

11 March 2019

## CORPORATE SPONSORED - MARKETING COMMUNICATION

MINING

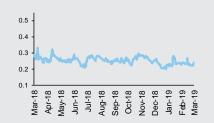
## Corporate

Share Price 17.5p

Reuters/BBG	EMH.L / EMH LN
Index	FTSE AIM
Sector	Mining
Market Cap	£27.6m
Shares in Issue	146.6m
NAV	4.6p
Gearing	NA
Interest Cover	NA

Performance	All-Share	Sector
1 month:	6.3%	7.3%
3 months:	4.6%	4.1%
12 months:	-22.7%	-11.6%
High/Low	26.9	p / 14.3p

Last Results	Jan. Dec 18 Quarterly
Next Results	Mar. H1 interims
Next Event	Drilling results



Source: © 2018, S&P Global Market Intelligence

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#### **Marketing Communication**

This document has not been prepared in accordance with legal requirements designed to promote the independence of investment research. Please refer to important disclosures towards the end of this document.

Under the Markets in Financial Instruments Directive II ("MiFID II"), this research is paid for by the subject issuer as declared in the disclosure and disclaimer pages of this document.

# **European Metals Holdings**

# Significant lithium resource at the heart of industrial Europe

European Metals Holdings is seeking to develop the large Cinovec lithium (tin/ tungsten) deposit in the Czech Republic. This is a brownfield reopening of a former tin/ tungsten mine focussing on recovery of battery-grade lithium compounds at site. European Metals is in the process of completing its Feasibility Study in preparation for permitting and financing. The large Cinovec deposit benefits from simple bulk mining and can use conventional processing techniques to produce an essential component to power European Electric Vehicles. Security of supply and a scalable project is the prize offered to Europe as the EU supports the developments of the next generation of EVs and begins the transition to a carbon neutral future. Our simple DCF model (suitably risked for stage) provides for a fair value of 78p/sh meaning that the company looks undervalued in our view against its European peers. We see continued access to the capital markets as the major risk.

### An investment in European Metals provides investors with:

- Exposure to the lithium market We see strong fundamentals for the lithium market.
   In our option, the supply response will be insufficient to fulfil the obvious growing demand.
   Long lead times to develop projects and the associated downstream conversion capacity together with difficult capital markets may keep the lithium price volatile and relatively high.
   We use prices close to current spot in our model.
- A development project about to go through final feasibility The plan for Cinovec is simple and achievable in our view. Conventional mining and processing to produce a battery-grade lithium hydroxide using well understood technology. Tin and tungsten credits will provide a small element of revenue diversification. There may also be synergies with the Zinnwald deposit over the German border.
- Attractive economics Expected post-credit costs place Cinovec in a low risk portion of the global cost curve and attractive profit margins will generate significant cash flow and returns.
- Strong location The European automotive industry will require security of supply, especially as China flexes its muscles by taking stakes in other global lithium deposits, and Cinovec is perfectly placed in the heart of industrial Europe. There is a strong interest within the EU in the whole battery chain with a particular emphasis on raw material.

Overall, we see the European Metals Holdings story as a **straightforward investment case** with the development of an operation to produce **lithium hydroxide direct for battery manufacturers**. Revenues are highly geared to lithium, but some by-product tin and tungsten will add a valuable revenue stream to the mine – perhaps 5-10% of net revenue. Growing demand in Europe will drive an incentive (and requirement) for domestic production as Europe's vehicle fleet electrifies. This is **driven by Europe's world-leading climate change approach and growth of a low-carbon economy**.

In our model we assume current spot prices (\$12,000/T LiOH) throughout the mine life and have inflated our capital cost requirement from the pre-feasibility study to \$550m (from \$393m). Using these inputs we calculate a fair value at 78p/sh using a DCF methodology risked at 20% and based on a 10% discount rate. There is strong potential for value appreciation as European Metals goes through its development cycle.

#### EUROPEAN METALS HOLDINGS

# GLOSSARY

APT – ammonium paratungstate Sn – tin SOP – sulphate of potash ( $K_2SO_4$ )  $WO_3$  – tungstate

### **CONVERSIONS**

ppm – parts per million ppm to % divide by 10,000 Li to Li<sub>2</sub>O multiply by 2.15 Li to LCE multiply by 5.32 Li to LiOH multiply by 6.06 LiOH to LCE multiply by 0.88 Li<sub>2</sub>O to LCE multiply by 2.47

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#### Zinnwaldite

A potassium lithium iron aluminium silicate hydroxide fluoride is a silicate mineral in the mica group KLiFeAl(AlSi<sub>3</sub>)O<sub>10</sub>(OH,F)<sub>2</sub>,

Figure 1: Zinnwaldite – lithium mica, from its type locality at Cinovec / Zinnwald



Source: Leon Hupperichs - http://www.mindat.org/photo-150086.html

## **Investment Case**

We initiate with a fair value of 78p/sh

European Metals Holdings is developing the Cinovec lithium (tin-tungsten) deposit in the Czech Republic. This resource (the largest defined lithium resource in Europe and 4<sup>th</sup> largest hard rock deposit in the world) is strategically located close to key automotive consumers in Europe and attracting a great deal of interest from industry within the wider European Union. We initiate with a fair value estimate of 78p/sh.

**Cinovec ticks the boxes of a low-risk, high-return project** The fundamental basis for investment in mining projects in our opinion are a low risk, high return project – an assessment reached based on geology, mining, metallurgy, location, economic returns, commodity market and management.

- Cinovec has a large resource, which is amenable to bulk mining and processing and is multi-commodity capable of producing several saleable products: lithium hydroxide or carbonate, tin, tungsten and potash (potassium sulphate). The PFS uses only 10% of the total outlined Indicated Resource (Table 4)
- **Mineralisation is consistent** large bulk of the resource shows little variability in grade and mineralogy.
- **Brownfield site** People in the local area appreciate mining and the employment benefits it can bring, and there is an understanding of the geotechnical, mining and processing characteristics of the orebody already available. The orebody is present for all to see.
- We view the location in the centre of Europe as a big positive, with stable democracies and significant expansion of automotive and battery industry infrastructure is underway; this is as a premier place to operate. There is little production of lithium in the EU and a project of the stature of Cinovec would provide a guarantee of domestic security of supply. Low costs of shipping final product to consumers.
- Production will be via **conventional processes**, **well-understood technology** which reduces the risk going forward.
- **Full value capture** with European Metals Holdings proposing to produce a final product direct to the battery manufacturers it is not losing value in the conversion from an intermediate concentrate (e.g. the spodumene producers).
- Our DCF using inputs from the April 2017 Pre-Feasibility Study (PFS), modified conservatively for the production of lithium hydroxide instead of carbonate, show strong returns and value creation.
- **Management** has been pursuing the project for several years and is well connected internally in the Czech Republic with **links at all levels of government**.

Positive choices on final product to produce lithium hydroxide European Metals Holdings is undertaking changes in its processing plans to achieve the final production of lithium hydroxide monohydrate (LiOH.H<sub>2</sub>O) instead of lithium carbonate (Li<sub>2</sub>CO<sub>3</sub>) as first envisaged in the PFS. This is because many battery manufacturers are turning to this compound as feedstock for batteries because it offers better power density (more battery capacity), longer life cycle and enhanced safety features. The changes for Cinovec are not a fundamental shift in processing, rather a few changes to the chemistry in the back end of the plant which will require a slightly higher capital expenditure. However, lithium hydroxide currently achieves a premium to lithium carbonate (15-20%), and this differential has been higher in the past. We believe this higher price differential will be maintained and that Cinovec will produce lithium hydroxide; the economics are compelling.

**Exposure to lithium** Lithium is increasingly seen as a metal for the near future. The demand for lithium-ion batteries is only set to increase and could eventually become very

Robust project on many levels

The change from lithium carbonate to lithium hydroxide production seems an easy decision to make

Exposure to lithium a positive

## **EUROPEAN METALS HOLDINGS**

large. Current utilization levels at existing lithium producers is low and in the short term, lithium production and therefore price can be managed. Further out as demand grows, there will be a requirement for additional supply – this is where Cinovec can come into its own, especially as it is located in the heart of industrial Europe. Geographically, the project is a sweet spot as a key component for security of supply for consumers. Demand will be led principally by the electric vehicle industry as more vehicles are manufactured and more batteries are required, with the majority of car manufacturers working on new and improved electric vehicles. This is shown graphically in Figure 2 with the Cinovec project right in the sweet spot for lithium demand in Europe. Demand for electric vehicles will in turn be led by improvements in infrastructure (e.g. charging points) for electric cars together with improved battery technology (capacity, charging speed) and specific legislation in countries (e.g. in Europe) which will challenge the use of the internal combustion engine.

Strategically located

Figure 2: Cinovec – right at the heart of EV development in Europe



Source: European Metals Holdings

Lithium batteries for EVs and other mobile power solutions (e.g. hand tools) very important at a Pan-European level

High-level European interest in the whole battery chain The European Union recognises the importance of the battery industry to the European economy going forward – the whole chain, from raw materials through battery manufacture and inclusion in EVs and back to raw materials again via recycling. To this end a European Battery Alliance (EBA) has been set up, composed of the European Commission, EU countries, the European Investment Bank and other stakeholders (mining companies, battery companies etc). This hopes to encourage the full development of the industry in Europe for an expected €250bn market requiring 10-20 "giga factories" to be set up – these will require significant amounts of raw material. The industry is therefore being promoted from within – European Metals Holdings is a member of the group and ideally situated to benefit from first-mover advantage in the heart of industrial Europe.

Nascent lithium industry – plenty of opportunities

Industry in a flux and it is a great time to make a deal The last few years have seen lithium chemical producers and mining companies tie up feed via offtakes and equity stakes – some of which show companies taking sizeable positions. This is a nascent industry in many parts of the world and as such a company such as European Metals Holdings could

generate interest from a variety of sources keen to gain a foothold in lithium production in Europe. Some recent transactions highlighted by European Metals Holdings are shown below in Table 1.

Table 1: Ro	ecent Transactions in lithium deposits
Date	Transaction
Jan 2017	Ganfeng Lithium – US\$40m equity investment and US\$125m debt facility in Lithium Americas
Feb 2017	Bacanora Minerals - €30m equity option for 50% of Deutsche Lithium
May 2017	Great Wall – A\$28m equity investment in Pilbara Minerals
Oct 2017	Hanwa – £10.2m equity investment in Bacanora and offtake
Jan 2018	Toyota Tsusho – US\$224m equity investment in Orocobre
Feb 2018	POSCO – A\$79.6m equity investment in Pilbara Minerals plus binding offtake
Aug 2018	Nemaska Lithium - €10m promissory notes and 5 year offtake in Northvolt
Aug 2018	POSCO – A\$280m purchase of Salar del Hombre Muerto project from Galaxy Resources

Source: WH Ireland research, European Metal Holdings

Value against its peers

**European Metals Holdings currently trades at a discount to its peers** There are several other lithium and development companies in Europe and European Metals Holdings appears undervalued against these on an EV/t LCE (total resource) considering size, stage and conventional development profile to final product. These are shown in Table 2 below.

Table 2: European Metals Holdings Peers in Europe (plus Bacanora Minerals – as a major London-listed lithium company)									
Company	Country	Deposit	Stage	Total Res (Mt)	Li₂O (%)	LCE (Mt)	EV (USDm)	EV/ t LCE	Comments
European Metals	Czech	Cinovec	DFS	696	0.4*	7.2	34.7	4.8	
Rio Tinto	Serbia	Jadar**	PFS	136	1.9	6.2			small part of large multi-national
Infinity Lithium Corp	Spain	San Jose	PFS	111	0.6	1.7	8.0	4.8	
Deutsche Lithium	Germany	Zinnwald***	DFS	40	8.0	8.0			optioned to Bacanora
Savannah Resources	Portugal	Mino do Barroso	DFS	20	1.0	0.5	60.9	117.2	
Keliber	Finland	various	DFS	10	1.2	0.3			subsidiary of Nordic Mining
European Lithium	Austria	Wolfsberg	DFS	11	1.0	0.3	32.3	119.7	
Bacanora Lithium ***	* Mexico	Sonora	DFS	559	0.6	8.8	29.4	3.3	

Source: WH Ireland Research, European Metals Holdings

Plenty of news flow expected to advance the project

**Catalyst-rich program**. Key catalysts for the short-term include completion of the definition drilling for resource and initial mine plan and an announcement on the lithium hydroxide metallurgical flow sheet. This will be followed by completion of the Feasibility Study. European Metals is well-funded for the short-term with £2.6m in cash (WHIe).

Simple investment case: Robust project, good location (to operate and sell directly) and strong commodity outlook to generate significant returns

Overall we see the European Metals Holdings story as a straightforward investment case. With the development of an operation to produce lithium hydroxide direct for battery manufacturers. Revenues are highly geared to lithium, but some by-product tin and tungsten will add a valuable revenue stream to the mine – perhaps 5-10% of net revenue. Growing demand in Europe will drive an incentive (and requirement) for domestic production as Europe's vehicle fleet electrifies. This is driven by Europe's world-leading climate change approach and growth of a low-carbon economy.

<sup>\*</sup> Grade is easily upgraded to 2.7%Li<sub>2</sub>O as part of the wet magnetic separation of the lithium-rich mica in the process route

<sup>\*\*</sup> Jadar is a clay deposit and was discovered in 2004. It has been slow progress. The mineral jadarite is the chemical equivalent of Kryptonite of superman fame

<sup>\*\*\*</sup> Zinnwald is the continuation of the Cinovec mineralisation over the Czech border into Germany
\*\*\*\* Resource only for Sonora and ignoring any component of value given by the market for Zinnwald.

Resource only for Soriora and ignoring any component of value given by the market for

Our fair value for European Metals Holdings is 78p/sh

We use a DCF approach for our fair value

#### WH Ireland Model Assumptions

Long-term LiOH price set at \$12,000/t
Long-term tin price set at \$20,000/t
Long-term price set at \$350/mtu APT
Potassium sulphate \$600/t
Capex - \$550m
Opex - \$5000/t LCE (pre-Sn/WO<sub>3</sub> credits)

Cinovec us a robust project and we expect once in production for it to lie in a low risk part of the global cost curve, with costs below the spodumene producers and benefiting from byproduct credit tin and tungsten

# **Valuation**

Our fair value for European Metals Holdings is 78p against the current share price of 18p.

#### **Approach**

Our model is based on Pre-Feasibility numbers from European Metals Holdings modified by assumptions from WHI – these are laid out in Tables 5 and 6 further in this report. We model to a final production of lithium hydroxide monohydrate as the economics with a higher price received against a modest increase in capital expenditure are compelling and justify the change in product, in our opinion. We risk the project using only 20% of the project NAV for this stage in our final fair value calculation using a share divisor of current outstanding shares.

Table 3: European Metals Holdings Valuation (US\$m)									
Valuation Approach		Valuation US\$m	Valuation £m**	Owned %	Risk %	Valuation GBP p/s			
Cinovec	DCF - 10%	745.4	573.4	100	20	78.2			
Cash & Cash Equivalents***		3.1	2.4			1.6			
Corporate Costs	3yr DCF-10%	-3.4	-2.6			-1.8			
WH Ireland Valuation						78.1			

Source: WH Ireland Research. Valuation based on 146.6m shares in issue

### Sensitivity to forecasts

The Cinovec project is a robust project as shown in Figure 3. Even if the lithium hydroxide price were to fall 20%, the project still returns ~\$300m in our model. The initial 20 year mine life outlined by European Metals Holdings is also only a minimum in our view as the whole outlined resource would justify a much longer life — subject to drilling and reserve definition. The valuation in the future of any project in production generating \$150-\$200m of free cash flow every year would be significant.

Figure 3: Cinovec - right at the heart of EV development in Europe 1,400 1,200 1,000 NPV US\$m 800 600 400 200 0 -20% -10% 0% 10% 20% Initial Capital Cost Price

Source: European Metals Holdings

<sup>\*</sup> Subjective risk

<sup>\*\*</sup> WHI est FX US\$:£ = 1.3:1. (Spot Feb 2019), \*\*\* WHI est Feb 2019.

## Advantages for the production of lithium hydroxide

Lithium hydroxide the obvious choice for final product

Lithium hydroxide has achieved a premium to lithium carbonate over the past few years and is currently achieving a price 15-20% higher than the more commonly used lithium carbonate. We believe this differential in price can be maintained as many battery makers are looking to build hydroxide battery capacity e.g. Panasonic and Tesla. This is a view shared by other industry commentators who believe that NMC batteries (lithium-nickel-manganese-cobalt batteries) will dominate the EV market – with lithium hydroxide the preferred choice of lithium compound in these batteries for automotive uses.

The result is that we use a long-term price of \$12,000/t for lithium hydroxide in our analysis versus a \$10,000/t for lithium carbonate price. We have added in a small \$50m component of capital expenditure increase for this production, as well as \$100m increase in capex over and above the PFS estimates – this raises our capex forecast from \$393m to \$550m. We keep operating costs similar as European Metals Holdings state they expect the consumable chemicals required to be cheaper in the lithium hydroxide process.

# **Risks**

Usual risks for exploration projects

Capital markets remain a risk

Country risk is low

Location key: central, infrastructure and reactivation of a brownfield site

Commodity risk is low

European Metals operates under the usual risks for exploration and development projects. Raising money (equity and debt) in the capital markets, and permitting, being specific risks.

The capital markets have recently been a difficult place for junior explorers and developers in the Natural Resources Sector. Bacanora (AIM:BCN) is a case in point when, even with a compelling feasibility study for production and several strong partners lined up, it has still run into difficulties with financing its project in Mexico. We believe that with European Metals Holdings' project location in Europe and the many car manufacturers pinning their future on EVs, and the potential growth of a significant battery industry, will create an environment where industry participation and/ or EU guarantees in the funding of the project may be a distinct possibility.

We feel the country risk for the project is a low to moderate. The Czech Republic is an established democracy in the European Union. There have been some issues at a government level which led to an MOU signed between European Metals Holdings and the Czech ministry to explore downstream processing being cancelled, but this has no effect on European Metals Holdings permitting in the country. This cancellation of the MOU seems to have been tied to a change in government and a domestic agenda on foreign-owned companies. We do not expect this to continue or to hinder the award of further permits to European Metals Holdings, and indeed drilling permits have been issued, but there is always a possibility this may delay developments slightly.

Location in an area full of infrastructure is also seen as a positive. The new spodumene producers in Western Australia are remote, the Chilean and Argentinian brine deposits often lack sufficient process water and the new clay deposits in Mexico are also remote and in areas which will be new to mining with all the lack of support services that implies. Cinovec by comparison benefits from significant infrastructure, access to experienced contractors and a trained workforce and is in fact a Brownfields development of a previous mine.

Our estimates of the supply-demand-price equation for lithium show that a front runner in lithium production in Europe would be relatively low risk. There is a growing demand for lithium, amongst a host of speciality and critical metals to enable green, efficient technologies and hi-tech applications; for which there are few metal substitutions possible and for which there are issues around security of supply. In the case of lithium there is a large anticipated expansion in electric vehicles which requires new producers to satisfy ever increasing demand.

# **European Metals Holdings**

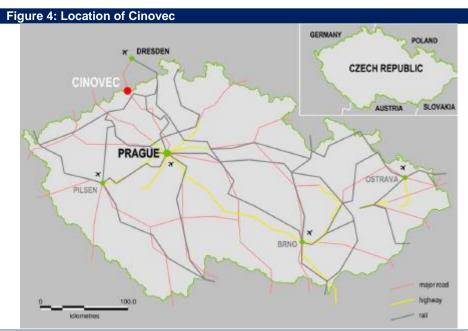
European Metals Holdings controls the mineral exploration licenses awarded by the Czech State over of the Cinovec lithium-tin deposit in the Czech Republic. The project is located 100 km NW of Prague on the border with Germany. It is part of the historic Cinovec-Zinnwald mining district which over the past 600 years has been a significant producer of tin. The deposit is in the heart of industrial Europe, close to the major centres for the automotive production and where technology industries are abundant.

## **History**

Current area has long been prospective for mining

Tin mining began in the 14th century with modern mining only ceasing in 1972 when near surface flat lying quartz-cassiterite-wolframite veins were mined underground using shaft access.

As the high grade tin ore was running out, the Czech State began an extensive underground exploration programme south of the workings. UG drilling and tunnelling defined significant blind tin-tungsten-lithium mineralization associated with greisenization and silicification with about 0.5Mt of ore test-mined in the 1980s and a feasibility study completed. All operations ceased with the demise of the centralized economy in 1990.



Source: European Metals Holdings

After gaining control of the licence, European Metals Holdings has quickly moved through the stages of study completing a scoping study in 2015 and a PFS in 2017.

#### Geology

Cinovec lies in the Erzgebirge region situated in a NW part of the Bohemian Massif in the Saxothuringian zone of the European Variscides. The mineralisation is related to post-orogenic granite intrusions and hydrothermal alteration – a "greisen" system with quartz and zinnwaldite (a lithium mica) with or without topaz, minor sericite, fluorite and potassium feldspar and forms as:

- irregular metasomatic greisen and greisenised granite zones from several tens to hundreds of metres thick that follow, and are located near or at, the upper contact of the cupola;
- thin, flat greisen zones enclosing quartz veins up to 2m thick parallel the intrusive

contact of the cupola. Ore minerals are cassiterite, wolframite, scheelite and zinnwaldite. In the greisen, disseminated cassiterite predominates over wolframite, while in veins wolframite is roughly equal to, or more abundant than, cassiterite;

steep quartz veins with wolframite

#### Resources

A resource was calculated for the lithium and the tin zones in November 2017 after a period of infill drilling. This incorporates all of the historical data (which is considerable: drill holes, production reports and underground sampling, 80km of historic diamond drilling plus 21.5km historic development tunnels) which had been checked with holes drilled by European Metals Holdings.

European Metals Holdings concentrated its recent drilling on known high-grade areas in the tin and lithium zones; high-grade which would substantially improve the economics of the deposit if targeted during the early years of production.

As Figure 5 clearly shows, the deposit is not constrained by the national border and the mineralisation does run into southern Germany where the licences are held by another company (which is now held 50% by Bacanora Lithium). There may be some synergies with the continuation of the deposit.

Table 4: Cinovec resource (Nov 2017) – see Figure 5 for location of resource									
Category	Cutoff Li	Mt	Li%	LCE kt	Sn%	Sn kt	W %	W kt	
Indicated	0.1	372.4	0.21	4,107	0.04	149	0.02	60	
Inferred	0.1	323.5	0.18	3,169	0.04	129	0.01	42	
Total	0.1	695.9	0.20	7,170	0.04	263	0.01	92	

Source: European Metals Holdings, WH Ireland research

The Prefeasibility Study (PFS) is based on mining 34.5 Mt of material over 22 years, 100% of which lies within the Indicated Mineral Resource category. The tonnage used in the PFS represents only 5% of the total Mineral Resource and 10% of the Indicated Mineral resource.

#### Proposed production plan

The Prefeasibility Study assumes mining 1.7Mt/a which is mined and crushed in the underground mine before stockpiling at the mine entrance (30kt capacity) over a 22 year period. The geometry of the orebody is largely flat or shallow dipping and massive enough to allow the use of long-hole open stoping. The mine will be accessed by a twin decline system. A conveyor will be installed from the underground primary crusher on 590m Elevation to surface in the conveyor decline. The second decline will be used as a service decline for men, material and as an intake airway.

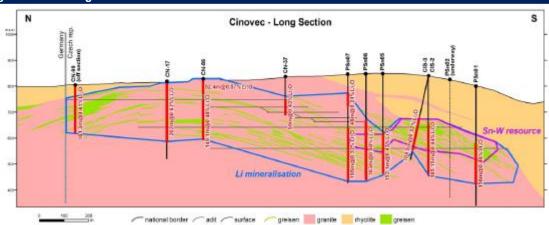
Comminution will be via a single stage 4MW SAG mill at the mining portal and will deliver ground ore ( $P_{80}$  < 212µm) to the Beneficiation Plant, which is to be located adjacent to the Lithium Plant. Wet High Intensity Magnetic Separation (WHIMS) will first separate out the lithium-bearing micas (zinnwaldite) and produce a magnetic mica concentrate. The ability to use wet magnetic separation is unique to zinnwaldite ore because zinnwaldite contains iron in its lattice and is paramagnetic. Magnetic separation offers cost and recovery advantages over beneficiation through froth flotation (recovery of 91% v 78%). The non-magnetic stream will then be treated by gravity, flotation, magnetic and electrostatic separation to produce tin and tungsten products.

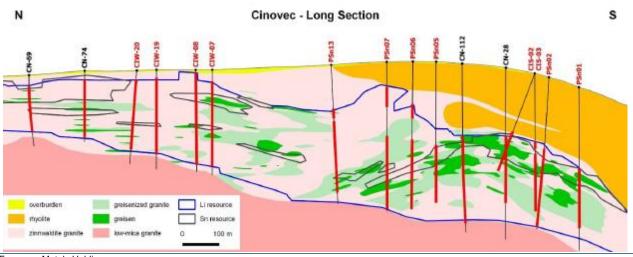
The lithium plant will take the mica concentrate from the Beneficiation plant and extract the lithium through roasting, leaching and then purification to produce battery grade lithium carbonate or hydroxide. The plant will also produce a by-product potassium sulphate. The tailings produced by both processing plants will be filtered to produce a filter cake which is

VHIreland 9

dry stacked in a nearby Tailings Storage Facility (TSF). Although higher cost than alternative methods, dry stacking significantly reduces environmental impact. Recent test work conducted at separate laboratories determined the optimal mass ratio of mica to gypsum and limestone additions to the roast. This roast recipe results in a leach lithium recovery of 94-95% at a roast temperature of 850 °C for 1 hour.

Figure 5: Long sections through Cinovec





Source: European Metals Holdings

Based on the best lithium extraction achieved in early roast optimisation test work, a bulk composite of mica concentrate, produced from representative Cinovec core samples, was roasted at Nagrom, and an initial lithium carbonate produced which had a purity of >99.5%.

As confirmed by test work conducted in both Anzaplan (Germany) and Nagrom (Perth), the quality of the lithium carbonate produced meets requirements for use in lithium batteries. Tin and tungsten concentrates would be sent to smelters with the lithium mica processed on site to produce battery-grade lithium carbonate or hydroxide.

Anzaplan began testwork on proving up a flowsheet for the production of lithium hydroxide in 2018 and we anticipate announcements on the new end stages of the lithium plant soon.

Overall the assumptions used in the PFS were:

- Lithium recovery to concentrate 90%;
- Lithium recovery in carbonate plant 85%;
- Overall lithium recovery 76.5%; and

• Tin recovery – 65%.

## Prefeasibility study economics

The PFS was completed in April 2017 and used the parameters laid out in Table 5 and 6. The accuracy of the estimates was put at +/- 25%. As the Project lies on the border of Germany and the Czech Republic, it is exceptionally well-serviced by supporting infrastructure including access to rail, national highways, power, water, gas, skilled workforce, engineering companies and chemical companies

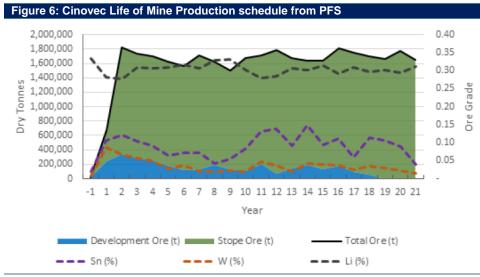
European Metals Holdings use a tin price of \$22,500/, a tungsten APT price of \$330/t and a potassium sulphate price of \$520/t in its economic model

Table 5: Cinovec PFS parameters – Capital Cost								
Parameters Feed Rate	<b>PFS</b> 1.7Mt/a	WHI assumptions 1.7Mt/a						
Costs								
	Capital Cost (US\$m)							
Mining	70.3							
Comminution / Beneficiation / Infrastructure	104.9							
Lithium plant (LCP)	179.9							
Tailings	2.6							
Contingency @ 10%	35.8							
TOTAL	393.4	550						

Source: European Metals Holdings, WH Ireland research

Table 6: Cinovec PFS parameters – Operating Cost								
Costs	\$M/a	\$/t ROM	\$/t LCE	%				
Mining	40.7	24.3	1,960	38				
Comminution / Beneficiation / Infrastructure	19.4	11.6	935	18				
Lithium plant (LCP)	47.3	28.2	2,274	44				
Admin	0.9	0.5	42	1				
Total Operating Cost	108.3	64.6	5,211	100				
By-product Sn/W	(29.2)	(17.4)	(1,404)					
By-product potassium sulphate	(6.7)	(4.0)	(324)					
Total Opex (net of by-product credits)	72.4	43.2	3,483					

Source: European Metals Holdings, WH Ireland research



Source: European Metals Holdings, WH Ireland research

### WH Ireland Assumptions

Lithium – pay 100% of LiOH.2H<sub>2</sub>0. Long-term LiOH price set at \$12,000/t

Tin (Sn) – TC of \$500/t conc. (Inc. low grade penalty), deduct 2% tin for low grade, Long-term tin price set at \$20,000/t

Tungsten (WO<sub>3</sub>) – pay 80% of APT price. Long-term price set at \$350/mtu APT

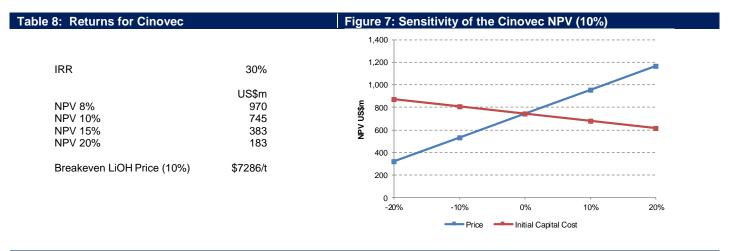
Potassium sulphate \$600/t

## **Discounted Cash flow analysis**

Table 7: Cash Flow 0	Cinovec lithium	– tin/tun	gsten pr	oject (10	00%) -Re	eal 2019	\$
		Yr-2	Yr-1	Yr 1	Yr 5	Yr 15	Yr 20
Tonnes to Mill	kt	-	-	1000	1700	1700	1700
Li	<b>%</b> *	-	-	0.30	0.30	0.30	0.30
Sn	%	-	-	0.09	0.09	0.09	0.09
$WO_3$	%	-	-	0.03	0.03	0.03	0.03
LCE	kt	-	-	13.7	23.3	23.3	23.3
Paid LiOH	kt	-	-	15.6	26.6	26.6	26.6
Paid Sn	kt	-	-	-	1.0	1.0	1.0
Paid WO <sub>3</sub>	kt	-	-	0.2	0.3	0.3	0.3
Paid potassium sulphate	kt	-	-	7.6	13.0	13.0	13.0
Price LiOH	US\$/t LCE	-	-	12000	12000	12000	12000
Price Sn	US\$/t Sn	-	-	20000	20000	20000	20000
Price WO <sub>3</sub>	\$/t APT	-	-	350	350	350	350
Price potassium sulphate	\$/t	-	-	600	600	600	600
NET REVENUE	US\$M	-	-	197.6	355.3	355.3	355.3
Mine Site Cost	US\$M	-	-	(71.0)	(117.9)	(117.9)	(117.9)
Royalties	US\$M	-	-	(4.0)	(7.1)	(7.1)	(7.1)
EBITDA	US\$M	-	-	122.6	230.3	230.3	230.3
DDA	US\$M	-	-	(26.5)	(48.1)	(48.1)	(48.1)
Interest	US\$M	-	-	-	(10.6)	-	-
Tax	US\$M	-	-	-	-	(34.6)	(34.6)
Net Profit After Tax	US\$M	-	-	96.1	171.6	147.6	147.6
Add back in DDA	US\$M	-	-	26.5	48.1	48.1	48.1
Add back in interest	US\$M	-	-	-	(10.6)	-	-
Expansion Capex	US\$M	(100.0)	(270.0)	(180.0)	-	-	-
Sustaining Capex	US\$M	-	-	(10.0)	(20.0)	(20.0)	(20.0)
CINOVEC CASH FLOW	US\$M	(100.0)	(270.0)	(67.4)	189.2	175.7	175.7

Source: WH Ireland. Note the break in years. Forecasts are Real 2019\$

<sup>\*</sup> Higher than resource grade in Table 4 as can high-grade in early years of production. Confirmation drilling for mine plan underway at the current time



Source: WH Ireland Research

## **Lithium Market**

Lithium is produced from two main sources: hard rock mines and salt lake brines, which account for roughly 50% each of production. Lithium is sold in several forms, but mostly in the form of lithium carbonate (of various grades) and lithium hydroxide. There are several lithium clay projects (e.g. Sonora in Mexico and Jadar in Serbia for example) and a large lithium mica project in the Czech Republic (Cinovec) which may also form a significant component of production in the future.

### **GLOSSARY**

LCE – Lithium Carbonate Equivalent LiOH – Lithium hydroxide

#### **CONVERSIONS**

ppm – parts per million ppm to % divide by 10,000 Li to LCE multiply by 5.32 Li to LiOH multiply by 6.06 LiOH to LCE multiply by 0.88

## Supply

The majority of production comes from four main producing countries — Chile, Australia, Argentina and China - with the top three, Australia, Chile and Argentina, accounting for 85%. Brines and Hard rock source account for roughly 50% of production respectively at the current time. The largest hard rock producer is Talison Lithium in Australia, which produces ~80kt LCE in spodumene concentrate (\$320m expansion to ~160kt/a early next decade) from its Greenbushes mine whilst the largest brine producer is SQM in Chile, which produced 48kt LCE in 2017. Hard rock producers send their concentrates to China, in the main, for conversion to one of the saleable lithium compounds with some small conversion capacity in Brazil. Albermarle is the world's largest lithium producing company in the world

The lowest cost production is from lithium brines with production costs of US\$3,000-\$4,500/t LCE forming the lowest cost 50% of the cost curve. Above this, the hard rock producers have production costs ranging from US\$6,000 – US\$8,000/t LCE. There is growth expected in recycled supply as companies gear up to reprocess electronic batteries and to the anticipated volume of batteries from electronic vehicles in the future.

The increased requirement for lithium over the short to medium term will be satisfied from increased capacity utilisation and a raft of hard rock and brine projects due for construction. Many of those already slated for production have been delayed (e.g. Bacanora a new project delayed due to financing difficulties, SQM, an existing brine producer with delayed expansions due to taxes and a lack of water in the Atacama). There are significant challenges to future supply growth – these include: 1) funding; 2) time to build (hard rock mine 4-5 years, brine salar plant 6-8 years); 3) commissioning then achieving and maintaining nameplate output; 4) requirement for new conversion capacity in China (or elsewhere?) to match concentrate production; and 5) delivering a battery grade product.

However, over the short to medium term the world will need ever increasing amounts of lithium and it is clear to us that new projects will be required as part of the production mix as we are not convinced that existing producers (especially the brine producers) can hit their optimistic expansion targets. We see strong lithium prices justifying new hard rock project development, with differential prices for the separate lithium chemicals required for different types of batteries.

#### **Demand**

Lithium is used for batteries, glass, ceramics, greases, metallurgical powders, polymers, and in the aluminium industry.

- Batteries are the growing use of lithium for rechargeable batteries in electronic hardware to the new exciting use as the source of power in electric cars at ~50% of lithium demand in 2017
- After batteries the largest market for lithium is in glass, glass-ceramics and ceramics which together accounted for ~15-20% of total consumption in 2017; lithium helps reduce the viscosity of the glass melt.
- Metallurgical powders, polymers and grease.

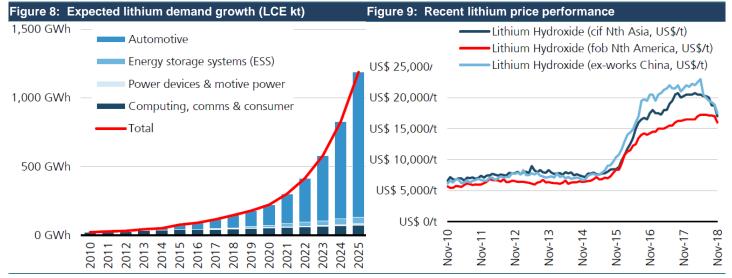
- Air treatment dehumidifiers and air purification
- Lithium is also used in the production of aluminium

The key theme in the lithium industry is increased demand going forward from all end uses, with the biggest area of growth arising from the expansion of the battery sector for electric vehicles. Battery-grade lithium carbonate consumption is expected to rise from 100kt/a in 2017 to ~1,000kt in 2025 (Figure 8). The demand is being led by increased EV production by all of the major automobile makers. Lithium-ion batteries are able to store more energy with greater longevity than other battery compounds, and are more lightweight than their lead nickel, nickel cadmium, and nickel metal hydride counterparts. The new battery factories, with their economies of scale, should reduce the cost per pack and make it able to compete with the internal combustion engine. Indeed, lithium-ion costs have dropped from \$1,000/kwh to ~\$200/kwh over the past 5 years driven by technological advances; the aim is to reduce the cost further to below \$100/kwh by 2030.

Battery life has also improved with many producers offering guarantees for 8 years / 100,000 mile warranties on their batteries. The speed of charging has also improved with fast chargers being introduced to many countries.

All the major German car manufacturers have plans to increase sales of Electric Vehicles (EVs) with Volkswagen, Porsche, Mercedes, BMW and Daimler all looking to build up their EV models by 2025. We anticipate that they will be seeking partnerships with battery manufacturers (e.g. LG, Samsung, A123 and northvolt) looking to build battery plants in Poland, Hungary, Austria, Czech Republic and Sweden (and possibly Tesla in Czech Republic as well) to cope with expected demand.

Growth in EVs will come from the continued decrease in cost of the batteries and as many countries look to ban the sale of new internal combustion engine cars over the next few decades.



#### Source: WH Ireland Research, UBS Research

#### **Price**

In our models, we use a long-term price of \$10,000/t lithium carbonate (99.5%) and \$12,000/t lithium hydroxide. These are a moderate discount to current prices (Figure 9) but one that we believe is a conservative forecast given our expectation of further supply delays and ever-increasing demand.

# Tin market outlook

#### **Market overview**

The market for tin is medium-size, mature and well-established. Tin has enjoyed a steady, growth in consumption over the years, and a long term growth trend from 1980 to 2017 of ~2% p.a. Total consumption of refined tin grew from 341kt/yr in 2012 to 368kt/a in 2016, with global production growing from 335,000 tons to 358,000 tons over the same period (ITRI). The consistent deficit between supply and production is balanced by recycling with secondary supply from scrap.

The positive outlook for tin is driven by slow but steady consumption growth and a potential under-supply. Demand is expected to grow steadily with tins continued use in the consumer electronics industry as a solder. Peaking production from Myanmar and decline in other alluvial districts (with volatility from Indonesia) could lead to supply disruption and an increased price. Whatever happens, there will be a requirement for more tin supply in the medium term and new hard rock supplies will have to fill the gap. We set our long-term price at \$20,000/t, which is an average of the past couple of years, as a conservative long-term price.

## **Outlook and price**

The tin market has been supplied from the informal sector over the past few years as consumption has been greater than yearly supply. Easy production from Myanmar is coming to an end with lower grades and resource depletion contributing to a fall in production from this source and with continuing volatility from Indonesia the outlook for the tin price due to potential supply disruption is good. Going forward more primary tin will be required to support the modest, but expected continued, rise in tin demand.

The price has recovered from the lows of \$13,800/t in January 2016 to a respectable long-term average price of over \$20,000/t. We believe there is further strength in the tin price, on the back of supply constraints, but set our long-term price conservatively at \$20,000/t to reflect uncertainty in the fall in production from Myanmar while anticipating the requirement for new supply as alluvial resources are depleted elsewhere in the world with demand growing at a steady 2%pa.

#### Tin has many uses

- Tin is used principally as a solder in the manufacture of electronics where it has replaced some of the lead content for environmental reasons. In 2015 it accounted for 47% of tin demand.
- Because tin readily bonds with other metals (iron, lead and zinc) it is used to coat metals to prevent corrosion. Tinplate accounted for 15% of demand in 2015.
- There has been an increase in the amount of tin used in lead acid batteries (where
  it replaces antimony and/or cadmium) for environmental reasons. The growth in
  ebikes in China has seen a large increase in tin consumption in China, but also the
  addition of ever increasing new cars to the global fleet, all requiring SLI batteries,
  has also impacted demand. In 2015 lead acid batteries accounted of 8% of
  demand.
- In 2015, 5% of demand for tin was in alloys principally with copper (bronze ~12% tin, pewter (tin, lead, copper)), but also growing uses of new alloys with niobium (for superconducting magnets), zirconium (for use in nuclear reactors) and lead (organ pipes)
- "Other" applications include tin in the sheet glass making industry where glass
  "floats" on molten tin, new applications associated with Li-ion batteries (for which
  the development of an EV fleet will come to provide strong demand) and organotin
  compounds (stabilisation of PVC, and a reducing use in biocides)

Solder is a fusible metal alloy to create a bond between metal components – it has to have a lower melting point than the components it joins. Traditionally lead was used, but tin is an increasingly important component (along with antimony, silver, copper, bismuth and zinc). In general tin forms the main structural metal of the solder alloy as it has good strength and good wetting properties. Tin replaces lead in solders in plumbing and electronics, with tin-zinc solders used in soldering aluminium joints.

# **Directors and Management**

**Dave Reeves - Chairman**. Dave is a qualified mining engineer with 20 years' experience in Africa and Australia. He holds a degree in mining engineering from the University of New South Wales, a graduate diploma in applied finance and investment from the Securities Institute of Australia and a Western Australian first class mine managers certificate of competency.

Dave is currently the Managing Director of ASX listed Calidus Resources Limited and non-executive director of AIM listed Keras Resources, which are Australian Gold and Togo Manganese exploration and mining companies respectively.

**Keith Coughlan – Managing Director**. Keith has almost 30 years' experience in stockbroking and funds management. He has been largely involved in the funding and promoting of resource companies listed on the ASX, AIM and TSX.

Until recently, Keith was the Non–Executive Chairman of ASX listed Talga Resources Limited. He is currently a Non-Executive Director of Calidus Resources Limited and a Non-Executive Director of Southern Hemisphere Mining Limited.

**Richard Pavlik - Executive Director**. Richard is the General Manager of Geomet s.r.o., the Company's wholly owned Czech subsidiary, and is a highly experienced Czech mining executive. He holds a Masters Degree in Mining Engineering from the Technical University of Ostrava in Czech Republic. He is the former Chief Project Manager and Advisor to the Chief Executive Officer at OKD. OKD has been a major coal producer in the Czech Republic. He has almost 30 years of relevant industry experience in the Czech Republic.

**Kiran Mozaria - Non-Executive Director**. Kiran is currently Chief Executive Officer and Director of the Company's largest shareholder, Cadence Minerals.

Kiran holds a Bachelor of Engineering (Industrial Geology) from the Camborne School of Mines and an MBA (Finance) from CASS Business School. He has extensive experience in the mineral resource industry working in both operational and management roles. Kiran spent the first four years of his career in exploration, mining and civil engineering before obtaining his MBA. He has served as a director of a number of public companies in both an executive and non-executive capacity.

**Neil Meadows – Chief Operating Officer**. Neil has previously held the positions of Chief Operating Officer at Karara Mining Ltd, Managing Director of IMX Resources Limited and worked with the Australian Premium Iron Ore Joint Venture as mine infrastructure project manager. Prior to that, he was the Chief Operating Officer of Queensland Nickel Pty Ltd, subsequent to the sale of the business by BHP. Neil was also previously the General Manager at the Murrin Murrin Nickel Operation for Minara Resources Ltd, a position he held for almost five years.

**Grant Harman – Metallurgical Consultant**. Grant is one of the world's foremost lithium metallurgists. Grant was previously Manager Lithium Chemicals for Talison Lithium and was involved in the management of the Talison Lithium Carbonate Plant from Scoping Study to Definitive Feasibility Study. He was involved in the design and technical direction of the Talison Test Facility and more recently been a technical consultant on the Sonora Lithium Project in Mexico.

**Dr Pavel Reichl – Geological Consultant**. Pavel has over 15 years' experience in precious, base and PGE metals exploration and production and has a PhD from University of Montana.

Pavel was formerly Business Unit Manager of a Canadian listed minerals exploration company responsible for Europe and Central Asia. He was the former head of the Newmont acquisition program in Eastern Europe and exploration manager for Kyrgyzstan and Uzbekistan.

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Recommendation	Total Stocks	Percentage %	Corporate	Percentage %
Corporate	52	86.7	52	100.0
Buy	6	10.0	0	0.0
Speculative Buy	0	0.0	0	0.0
Outperform	1	1.7	0	0.0
Market Perform	1	1.7	0	0.0
Underperform	0	0.0	0	0.0
Sell	0	0.0	0	0.0
Total	60.0	100.0	52.0	100.0

#### FUROPEAN METALS HOLDINGS

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#### Company/Issuer Disclosures

Company Name	Table of interest number	12-month recommendation history	Date
European Metals Holdings (	2,3,4,5,7	Corporate	07/11/2018

### **Companies Mentioned**

Company Name	Recommendation	Price	Price Date/Time
Sociedad Química y Minera de Chile S.A. (NYSE:SQM)	No Rec	USD 38.53	11/03/2019 00:00
Albemarle Corporation (NYSE:ALB)	No Rec	USD 86.37	08/03/2019 00:00
European Metals Holdings Limited (AIM:EMH)	Corporate	GBP 0.18	08/03/2019 00:00
Rio Tinto plc (LSE:RIO)	No Rec	GBP 44.78	08/03/2019 00:00
Infinity Lithium Corporation Limited (ASX:INF)	No Rec	AUD 0.08	08/03/2019 00:00
Savannah Resources Plc (AIM:SAV)	No Rec	GBP 0.06	08/03/2019 00:00
European Lithium Limited (ASX:EUR)	Corporate	AUD 0.09	08/03/2019 00:00
Bacanora Lithium Plc (AIM:BCN)	No Rec	GBP 0.18	08/03/2019 00:00
Jiangxi Ganfeng Lithium Co., Ltd. (SZSE:002460)	No Rec	CNY 28.27	08/03/2019 00:00
Great Wall Motor Company Limited (SEHK:2333)	No Rec	HKD 5.89	08/03/2019 00:00
Lithium Americas Corp. (TSX:LAC)	No Rec	CAD 5.35	08/03/2019 00:00
Hanwa Co., Ltd. (TSE:8078)	No Rec	JPY 3225	08/03/2019 00:00
Toyota Tsusho Corporation (TSE:8015)	No Rec	JPY 3545	08/03/2019 00:00
Posco Daewoo Corporation (KOSE:A047050)	No Rec	KRW 18550	08/03/2019 00:00
Nemaska Lithium Inc. (TSX:NMX)	No Rec	CAD 0.37	08/03/2019 00:00
Galaxy Resources Limited (ASX:GXY)	No Rec	AUD 2.11	08/03/2019 00:00
northvolt (private)	No Rec	NA	08/03/2019 00:00

Headline	Date
Significant lithium resource at the heart of industrial Europe	March 2019

Recommendation	From	То	Analyst
Corporate	November 2018	-	CA

Current Analyst (CA), Previous Analyst (PA)

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