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Rare Earth Minerals

A bull market in lithium?

Technical & lithium market overview

Metals & mining

Contrary to current sentiment surrounding the mining industry is the realistic positive outlook for lithium. The electric vehicle (EV) market has experienced heightened interest despite a more than halving of the oil price over the past year, helped in no small part by North American EV evangelists and by the Volkswagen (VW) scandal. The latter has already caused the automaker to unveil new, purer clean-tech vehicles to help recover its brand image. In our opinion, lithium supply risk may not be correctly factored into the ambitious plans of EV automakers, which should be recognised as a positive for investment into the lithium mining subsector.

Year end	Revenue (£m)	PBT* (£m)	EPS* (p)	DPS (p)	P/E (x)	Yield (%)
12/12	0.0	(0.9)	(0.06)	0.0	N/A	N/A
12/13	0.0	1.5	0.05	0.0	15.0	N/A
12/14	0.0	(3.5)	(0.07)	0.0	N/A	N/A
12/15e	0.0	(0.9)	(0.01)	0.0	N/A	N/A

Note: *PBT and EPS are normalised, excluding intangible amortisation, exceptional items and share-based payments.

Future lithium demand & improving energy densities

The generation of 1KWh as provided by a lithium-ion battery, adjusted for production losses, capacity fade, etc requires approximately 1.3-3.9kg of lithium carbonate (dependant on battery energy density), or roughly 14% more if stated in terms of lithium hydroxide. This figure can then be used to calculate the demand of a battery factory with a lithium-ion battery production capacity of 35GWh (ie 35,000,000KWh). Taking a 1.3kg/KWh value such a factory would require, at full battery production rates, approximately 45,500 tonnes of lithium carbonate equivalent (LCE) pa. This compares to 2014 global supply of LCE of 160,000t.

Bacanora significantly upgrades Sonora resources

Rare Earth Minerals' (REM) majority partner Bacanora Minerals has reported a significant increase in tonnage, grade and resource confidence for the Sonora Lithium Project in Mexico. The overall improvement has seen a large proportion of the inferred fraction converted to indicated, which is pivotal for the completion of feasibility studies and advancing the project to production. With an offtaker for future Sonora lithium production in place, it is down to Bacanora and REM to rapidly advance Sonora to meet the time frames of its offtaker.

Sonora PFS in Q116 needed to update valuation

Our previous base case valuation was for the Sonora Lithium Project, for which REM commissioned its own LCE-based scoping study. This study will be superseded initially by Bacanora's (BCN) PFS in Q116, and then by a BFS. We therefore suspend our valuation and await the release of the PFS to revisit our forecasts relating to the development of the Sonora Lithium Project. We will also seek to address the potential value of REM's stake in the Yangibana rare earths project held in JV with Hastings Rare Metals, on release of that PFS, also expected during Q116.

15 January 2016

Price	**0.75p**
Market cap	**£51m**
	US$/£:1.5
Net cash (£m) at 30 June 2015	0.3
Shares in issue	6,815.7m
Free float	97%
Code	REM
Primary exchange	AIM
Secondary exchange	OTC

Share price performance

%	1m	3m	12m
Abs	11.1	(22.3)	(18.0)
Rel (local)	10.9	(18.2)	(13.4)
52-week high/low		1.2p	0.6p

Business description

Rare Earth Minerals (REM) is a minerals investment company with direct and indirect interests in lithium and rare earth projects. REM's primary value proposition is a 42.04% effective interest in the Sonora Lithium Project concessions in Northern Mexico.

Next events

Yangibana PFS	Q116
BCN Sonora PFS	Q116

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Edison profile page

Asset overview and lithium demand forecasting

REM's strategy is to invest in lithium, both directly and in lithium companies and, to a lesser extent, in rare earth projects. In this note we provide an overview of REM's assets and incorporate H115 accounts published on 21 September 2015. We also assess the potential growth scenarios for lithium-ion battery manufacturing capacity. This is driven by six international technology companies building battery manufacturing plants through to 2019.

Highlights from REM's lithium and REE portfolio

Sonora Lithium Project, Northern Mexico

- REM's holding in Bacanora Minerals (BCN.AIM) increased from 12.0% to 17.02% (17 September 2015). Total economic interest in the Mexalit and Megalit licences has increased from 38.4% to 42.04% (17 September 2015).
- The updated MRE is 19% larger at 8.85Mt (cf 7.42 Mt previously) of LCE.
- Full pre-feasibility study (PFS) is advancing on schedule and due for completion in Q116.
- The ongoing development work and the resulting PFS are expected to be used to design a plant capable of delivering up to 35,000t pa of LCE, making it one of the largest lithium-producing mines in the world.

Development prospects for the Sonora Lithium Project have materially improved with the announcement that REM has agreed a conditional lithium hydroxide supply contract (announced on 28 August 2015). Subsequently, the joint owner of Sonora, Bacanora Minerals, has implemented a revised and accelerated programme of works to provide the technical confidence over the project to satisfy the conditions in the contract.

Sonora mineral resource estimate significantly upgraded

Sonora's lithium resource now comprises an indicated mineral resource of 5.0Mt of LCE, from 364Mt of clay ore bearing a lithium grade of 2,600ppm. This is an 18% increase in lithium grade and an increase in indicated resource tonnes of c 340% over the previous inferred estimate of 1.14Mt LCE from 95Mt of clay at 2,200ppm.

Exhibit 1: Net attributable mineral resource statement for the Sonora Lithium Project at 19 November 2015

Classification	Concession	Owner & operator	Geological unit	Clay tonnes (Mt)	Clay grade (Li ppm)	Contained metal (Kt Li)	Contained metal (Kt LCE)	Net attributable based on REM's current (at 15/12/15) total economic interest in Sonora
Indicated	La Ventana	Minera Sonora Borax	Lower Clay	75	3,500	261	1,385	238
			Upper Clay	66	1,500	99	523	90
	El Sauz	Mexilit	Lower Clay	60	2,900	174	924	388
			Upper Clay	47	1,100	52	274	115
	Fleur		Lower Clay	60	4,300	258	1,365	574
			Upper Clay	50	1,600	81	428	180
	El Sauz1		Lower Clay	4	4,000	15	80	34
			Upper Clay	3	1,200	3	18	8
Indicated total			Combined	364	2,600	943	4,997	1,627
Inferred	La Ventana	Minera Sonora Borax	Lower Clay	55	3,800	209	1,108	190
			Upper Clay	80	1,500	120	636	109
	El Sauz	Mexilit	Lower Clay	85	1,600	136	721	303
			Upper Clay	55	800	44	233	98
	Fleur		Lower Clay	20	4,200	84	445	187
			Upper Clay	20	1,500	30	159	67
	El Sauz1		Lower Clay	20	4,000	80	424	178
			Upper Clay	20	1200	24	127	53
Inferred total			Combined	355	2,000	727	3,853	1,186

Source: Rare Earth Minerals announcement, 23 November 2015

Inferred tonnages have decreased 38% to 3.9Mt LCE, a reduction from the previous estimate of 6.3Mt, resulting from upgrading the inferred resource tonnages to indicated. This improved and upgraded mineral resource estimate is integral to the completion of a feasibility study on Sonora, to be finalised by Bacanora, and expected to be released to market during Q116. REM currently has an effective economic interest in the Sonora Lithium Project of 42.04%.

Sonora's size relative to its peers

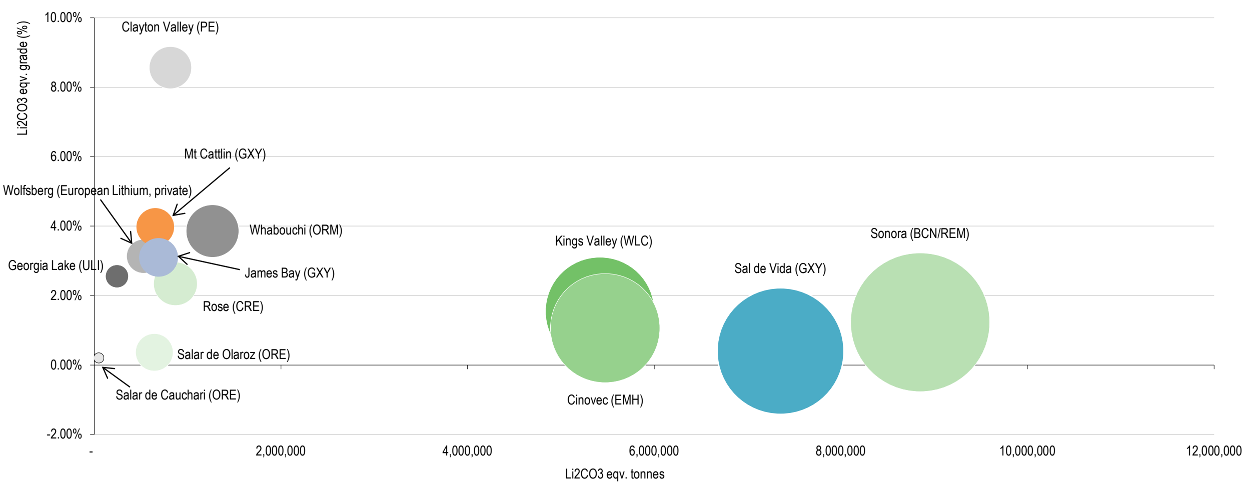
Exhibit 2 provides a view of Sonora's large resource size compared to various other lithium resources currently being delineated, developed or mined. It shows resource sizes and grade, given in LCE terms. Resource sizes are stated in global terms, containing all three resource categories: measured, indicated and inferred. We have used this approach to capture as many projects as possible.

From the resource shown in Exhibit 2, we can see that two broad groups exist, the first being the smaller sub 2Mt of contained LCE size containing such projects as Wolfsberg, Clayton Valley and James Bay. The second group contains projects with resources of plus 5Mt of contained LCE, namely Sal de Vida, Cinovec and BCN/REM's Sonora Lithium Project.

The first group contains all hard rock deposits. This class includes pegmatite projects (eg Wolfsberg, Whabouchi and Rose), clay-based projects (eg Kings Valley), smaller brine deposits (eg Salar de Olaroz) plus one jaderite-hosted lithium (+borates) resource in Ultra Lithium's Georgia Lake resource.

The second, larger-size resource group contains the large brine deposit of Galaxy Resources Sal de Vida project (which has a DFS completed and is awaiting an investment decision), the large brine deposit of Kings Valley (owned by Western lithium in which Rem has a 3% shareholding) plus the inferred resource of Cinovec and the indicated and inferred resources of Sonora. While currently in the second group of larger resources, we note Cinovec's inferred-only resource size and slightly unusual host of greisenized veins (as such the resource also contains material amounts of tin and some tungsten) as potential reasons why future resource estimations may materially reduce Cinovec's size.

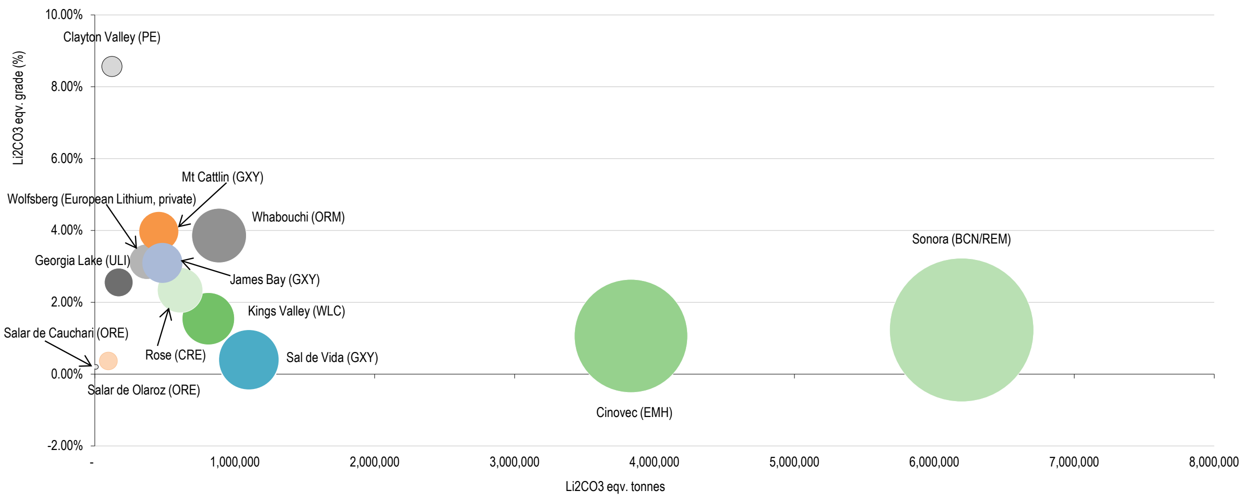
Exhibit 2: Lithium projects by resource size (given by area of circle) and grade, all presented in LCE terms



Source: Edison Investment Research

Exhibit 2 does not show how much of each resource is recoverable. For example, in terms of conventional hard rock deposits of a particular commodity, a rule of thumb is that 60-70% of the mineral resource reports to the ore reserve, ie 60-70% of a mineral resource is economically viable to extract and process at any given commodity price.

Exhibit 3: Lithium project resources adjusted for assumed resource to reserve conversion factors



Source: Edison Investment Research

Galaxy Resources has published the only available brine-based ore reserve estimate for its Sal de Vida project in Argentina. In LCE terms, Sal de Vida contains 7.2Mt in resource. After conversion to reserves, the amount of retrievable LCE reduces 85% to 1.1Mt. Only 15% of the mineral resource reports to an ore reserve. To further support this, although it has not produced a reserve estimate, Orocobre states that only 15% of its Sal de Olaroz mineral resource is extractable.

However, we note that the method of converting resources to reserves is intimately linked to the method of extraction, and that both the aforementioned brine deposits contemplate the use of evaporation ponds to extract the contained lithium. This could be the reason certain brine companies are looking to develop their deposits using new alternative, less energy-intensive, more environmentally friendly and quicker process methods. Such a method could involve Tenova Bateman Technologies' proprietary LiSX extraction process. While such methods have not yet been developed at the mine scale, they could increase the yield of lithium brine deposits over those developed using evaporation ponds.

Notwithstanding the above, if a resource-to-reserve conversion of 15% is used to adjust all the brine resources given in Exhibit 2 and a 70% resource-to-reserve conversion factor is applied to all other deposit types, brines (ie Kings Valley and Sal de Vida) no longer appear in the second group of larger resource sizes (Exhibit 3).

Under our assumptions, the only projects that remain around or above 4-5Mt of contained LCE on conversion to reserves are Cinovec (notwithstanding its early stage of assessment) and Sonora. Although we highlight the very limited data we have in terms of resource-to-reserve conversion factors for brines and use an indicative 70% conversion for all other deposit types, the above analysis suggests that brines are not the deposits that yield the largest mineable amounts of lithium. Based on our assumptions and selection of lithium-based mining companies, Sonora is the only deposit of the second larger resource group that retains the majority of its mineral resource on conversion to reserves. Sonora is a clay base.

Although Cinovec and Sonora have the lowest resource grades of our peer group, their resources potentially support the longest life mining operations with lowest production costs of the hard rock and clay deposits achieved through appreciating the inherent economies of scale present in low-grade large tonnage mining projects. To better understand whether Sonora satisfies this assertion, we await REM and Bacanora's Sonora PFS in Q116.

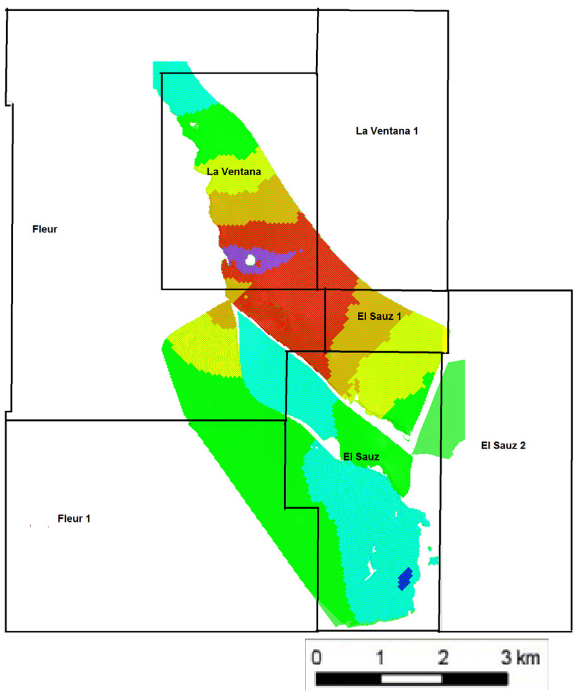
Note that all values given above are in LCE terms. To convert to lithium hydroxide, we use a factor of 1.14 xs and to convert LCE into lithium oxide a factor of 0.40x must be applied.

Higher-grade portions of Sonora coincident with flatter ground

The May 2015 iteration of Sonora's lithium resource stated a global lithium grade of 2,600ppm for the 5.0Mt contained in the indicated resource category and a grade of 2,000ppm for tonnes contained in the inferred category. Making any kind of comment on the potential mineability based on these alone would be incorrect, as the grades at Sonora vary considerably between the higher-grade Lower Clay and lower-grade Upper Clay beds (see Exhibit 1). For indicated material, grades in the Upper Clay horizons vary by 500ppm and likewise, for the Lower Clays, by 1,400ppm. A similar situation occurs for the inferred material.

Therefore, to understand better the quality of the potentially mineable portions of the Sonora resource, it is crucial to grasp where the higher-grade zones (associated with the Lower Clay) are located spatially and, in particular, relative to the topography of the area. The following screenshot is taken from the Sonora block model used to calculate the resource given in Exhibit 1. The purple zone identifies ignimbrite (also known as consolidated volcanic ash), grading down towards green where the lower grades are seen associated with the overlying Upper Clay. Overlaid on this are the licence areas, of which REM's 30% direct interest held in JV with Bacanora Minerals relates to the Fleur and El Sauz concessions.

Exhibit 4: Grade distribution across the Sonora project with concession boundaries overlaid



Source: Rare Earth Minerals

It is obvious that any future open pit will be designed to capture as much of the red areas as possible. These areas are coincident with topographic lows with relief increasing to the north-east and south-west. As such, future pit designs capturing the higher-grade portions of the Sonora resource are likely to incur the lowest strip ratios, a key factor determining the cost of mining and production of lithium-based concentrates.

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Future reserve estimate to have higher lithium grade than resource?

The indicated (being the first resource category that can be converted into an ore reserve) grades of Fleur, La Ventana and El Sauz 1 are 4,300ppm, 3,500ppm and 4,000ppm respectively. These are far higher than the average of 2,600ppm given for all indicated tonnages for the Sonora project, and suggest that when an ore reserve is calculated its lithium grade should be materially higher than that of the resource, potentially creating one of the largest and highest-grade lithium reserves worldwide.

Outdated Sonora LCE-based scoping study value, PFS due in Q116

For reference only, our previous LCE-based valuation outlined 34.6Mtpa of run-of-mine (ROM) ore with an average output of 69.8kt of battery-grade LCE or equivalent over a 20-year mine life. We tentatively estimated that production would start in 2017, which was based on BCN timelines. The study detailed capex of US$485m and a US$6,500/t LCE price, and we applied a 10% discount rate to reflect general equity risk. On this basis, we valued REM's effective 42.04% (previously 41.75%) of Sonora at 2.35p (previously 2.40p) per share.

We stress the outdated nature of REM's scoping study (ie based on LCE production and not on lithium hydroxide) and await the publication of the PFS, due in Q116, to assess Sonora's value based on LCE output.

Cinovec Lithium Project, Czech Republic

- REM currently holds an 11.7% interest in the Cinovec lithium (owned by European Metals) and tin deposit, on the German border.
- EMH is currently undertaking a resource upgrade drill programme and has released the first results of historical drill hole confirmation drilling. Assay results announced so far (see EMH RNS dated 17 November 2015).
- It has an inferred mineral resource estimate (MRE) of 515Mt of ore at an LCE grade of 1.06% (using an Li cut-off grade of 0.1%) for 5.5Mt of contained lithium carbonate (514.8Mt @ 0.43% Li_2O).
- It has a combined tin MRE of indicated and inferred portions of 183kt of contained tin (ie 79.78Mt of ore at 0.23% Sn using a 0.2% Sn cut-off grade). This tin resource also contains tungsten, both of which will be received by EMH on mining Cinovec in the form of tin-tungsten credits and is the main reason that this lower-grade lithium resource could be viable to mine. Note: the Czech government undertook trial mining from the 1960s through to the 1980s, extracting c 400kt of ore via a sublevel open-stope mining method.

The European location of this lithium and tin asset may become its most attractive non-technical characteristic. The recent controversy surrounding VW's clean diesel technology, first exposed in the US, and which is now reported to affect 11m VW group cars globally, may provide the catalyst for a more rapid adoption of hybrid and plug-in electrical vehicle use than has been seen previously in Germany. While currently limited to the Volkswagen group, the scandal has tainted the reputation of German engineering in general. A positive consequence is that Germany, in an effort to improve its image, may increase pressure on the automotive industry to move away from optimised diesel technology and accommodate a purer clean-tech approach. As evidence that this may already be starting to occur, at the Consumer Electronics Show (CES) held in Las Vegas in January 2016, VW unveiled its new Budd-e all-electric microbus concept vehicle using its new Modular Electric Drive (MEB) platform. VW intends this new platform to be used across a new range of electric vehicles and complements its existing MQB system, which is already used in electric versions of other VW group cars such as the Golf, Skoda Octavia and Audi AC, among others (7 January 2016 article on www.thisismoney.co.uk).

Key characteristics of the Budd-e concept are a 15-minute charge time for 80% of battery capacity, a 223-mile range and a 0-60mph time of 6.9 seconds.

Further moves by VW towards expanding its electric vehicle range in Germany will only serve to support the development of lithium projects located in Europe, such as Cinovec.

Lithium America (previously Western Lithium), Nevada

- REM holds approximately 1.35% (17 September 2015) interest in Western Lithium USA Corp, which owns the Kings Valley Lithium Project (KVLP) in Nevada and the Cauchari-Olaroz Project in Argentina (as a result of the recent merger with Lithium Americas Corp – announced on 30 June 2015).
- Western Lithium has produced 99.8% lithium carbonate from a demonstration plant.
- Lithium Americas' combined MRE of 11.7Mt of LCE in measured and indicated resources and 2.7Mt of LCE in probable and proven reserves.
- Initial commercial production from the Cauchari-Olaroz Project is planned at a rate of about 20,000t pa of LCE when ultimately funded and completed.
- The Cauchari-Olaroz Project is permitted for construction.

Lithium Americas' assets include the KVLP in Nevada (held by Western Lithium before the merger). This is in the same state of the US as the offtaker. It is notable that the KVLP has not achieved the same kind of recognition by the offtaker as the Sonora Lithium Project. This could be attributed to the KVLP producing, via a pilot plant, LCE, and not lithium hydroxide. Lithium hydroxide is the required feedstock for production of the offtaker's battery type. However, production of LCE still plays to the market for electrical vehicle battery production, and conversion of LCE to lithium hydroxide is achievable, although it requires additional initial capital and operating costs to undertake. We note that Sonora's geology and process flowsheet indicates lithium hydroxide can be produced without the production of LCE as an intermediate process step, thereby reducing both initial capital and its operating cost base. This latter point will likely reduce capital intensity, thereby increasing the probability of successfully financing Sonora. Only release of the Sonora PFS will provide the data required to assess this latter point in sufficient detail.

Yangibana Rare Earth Minerals Project, Australia

The Yangibana heavy rare earth element (HREE) enriched project is 70% owned by Hastings Rare Metals (HAS.ASX), with REM holding a 30% free carried interest until HAS completes a bankable feasibility study.

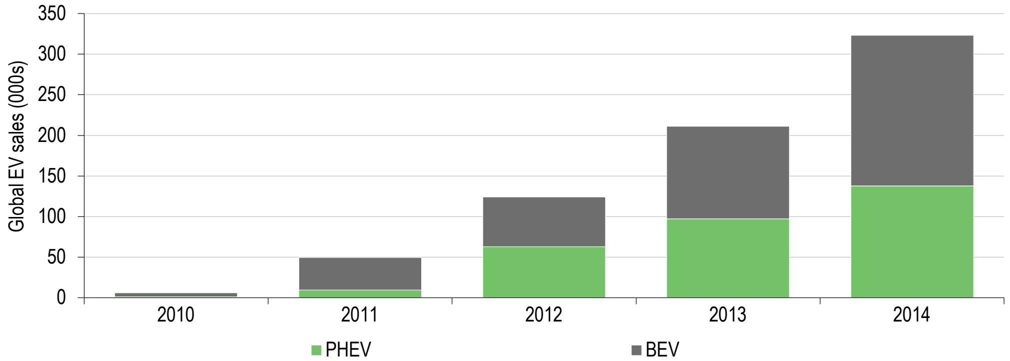
- REM holds a 30% free carried interest to bankable feasibility study on the project.
- MRE of 6.79Mt at 1.52% Total Rare Earth Oxides (TREO). This comprises an indicated portion of 3.96Mt at 1.59% TREO and an inferred portion of 2.83 Mt at 1.43% TREO.
- Flotation tests resulted in 90% recovery of rare earths.
- A scoping study, published in December 2014, had an indicative pre-tax NPV8 of A$900m to A$1.2bn based on a 10-year mine life. Scoping studies provide largely illustrative valuations on assets and should be viewed with caution. Minimal advanced technical data are available at the time of writing scoping studies to provide an appropriately de-risked view of discounted future net cash flows.
- The PFS is due for release in Q116.

We currently view Yangibana as non-core to REM's lithium-centric investment case. Yangibana is relatively interesting in terms of HAS focusing its efforts on developing only key valuable rare earth metals (ie neodymium, praseodymium, dysprosium and europium). However, we will revisit our assessment of this asset on release of a pre-feasibility study, which is on track for release in Q116.

Lithium market: Battery factories highlight opportunity

The lithium subsector of the mining industry is currently enjoying a period of increased interest. The much-hyped reason for this is the rapidly growing electrical vehicle market (122% CAGR in 2010-14, source: International Energy Agency), either plug-in hybrid electric vehicles (PHEVs) or battery electric vehicles (BEVs). The majority of these use lithium due to its cost benefit, which reflects its currently unrivalled energy density per kg of weight. This latter point has been used as the principle guide in designing suitable battery packs for automobile use. Although the automotive industry is a key driver for growth, the current market for lithium is highly diversified (Exhibit 5). The metal, in refined, concentrate or various chemical forms, is used in the medical, ceramics and glass, automotive and industrial sectors.

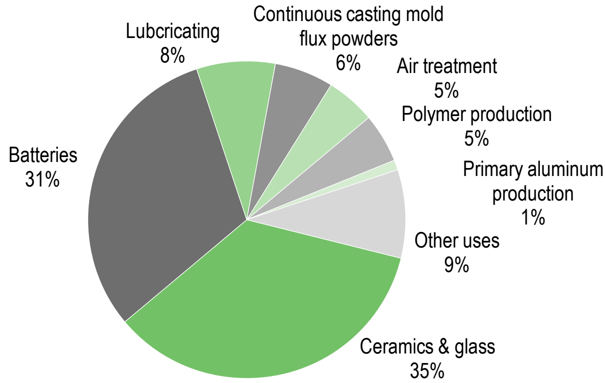
Exhibit 5: Global PHEV, BEV sales 2010-14



Source: International Energy Agency Global EV Outlook

Exhibit 5 above shows the International Energy Agency (IEA) estimates of unit sales of plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs). The EV industry is still very much in its infancy and accurate forecasts of EV market growth are based on unreliable assumptions. However, a 16-member multi-government policy forum called the Electric Vehicle Initiative forecasts 6m EVs sold pa by 2020 (source: IEA website). Furthermore, simply looking at predicted EV unit sales in isolation may not sufficiently account for the volumes of lithium that would be required to support this. In this note, therefore, we assess the implied lithium requirements and feasibility of this assumption. Our conclusion is that lithium supply is likely to be a limiting factor to EV manufacturers achieving planned output levels over the next decade. This is likely to support and stimulate lithium pricing, which, in turn, supports the investment thesis for lithium asset owners and producers.

Exhibit 6: Lithium global end-use markets



Source: US Geological Survey

Estimating lithium demand from first principles

The following provides a walk-through estimation of how much lithium may be required in the coming years. First we start with how much energy lithium can theoretically produce, then factor in the losses associated with current lithium-ion battery production, before looking at what battery production capacity is currently available, planned or under construction. The latter provides an estimate of potential future lithium demand.

Although we understand that lithium hydroxide will be the preferred feedstock for certain battery factories, for the purposes of estimating future lithium demand we have presented all our assumptions in terms of LCE, as this variant is the prevalent feedstock for lithium-ion battery manufacture at the time of writing. To convert LCE into lithium hydroxide, a factor of 1.14x must be applied.

We also note that energy storage solutions (both domestic and commercial) involving lithium-ion battery technology are being developed. However, this market segment is its infancy, particularly concerning domestic (ie home) energy storage solutions, and so market growth rates at the current time are relatively meaningless in forecasting long-term growth trends.

How much lithium and LCE is needed to produce 1 KWh

The data in Exhibit 7 below assume 100% conversion of lithium metal into ions and free electrons in a chemical reaction using physically real electrodes, electrolytes and the other battery components. In reality, the 100% energy conversion scenario is not possible as the theoretical capacity of a cell only applies at zero current. As soon as a current is drawn from a cell, it loses 'free energy' (ΔG) and capacity will fall.

Exhibit 7: Lithium requirement estimate per KWh (assumes 100% energy conversion)

Parameter	Unit	Value
Theoretical charge density of lithium metal	Ah/g	3.8
Battery voltage	V	3.6
Watt hours	Wh	13.68
Lithium metal per KWh	g	73.1
Li to LCE conversion factor	number	5.323
LCE per KWh	LCE/KWh (g)	389.1

Source: After William Tahil, *How much lithium battery does LiIon battery really need?* Meridian International Research, March 2010

Current lithium ion batteries are 10-25% efficient in delivering the theoretical energy contained in lithium. This therefore allows us to estimate the lithium requirements for a range of sizes of KWh battery packs used in EVs (eg 5KWh size is comparable to that used in a Toyota Prius, 85KWh is the battery pack size used in a Tesla Model S).

Exhibit 8: Edison estimate of LCE requirements (in kg) for a range of power pack sizes and lithium energy conversion efficiency factors

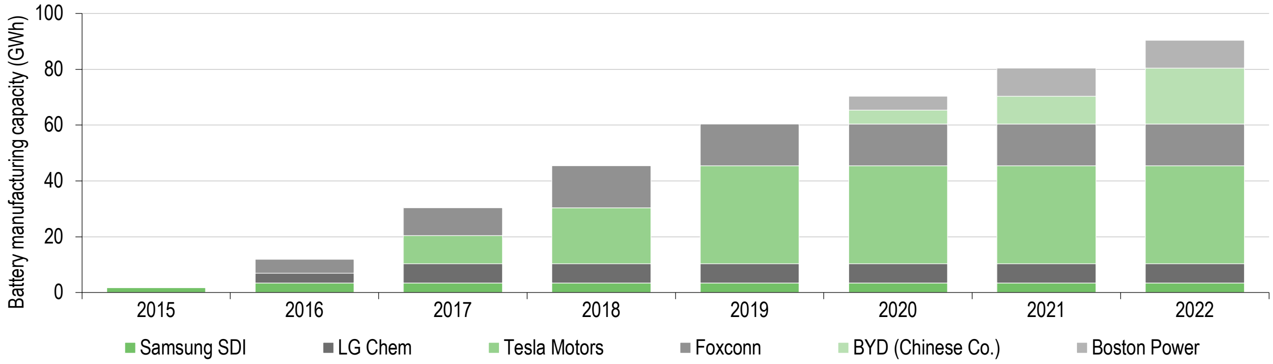
Power pack (ie engine) size (KWh)	Li energy conversion efficiency (%)				
	10.00%	15.00%	20.00%	25.00%	30.00%
1	3.89	2.59	1.95	1.56	1.30
5	19.46	12.97	9.73	7.78	6.49
10	38.91	25.94	19.46	15.56	12.97
15	58.37	38.91	29.18	23.35	19.46
20	77.82	51.88	38.91	31.13	25.94
30	116.73	77.82	58.37	46.69	38.91
40	155.64	103.76	77.82	62.26	51.88
85	330.74	220.49	165.37	132.30	110.25

Source: Edison Investment Research

Battery factories planned or in construction

Highlighting the very real interest by technology firms in the potential for lithium ion battery technology to become the mainstay of EV manufacture are a number of battery factories currently planned or under construction. The most significant of these is the Gigafactory in Nevada which is nearing completion. Exhibit 9 below provides our assumption of the ramp-up that could occur at each factory, which we then use to underpin our estimate of future LCE demand.

Exhibit 9: New lithium-ion battery factories under construction or planned 2015-22 showing cumulative lithium-ion battery manufacturing capacity in GWh



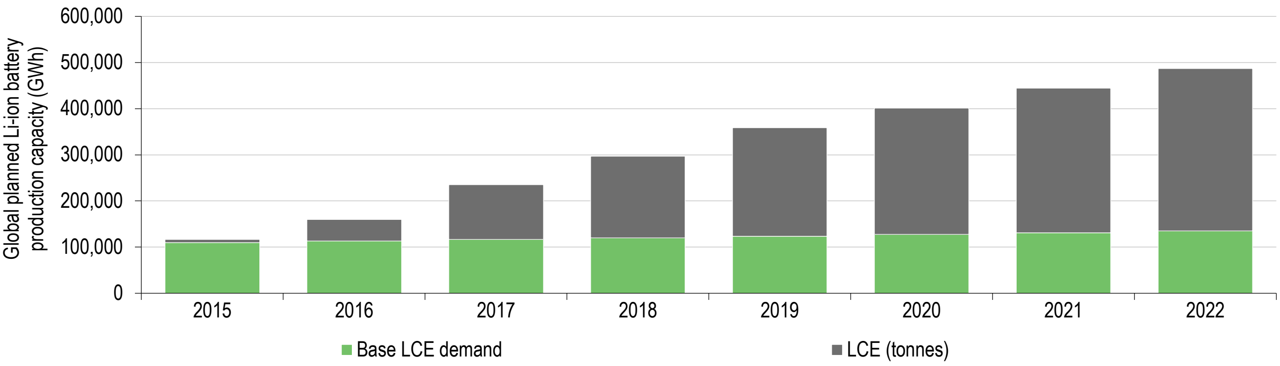
Source: After The lithium-ion battery megafactories are coming chart, 8 May 2015. Note: Includes assumed ramp-up of battery plants.

Exhibit 9 above assumes a much idealised ramp-up in production and does not factor in EV growth rates. Effectively, it assumes that lithium-ion battery demand is governed by production capacity and not by the number of EVs sold.

If battery factories are completed, lithium demand will skyrocket

If all the companies given in Exhibit 9 build all the battery factories planned and a ramp-up in production follows our assumptions, we can estimate the amount of LCE that would be required to operate them. Exhibit 10 below provides an illustrative profile of LCE demand growth based on battery manufacturing increasing as per Exhibit 9, assuming 3.89kg of LCE is required to produce 1 KWh (ie a battery converts 10% of the theoretical energy contained in lithium). We also estimate base LCE demand growth at 3% pa in line with current global GDP growth levels.

Exhibit 10: Illustrative growth profile of automotive EV LCE demand 2015-22 – includes assumed ramp-up of battery plants



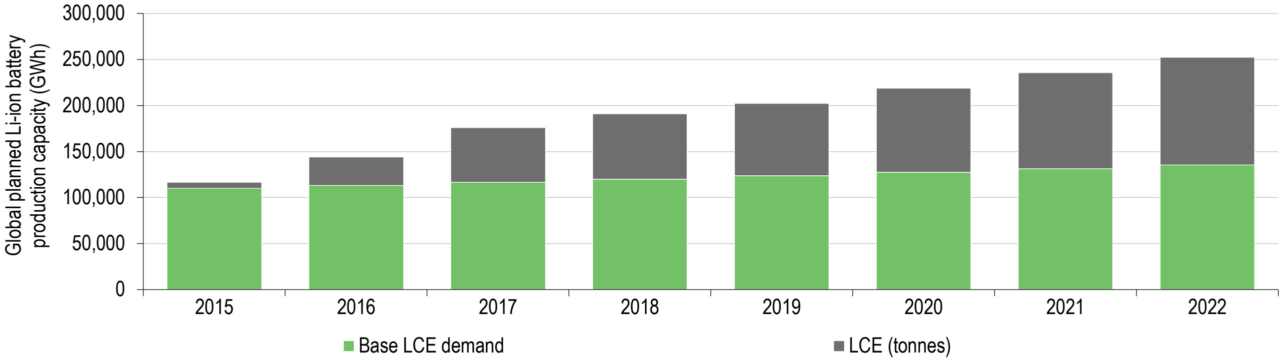
Source: Edison Investment Research. Note: Uses a flat 3.89kg/KWh of lithium.

Assuming a flat 3.89kg/KWh of LCE is used, effectively that no advance in energy density will be realised, there is the potential for demand for LCE to increase by 318% from current levels by 2022. However, increasing energy density is likely to be a key efficiency driver for manufacturers of lithium-ion batteries; especially as lowering the weight of EVs is a key component of increasing range. The following section provides a scenario whereby increasing energy density leads to reduced LCE demand

Increasing energy density reduces LCE demand growth

We use the same assumptions of potential battery manufacturing capacity set out above to assess the impact of a 5% pa increase in battery energy density. This represents improvements in battery technology and improvements in the amount of energy that can be realised from any given weight of lithium. Assuming a 5% increase in energy density pa, whereby 3.9kg of lithium is required to produce 1 KWh currently, which then reduces to 1.30kg by 2019 (ie 30% energy conversion efficiency), potential future demand would reduce from the estimate in Exhibit 10 to that shown in Exhibit 11 below.

Exhibit 11: Illustrative growth profile of automotive EV LCE demand 2015-22 – includes assumed ramp up of battery plants

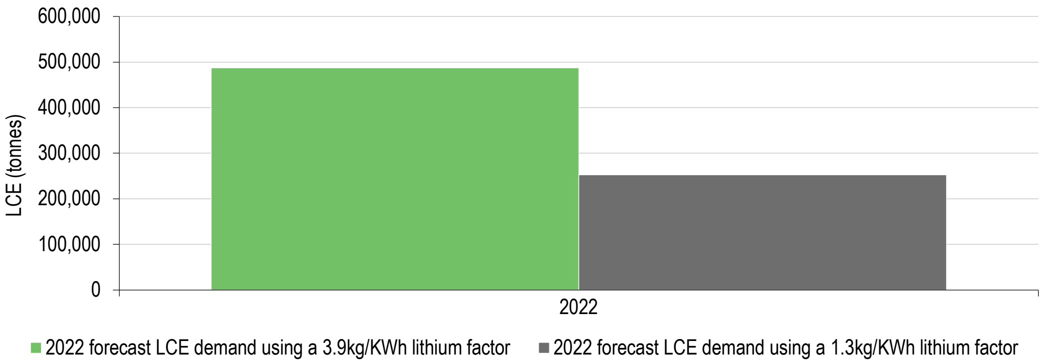


Source: Edison Investment Research. Note: Applies a 5% y-o-y increase in energy density.

Conclusion: A tight lithium market should only become tighter

The impact of increasing energy densities on future potential lithium demand is material. If energy densities improve by 5% pa (indicated as a scenario in Exhibit 11), we can see that future potential demand growth for LCE based on the assumed ramp-up in battery manufacturing capacity (shown in Exhibit 9) could reduce by as much as 48% relative to using a flat 3.9kg/KWh value through to 2022. While there is no certainty over any of the assumptions provided above, we can observe that if only a number of the battery factories currently planned were to materialise, a lithium market already in balance would experience tightening, with the associated result of increased lithium product prices.

Exhibit 12: Difference between 2022e LCE demand using 3.9kg/KWh vs 1.3Kg/KWh lithium factors



Source: Edison Investment Research

We do not believe that the companies shown in Exhibit 9 will have adequately factored lithium supply risk into their supply chain assumptions. The time and money required to assess lithium resources will be longer than for conventional open market-traded commodities. This is due to the requirement of resource developers to satisfy end-user criteria and product testing, inter alia. This could be viewed as a long-term positive for lithium mining, with demand driven by EV growth likely to outstrip lithium supply.

Financials

REM's interim results for 1 January to 30 June 2015 highlight the considerable growth currently seen in the general lithium space. Its portfolio of predominantly lithium-based investments (note: Yangibana is the only non-lithium investment REM has under ownership) returned a total post-tax loss for H115 of £1.2m, after half-year G&A of £1.0m and other costs totalling £0.2m. Comprehensive income of £2.6m in H1 reflects largely the £3.7m increase in the value of asset investments. The growth in the lithium sector also resulted in a strengthening of REM's balance sheet, with net assets increasing 39% from £15.6m at end December 2014 to £21.8m at end June. REM states that £12.7m of this represents the market value of its investments at end-June 2015.

Liquid assets available for use

REM has three types of liquid assets at its disposal to grow its portfolio, make new investments and satisfy the future requirements of its joint venture agreements with Bacanora Minerals and, potentially, Hastings Rare Metals (if it manages to succeed in funding a bankable feasibility study on Yangibana).

- At end June 2015 the company had cash and cash equivalents of £1.65m (net cash £0.3m).
- REM has an equity swap agreement with YA Global Master (YAGM), which in February 2015 started payments of a base sum of £308k per month (REM reported receipt of £1.0m from the settlement of a share swap at the half-year stage). We therefore include £2.5m as the total payment received by REM during FY15.
- At end June 2015, REM had c £5.48m left of its US$10m ($8.3m at a £/US$ rate of 1.52) debt facility with YAGM available for draw down (individual withdrawals are approved at YAGM's discretion). The facility has an expiration date of June 2016.

The above three items total £8.3m in liquid assets available for use by REM. We forecast no further investment for the remainder of FY15 in any of REM's interests (ie Bacanora, EMH or Lithium America). We estimate FY15 G&A of £0.8m and £2.6m investment in the Sonora Lithium Project, leaving REM with an estimated end-year net debt position of £1.6m. We expect this to be met via its YAGM debt facility.

Exhibit 13: Financial summary

£000s	2012	2013	2014	2015e
Year-end December	IFRS	IFRS	IFRS	IFRS
PROFIT & LOSS				
Revenue	0	0	0	0
Cost of Sales	0	0	0	0
Gross Profit	0	0	0	0
EBITDA	(916)	1,501	(3,124)	(800)
Operating Profit (before amort. and except.)	(916)	1,501	(3,124)	(800)
Intangible Amortisation	(57)	(54)	(49)	0
Exceptionals	(184)	(2,309)	456	(97)
Other	0	0	0	0
Operating Profit	(1,157)	(862)	(2,717)	(897)
Net Interest	0	0	(342)	(100)
Profit Before Tax (norm)	(916)	1,501	(3,466)	(900)
Profit Before Tax (FRS 3)	(1,157)	(862)	(3,059)	(997)
Tax	0	0	0	0
Profit After Tax (norm)	(916)	1,501	(3,466)	(900)
Profit After Tax (FRS 3)	(1,157)	(862)	(3,059)	(997)
Average Number of Shares Outstanding (m)	1,480.2	3,167.7	5,232.1	6,802.8
EPS - normalised (p)	(0.06)	0.05	(0.07)	(0.01)
EPS - normalised and fully diluted (p)	(0.06)	0.05	(0.06)	(0.01)
EPS - (IFRS) (p)	(0.08)	(0.03)	(0.06)	(0.01)
Dividend per share (p)	0.0	0.0	0.0	0.0
Gross Margin (%)	N/A	N/A	N/A	N/A
EBITDA Margin (%)	N/A	N/A	N/A	N/A
Operating Margin (before GW and except.) (%)	N/A	N/A	N/A	N/A
BALANCE SHEET				
Fixed Assets	879	2,194	4,107	9,307
Intangible Assets	879	698	1,174	1,174
Tangible Assets	0	0	0	2,600
Investments	0	1,496	2,933	5,533
Current Assets	700	2,978	11,529	12,203
Stocks	0	0	0	0
Debtors	489	688	1,047	0
Cash	176	961	1,463	0
Other	35	1,329	9,019	12,203
Current Liabilities	(122)	(227)	(1,110)	(1,593)
Creditors	(122)	(227)	(475)	0
Short term borrowings	0	0	(635)	(1,593)
Long Term Liabilities	0	0	0	0
Long term borrowings	0	0	0	0
Other long term liabilities	0	0	0	0
Net Assets	1,457	4,945	14,526	19,917
CASH FLOW				
Operating Cash Flow	(957)	(906)	(1,438)	(520)
Net Interest	0	0	(342)	(100)
Tax	0	0	0	0
Capex	0	0	(539)	0
Acquisitions/disposals	250	(2,364)	(6,036)	(5,784)
Financing	399	3,953	8,126	3,975
Dividends	0	0	0	0
Net Cash Flow	(308)	683	(229)	(2,429)
Opening net debt/(cash)	(243)	(176)	(961)	(828)
HP finance leases initiated	0	0	0	0
Other	241	102	96	8
Closing net debt/(cash)	(176)	(961)	(828)	1,593

Source: Company accounts, Edison Investment research

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