started to acquire equity interests in lithium resources as early as 2011…We believe it is critical to partner with the best industry players to ensure sustainable and quality growth."

Indeed, partnering with lithium miners has become a key part of Ganfeng's vertically integrated strategy. Besides ILC, Ganfeng has made three strategic investments:

- Acquired a 43.1% stake in the Mt Marion project in Western Australia, which it co-owns with Mineral Resources and Neometals.
- Acquired a 19.9% stake in Lithium Americas, which is developing the Cauchari-Olaroz project in Argentina and the Lithium Nevada project in the US.
- Acquired a 4.84% stake in Pilbara Minerals which is developing the Pilangoora project in Western Australia.

ILC's partnership with Ganfeng was strengthened after the latter acquired direct ownership stakes in two of ILC's three lithium projects:

- An 82.7% stake in the Mariana lithium brine project in Argentina, with ILC having "back-in" rights to acquire an additional 10% (see below) after the completion of a feasibility study.
- A 55.0% stake in the "hard rock" Avalonia pegmatite lithium project in Ireland.

In Ganfeng's 2018 prospectus, the company emphasised its commitment to the Mariana project, while noting the homogeneity of Mariana's brine and its low cost – two of the attractions we discuss in this report. However, it was the target commissioning date cited by Ganfeng that took us by surprise:

"Mariana has a homogenous geochemical concentration that can be extracted through conventional solar evaporation process at a relatively low cost…We also intend to continue exploration efforts at the Mariana Project in Argentina and expect to commence production in 2019 and target commissioning in 2021."

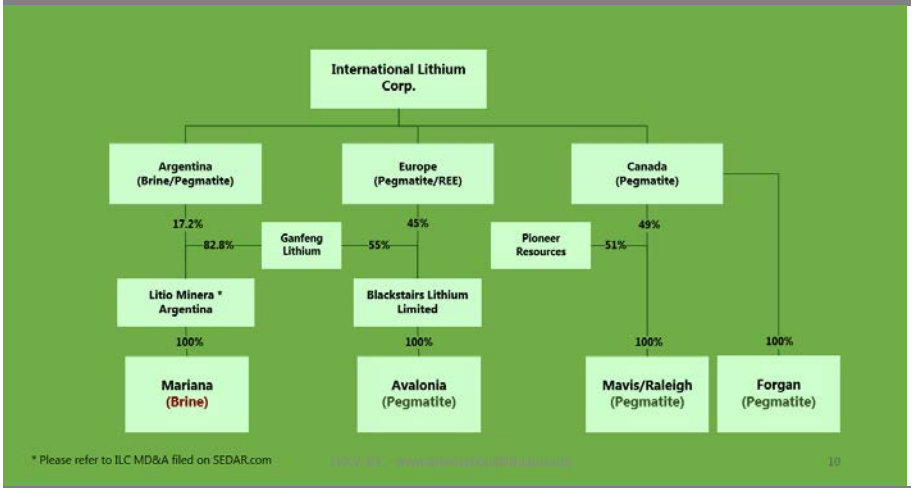
Our assumption for Mariana's commissioning remains conservative for now

Our slightly more conservative assumption for the commissioning of Mariana is 1 January 2022; however, we were encouraged by the upbeat assessment.

We should also note that, following the Mariana and Avalonia deals with Ganfeng, ILC concluded a partnership agreement for its third exploration project with ASX-listed exploration company, Pioneer Resources. In March 2016, Pioneer took a 51% stake in the hard rock Mavis/Raleigh lithium deposit in Ontario, Canada.

The chart below summarises ILC's ownership in its three exploration projects.

ILC – project ownership



Source: ILC

Despite putting together a strong portfolio of exploration projects, ILC temporarily lost its way

ILC put together a strong portfolio of lithium assets, including working in partnership with a major blue-chip lithium industry partner. However, by late 2017, ILC's previous management had steered the company into operational and funding difficulties, which the recently appointed Chairman/CEO is reversing.

Management change and financing

March 2018 – John Wisbey appointed Chairman/CEO

Out with the old

On 16 March 2018, ILC announced the replacement of CEO Kirill Klip with John Wisbey. The latter is a tech entrepreneur who founded two AIM-listed companies: Lombard Risk Management plc (acquired by Vermeg for US$73.2m in February 2018) and IDOX plc. Lombard Risk Management is a software company that specialises in risk management and regulation. IDOX creates software that facilitates Local Authorities' planning applications.

Wisbey bought shares in ILC as an outside investor in 2015, and was subsequently appointed to the board as a NED and then Deputy Chairman. During 2017, ILC ran into problems, with the company falling behind on funding its operations, while relations with Ganfeng became strained temporarily. Late last year, Wisbey took control of "rebooting" the Ganfeng relationship, sorting out a dispute going back to early 2017 regarding outstanding management fees and a missed project payment in early 2017. Under the outcome, ILC maintained its status as having zero defaults, as defined in the joint venture agreement. He was also able to address funding and operational issues, which, subsequently, led to the board appointing him Chairman and CEO.

Operational issues and Ganfeng partnership required immediate attention

Key issues began to be addressed. A cash call on Mariana had been missed in February 2018. Aside from funding Mariana and repairing the relationship with Ganfeng, the company needed to repay C$0.4m of convertible debentures by April 2018 and, on several occasions, had been behind on normal monthly expenses.

New Chairman/CEO funds C$1.18m convertible issue

Following the change in CEO, ILC announced a C$1.18m convertible debenture issue, funded by John Wisbey, on 29 March 2018. The proceeds were to be used for payment of creditors, other working capital needs and to fund ILC's 17.2% share of development spending on the Mariana lithium project to prevent further dilution. Prior to the issue, Wisbey owned 2.39% of ILC's outstanding equity on an undiluted basis and 8.45% on a diluted basis (assuming exercise of all warrants and options). Should the C$1.18m debenture and the subsequent C$1.8m debenture be converted, Wisbey would own up to 19.90% of ILC on a diluted basis.

The net issue was funding

In the statement accompanying the issue, Wisbey emphasised the change in management style that ILC shareholders should expect. In particular, he noted that it was imperative for ILC to stay ahead of the funding curve as it progressed its exploration assets, especially Mariana in Argentina, towards production:

"This private placement will allow us to be current with all our existing payables, including cash calls on the Mariana project, and still have sufficient contingency. We now need to address staying ahead of the Company's cash requirements for the future, and I am hoping that some of our existing shareholders, as well as some new shareholders, will support us in the next round of financing.

I believe strongly in the Company and the underlying value of Mariana and our other projects, which is why I have been willing to invest a lot of my own money in the Company at a time that it needs it. We have finished a challenging quarter, but now we need to ensure that the next quarter keeps us in the same or a better financial position than after this financing, so that we can again concentrate on value creation for our shareholders."

Second convertible issue completed

Following on from the C$1.18m issue, ILC announced the closing of the first and second tranches and subsequent completion of a C$1.8m second convertible debenture during 3 May 2018 to 16 July 2018. The debentures mature on 30 June 2019 and are convertible into ILC common shares at C$0.085 for the first year, and thereafter C$0.10, versus the current share price of C$0.09.

On 15 June 2018, when the closing of the second (C$0.9m) tranche was announced, ILC's share price rose by 20%, from C$0.075 to C$0.09. The announcement of the final closing on 16 July 2018 led to an 11% rise in the share price, from C$0.09 to C$0.10. Several directors, including John Wisbey, participated in the issue - in aggregate purchasing C$709,500 of the issue, or 39%.

Going forward, the new management team needs to communicate ILC's investment case to the market

We should also note that ILC's current shareholder register has no significant institutional shareholders, in contrast to some other exploration companies in the space. This reflects the previous management's disappointing record of raising funding for attractive assets in an investable industry, driven by exponential growth in lithium-dependent EVs.

Mariana – ILC's core project

- **Centrally located in South America's "Lithium Belt".**
- **Mariana salar benefits from high transmissivity and uniform lithium grades.**
- **PEA due in Summer 2018, followed by PFS in early 2019.**
- **Company envisages 10,000kt p.a. production from 2022.**

Located in north-western Argentina

Mariana covers 160 sq km

ILC acquired the Salar de Llullaillaco ("Mariana") in May 2009 for a price of US$3.0m, paid over a five-year period. The acquisition initially covered mineral claims over 120 sq km of the Mariana salar (brine lake), which extends 12km north-south and 10.5km east-west. In August 2010, ILC was granted an additional 40 sq km claim adjacent to the existing claims. The newer claim provides land for a potential processing plant.

Favourable logistics

Mariana is located in north-western Argentina, 120km west of the village of Tolar Grande, at an altitude of 3,800 metres, in Argentina's Salta province – see the map below. The deposit is accessible by paved and dirt roads on a year-round basis, and (critically) a major railway line, from Salta to the port city of Antofagasta on the Chilean cost, is approximately 20km away. This improves the competitive position of Mariana vis-à-vis other (seemingly) more attractive projects in the region.

Mariana location

Source: ILC

Salars – key features

Understanding lithium salars

Salars are brine lakes formed by the accumulation of saline groundwater enriched in lithium salts, often with magnesium, potassium, sodium and borate salts, which have leached from surrounding uplands. Unlike some lithium producers and explorers, ILC's mineral claims encompass an entire salar. In those cases where more than one company owns the claims, they can compete to extract the brine resource.

High-quality lithium brine deposits include the following features:

- a closed basin that drains into a salar;
- suitable lithium source rocks in the surrounding basin;
- one or more brine aquifers (defined as a body of permeable rock containing groundwater); and
- an arid climate and strong winds, which promotes evaporation to concentrate the lithium salts.

How lithium salars are formed

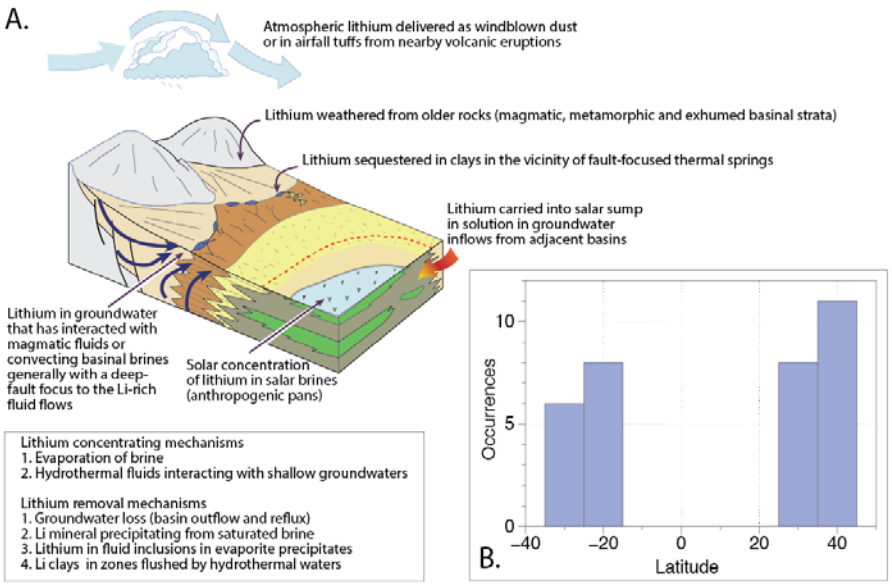


Figure 14. Lithium levels in lake brines and pore waters in various lithium brine lake deposits and prospects in China, South America and North America (plot points extracted from various literature sources compiled in SaltWork® database 1.7)

Source: Saltwork Consultants

First stage of extraction incorporates solar evaporation

To extract the lithium, the brines are pumped to the surface from boreholes, after which they flow into a series of evaporation ponds, where solar evaporation occurs over many months. The evaporation ponds serve a threefold purpose:

- increasing the lithium concentration of the brine;
- removal of impurities, especially sodium chloride, sulphates and magnesium; and
- the extraction of economically significant by-products, such as potash.

Potash contains potassium compounds in water-soluble form, mostly potassium chloride. It is often harvested in the early evaporation ponds. Sodium chloride

usually precipitates in the second series of evaporation ponds, before the brine moves into a third series of ponds, where it remains until the lithium concentration reaches the 6% threshold, which is the saturation point of lithium chloride.

Upgraded lithium-containing brine is used as a feedstock in a recovery plant for further purification and extraction in the form of lithium carbonate (usually) or lithium hydroxide. In the case of lithium carbonate, soda ash (sodium carbonate) is added to the concentrated brine, which precipitates the lithium carbonate, and which is then filtered and dried.

The "Lithium Belt"

Putting Mariana in a bigger picture of global lithium supply, the project is centrally located in South America's "Lithium Belt", an area marked by large expanses of salt flats, believed to contain 60%-65% of the world's lithium reserves. The triangle is a north-south strip of land measuring approximately 800km by 300km at the intersection of Argentina, Bolivia and Chile. Part of the Lithium Belt is shown in the map below. The map on the left-hand side shows Mariana's proximity to the world's most productive salar, the Salar de Atacama (due north) and several others.

Mariana in South America's "Lithium Belt"

Source: ILC

Historical sampling at Mariana, confirmed by ILC, reported high lithium, boron and potash levels in the main body of the salar. Lithium values are usually measured in milligrams per litre (mg/L), which are approximately equal to parts per million (ppm), when brine density is similar to fresh water. During ILC's initial testing, water samples from the shallow subsurface covering a 3km stretch of the salar showed values ranging from 188-283mg/L lithium. As exploration progressed, average lithium grades rose, and the brine was found to be surprisingly rich in potash.

Phase I exploration – Ganfeng takes stake in Mariana

It's "mining", but not as we know it

Evaluating lithium brine projects presents very different challenges to conventional hard rock mining. Brine deposits are fluid and, therefore, dynamic rather than stationary, mixing with adjacent fluids before and after a brine deposit is exploited.

Mariana – Salar de Llullaillaco

Source: ILC

Size isn't everything

Size isn't everything when it comes to exploiting brine deposits. In fact, specific yield is an equally important consideration regarding the economic potential of a salar, along with (not surprisingly) porosity and specific retention.

- **Specific yield:** the ratio of brine that can be pumped to the surface under gravity relative to the total brine available – since a substantial amount of brine will remain trapped in the aquifer.
- **Porosity:** the percentage of void space in a rock defined as the ratio of the volume of the voids to the total volume.
- **Specific retention:** the percentage of the volume of water that will be retained by rock against the pull of gravity and after saturation.

Determining the magnitude of recoverable lithium (usually expressed as tonnes of LCE, i.e. lithium carbonate equivalent) is typically based on a consideration of:

Estimating lithium resources

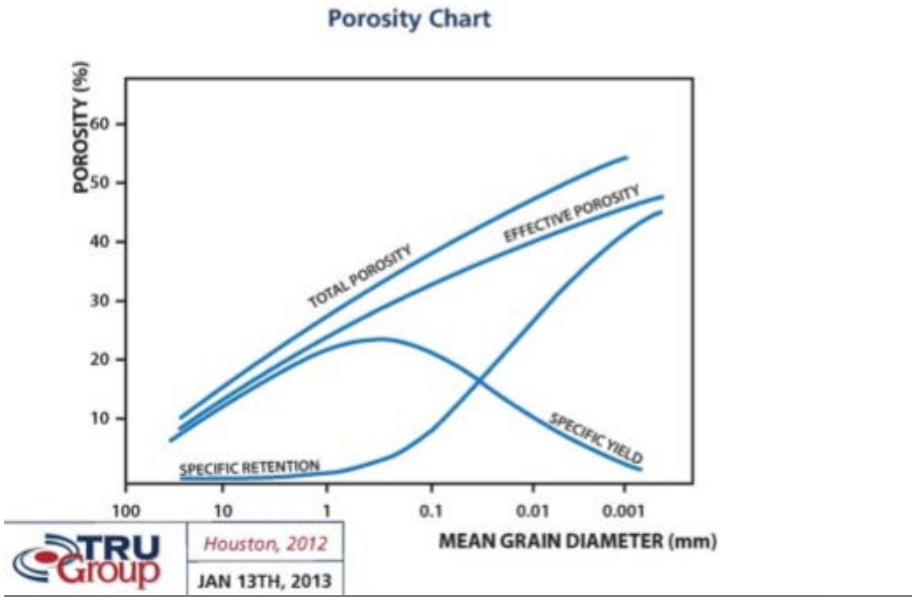
- the geometry of the host aquifer;
- its specific yield;
- the porosity of the aquifer;
- specific retention; and
- the concentration of the economically significant elements in the brine.

Let's briefly discuss porosity in relation to other brine resource parameters. For example, it typically declines sharply at depths of more than 50 to 60 metres. There are exceptions, however, when there is significant faulting, e.g. at Mariana.

Brine resource parameters

Porosity tends to increase with declining average size in grains in rock sediments. However, this needs to be balanced against specific retention and specific yield. Fine silts and clays, for example, can be very porous, but specific retention typically increases sharply as "fineness" increases (and average grain diameter declines). In addition, both porosity and specific retention have to be balanced with specific yield. The chart below shows a typical interaction of these parameters and how specific yield is typically optimised by grain sizes in the range 0.1mm-1.0mm.

Porosity, specific yield and specific retention versus mean grain diameter



Source: Tru Group

Exploration begins at Mariana

Following the acquisition of Mariana, the first stage of the exploration programme focused on geochemically characterising the shallow subsurface brine in the salar to determine zones with a high lithium concentration for drilling. Key tasks included:

- A brine sampling programme at a grid spacing of 2km covering the entire salar.
- A geochemical investigation to develop a hydrogeological model of the salar, i.e. the distribution of brine below ground.
- A lithogeochemical analysis or, in other words, an interpretation of the mineral structure of the immediate area.

Brine sampling returned a majority of samples within the main 10km x 15km body of the salar with lithium values of 250mg/L-650mg/L. Drilling began in January 2012 with a "4-5 hole" drill programme. This consisted of four drill holes (totalling 444 metres) positioned 5km apart within the main 10km x 15km salar basin. Phase one drilling intersected extensive, brine hosting sand-rich layers below the upper halite (rock salt) level. The combined brine densities, i.e. encompassing lithium, potassium and boron, ranged from 1,190mg/L to 1,298mg/L.

Exploration drilling at Mariana

Source: ILC

Let's talk lithologic types

Salars containing brine deposits generally conform to two main lithologic types, although they can be a mixture of both:

- **Evaporite-dominant:** a sedimentary rock consisting of one or more minerals formed as precipitates of an evaporating brine solution. Halite is one example of an evaporite, and is known as "rock salt", which is the mineral form of sodium chloride or salt.

- **Clastic-dominant:** these are sedimentary rocks and rocks composed of fragments, or clasts, of pre-existing minerals and rock. Clastic sediments often include high levels of gravel, sand and clay.

The chart below shows indicative brine flow rates through different types of sedimentary layers.

Brine flow rates through different sedimentary layers in aquifers

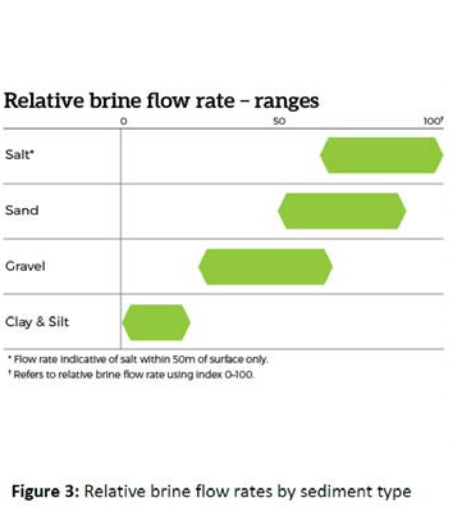


Figure 3: Relative brine flow rates by sediment type

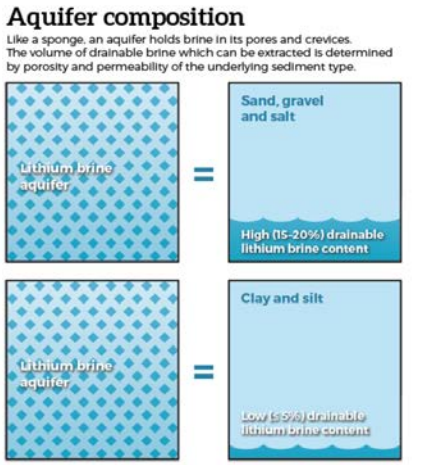


Figure 4: Drainable brine hosted in an aquifer

Source: Lithium Power

Evaporite and clastic at Mariana

The Salar de Atacama in Chile, for example, is dominated by evaporite zones. Clastic-dominant salars are characterised by predominantly clastic strata interbedded with minor evaporites, particularly halite. **At Mariana, both evaporite and clastic zones are prominent**.

Salar de Atacama

Source: SQM

In terms of the geology, the initial exploration results at the Mariana salar showed:

- An upper halite layer, which varied in depth from 18 to 32 metres in the peripheral areas and 66 metres in the centre of the salar.
- Below the halite layer was a mixed evaporite layer approximately 32 to 52 metres thick, consisting of more than 60% fine to coarse sand, i.e. it was predominantly clastic.

- Below the evaporite sequences in all drill holes was a medium/coarse-grained, dark-coloured, basaltic sand interval.

The existence of an aquifer at Mariana was confirmed by brine flow measurements recorded during the drilling programme. The flow within the aquifer increased below the halite throughout the sand-rich layers. It was also noteworthy that none of the drill holes struck basement rock, all remaining in potential basin material. Subsequently, a bulk sample of Mariana brine, amounting to approximately 17,000 litres (20 tonnes), was collected from several depth horizons and shipped to Ganfeng's laboratories in China for metallurgical analysis.

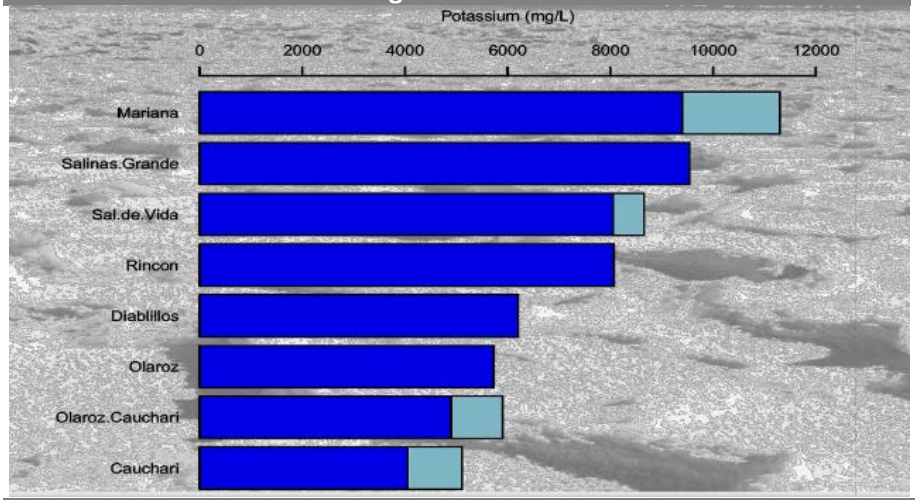
Mike Sieb, then President of ILC, noted at the time:

"We are very encouraged by the granular stratigraphic units (i.e. rock layers/strata) intersected, which in conjunction with the brine density measurements and flow observations, indicate the potential for a significant brine aquifer at the Mariana lithium-potash project."

Plenty of potash

An unexpected benefit of early exploratory work was the discovery of high levels of potash in the brine samples from the surface to the bottom of the drill holes. Potash consists of potassium salts, mainly potassium chloride, which are used as a fertilizer. The grades of potash reported at Mariana were some of the highest reported in any Argentine salar (see below).

Potassium concentrations in Argentinian salars



Source: ILC

Ganfeng takes majority stake

As exploration of the salar advanced, Ganfeng acquired an 80% interest in the Mariana project, in March 2014, in exchange for the cancellation of US$3.3m of loans to ILC and related interest. As noted earlier, ILC negotiated a "back-in" right to acquire an additional 10% in the project following the completion of a Feasibility Study demonstrating viability of commercial production. To activate the "back-in", ILC would pay back 10% of the project costs to date, estimated to be about C$5.0m by March 2019.

Phase II exploration – transmissivity and uniformity

After the successful start, ILC and Ganfeng identified the main objectives for the next stage of the Mariana exploration programme to work towards a resource estimation:

- Completing the remaining 10-12 holes needed for delineation drilling.
- Further hydrogeological testing required to produce a reportable resource.
- ILC retained GEOS Mining, an Australian geological consultancy with experience in brine resource estimation to provide assistance.

A second aquifer

Significant progress towards a better understanding of the salar was made after drilling a 171 metre core recovery hole (DHMA15-09PW) near its centre in 2015. This drill hole was approximately 20 metres from an earlier reverse circulation drill hole, DHMA12-07. The new drill hole confirmed the presence of two aquifers – one in the predominantly halite layer and a deeper one in the sandy layer:

- The first aquifer is from the surface to a depth of 30 metres, and consists of granular and massive halite with silt and fine tuffs.
- The second aquifer is from the surface to a depth of 53 to 119 metres, and consists of medium- to coarse-grained gravels in a sandy matrix.

Pump tests begin

With the completion of drill hole DHMA15-09PW, ILC began pump tests to provide greater clarification of the hydrological characteristics of the brine aquifers under realistic pumping conditions and their response afterwards. These tests would help determine the potential rate at which brine could be drawn from the upper aquifers.

Pump tests at Mariana

Source: ILC

ILC's then President, Kirill Klip, commented:

"We are highly encouraged by what we are learning about the thick brine aquifers at Mariana. We look forward to completing the pump test which will give us a sense of the potential productivity of wells in these aquifers and we are confident that our plan to acquire these key preliminary hydrological results prior to a

mineral resource estimation is both an expeditious and cost-effective approach toward an initial production assessment."

That's what we call quite good

The most important findings from the 2015 exploration programme were as follows:

- **Transmissivity** – pumping tests indicated that both aquifers had a high transmissivity, i.e. the rate at which water can flow horizontally through an aquifer, e.g. to a pumping well.
- **Uniformity** – drilling and sampling confirmed relatively uniform grades of lithium, and both laterally and vertically throughout the aquifers.

It is hard to underestimate the significance of these findings for the economics of future Mariana production.

Explaining transmissivity

The high transmissivity is due mainly to Mariana's

- high porosity, and
- high specific yield.

giving the aquifers the ability to release the lithium and potash-containing brine.

Pumping tests have indicated that the "specific yield" of the deposit's aquifers is high. Specific yield is technically defined as the volume of water released per unit surface area per unit decline in the water table. The tests also showed that, after brine is pumped at Mariana, drawdown in the water table around the well is limited and brine is replaced rapidly – which also contributes to its potential productivity.

It's more than porosity

The limited drawdown and rapid recovery is due to more than porosity, being helped by the water balance at Mariana, i.e. the ratio of water entering the aquifer from the surrounding region, versus water leaving the aquifer (extent to which it is a closed system). While porosity is a factor in the water balance, so is the drainage basin.

The drainage basin supplying Mariana is large relative to the size of the salar, both horizontally and vertically. In terms of the latter, it includes a large vertical drop from a nearby mountain peak of approximately 6,700 metres. In the long-distant past, it is possible that the drainage basin was connected to the Salar de Atacama, before younger volcanoes sprang up and blocked the flow, creating a closed basin.

Grade uniformity at Mariana

The uniformity of lithium grades at Mariana is due to

- its high porosity (again), and
- the high degree of faulting and fracturing in its geology.

These factors contribute to the high flow in the aquifer, which facilitates "mixing" of the brines from different parts of the aquifer, making them more homogenous.

The uniformity of grade at Mariana, e.g. LCE rarely falls below 200mg/L, means that downstream processing of the brine will be less costly if the project is developed. Varying brine grades adversely affect the following:

- Evaporation times – which are shortened or lengthened.

- Using the correct volumes of reagents becomes problematic, e.g. in liming stages to remove magnesium and sulphate impurities.

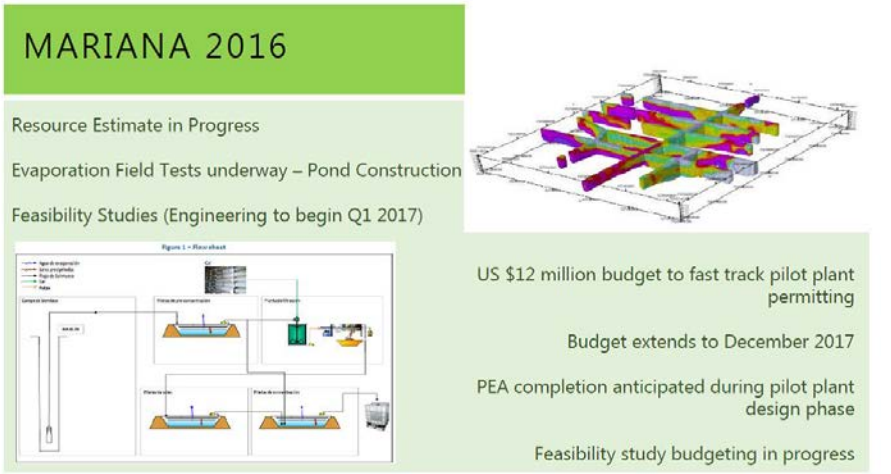
So…the second phase of exploration at Mariana established the project's potential to punch above its weight in economic terms. However, there was still no resource estimate, and there was more to learn about the salar itself.

Phase III exploration – maiden resource estimate

We need a resource estimate

The third phase of exploration, with the primary objective of producing a maiden resource estimate, began in 2016. This followed the agreement between ILC and Ganfeng on a US$12m exploration budget to accelerate Mariana's development.

Exploration work accelerated in 2016



Source: ILC

The drilling programme saw three drill holes completed (MA16-11, 12 and 13) at depths beyond 170 metres, i.e. beyond the maximum depth of any previous drilling. The three drill holes were in a triangular formation centred in what gravimetric and seismic geophysical surveys indicated was the deepest part of the basin. The drilling reached a maximum depth of 202 metres below the surface.

Potential third aquifer

Of note, the new exploratory work discovered a potential third aquifer deeper in the salar. This deeper aquifer was intersected at a depth of approximately 162 metres and extended beyond the ends of the drill holes. The existence of a third aquifer was also suggested by Transient Electromagnetic (TEM) geophysical data testing, represented by a highly conductive zone at greater depths. In addition, the TEM results suggested that the first two aquifers were likely to be connected – which was probably one of the factors in the high transmissivity and low drawdown findings of the previous exploration programme.

Following completion of the 2016 drilling programme, ILC and Ganfeng were able to complete the resource estimate. In total, 23 holes had been drilled: 10 reverse circulation holes and 13 cored holes. All but two of them showed the aquifer was open at depth. Besides delineating the host aquifer and estimating the grades of the key minerals, the other key determinants of the recoverable resource included:

- the aquifer's permeability;
- its specific yield;

- the water balance; and
- the cut-off grade.

Resource estimate, March 2017

The resource estimate was published in March 2017 (effective 20 January 2017), and complied with National Instrument 43-101 – *Standards of Disclosure for Mineral Projects* (the "NI 43-101 Technical Report") and the Joint Ore Resources Code – JORC – (2012) for mineral projects.

The report detailed an indicated resource estimated at 1,248,000 tonnes of lithium carbonate equivalent (LCE) and a net estimate of 749,000 tonnes, assuming a 60% recovery rate. This was based on 765 billion litres of brine, grading 306mg/L lithium. The brines in the indicated resource covered an area of 135 sq km, extending from depths of about 0.5 to 329 metres. The gross inferred resource was 618,000 tonnes of LCE, or 371,000 tonnes net, assuming an identical 60% recovery rate. In aggregate, the total indicated and inferred resources were estimated at 1.866m tonnes gross and 1.127m tonnes net.

Mariana resource estimate (tonnes)

Date – January 2017	Li mg/L	Lithium	LCE
Indicated	306	234,000	1,248,000
Inferred	322	116,000	618,000
Total (gross)		**350,000**	**1,866,000**

Source: ILC

Towards a PEA and a PFS

Resource estimate…tick, what's next?

The publication of the maiden resource estimate was confirmation that sufficient lithium was present in the salar to continue the economic evaluation of the project. However, further work was needed, with the goal of producing a PEA and, subsequently, a PFS. For example, knowledge of the aquifer, e.g. in terms of geometry and permeability, was based on broadly spaced drill holes, and only two of them, as noted, had potentially intercepted the basement of the aquifer. ILC noted that, to assess the recoverable brine with a higher level of confidence, it required more information on permeability and flow regime in the aquifer and water balance. Exploration goals were set for the rest of 2017, which included the following:

- detailed pump tests;
- initial construction of test evaporation ponds;
- water balance studies;
- transportation studies; and
- environmental baseline and archaeological studies.

Progress initially disrupted by bad weather

However, a combination of bad luck and the previous management regime meant that limited progress was made. Work was disrupted for a few months, after snowstorms in May and June 2017 affected access to the site and the surrounding region. Following the disruption, activity began to return to normal in August 2017, which included geophysical surveys, e.g. electromagnetic surveys to highlight possible freshwater sources and a second phase of gravity surveying to provide a more complete map of the depth of the basin. On the positive side, 2017 saw the start of construction of large-scale evaporation ponds for evaporation tests, as well as some smaller ponds for the later stages of brine concentration. Work also began on a field laboratory, liming plant and environmental studies.

In December 2017, ahead of the change in senior management and as John Wisbey "rebooted" the partnership with Ganfeng, ILC released details of a C$17.3m (US$14.0m) budget in 2018 for ongoing exploration and evaluation work at the Mariana project. Key elements included:

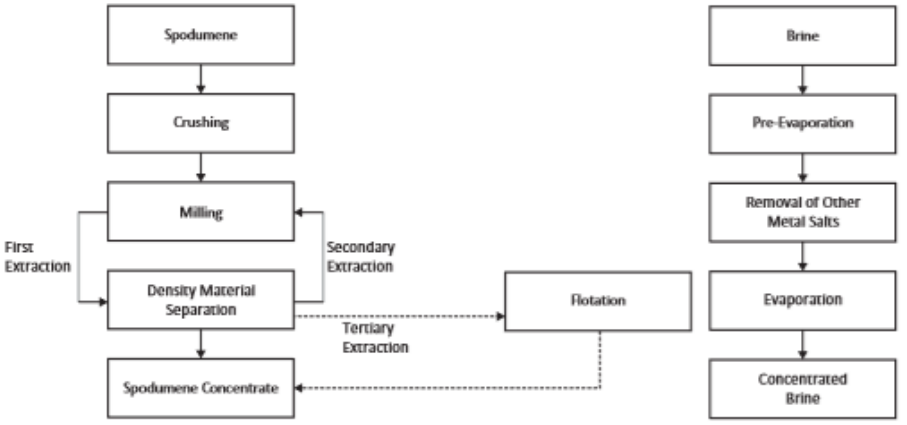
- continued natural evaporation studies;
- aquifer characterisation studies; and
- membrane separation studies (see below).

The latest indication from ILC's senior management is that the timeframe for the release of the PEA is likely to be during summer 2018, probably in late August. Should the PEA confirm the viability of Mariana, the company expects to follow up with a PFS by early 2019.

10,000 tonnes of LCE p.a. assumption

At this stage, we expect the PEA to suggest a potential production of 10,000 tonnes of LCE p.a. However, it could be higher, subject to decisions on downstream processing. An in-depth consideration of the latter will probably be included in the PFS, which will outline options for processing the brine. The chart from Ganfeng below compares the lithium extraction processes from brine and spodumene hard rock through to the stages of concentrated brine and spodumene concentrate.

Flow chart for processing lithium raw materials



Source: Ganfeng

Three options for brine processing

At this stage, ILC has three options for processing concentrated brine:

- A conventional downstream processing plant for on-site production of lithium carbonate.

- Export concentrated brine for toll conversion at Ganfeng's Chinese facilities.
- Build a membrane separation plant on-site to recover lithium hydroxide.

It is too early to say which outcome is most likely, although the third one would likely generate higher returns if adopted. In September 2017, ILC reported positive test results from using membrane technology to separate lithium from the raw brine, which contained impurities such as magnesium and sulphates. Lithium brine projects contain widely differing impurity levels, as the following table shows.

Brine lakes – magnesium and sulphate concentrations (mg/L)

Mine/project	Magnesium	Sulphate
Atacama	11,740	20,180
CITIC Guoan (China)	8,447	183,581
Maricunga	8,280	720
Uyuni	7,872	10,294
Rincón	3,697	12,383
Olaroz	1,908	0
Cauchari-Oaroz	1,586	19,032
3Q	1,418	604
Hombre Muerto	1,024	10,279
Zhabuye Lithium	13	67,963
Mariana	**4,291**	**15,530**

Hardman & Co Research, company reports

ILC's press release, "Proof of Concept Study – Lithium Recovery Using Membrane Separation", noted.

"Results from the Study indicate that the selective recovery of lithium directly from raw (filtered) brine, with the simultaneous rejection of other cation and anion species, using a proprietary lithium selective separation process is possible. Lithium was selectively recovered from the raw brine to produce lithium hydroxide…used directly in lithium battery manufacturing, as a final product.

The study showed that the resultant retentate from the membrane separation could be directly converted to hydrated lithium hydroxide. In other words, it could be possible to make a more refined end product at the Mariana joint venture. Further, it would eliminate the need to remove contaminants, especially magnesium via the liming process, as is typical in the natural evaporation process."

In the US$14.0m 2018 exploration budget, US$400,000 was allocated to further study of the potential for using the membrane separation technology. The next stage will be carried out by Ganfeng in its Chinese facilities.

Successful testing of membrane separation could increase production significantly

We await further updates, but ILC is optimistic that the membrane technology can improve the economics of the Mariana joint venture significantly. Besides reducing production costs and simplifying downstream processing, the technology has the potential to increase the production rate of the project, compared with using conventional evaporation ponds. Indeed, should the test results confirm the validity of the technology and its potential for commercialisation, it could double annual lithium production (defined in LCE terms) if Ganfeng took the decision to go ahead. However, there are pros and cons to using this technology, and it is possible that evaporation and shipment of brine concentrate may be the path preferred by Ganfeng, leveraging its existing production facilities in China.

Avalonia – "hard rock" in Ireland

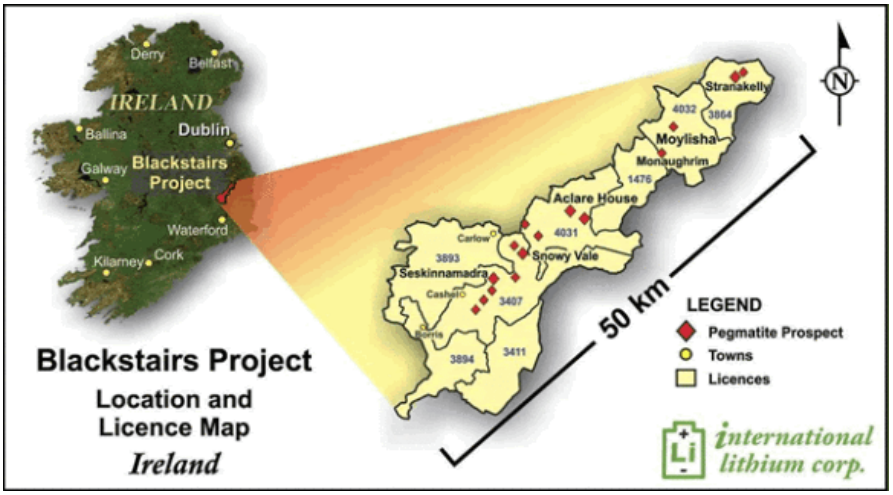
- **Exploring for lithium-containing spodumene ore in south-east Ireland.**
- **Ganfeng took a majority stake in 2014.**
- **Intersections of 2.33%-4.59% at the Moylisha and Aclare strikes.**
- **Drilling programme resumed in May 2018 with C$1.0m budget.**

Exploration licences cover 292 sq km

Licences cover 292 sq km

In August 2009, ILC, then part of TNR Gold Corp., was granted eight licences by the Irish government to explore the lithium, tantalum and rare earth-containing Leinster Pegmatite Belt in south-east Ireland. TNR initially called the project "Blackstairs", although it was subsequently renamed "Avalonia". The licences covered an area of 292 sq km in rural farmland, about 80km south of Dublin, in the counties of Carlow and Wicklow. The belt is about 50km long and oriented NE-SW.

Location of Avalonia (formerly Blackstairs) project



Source: ILC

Ireland…seriously?

ILC is not the only company exploring for lithium in Ireland. According to the Irish government's Department of Communications, Climate Action & Environment:

"Ireland's varied geology makes it prospective for a number of commodity types. In addition to gold and base metal potential, recent exploration has been carried out for the following commodities:

- Platinum Group Metal (PGM) mineralization associated with mafic intrusive complexes in northeast Ireland.
- Rare Earth Element and speciality metals (e.g. lithium, tantalum, tungsten and tin) associated with 'pegmatite' intrusions that cross-cut the Caledonian Leinster granite batholith in southeast Ireland.
- Nickel and chromite associated with ultramafic intrusions in the west of Ireland

- Diamonds and other gem minerals associated with the Pre-Cambrian rocks of Inishowen, Co. Donegal."

Lithium occurs in granitic pegmatites, primarily spodumene

In terms of conventional hard rock mining, lithium is found in low concentrations in some igneous rocks (formed by cooling of lava/magma). The largest concentrations of lithium-containing minerals are found in granitic pegmatites, i.e. coarsely crystalline granites. The most important mineral is spodumene.

Spodumene is a lithium aluminium inosilicate with the chemical formula $LiAl(SiO_3)_2$, sometimes expressed as $LiAlSi_2O_6$. Relative to brine-based lithium operations, spodumene deposits have higher in-situ concentrations of lithium. Spodumene in a pure form contains 8% lithium as Li_2O (lithium oxide), although most productive ores contain less, e.g. 1.5%-4.5% Li_2O.

Spodumene rock

Source: ILC

From spodumene to lithium compounds

Processing spodumene into usable lithium compounds (e.g. carbonate and hydroxide) is complex and costly. To produce lithium carbonate from spodumene concentrate, it is first roasted at a temperature of about 1,050°C. This roasting causes spodumene to go through a phase transformation from α-spodumene to β-spodumene. The α-spodumene is virtually refractory to hot acids and, therefore, very difficult to process. The phase transformation causes the spodumene crystal structure to expand, making it about 30% less dense and amenable to sulphuric acid. The material is cooled, mixed with sulphuric acid (95%-97%), and then roasted again – this time at about 200°C. An exothermic reaction begins at 170°C, and lithium is extracted in the form of lithium carbonate by the addition of soda ash (sodium carbonate) to precipitate the carbonate.

The concentrations and dispersion of lithium in the deposit, the presence of valuable co-products, the absence of deleterious elements and favourable logistics, since concentrates are generally shipped to converters that can be located far away, are all important factors in having a viable industrial scale operation.

Lithium-bearing pegmatites were first discovered in Ireland's Leinster area in the 1970s during exploration for base metals. Prior to 1977, Irish Base Metals carried out a preliminary exploration programme comprising prospecting, sampling, trenching and geophysical surveys, culminating in 47 short boreholes totalling 2,300 metres at four of the 19 lithium pegmatite occurrences.

Finding boulder trails

The pegmatite occurrences were primarily discovered as boulder trails. With little outcrop, boulders are a useful indication of the underlying geology. Below is an example of a pegmatite boulder at the Avalonia site.

Pegmatite boulder at Avalonia

Source: ILC

First stage of exploration

After taking control of Avalonia, ILC outlined the first stage of its plan for the Blackstairs/Avalonia project as follows:

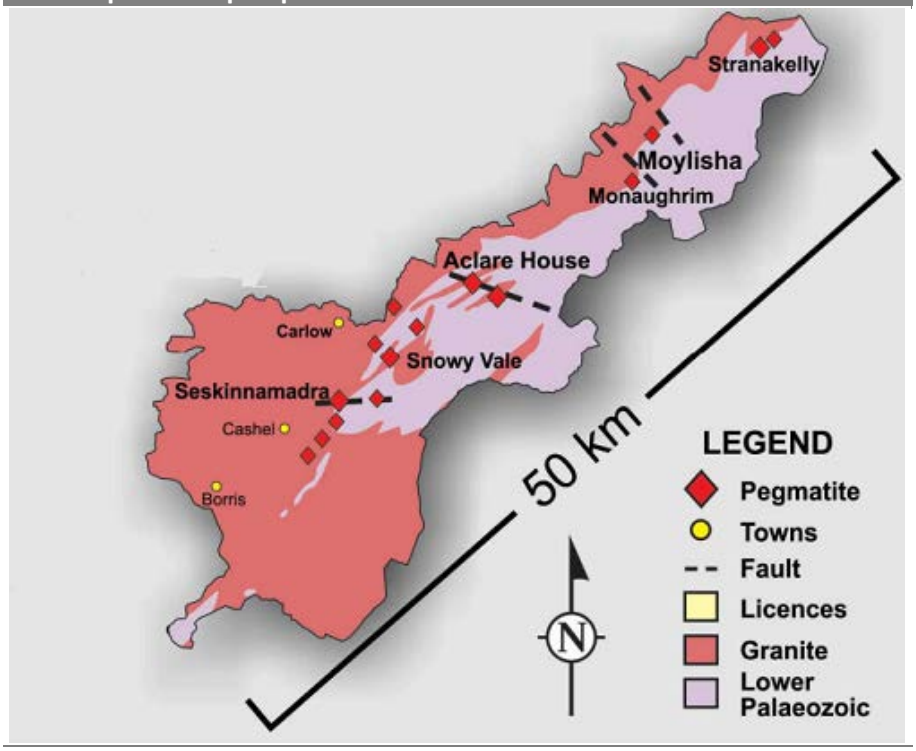
- evaluate all 19 pegmatites that make up the Leinster Pegmatite Belt;
- confirm historical drilling results;
- evaluate the pegmatite bodies to assess the full suite of potential minerals.

ILC engaged Aurum Exploration Services, an Irish geological consultancy, which undertook a preliminary reconnaissance of the property, reviewed historical deep overburden sampling and identified two initial drilling targets. Aurum's preliminary results confirmed trends and zonation in lithium, caesium, tantalum and other rare metals.

This reinforced the belief of ILC executives of the existence of additional prospects and extensions to known prospects throughout the belt.

Further exploration work discovered a high-grade lithium, high-density pegmatite boulder field on the project in January 2012, at a newly exposed area at Moylisha. Five holes were drilled for a total of 212 metres approximately 10km northeast of Aclare House, which lies at the centre of the property.

Main exploration prospects at Avalonia



Source: ILC

Location of Moylisha prospect

The Moylisha strike was located 500 metres southwest of past pegmatite exploration, and the width of the pegmatite body encountered varied between five and 10 metres. Samples included 4.59%, 3.45% and 3.27% Li_2O.

Ganfeng takes a majority stake

Enter Ganfeng

In 2012, Ganfeng began negotiating with ILC about taking a majority stake in the Avalonia project. Formal due diligence began the following year, and ILC and Ganfeng finalised the joint venture in March 2014. Initially, ILC retained 49% ownership, with Ganfeng taking 51%. The agreement with Ganfeng was amended in October 2015, with the Chinese company taking an additional 4%, after repayment terms on C$1.169m of ILC's indebtedness to Ganfeng were altered. This saw C$126,000 of its loan extinguished and C$1,042,841 (US$798,500) added to a previously granted Mariana exploration loan. The exploration loan carries an interest rate of 10% and is repayable from ILC's share of proceeds or net smelter royalty payments derived from the joint venture (before which no interest is payable). If no proceeds or net smelter royalty payments are derived from the joint venture, the loan is payable by 14 March 2024.

Under the terms of the agreement, Ganfeng would earn a 75% interest by either:

- making development expenditures of C$10m; or
- producing a positive feasibility study for the project.

This potentially valued the project at C$50m, but only if the Chinese company continued to believe in the project viability as it funded further exploration.

€1.6m exploration programme announced

In September 2014, six months after Ganfeng bought its initial stake, the joint venture announced a €1.6m (C$2.3m) exploration programme. This phase included regional scale geological mapping and geochemical surveys in preparation for drill target selection, which were aimed at providing a better geochemical picture of the Leinster Pegmatite Belt. For example, it was hoped that mineralised zones could be extended and new prospects identified in areas with less historical exploration.

Pegmatite boulder at Avalonia

Source: ILC

Exploration findings

The main findings were as follows:

- Soil geochemistry revealed anomalies, both adjacent to some of the historical prospects and in areas not previously identified. This could reflect extensions to known mineralisation.
- The prospective belt could be significantly wider than previously realised, with pegmatite bodies now indicated to occur in parallel at the Leinster granite contact or on either side of the contact in the two host rock units.

With these results, the joint venture was able to prioritise exploratory drilling and resource delineation drilling in the next phase. Meanwhile, soil sampling continued to infill areas along the belt, test extensions to newly identified anomalies and tests for parallel pegmatites along the newly defined, wider belt. The aim was to identify further attractive targets for drilling, and a further 700 metres of drilling was announced in April 2015. Drill hole depth was generally about 30 metres, reflecting the company's belief that mineralisation at Avalonia is located at or near the surface below shallow overburden (rick/soil above the mineral deposit).

2016 saw 23 holes drilled

The 2016 exploration programme saw the drilling of 23 drill holes to continue the delineation of the Aclare target area. The programme also tested the Aclare C spodumene pegmatite boulder train target east of the main prospect, and a previously untested pegmatite 400 metres southeast of the main Aclare pegmatite. The highlights were announced in July 2016, including the following:

- The drilling, e.g. drill hole ACL16-22, confirmed that high-grade mineralisation was open along the trend to the southwest and at depth.
- There was a notable pegmatite intersection grading 2.33% Li_2O over 4.62 metres at the southern extent of the Aclare pegmatite.
- Holes ACL16-15 and 22 determined that an area previously mapped as a fault-controlled break in the pegmatite was, in fact, a bend in the mineralised zone, revealing that the pegmatite is continuous and forms several closely spaced parallel bodies in this area.

The 2018 drilling programme

ILC and Ganfeng announced the resumption of the drilling programme in May 2018, having approved a C$1.0m budget (€705,000) for the current year on 11 January 2018. There are two phases to this exploration work, which will consist of a maximum of 25 drill holes:

- Drilling in proximity to the previous drilling since the 1970s to support the geophysical work conducted in 2017.
- Drill previously undrilled areas at Moylisha and any new targets identified during the first phase.

If the exploration work is successful, a resource estimate for Avalonia is in prospect in approximately two years. An update on the 2018 drilling programme is expected before the end of the year.

Mavis Lake – Canada and Pegmatite 6

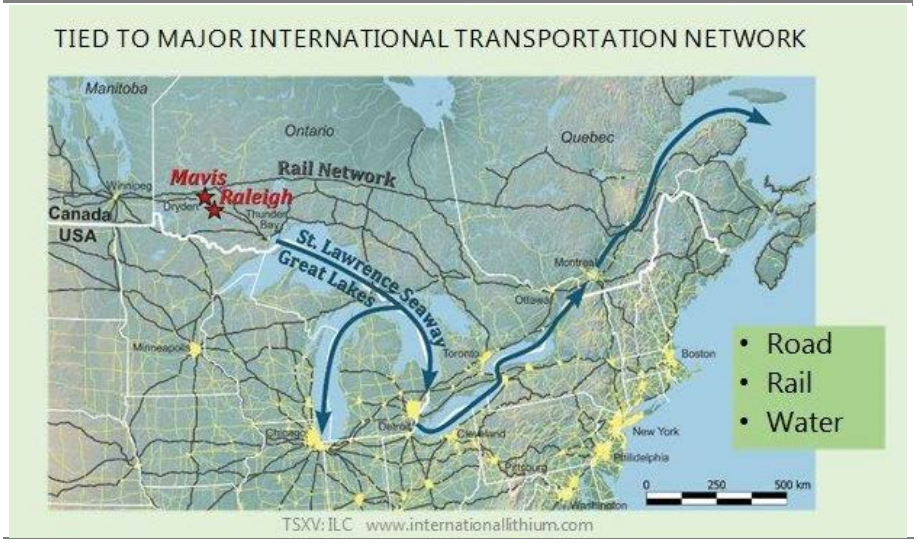
- **Located in the "Upper Canada Lithium Pool".**
- **Intersections include 1.51%-2.97% Li_2O.**
- **ASX-listed Pioneer Resources acquired 51% stake in 2016.**
- **Exploring for a wider/deeper pegmatite system.**

Background

3,000 hectares straddling a pegmatite field

The Mavis Lake and Raleigh claims (collectively termed "Mavis Lake") cover more than 3,000 hectares about 20km northeast of Dryden Ontario. The acquisition was made by staking in April 2009 by ILC's former parent, TNR Gold. The property is accessed by the Trans-Canada Highway and roads built for the logging industry, and a major electricity transmission line passes about 1km to the south. The claims straddle a continuous pegmatite field with high-grade lithium and tantalum zonation, in addition to significant levels of caesium and rubidium.

Location of Mavis



Source: ILC

20 drill holes in 2011

A preliminary exploration programme during August-September 2011 included drilling 20 holes covering 1,753 metres to test eight pegmatites and confirm historical grades and width. Most drill holes were, therefore, oriented perpendicular to the surface trace of mapped pegmatites and parallel to historical drilling. The highlights of the drilling programme in terms of lithium mineralisation included:

- A 1.86% Li_2O intersection over 26.25 metres in drill hole MF11-12.
- A 2.58% Li_2O intersection over 7.80 metres in drill hole MF11-09.
- A 78 metre intersection in hole MF11-12 in a previously unknown pegmatite body.
- Of 17 drill holes intersecting pegmatites >2 metres thick, 13 returned notable lithium grades.

In late 2012, ILC contracted Naicatchewenin Development Corporation, a 100% aboriginal-owned corporation, to provide drilling services for a minimum 2,000 metre programme from 19 drill holes. Drilling focused on extending significant pegmatite bodies discovered in the 2011 drilling campaign, especially the previously unknown pegmatite body indicated by drill hole MF11-12. In addition, the programme included infill drilling along historical pegmatite bodies to test continuity and grade in those bodies.

Further intersections in 2012 programme

Results announced in February 2013 included the following intersections:

- 1.51% Li_2O over 21.40 metres (including 2.37% Li_2O over 9.2 metres) intersected in drill hole MF12-24.
- 1.51% Li_2O over 6.20 metres intersected in drill hole MF12-25.
- 2.53% Li_2O over 6.0 metres occurring at surface in drill hole MF12-28.

As exploration progressed, ILC concluded that there could be several banks of pegmatites across the property, in addition to the central band. An equally significant finding from the drilling programme was the existence of a wide alteration halo surrounding and between the pegmatites containing holmquistite. The latter is a lithium-containing mineral found in rocks adjacent (typically a few metres) to lithium-bearing pegmatites. Consequently, it can be a useful exploration indicator regarding the discovery of hidden lithium-rich pegmatites.

Potential for larger pegmatite system

The holmquistite halo at Mavis Lake was surprisingly wide, being observed up to tens of metres from the pegmatite contacts. This unusually wide alteration suggested that a substantial volume of lithium permeating the rocks could derive from a larger, deeper pegmatite body or pegmatite system that was yet to be discovered. As a result, there was a change to the targeting of the next phase of exploration from shallow mineralisation to more substantial targets at depth.

In the meantime, ILC added to its Canadian portfolio with the acquisition of the nearby Raleigh project in March 2016. This consisted of an additional 464 hectares of mineral claims located 7km south of the Trans-Canada Highway and 60km east of Mavis Lake.

Mineralisation at Raleigh

Rare metal mineralisation at Raleigh was identified in 1966 and further categorised between 1993 and 1999 by the Ontario Geological Survey. This led to two periods of exploration – the first occurring from 1999 to 2001, focusing on tantalum, while the second, in 2010, was expanded to encompass lithium. These exploration campaigns included mapping, litho-geochemistry, trenching (1,500 metres) and diamond core drilling (2,818 metres in 17 holes), resulting in the identification of several substantial pegmatites and numerous smaller ones.

From ILC's perspective, the close proximity of the Mavis Lake and Raleigh projects in the Upper Canada Lithium Pool provided potential strategic and operational advantages. These could be enlarged if ILC partnered with other companies, e.g. in a central downstream processing facility. Anthony Kovacs, ILC's Chief Operating Officer, noted.

"Pooling projects to optimize development potential in this area has long been known as a strategy, but that only now is being executed. International Lithium Corp. is spearheading this directive and uniquely positioning itself to be the focal point for the burgeoning rare metals exploration activity in this region."

Pioneer takes majority stake…

In March 2016, the multi-commodity explorer, Pioneer Resources, acquired a 51% stake in ILC's Mavis Lake lithium project. Pioneer is an exploration company listed on Australia's ASX exchange, with projects in gold, nickel, lithium caesium and tantalum. Under the terms of the deal, Pioneer can earn up to 51% in the Mavis Lake project by:

- spending C$1.5m on exploration activities within three years; and
- paying ILC a total of C$375,000 in cash and shares (on a 50:50 basis) over the same three years.

…with an additional earn-in

ILC granted Pioneer a second "earn-in", allowing it to acquire an additional 29% – making 80% in aggregate – by spending C$8.5m within seven years. This would amount to a C$10m spend in aggregate by Pioneer over 10 years.

Exploration resumes

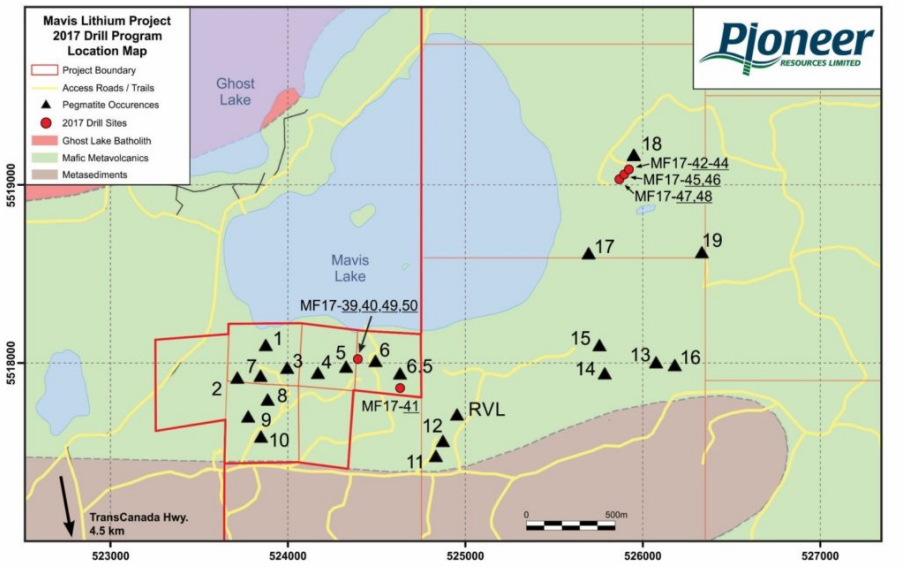
Subsequently, however, ILC and Pioneer agreed to contribute to development spending on a pro-rata basis. With Pioneer on board, the hiatus in exploration at Mavis Lake came to an end. A month after the deal, ILC announced a US$1.0m exploration programme, as Pioneer moved personnel onsite to begin field programmes. The key elements were as follows:

- Drilling six diamond drill holes to test spodumene intersections from the 2011 and 2012 drilling programmes.
- Ground magnetic surveys totalling approximately 170 line-kilometres to help define the pegmatite targets.
- Litho-geochemical surveys to identify the rare metal dispersion corridors within the host rocks adjacent to, or capping, buried rare metal pegmatites.

Winter 2017 programme details

The winter 2017 drilling programme at Mavis, which commenced on 4 February 2017 under the direction of Pioneer, saw the drilling of 12 core drill holes for a total of 1,305 metres across three target areas: PEG006 (i.e. Pegmatite 6), PEG006.5 (Pegmatite 6.5) and PEG018 (Pegmatite 18.0). All four drill holes in the Pegmatite 6 Target Area intersected spodumene-bearing pegmatites of varied thickness, with Li_2O grades up to 2.97%. Drill holes MF17-49 and MF17-50 – shown by the left-hand red dot in the project map below – intersected zones of mineralised pegmatite at deeper depths than previously encountered, representing a new discovery.

Drilling programme 2017



Source: ILC

Pegmatite 6 potential

In the Pegmatite 6 target area, the joint venture drill tested a horizontal strike length of 60 metres and a down dip to a maximum depth of 145 metres below surface. This supported ILC's belief of the existence of a larger and deeper pegmatite system. In October 2017, then ILC Executive Chairman, Kirill Klip, commented:

"The new deeper discoveries at the Pegmatite 6 area is cause for our joint venture partner, Pioneer Resources to investigate the prospectivity of this target in more detail in upcoming drilling campaigns. To build on the successful discoveries here at Mavis Lake will add significantly to our concept of the Upper Canada Lithium Pool."

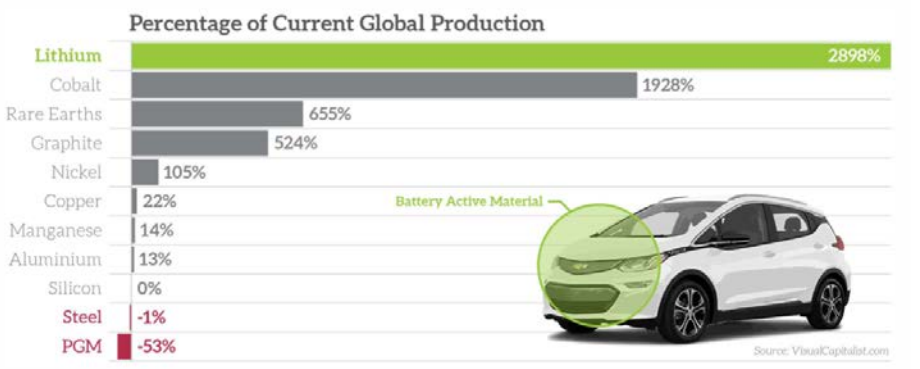
Lithium market and EV batteries

Background

EVs entering parabolic growth phase

The coming explosive growth in lithium-ion batteries (LIBs) will clearly be driven by the demand for EVs and energy storage batteries as they enter the parabolic phase in growth during the next 20-30 years. This thought-provoking chart (below) compares the incremental demand growth for lithium versus other key EV battery components if the world were to switch to 100% EV.

Incremental demand in a 100% EV world

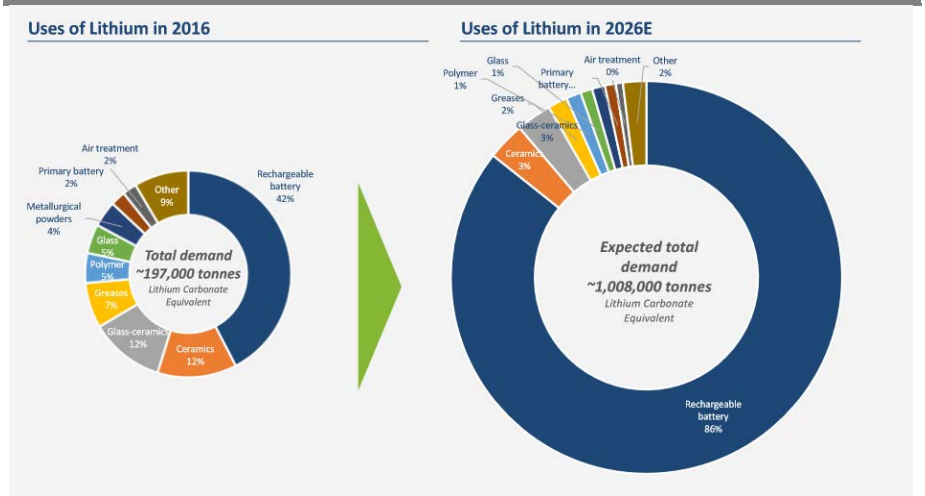


Source: Lithium Power

LIBs are manufactured from high-purity lithium carbonate and lithium hydroxide, which are then processed into lithium-containing cathodes. The cathodes are combined with an anode and a liquid electrolyte, which also comprises lithium salts.

The industry consultants, Roskill, estimate that lithium for batteries will account for nearly 90% of demand by 2026.

Lithium uses, 2016 and 2026E



Source: Roskill, Nemaska

Lithium carbonate and lithium hydroxide market shares

Lithium carbonate is the most widely used lithium compound, accounting for 61% of lithium compounds used in battery applications last year. Lithium carbonate can be processed into other lithium compounds, the most important of which is lithium hydroxide. The latter can also be manufactured from spodumene and other hard rock lithium ore, and is a key raw material in NMC and NCA batteries. According to

consultant CRU, the top five global lithium compound suppliers accounted for 66% of global lithium carbonate and 83% of lithium hydroxide capacity in 2017.

Global lithium carbonate and hydroxide capacity

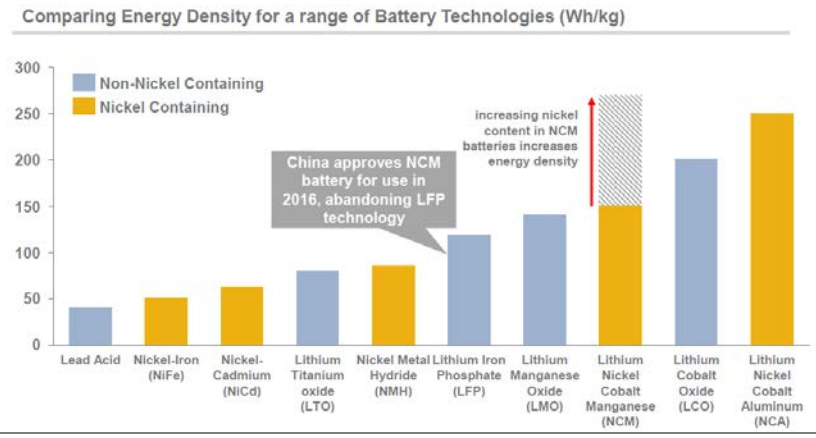
Market share	Carbonate	Hydroxide
SQM	21%	9%
Albemarle	16%	27%
Sichuan Tianqi	12%	18%
Ganfeng	10%	18%
FMC	7%	11%
Others	33%	18%

Source: Ganfeng, CRU

Drivers of cathode market

Currently, the evolution of cathodes is based on a twofold effort to increase storage capacity and reduce manufacturing costs. Lithium combined with nickel cobalt manganese (NCM) and nickel cobalt aluminium (NCA) batteries are prevailing. NCM and NCA have the highest energy densities, as the nickel content in the former is increased, which also reduces the requirement for scarce and expensive cobalt.

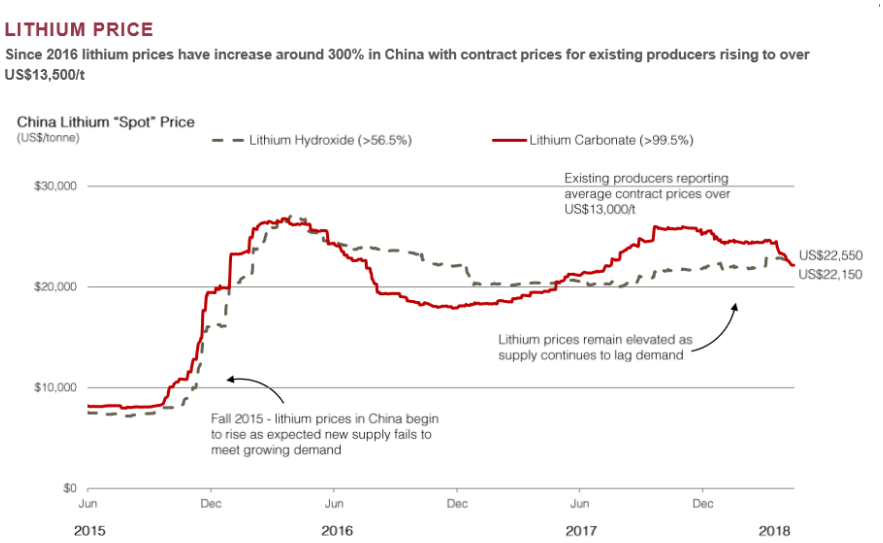
Lithium-ion batteries – superior energy density



Source: Vale

The prices of lithium compounds are based on contracts negotiated between major producers and buyers, in the same way as iron ore was until a decade ago. There is currently no exchange traded market for lithium products. The ramp-up in lithium demand in recent years has led to an approximate trebling in lithium prices since 2016, as the chart below, from Lithium Americas, shows.

China spot lithium price, 2015-18 (US$/t)



Source: Lithium Americas

Lithium carbonate is the benchmark

Lithium carbonate is the most heavily traded lithium product, and is typically considered as the benchmark in discussions of pricing trends. That said, lithium hydroxide is becoming an increasingly important component in lithium cathodes. Indeed, the majority of new lithium supply (estimated at around 70%) between 2017 and 2025) will be sourced from spodumene ores, rather than brines, from which lithium hydroxide can be sourced without a lithium carbonate step (see below).

Gauging the outlook for supply and demand of lithium compounds…

Despite the vast amount of information and analysis available, establishing a reasonable degree of confidence regarding the demand/supply balance for lithium compounds, and (critically) its impact on pricing in the coming years, is more difficult than it might appear. Yes, we'll see an explosion in demand, and, yes, we'll see an explosion in supply, but…

…there are several "buts" that require consideration.

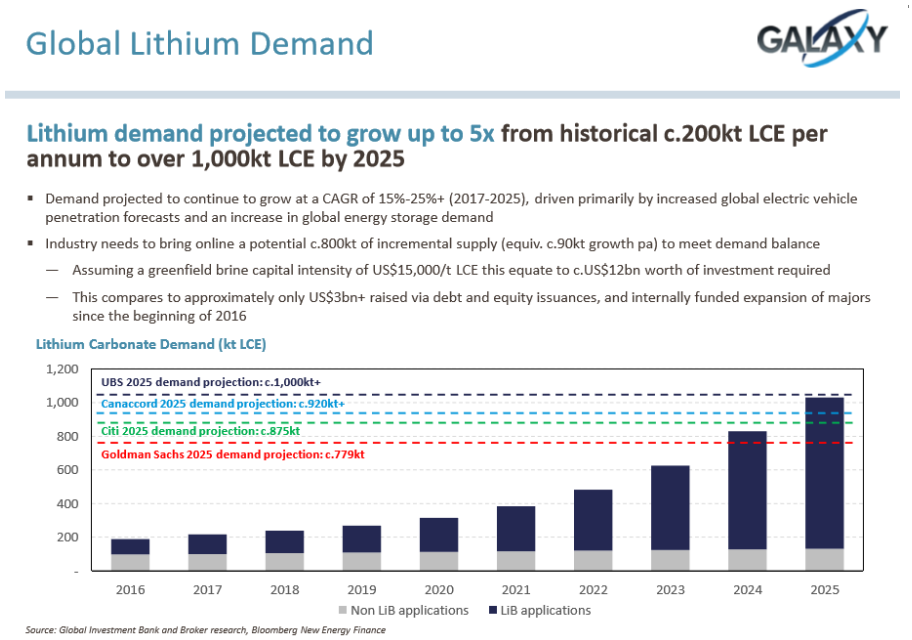
…is far from easy

Predicting the trajectory of exponential growth with any degree of accuracy is fraught with difficulty, especially as the compounding effect of even modest errors is multiplied greatly over the years. Indeed, one is reminded of the McKinsey forecast from the 1990s for mobile phone penetration, which undershot the actual outcome by a factor of 125x. The embracing of the transition to EVs by the auto industry and governments will act as a powerful tailwind.

Global EV sales – including battery vehicles and hybrids – increased from 1.2m units in 2012 to 3.0m units in 2017, and are poised to enter the exponential phase of the curve. Last year, EVs accounted for 1% of the global vehicle market, and this is expected to grow by 12-16x by 2025-26. Geographically, the driving force will continue to be China, which is expected to maintain its dominance, with more than a 50% global market share throughout this period.

In terms of converting EV battery and energy storage growth into lithium demand, the consensus estimate is now around the 900,000 tonnes of LCE – with a range of about 800,000-1,000,000 tonnes of LCE, as the following chart from Galaxy Resources illustrates.

Lithium demand surging



Source: Galaxy Resources

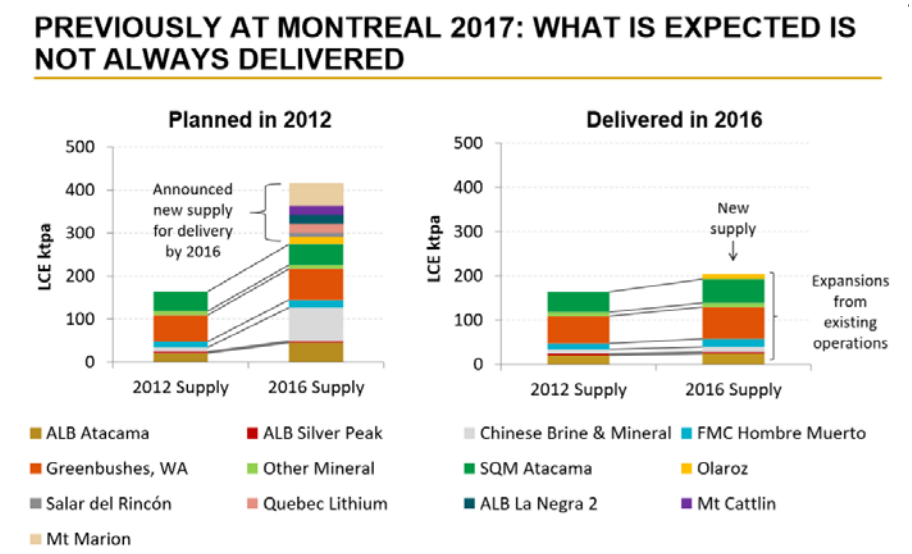
Our current estimate for 2025 global lithium demand, which is very speculative, as it has to be at this point, is 870,000 tonnes LCE.

Forecasting lithium supply is complicated by the lead times and ramp-ups for new mines, especially when it comes to brine deposits, and the balance between mine supply and downstream conversion capacity.

Lithium supply often takes much longer to come onstream than analysts expect…

The slide below, from lithium brine producer Orocobre, compares projected global lithium supply during 2012-16, based on new capacity announcements, and the surprisingly disappointing (bullish for lithium prices) outcome by the end of that period.

How lithium capacity expansions disappoint expectations

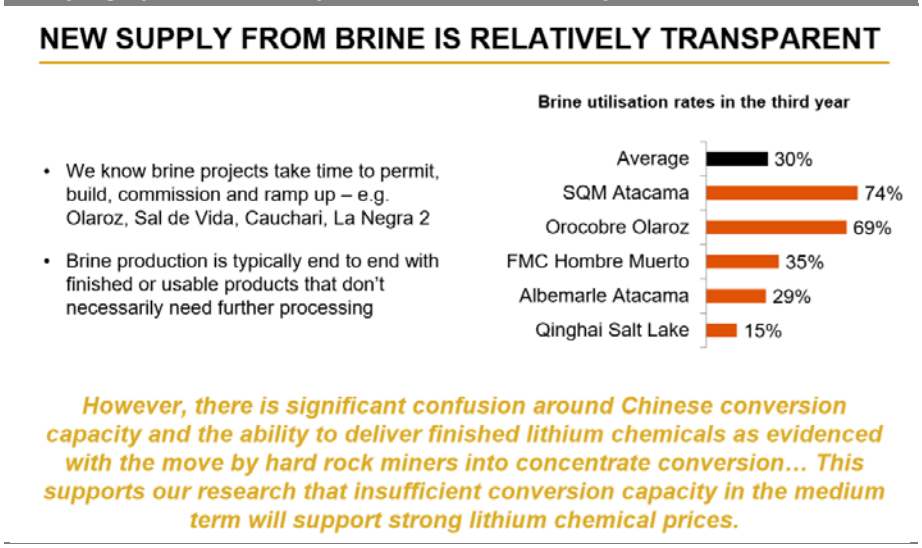


Source: Orocobre

…and management

The development of new hard rock or brine mines is already lengthy, typically taking at least eight to nine years from discovery to commissioning. However, that is not the end of the story, as ramping up production often fails to meet expectations. Below is another thought-provoking chart, which, on the right-hand side, highlights the shortfall in meeting design capacity in the third year of several lithium brine projects.

Ramping up new lithium production takes time (years)

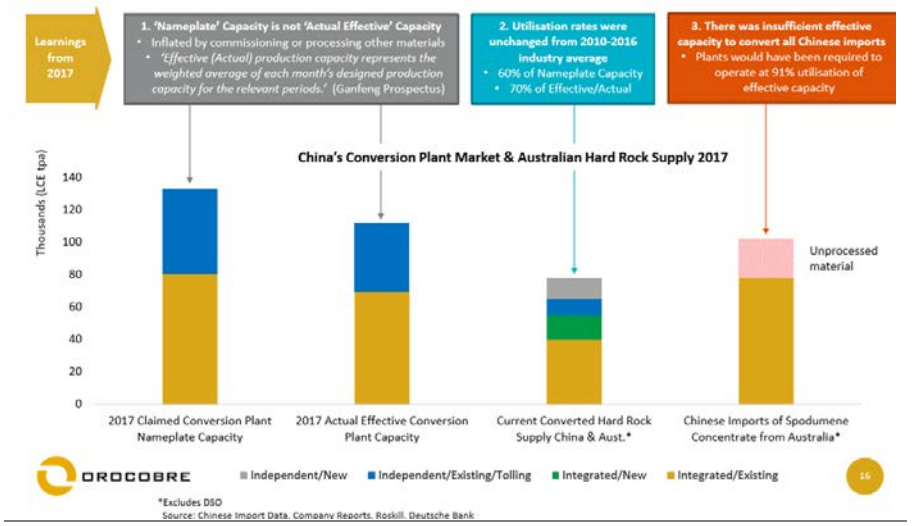


Source: Orocobre

It's a similar story in Chinese conversion capacity

It's not just upstream lithium production where actual production versus nameplate capacity is a significant issue. The same has been true recently in terms of downstream conversion capacity, especially in China. The reason for this is twofold, as brine producer Orocobre, in particular, has been educating commentators for months. Firstly, some Chinese capacity is decades old, has been poorly maintained and is ill-suited to multiple feedstocks. Orocobre estimates that utilisation rates and effective production capacity for the conversion sector can be as little as 60%-70%.

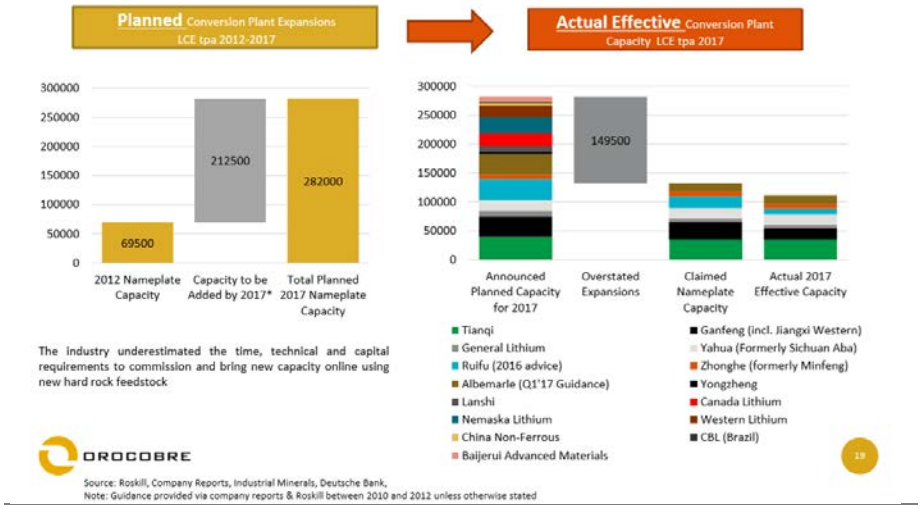
Chinese converters – claimed capacity vs. actual production



Source: Orocobre

Secondly, Orocobre has shown how capacity expansions at converters have fallen well short of expectations in recent years. The company estimates that, from 2012-17, only about 30% of planned capacity was in production by end-2017.

Chinese converters – 30% of capacity additions completed in 2012-17



Source: Orocobre

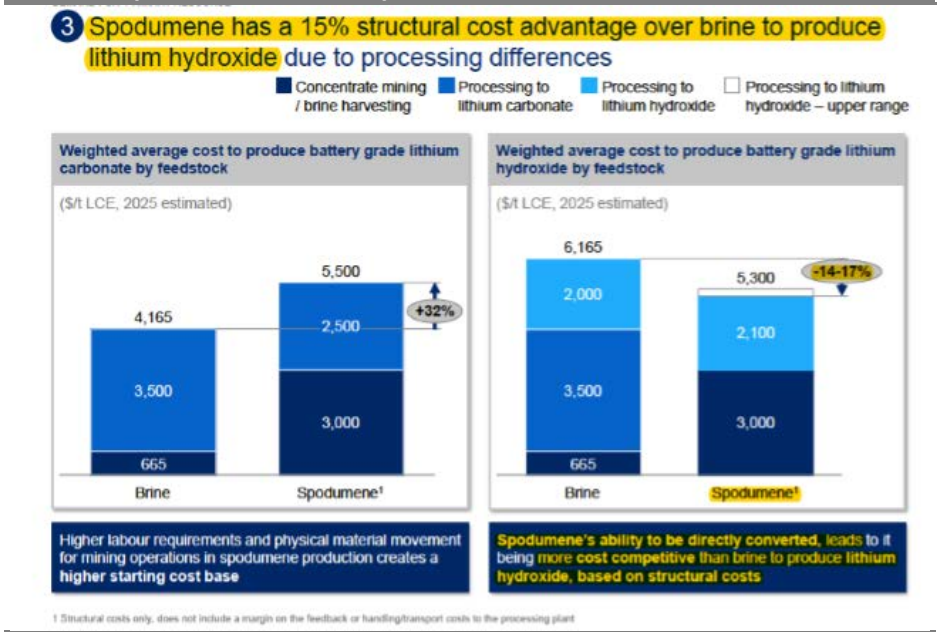
It's never simple where lithium is concerned

Things are rarely simple with lithium. Another example concerns the industry cost curve, with growing spodumene supply and increasing use of lithium hydroxide vis-à-vis carbonate. To an extent, the impacts are offsetting. An increasing proportion of spodumene versus brine will raise the median unit cost. However, since spodumene concentrate can be processed into hydroxide without the carbonate step, there is an offsetting impact. The question is, "what is the net effect?"

For what it's worth, this is McKinsey's view…

Management consultants, McKinsey & co., estimate that the cost advantage of producing battery-grade lithium carbonate from brine, rather than spodumene, is reversed in the case of battery-grade lithium hydroxide.

Brine vs. spodumene cost comparison

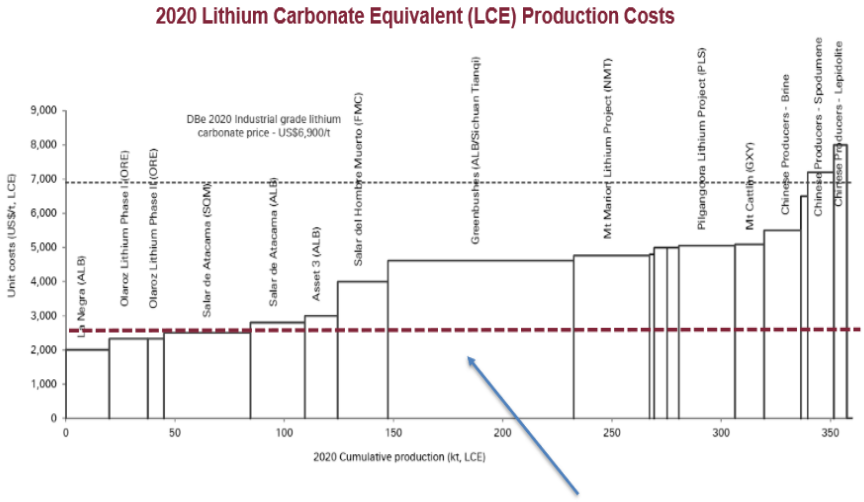


Source: McKinsey

…but some commentators disagree

An alternative argument, which rebuffs McKinsey's, is that the typical industry cost curve, showing both brine and spodumene production, is flawed in its assessment of "all-in" marginal costs.

Brine vs. spodumene cost comparison



Source: Lithium Americas, Deutsche Bank

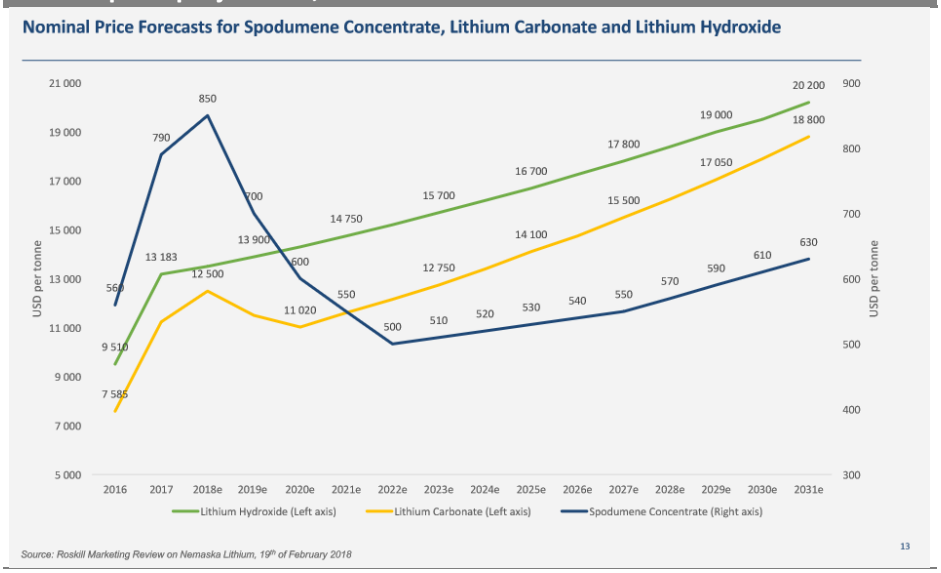
Some commentators argue that, with hard rock lithium mining producing spodumene concentrate as an intermediate product, cost calculations for this route to lithium compounds fail to incorporate the full cost of conversion. Merely adding the costs of producing spodumene concentrate and the conversion costs fails to fully take account of the significant role of the non-integrated lithium converters, primarily in China. For example, it excludes logistics costs and a profit margin to the converters.

Cost curve providing more support to lithium prices than generally realised

So, while it's extremely difficult to make accurate calculations, it is reasonable to argue, when it comes to marginal costs, that there is likely more support to lithium carbonate and lithium hydroxide prices from the cost structure than is generally appreciated. While lithium prices have been very strong for the past three years, this could be significant, because the supply response for lithium production could lead to temporary weakness in prices at times over the next few years.

Owing to the surging growth in demand, not all commentators expect lithium prices to experience any significant pressure. For example, the price deck from industry consultants Roskill (see chart below) sees severe downward pressure in spodumene concentrate prices (we concur) but a fairly stable/rising picture for lithium hydroxide and carbonate – with only a temporary downward blip in the case of the latter.

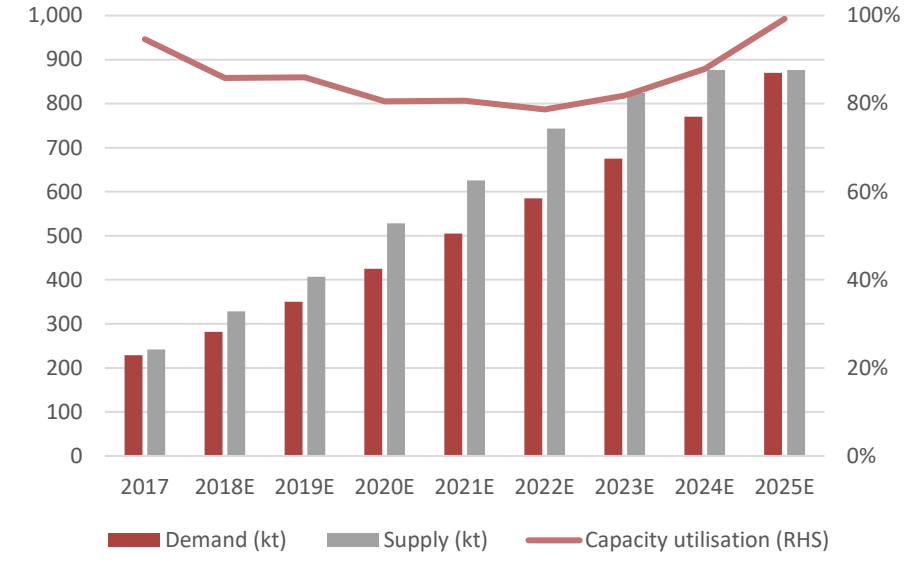
Lithium price projections, 2018-31E



Source: Roskill, Nemaska

We noted earlier in this report that our long-term lithium carbonate price assumption for ILC's Mariana project is $11,000/t – so somewhat below the prevailing price now. While it's nigh on impossible to have confidence in lithium supply and demand estimates from any source, ours are summarised in the chart below.

Lithium supply and demand estimates, 2017-25E



Source: Hardman & Co Research, company reports

On this basis, capacity utilisation bottoms in 2022E, but would be fully utilised once again by the end of the forecast period, necessitating further expansion plans to be actioned within the next few years.

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The full detail is on page 26 of the full directive, which can be accessed here: http://ec.europa.eu/finance/docs/level-2-measures/mifid-delegated-regulation-2016-2031.pdf

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