

## **COBALT BLUE HOLDINGS LTD (COB AU, \$0.47)**

### **An emerging Australian pure cobalt producer**

- Cobalt Blue is an ASX-listed company that now controls the Thackaringa cobalt project (with a current resource of 61.5kt contained cobalt at a grade of 852ppm), located near Broken Hill, in western NSW, Australia.
- A pre-feasibility study (PFS) for Thackaringa was completed in under 12 months, a remarkable effort given the complexity of the task. Sufficient ore was identified to deliver a 9-10 year mine life, and an innovative metallurgical solution has been proposed to produce cobalt salts for the rechargeable battery industry at a sub-US\$13/lb cash cost, net of credits.
- By-product sulphur is forecast to make up some 14% of revenues.
- While a low grade deposit, the metallurgical circuit proposes a significant upgrade using a simple gravity circuit applied to relatively coarsely crushed ore.
- The project is well located with regard to transport and power infrastructure.
- The PFS delivered a 27% pre-tax IRR from a capital cost of A\$550m.
- Completion of the PFS will take COB's equity in the project to 70%.
- COB has now embarked on a Bankable Feasibility Study (BFS). We see a number of opportunities to enhance the returns from Thackaringa.
  - A major drill programme is to start in September to extend the mine life.
  - COB may look to regional opportunities to help extend the mine life to 20 years.
  - Construction of a pilot plant of suitable scale to undertake processing of bulk samples, to produce samples of cobalt salts for delivery to potential customers.
  - The tight PFS timetable did not allow optimisation of capital and certain operating costs. These estimates will be refined in the BFS.
- The BFS is part-funded, with cash at the end of June at around A\$9.8m
- With the successful completion of the BFS by June 2019 and a funding solution by June 2020, COB's equity in the project will rise to 100%.
- LGI (LG International) is now on the COB register with 6.1% of the company. LGI's sister company LG Chem is the 3<sup>rd</sup> largest lithium ion battery maker globally. This may open up funding alternatives.
- COB and LGI have entered into a "First Mover" partnership in which LGI will provide capital and technical assistance to COB.
- Our base case valuation, imagines a sell-down of 49% of the project to end-users and delivers a conceptual NPV(10) of around A\$1.50 at a long term cobalt price of US\$33.80/lb and A\$/US\$ of 0.70.
- Our valuation is sensitive to mine life. For example, an 8 year extension to our assumed mine life delivers a 34% increase in NPV(10).
- We believe the outlook for cobalt, an essential component of rechargeable batteries for some years to come, is strong. This should be reflected in a +US\$30/lb cobalt price for the medium to long term.
- We believe that battery makers will look to alternative sources of cobalt, for which 60-70% of global supply is derived from operations in the Democratic Republic of Congo.
- Share price rerating of COB should accompany (1) final confirmation COB has earned 70% of the project, (2) an expansion of Thackaringa's reserve base, (3) pilot plant testing of bulk samples, (4) a successful outcome of the BFS, including permitting and (5) a financing outcome.

## OVERVIEW

Cobalt Blue is an ASX-listed company that now controls the Thackaringa cobalt project, located near Broken Hill, NSW, Australia. The company was spun out of Broken Hill Prospecting in 2016 and is required to achieve certain milestones to earn its way to 100% equity in the project (largely centred around establishing the project's technical, environmental and financial viability).

Cobalt Blue attracted the market's attention in April this year when it announced a strategic First Mover partnership with LG International (LGI), the resources investment arm of LG Corporation, acting in cooperation with LG Chem. LG Chem is one of the world's largest lithium ion battery makers. Under the First Mover partnership LGI will provide capital and technical assistance for Cobalt Blue to make a high purity battery grade cobalt sulphate. LGI took a placement in COB at \$1.10 and is now a 6.1% shareholder in the company. This is the first time the LG group has taken an equity stake in a cobalt development company.

<b>Cobalt Blue (COB AU)</b>		
Share price	A\$	\$0.47
Number of shares (fpo)	m	116.1
Market capitalisation	A\$m	\$53.99
Share options	m	24.4
Cash (as at 1/7/18)	A\$m	\$9.80
Debt	A\$m	\$0.00

Cobalt Blue recently completed a PFS for the Thackaringa project. This was funded by capital raised at the IPO (A\$10m at 20c), a small subsequent placement in 2017 and a A\$6m placement to LGI. It has embarked on a bankable feasibility study.

Outside the 13% owned by LGI and a major shareholder in Broken Hill Prospecting COB is largely owned by retail investors.

## KEY PERSONNEL

### Joe Kaderavek, CEO

Joe is an engineer by background and has worked in the finance industry for much of his career. His background includes senior roles within Deutsche Bank (equities) Five Oceans Asset Management (investment management) and PWC (consulting to the mining industry).

### Dr Andrew Tong, Executive Manager

Andrew's extensive experience in metallurgical processing has allowed him to develop an innovative process for the treatment of Thackaringa ore. Andrew is an inventor and holds several patents in mineral processing.

## THE EARN-IN TO THE THACKARINGA PROJECT

Cobalt Blue was a spin-out from a small, diversified Australian explorer, Broken Hill Prospecting (BPL, an ASX listed company), which had held the tenements for many years. Should COB earn its way to 100%, BPL will retain a 2% net smelter return royalty in respect of all cobalt mined on the tenements. (COB has a right of first refusal to purchase this royalty).

The earn-in is as follows:

- Payment of A\$800,000 on execution of the agreement. **COMPLETE.**
- Stage 1: In ground expenditure of A\$2m to 30/6/17 and completion of a scoping study. COB retains 51%. **COMPLETE.**
- Stage 2: Further in ground expenditure of A\$2.5m to upgrade a proportion of the resource to Indicated status and the completion of a pre-feasibility study (PFS). COB earns a further 19% taking equity ownership to 70%. **COMPLETE,** but subject to confirmation by BPL.
- Stage 3: In ground expenditure of a further A\$5m to define a measured mineral resource and ore reserve to a level supported by the PFS and complete a bankable feasibility study (BFS). COB earns a further 15% taking ownership to 85%. **INCOMPLETE.**
- Stage 4: The COB board confirms a decision to mine, obtains all necessary project approvals, obtains project financing and pays BPL the sum of A\$7.5m by 30/6/2020. COB earns a further 15% taking ownership to 100%. **INCOMPLETE.**

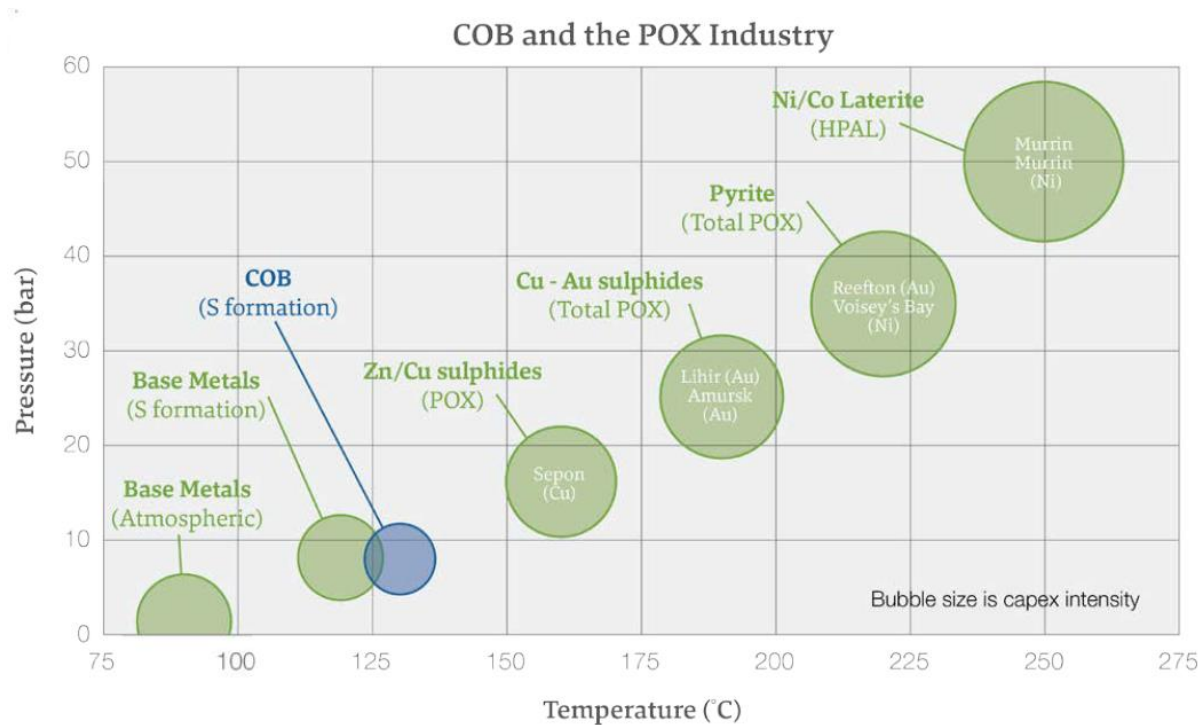
In the event there is a dispute between COB and BPL relating to the satisfaction of any of the Stage 4 earn-in obligations, COB can elect to pay BPL the sum of \$7.5m and secure the full 100% of the project.

COB has now embarked on a busy year of exploration drilling, the commissioning of a pilot plant to demonstrate the scale-up of the proposed metallurgical circuit and permitting.

## THE THACKARINGA COBALT PROJECT PRE-FEASIBILITY STUDY

- The Thackaringa cobalt deposit comprises a large and relatively low grade cobalt ore, available at a relatively low strip ratio. Previous owners were unable to identify an economic solution for the recovery of cobalt from host pyrite. (See Appendix 1 for a summary of the geology of the Thackaringa deposit and resources.)
- Cobalt Blue's 2017 scoping study identified a metallurgical solution which demonstrated potential economic recovery of cobalt and sulphur. Subsequent work for the pre-feasibility study (PFS, completed in June 2018) confirmed the metallurgical pathway for producing cobalt sulphate heptahydrate ("cobalt salts") of suitable quality for the manufacture of lithium (and other) rechargeable batteries.
- Two important metallurgical initiatives have established the viability of the project at a bench top scale. COB's test work established that 92% of the cobalt in a bulk sample could be recovered into a gravity concentrate from quite a coarse grind.
- This was an important breakthrough in that the valuable metal can be liberated with a relatively small energy input to the grinding circuit. It results in a significant upgrade of the contained cobalt, from 0.09% in run-of-mine ore to around 0.45% in the gravity concentrate.
- The subsequent pyrolysis of the pyrite concentrate produces the mineral pyrrhotite which is easily leachable of its contained cobalt, and produces elemental sulphur as a material credit.

- It is proposed that sulphur will be produced as a by-product (around 14% of revenue), to be sold into the Australian market.
- The pyrolysis process proposed and tested at bench scale by COB uses far less aggressive (and therefore energy intensive) conditions than that which will be required for the nickel/cobalt laterite projects.



The outcomes of the Thackaringa PSF are summarised below:

**Table 1. PFS Key Outcomes**

Operating Metric – PFS Reserve	Input	Comments
Plant Capex (±25%)	A\$550m	Incl A\$66m in contingency, excl \$25m pre-strip
Plant throughput	5.25Mtpa	Following commissioning period
Cobalt production (metal in sulphate)	3,657 tpa	Average over first 7 years post ramp-up
Cobalt production (metal in sulphate)	32,453 tonnes	LOM Total
C1 Cash Cost (incl sulphur credit)	US\$11.90/lb	Average based on Reserve
Initial mine life (Reserve)	9.3 years	Reserve 46.3Mt @ 819ppm cobalt

Source: COB release, 4 July 2018

- The company also published a “Product Target Financial Model”. This delivered a pre-tax IRR of 27% using a US\$33.80 cobalt price at a long term AUD/USD rate of 70c. The capital cost was estimated at A\$550m (ca. US\$400m).

Table 2. Summary of Product Target Financial Model

Throughput, CAPEX, Costs	Input	Comments
Plant Capex (±25%)	A\$550m	Incl A\$66m in contingency, excl \$23m pre-strip
Plant throughput	5.25 Mtpa	Following commissioning period
Cobalt production (metal in sulphate)	3,558 tpa	Average over first 10 years post ramp-up
Cobalt production (metal in sulphate)	40,331 tonnes	LOM Total
C1 Cash Cost (incl sulphur credit)	US\$12.76/lb	Average based on Production Target
Initial mine life (Production Target)	12.8 years	Production Target 58.7mt @ 802ppm cobalt
Macro Assumptions	Input	Comments
A\$/US\$ Exchange Rate	Fwd curve	2018 \$0.75, 2019 \$0.73, 2020 \$0.71, 2021 \$0.71 then \$0.70 onwards
Avg LOM Cobalt Sulphate Price	US\$33.80/lb	Independent expert – CRU International
Avg LOM Sulphur Price (landed in Aus)	US\$145/t	Independent expert – CRU International
Financial Metrics	Input	Comments
Pre Tax NPV (8%)	A\$792m	Based on Production Target
Pre Tax IRR (%)	27.0%	
Post Tax (7.5%)	A\$544m	
Post Tax IRR (%)	22.0%	
Project Payback (simple)	4 years	

Source: Cobalt Blue

Source: COB release, 4 July 2018

## THE BANKABLE FEASIBILITY STUDY

Following completion of the PFS, we see the following issues as important in achieving the goals of the BFS set out in the Prospectus.

1. Increase the resource and therefore reserve to allow a minimum mine life of 15 years and to understand metallurgical variability within the orebody.
2. Build a suitably sized pilot plant to process several bulk samples of Thackaringa ore.
3. Refine capital and operating cost estimates for the project.
4. Establish funding alternatives.
5. Permitting and water.

Other issues, such as the economic optimisation of open pit mining, access to infrastructure, etc are important, but are no different to any other mining project at BFS status.

In the following sections we examine each of these critical elements of the BFS.

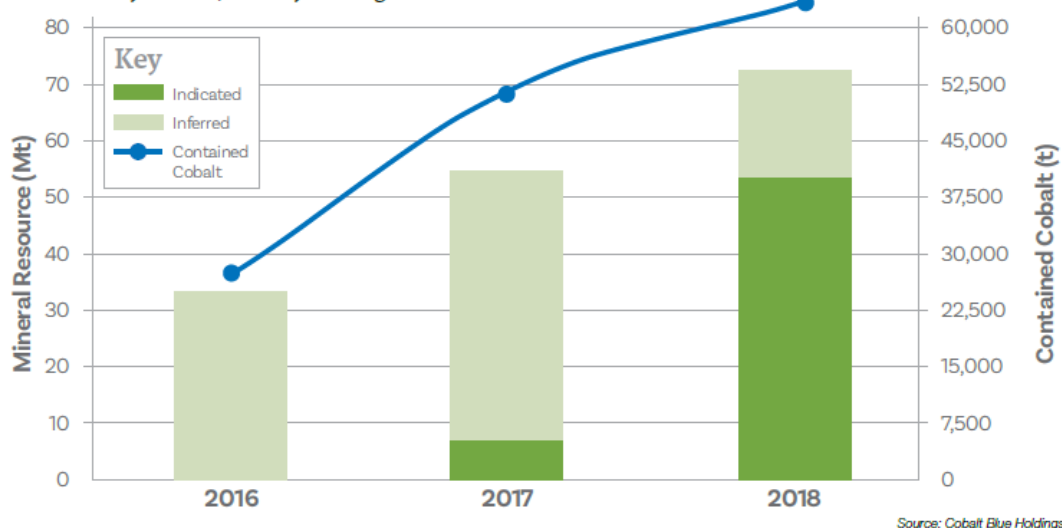
## 1. UPGRADING THE MINERAL RESOURCE AND RESERVES

### Background

Following a 12,500m drilling programme in 2017, COB were able to upgrade the Thackaringa resource from 54kt to 61.5kt of contained cobalt. Resources now stand at 72Mt at 852ppm cobalt. Around 73% of this resource is now in the indicated category.

Drilling since COB's float has seen a progressive increase in contained cobalt as illustrated in the chart below. The 2018 resource now stands some 223% higher than it was in 2016, with a slightly lower grade (852ppm vs 910ppm).

Figure 3. Sustained Mineral Resource growth for the Thackaringa deposits inclusive of Pyrite Hill, Railway and Big Hill



The PFS was required to be completed by 30 June 2018 under the terms of the earn-in from Broken Hill Prospecting. As a result COB was only able to offer a reserve base of 46Mt for a 9.3 year life (at the proposed production rate of ca. 3.5kpta cobalt). For a project of this scale, we would judge that a +15 year reserve life is essential.

### Where are the additional years of reserves to come from?

We can see 4 separate opportunities for COB to expand the resource and therefore reserve base at Thackaringa.

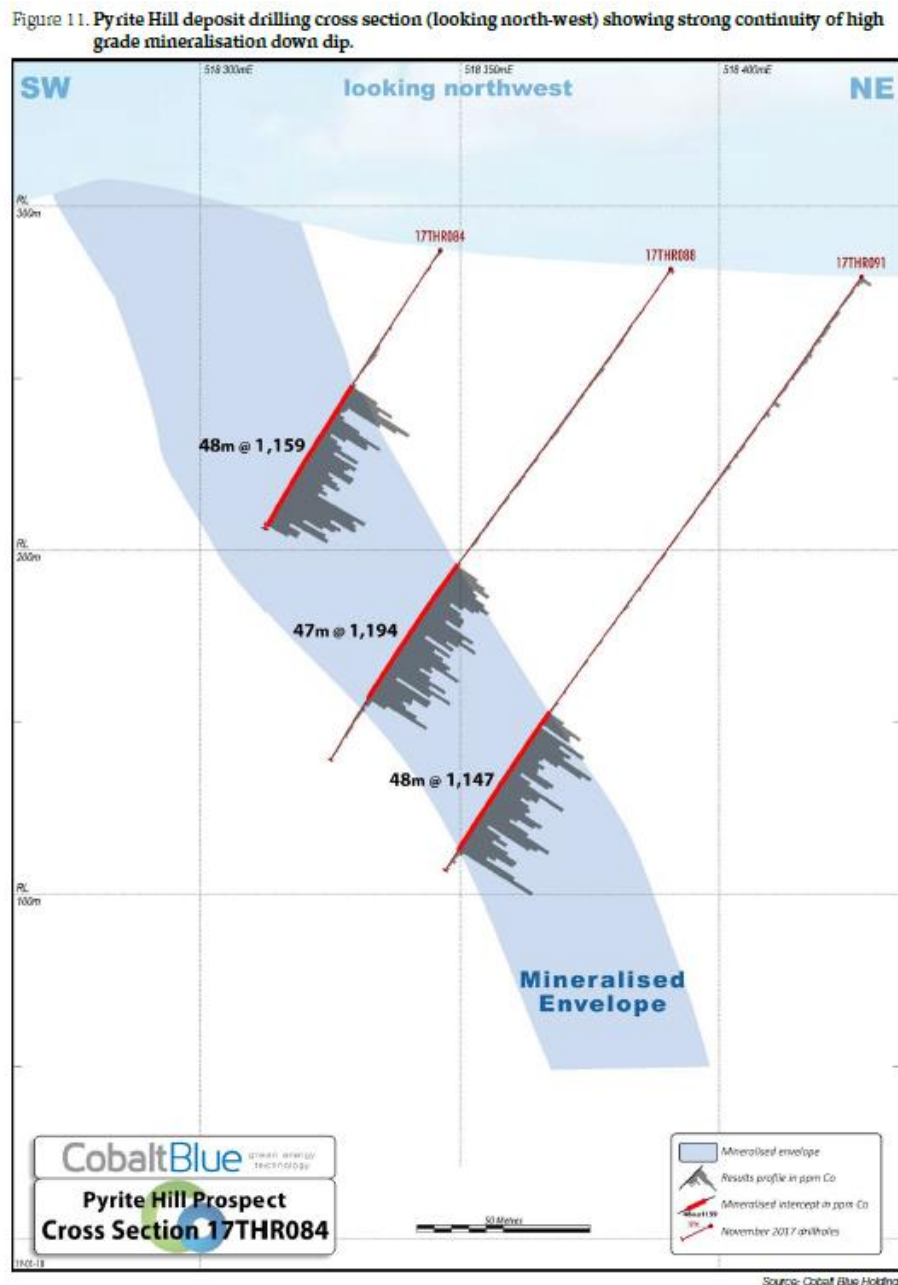
#### 1. The drill bit

COB have a major follow-up exploration programme about to start, with the following objectives:

- Identify extensions of the resource along strike and down dip.
- Upgrade the balance of inferred to indicated and measured status.

- Upgrade a proportion of the indicated resource to measured.

Looking at sections through the 3 orebodies, it is fairly clear that the Pyrite Hill orebody has the greatest potential for resource upgrades. As illustrated in one of the sections provided by COB, the Pyrite Hill orebody dips at around 60 degrees to the NE. It is wide and quite uniformly mineralised.

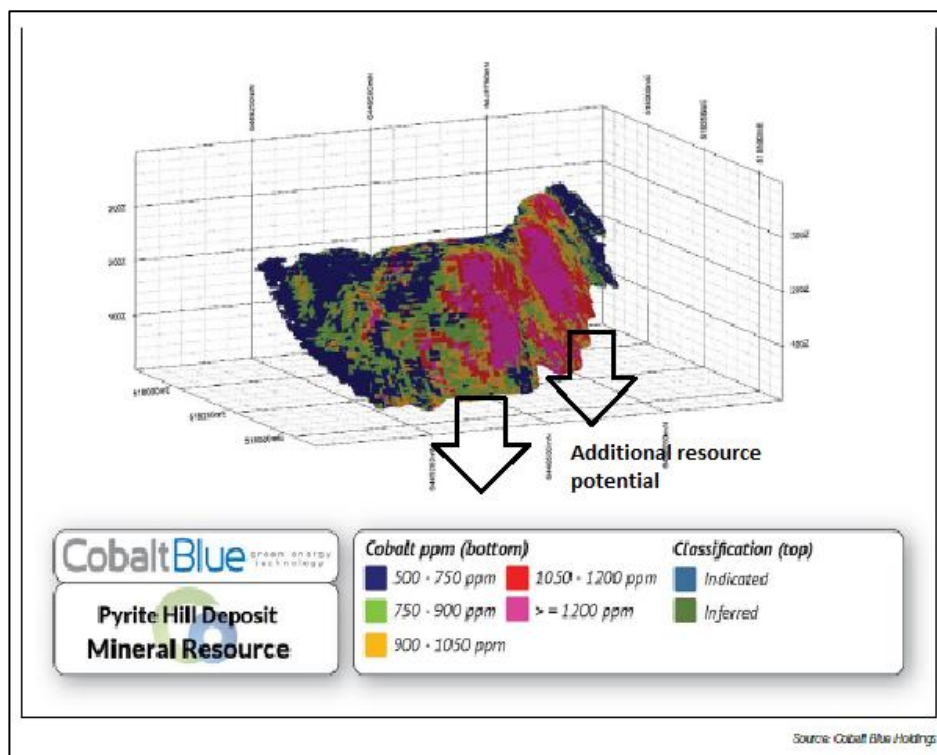


Source: COB release 19 March 2018.

As shown in the following figure there are at least 2 high grade shoots which plunge down dip. Assuming an open pit optimiser can chase the orebody down say another 50m and adding volume to the NW, it is not hard to imagine a 30-50% increase in tonnes at Pyrite Hill (10mt or so, or a further 2 years life).



That the Pyrite Hill orebody is wide and dips at around 60 degrees suggests that the overall strip ratio of the proposed open cut will not increase dramatically, but it will increase.



Source: COB release 19 March 2018. “Additional resource potential” inferred by BSCP.

The geometry of the other two deposits provides less scope for resource addition as the orebodies are subvertical and therefore could see a more rapid increase in strip ratio with depth. It’s not unreasonable to expect that we could see an additional 10% added to the total resource for Railway and Big Hill (4-5Mt).

We see the following increases in reserves as possible.

		Current	Potential reserve	Comment
<b>Pyrite Hill</b>				
Indicated	Mt	22.0	30.8	40% increase via stepout
Inferred	Mt	4.0	3.9	40% via stepout + 70% conversion of to indicated
Potential indicated	Mt	26.0	34.7	
<b>Big Hill + Railway</b>				
Indicated	Mt	30.0	33.0	10% increase via stepout
Inferred	Mt	16.0	12.3	10% via stepout + 70% conversion to indicated
Potential indicated	Mt	46.0	45.3	
Total existing resource	Mt	72.0		
Total potential reserve	Mt		80.0	Assuming 100% conversion of indicated to probable reserve
Nominal mill throughput	Mtpa		5.25	
Nominal mine life	Years		15.2	



So, based on extensional and infill drilling alone, we think there is a good opportunity to increase the mine life to over 15 years. As ever, nothing involving a drill rig delivers certainty. But we see the above scenario as entirely reasonable.

## 2. Cut off grade

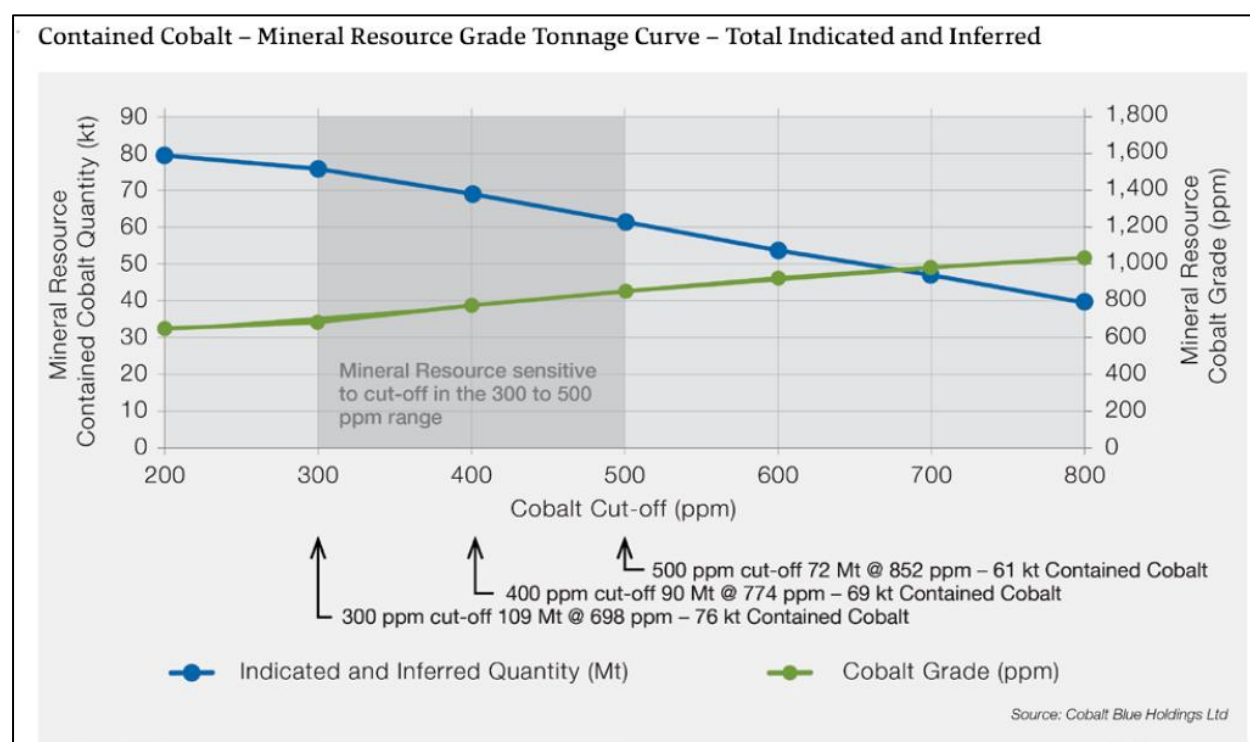
The concept of cut-off grade (COG) lies at the core of resource and reserve estimation. What is the grade of ore which, at the margin, is uneconomic to mine and mill. The cut-off grade is derived from underlying economic assumptions for the project.

COB has consistently used a 500ppm per tonne COG for resources and reserves at Thackaringa. At a notional cobalt price of US\$73,000/tonne, this equates to an in situ value of US\$36/t. Convert that into a commodity we are all familiar with, gold, that equates to just under 1 gram/tonne. We sense that this is quite a high cut-off grade.

COB states that the company will undertake a 'complete review of modifying factors' to derive a COG for the bankable feasibility study. These modifying factors could include the following

- Metallurgical recovery. In the PFS COB state that it is targeting 90% against the 85.5% used in the PFS.
- Power costs.
- Mining costs and pit wall geometry.
- The inclusion of by-product credits in the COG revenue calculation. In the PFS the sale of elemental sulphur made up some 14% of life of mine revenue. It is understood that that has not been accounted for in the calculation of reserve cut off grade.

As illustrated in a recent presentation, Thackaringa's resources (and therefore reserves) are quite sensitive to the cut off grade.

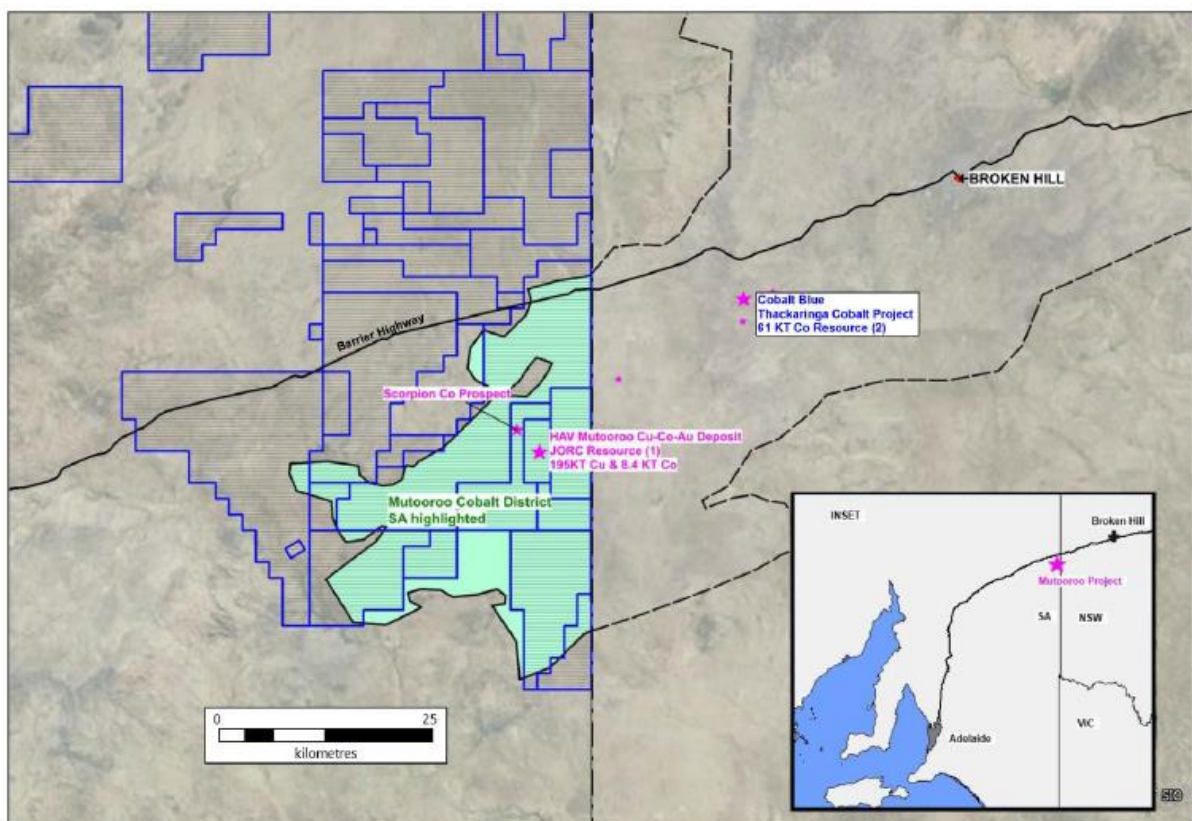


If the COG was 450ppm (taking into account the value of the sulphur for example) there would be an incremental 9mt of resources at a grade of ca 813ppm. This is conjectural, but is not an unreasonable outcome in our view.

### 3. Satellite feed.

The Broken Hill block contains a number of occurrences of cobalt, and with just a few exceptions, there have been only a few occurrences prospected in any detail.

One of the larger of these is the Mutooroo deposit of Havilah (100%), located less than 30km SW of Thackaringa. Both owners have been in dialogue regarding this deposit, and testwork has been undertaken by COB on samples from Mutooroo.



Source: Havilah Resources release 21 June 2018

Mutooroo sounds to be geologically similar to Thackaringa, but importantly it has a copper overprint. The resource is as follows.

<b>Resource statement 2017</b>								
		Tonnes	Copper (%)	Gold (gpt)	Cobalt (%)	Copper (t)	Gold (oz)	Co (t)
Sulphide	Measured	4149000	1.23	0.18	0.14	51033	24014	5809
	Indicated	1697000	1.52	0.35	0.14	25794	19098	2376
	Inferred	6683000	1.71			114279		
	<b>TOTAL</b>	<b>12529000</b>				<b>191106</b>	<b>43112</b>	<b>8184</b>
Oxide	Measured	598000	0.56	0.08	0.04	3349	1538	239

The inferred resource has had insufficient assays to allow the determination of a cobalt grade. However we'd be fairly certain that at least a proportion of the inferred resource would move into M+I with similar copper and cobalt grades. Even converting just 33% of the inferred resource into measured and indicated classification, the total resource (and possible reserve) could be in the order of 8Mt at 1.3% copper and 1400ppm cobalt. The few cross sections presented by Havilah suggests that the orebody could be open-pittable at a modest stripping ratio.

COB and Havilah resources entered into an MOU to examine whether Mutooroo ore would be suitable for beneficiation using the COB met. circuit. The results were very encouraging, with the copper extracted into a 29% copper concentrate and 88% of the cobalt recovered. While a small deposit, it would be quite valuable to the Thackaringa project for high grade satellite feed. Recently Havilah have conducted additional rock chip sampling, suggesting extensions to the Mutooroo orebody and potentially other targets.

Given the modest size of the deposit (it is very unlikely to stand alone as a mining project), and with Havilah's stressed balance sheet, we could easily imagine a commercial outcome here. Mutooroo ore would be easily truckable to Thackaringa.

Given that Mutooroo is too small a deposit to stand alone, we can't imagine COB having to pay a large sum to acquire the project from Havilah.

#### 4. Regional potential.

There are numerous cobalt showings in the Broken Hill block. A brief search of the Geological Survey of NSW database pinpoints hundreds of occurrences. Most comprise small workings by early explorers and only a handful of these have been classified as anything larger than an occurrence. The exploration potential for cobalt in the Broken Hill area is very real.

**So, what reserves could be available for a central processing facility at Thackaringa?** The following table aggregates the potential upside to the existing 46.3mt reserve. Adding what we think could be a realistic expectation of the next drilling programme at Thackaringa itself, together with modest tonnes from a drop in COG and a commercial outcome for Mutooroo, the nominal mine life expands from under 10 years to over 18 years.

		Tonnes (Mt)	Co (ppm)	Comment
Existing reserve		46.3	819	JORC 2012
Additional 'reserves'		33.7	819	Stepout + infill, at current reserve grade
Incremental tonnage at 450ppm COG		9.0	813	Incorporating sulphur credits into COG estimation
Muteroo (100% HAV)		8.0	1400	Guesstimate. Copper grade of existing M+I is 1.3%
Total		97.0	866	
Contained cobalt	Kt	84.1		
Nominal mill throughput	Mtpa	5.25		
Nominal mine life	Years	18.5		

It must be stressed that this is speculative, but it is certainly not unrealistic.

COB's major priority is to expand the existing Thackaringa resource (and reserve) with the drill-out, which commences in the current quarter.

The current Thackaringa resource is summarised in Appendix 1.

### Metallurgical variability

This is not envisioned to be an issue given the relatively uniform nature of mineralisation, and that cobalt is entirely confined to the crystal lattice of the contained pyrite. However it is an issue which needs to be addressed in the forthcoming BFS.

## 2. THE PILOT PLANT: FINE TUNING THE METALLURGICAL FLOWSHEET

### Background

The Thackaringa cobalt deposit was first discovered in the 1960's, and is one of the most commonly referenced in NSW. But it is low grade, and refractory, which in gold parlance means it is not amenable to a simple metallurgical circuit. This was the conventional wisdom, and while cobalt prices were low, little work was undertaken on a metallurgical outcome. COB's metallurgical consultant went back to 'square one' and looked at a variety of options for the extraction of cobalt from Thackaringa ore. This delivered remarkable results.

### Gravity concentration delivers 92% recovery

In 2016, COB's test work established that 92% of the cobalt in a bulk sample could be recovered into a gravity concentrate from quite a coarse grind. This was a significant result in that the valuable metal can be liberated with a relatively small energy input to the grinding circuit. This was an important breakthrough.

The gravity concentrate largely consists of cobalt in pyrite. Conventional wisdom would have had the cobalt liberated by conventional roasting then leaching. The downside of this approach is that it produces sulphur dioxide (which must be precipitated at sulphuric acid). It also produces a cobalt-bearing iron oxide residue, which delivers poor leach recovery.

### **Pyrolysis delivers 97-98% cobalt recovery from the concentrate**

COB's breakthrough here was to establish a better outcome: thermal decomposition (otherwise known as pyrolysis) under a nitrogen atmosphere. By excluding oxygen, the process can precipitate elemental sulphur, rather than sulphur dioxide. Sulphur is a much easier raw material to monetise than sulphuric acid. Around 40% of the sulphur is recovered by this process.

More importantly this process delivers a roasted product which is very amenable to acid leaching to liberate the cobalt. The concentrate is then leached under moderate temperature and pressure to deliver up to 97-98% recovery.

The cobalt is then precipitated into a mixed metal hydroxide (cobalt with nickel and manganese) which can then be sent for refining.

### **Refining: production of a cobalt salt suitable for use by battery manufacturers**

It is then envisaged that the mixed metal hydroxide will be delivered to the solvent extraction refinery to deliver commercial quality cobalt sulphate (a salt which at the right quality specifications is in strong demand by battery manufacturers).

*This process sounds complex. But it's like making a cup of tea compared to the metallurgical pathways proposed for the laterite cobalt/nickel deposits.*

### **The pilot plant**

As part of the PFS, COB have been able to produce small quantities of cobalt salt (cobalt sulphate heptahydrate) with moderate impurity levels at bench scale. The next step is to demonstrate that these encouraging results can be replicated at pilot scale. As part of the BFS, it is proposed that a semi-industrial scale pilot plant is built at Broken Hill during 2018/19. We have not yet seen the final parameters for the pilot plant which might be sized at an annualised rate of around 5000-10000 tonnes.

As well COB will need to source several representative bulk samples to run through the pilot plant. This could be undertaken using small box cuts or with large diameter diamond drill cores.

Costs (capex plus opex) for such a plant and bulk sampling programme might be in the range \$5-10 million.

## **3. RIGHT-SIZING THE PROJECT AND CAPEX.**

The proposal from the PFS is to construct a 5.25mtpa plant to produce around 3500 tonnes of cobalt metal equivalent as a cobalt salt which can be sold to the rechargeable battery manufacturing industry. This will require a capital expenditure of around A\$550m based on PFS estimates.

This is, of course, a large bite for a sub-\$100m company and therefore we see a number of opportunities to (1) right-size the project and (2) source capital to fund the project. These are critical elements for the BFS to address.

### **Optimising capital and operating costs**

The Thackaringa PFS was completed in under 12 months, a remarkable effort given the complexity of the task. Sufficient ore was identified to deliver a 9-10 year theoretical life, and a metallurgical solution was proposed and demonstrated to deliver near-final product specification cobalt sulphate. Together with a PFS-level capex estimate the project was able to deliver a 27% pre-tax IRR. This was sufficient to allow COB to take its equity in the project to 70%, a very important milestone.

In the PFS release COB talk about the following areas for capex and opex optimisation:

- Reduction in capex for the tailing dam (currently estimated at \$260m for life of mine).
- Optimisation of power pricing.

We believe there will be many more opportunities to improve the project's economics.

### **Right sizing the project**

Here we draw a comparison with another large capex project we are familiar with, Sheffield's Thunderbird mineral sands project in WA. The feasibility studies identified Thunderbird's capex at around A\$500m. The final BFS delivered in 2016, presented a staged approach to the capex, Stage 1 at around A\$350m and Stage 2 around \$150m. The geometry and grade distribution of the orebody allowed the project to be staged in such a fashion.

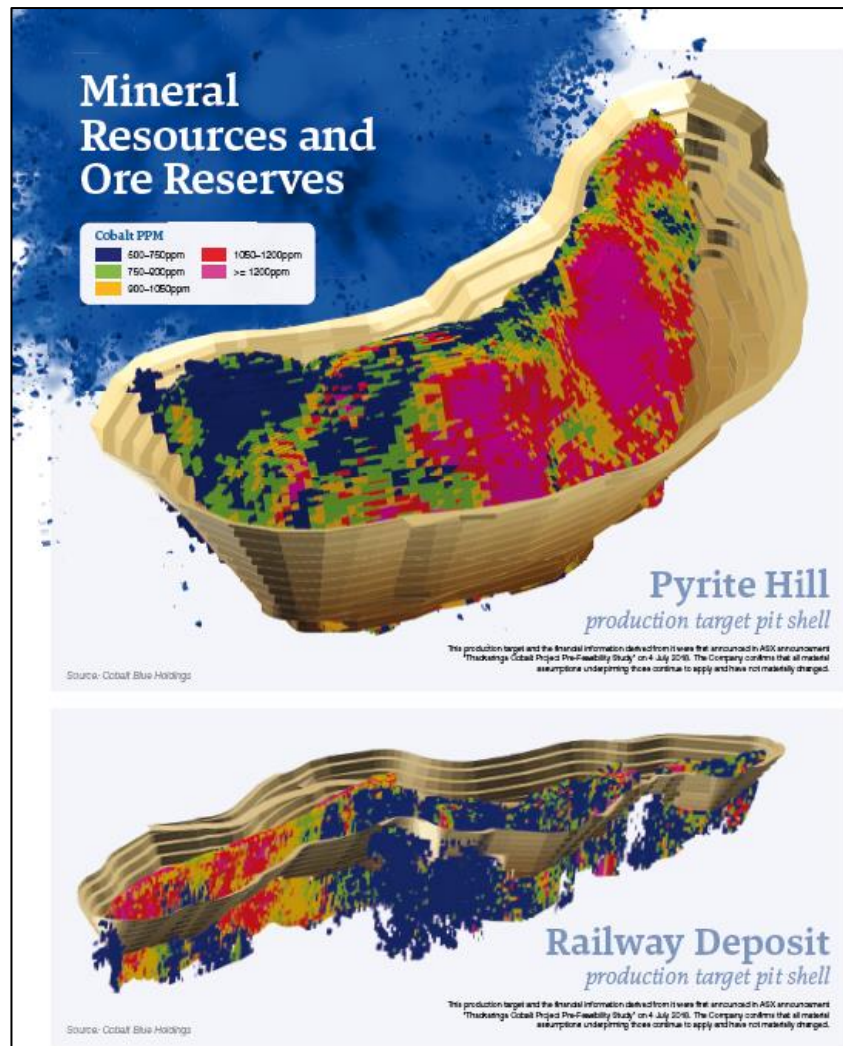
Is it possible we will see a similar approach at Thackaranga? There are several options which may be under consideration by COB.

### **Use of an elevated cut-off grade strategy**

The use of an elevated cut-off grade strategy (or grade-streaming) could be employed in the early years, stockpiling lower grade material and selectively processing higher grade ore through a smaller plant. This could enable COB to take a staged approach to the capital, and reduce the substantial up-front capex.

As illustrated below, there are several higher grade shoots within two of the 3 deposits (Pyrite Hill and Railway) which could allow higher grades to be selectively mined in the early years.





Source: COB Diggers and Dealers presentation, 2018

### Sale of an intermediate cobalt rich product

- **The sale of a 0.5% cobalt in pyrite concentrate.** While the intrinsic value of such a concentrate is quite high (>US\$300/t) we would guess that transport and treatment and refining charges would be too high to make this an economic proposition.
- **The sale of an intermediate cobalt-rich** product to refineries, eliminating some of the early capex associated with the proposed refinery at Thackaringa (where the capex could be as much as \$50-80m).
- The sale of such a product (known as mixed metal hydroxide product or MHP) is quite common in the industry. For example, a nickel rich MPH was produced by the Ravensthorpe project and the contained nickel and cobalt refined at the Yabulu refinery in Queensland. It is also a strategy employed in the DRC for the treatment of cobalt ores.
- The saving in capex and operating cost might be offset by reduced payability for the contained cobalt. However, with the current high demand for cobalt in any form, it's possible this could present an economic outcome.



- This approach would also help to de-stress the commissioning of the Thackaringa project. Undoubtedly one of the challenges to the project is in the production of a cobalt salt to a battery-maker's specification.

#### 4. FINANCING OPTIONS

It's too early to predict what financing route COB might take should it be able to successfully establish an attractive BFS. The options are:

- Equity. At COB's current share price it would not be possible to fully fund the project using equity alone. It would be far too dilutive to existing shareholders
- Debt. We could imagine a 50% debt/equity ratio as acceptable for a project of this type. The involvement of LGI in the company, with a 6.1% equity holding, there must be a reasonable chance of Korean debt sources.
- Sell-down at project level. It is possible to imagine a consortium of Asian battery makers taking an equity stake in Thackaringa.

Our conceptual valuation below assumes all of the above are used by COB to finance the project.

#### PERMITTING AND WATER

We do not envisage too many challenges in obtaining mining leases over the Thackaringa deposits. Native Title has largely been extinguished, and the areas that haven't, we're told, do not impact the orebodies themselves.

Environmental issues are critical, particularly in a heavily regulated state such as NSW. There really is no land use conflict: it is poor quality grazing land, probably available for purchase at a relatively modest price. It is arid country; watercourses are ephemeral. It is a mining district. One critical issue will be acid mine drainage from sulphides in waste dumps, but this is easy to manage and monitor. Base line environmental data is being accumulated for inclusion in an environmental impact statement. An environmental manager has recently been appointed by the company. Typically mining leases in NSW take around 2 years to obtain.

Water is likely to be sourced from the soon-to-be-constructed pipeline from the Murray River. COB has applied for a 1.5GL/year allocation, and are optimistic they will obtain this. It is an issue to watch closely.

#### VALUATION OF THACKARINGA AND COBALT BLUE

We have used the publically available information provided from the PFS to broadly replicate the economic outcome of the PFS and their target financial model. This is summarised below:

Thackaringa cobalt project, summary economics		
<b>Assumptions</b>		
Cobalt	US\$/lb	33.8
Sulphur	US\$/t	145
A\$/US\$		0.70
<b>Production</b>		
Cobalt	tonnes per year	3,558
	Mlb per year	7.85
Sulphur	Kt/year	291
<b>Revenue</b>		
Cobalt	US\$m	265.2
<b>Costs</b>		
Mining costs	US\$/lb	5.3
Processing	US\$/lb	12.4
R&M	US\$/lb	0.9
Sulphur credit	US\$/lb	-5.8
Costs	US\$/lb	12.8
Royalty	US\$/lb	1.4
Total costs	US\$/lb	14.2
<b>Margin</b>		19.6
<b>Average annual EBITDA</b>		
	US\$m	153.8
	A\$m	219.7
<b>Capex</b>	A\$m	575.0
<b>Mine life</b>	Years	12
<b>Valuation</b>		
Pretax NPV, at the following discount rates		
	8% A\$m	790.2
	10% A\$m	626.4
IRR		29%
After-tax NPV, at the following discount rates		
	8% A\$m	535.8
	10% A\$m	408.7
IRR		23%

Note that we have used cobalt and sulphur price assumptions from COB's PFS (in turned derived from CRU). We have loaded the capex a little (A\$575m vs \$550m for the PFS, and assumed a 12 year mine life. (The current reserve life is 9-10 years.)

We have then translated this valuation into a "what if" corporate NPV incorporating assumptions as to what might happen as the project is derisked and as sources of capital become available. So in the following valuation we have assumed:

- Debt equity funding at the project level of 50%.
- A sell-down of 49% of the project to a consortium of end-users at a 50% discount to project NPV following completion of the BFS.

- A total equity raise of A\$60m at around the current share price progressively by COB as the project is derisked. (Note COB has ca. \$10m cash currently and can fund the early stages of the BFS.)

Our base valuation is that derived for Thackaringa at a 10% real discount rate.

Thackaringa cobalt project, preliminary valuation			
Thackaringa (NPV10), post tax	A\$m	\$ 408.7	
Add back capex	A\$m	\$ 575.0	
Thackaringa (NPV10)	A\$m	\$ 983.7	Unfunded NPV
Equity NPV	A\$m	\$ 983.7	
Project debt	A\$m	-\$ 287.5	50% debt/equity
NPV less debt	A\$m	\$ 696.2	
Ownership by COB	A\$m	51%	Sell down of 49% at a 50% discount to NPV
Implied COB equity	A\$m	\$ 355.1	
Cash	A\$m	\$ 10.0	Current
PV of corporate costs	A\$m	-\$ 100.0	Estimate
Other exploration	A\$m	\$ -	
Corporate NAV	A\$m	\$ 265.1	
Number of shares, current	m	112.7	
New equity required	A\$m	\$ 60.0	Estimate
Number of new shares	m	109.1	Issued at 55c/share
Total number of shares	m	221.8	
NAV adding new cash	A\$m	\$ 325.1	
NAV/share	A\$	\$ 1.47	

Looking at sensitivities to this analysis leaves little doubt as to how value is most easily added to Thackaringa. Drilling will soon be underway.

Sensitivities	NPV/share	Change
Base valuation	\$1.47	
Reduce capex by 10%	\$1.51	3%
Reduce opex by 10%	\$1.62	10%
Add 10% to US\$ cobalt price	\$1.82	24%
Add 8 years to mine life	\$1.97	34%

## SWOT ANALYSIS

### Strengths

- Scarcity of cobalt-dominated resources worldwide.
- A well-defined outcropping resource, easily open-pittable at relatively low stripping ratio.
- Well located: very close to transport infrastructure and a major industrial centre (Broken Hill).
- Located close to low-medium cost grid power.
- No need for fly-in/fly-out arrangements for the workforce.
- Reasonably low environmental impact.
- Based on current cobalt pricing, no need for support from co-products.

### Weakesses

- A low grade, large tonnage deposit.
- Refractory mineralisation necessitating a multi-stage treatment route.
- High capital costs.

### Opportunities

- Potential to significantly expand the current resource base at Thackaringa.
- Opportunities to extend the resource base outside the Thackaringa area with existing orebodies (eg Mutooroo) and through regional exploration.
- Reduction in capex/opex especially regarding tailings disposal.
- Potential to stage capex and reduce the capital burden.
- Potential to prepare and sell an intermediate MHP allowing for the deferment of capex associated with an on-site refinery.
- Strong demand for cobalt may facilitate project funding.

### Threats

- A declining cobalt price and/or a strengthening A\$/US\$.
- Environmental and other permitting issues.
- Inability to achieve production levels outlined in the PFS.

## FUTURE RERATING OF COBALT BLUE

Since the collapse in commodity price for the battery raw materials (such as lithium and cobalt) most companies exposed to this space have underperformed dramatically. Often regarded as the benchmark for the Australian cobalt exposures, the Clean Teq share price (CLQ AU) has fallen nearly 70%. In part this was driven by a disappointing blow-out in capex in the recently released BFS. The cobalt price has not helped, down some 32% from its March 2018 highs of over US\$43/lb.

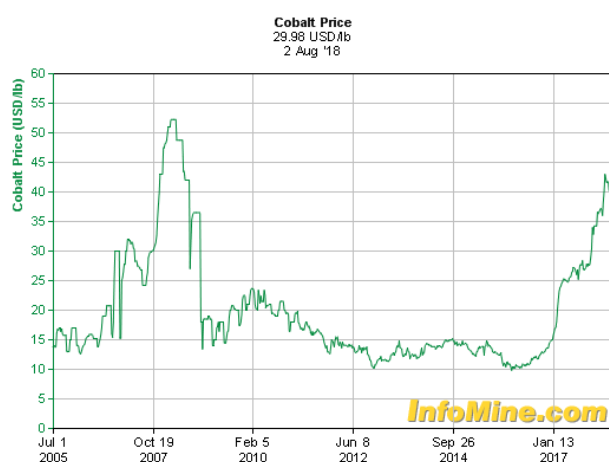
A rerating of COB will obviously be helped by a recovery in the cobalt price. Other factors we consider important milestones for rerating will include the following:

1. **Final confirmation COB has earned 70% of the project.** Vendor, BPL, has not yet confirmed that COB has satisfied all conditions to move to 70% of the project. This may just be a formality, but the market will rest easier when final confirmation is obtained.
2. **An expansion of Thackaringa's reserve base.** The current reserve base is simply too small for a project of this size. We can see potential for a reserve base approaching 100mt as achievable (mainly from Thackaringa, but also from satellite deposits). This could see the project's mine life expand to over 15 years.
3. **Pilot plant testing of bulk samples.** Bench scale testing of the extraction of cobalt from a composite sample of Thackaringa ores has delivered very encouraging results. A pilot plant of suitable scale is essential to confirm that this process can perform at a commercial scale.
4. The successful completion of a **BFS**
5. Full **permitting** of the project.
6. A **financing** outcome.

Undoubtedly a recovery in the cobalt price will assist the rerating of Cobalt Blue.

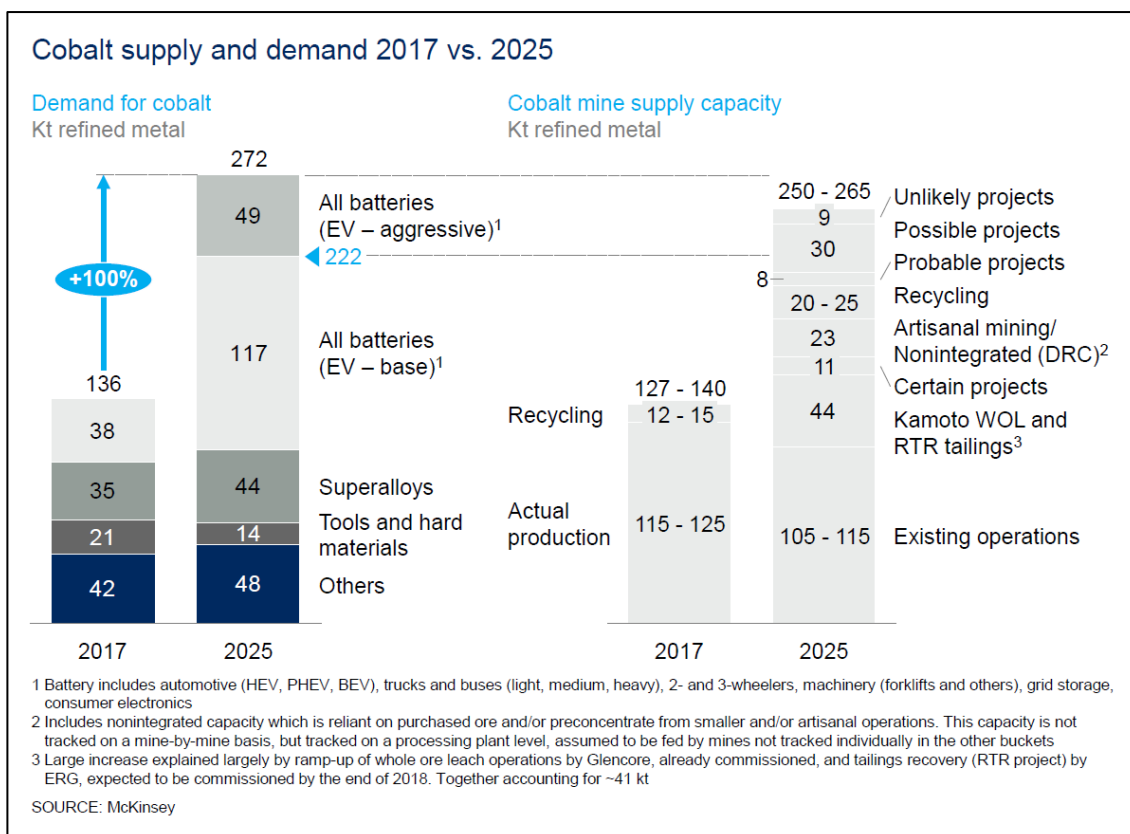
## UPDATE ON THE COBALT PRICE

The cobalt frenzy apparent during the first half of 2018 has started to roll over. Peaking at prices north of US\$40/lb, LME prices have edged back by over 20% over recent weeks.



The March quarter, which saw price rises akin to those seen prior to the GFC, seem to have been driven with quite urgent restocking by end-users and quite likely by speculative investment. Short term working capital issues, and perhaps the disappearance of speculators in the short term, may have driven recent price weakness.

There is so much expert advice, speculation and mis-information emerging in the cobalt space. Of all the commodities we've examined over the past 30 years it is one which is based on least solid footings. On the demand side, we have seen numbers from reputable research groups suggesting total cobalt demand doubling to over 250kt by 2025, based on CAGR's for EV's of around 13%pa. Miners and recyclers currently deliver some 130-140ktpa.



The bear case for cobalt would have thrifting of cobalt in storage batteries increasing, with 6 2 2 ternium batteries (a shorthand way of expressing the ratio of nickel, manganese and cobalt) moving to 8 1 1, so 20% cobalt moving to 10% of the battery's cathode. While 8 1 1 batteries exist (and are used in smaller applications, eg power tools) there is a reasonably credible consensus emerging that lower levels of cobalt will compromise battery life, energy density and safety. Will the Panasonic/Telsa headlines of halving cobalt usage will undoubtedly be driven by a view that 8 1 1 become the new normal? Perhaps. But given the natural conservatism of the automotive industry, it is hard to imagine that new technology being adopted within the next 5 years. It has taken at least 10 years to establish the current battery technologies. A technical breakthrough is undoubtedly on the cards, but to deliver this within a reasonable timeframe for the auto makers seems unlikely.

The cobalt bears have a dramatic uptick in cobalt production, from the current 130-140ktpa to +250ktpa by 2025. Glencore are forecasting an additional 34kt by 2020 from their re-opened Katanga mine. Much (if not all) of this new production will be from Africa, and most will be from mining's bete noir, the DRC. Very few of the new generation mines from outside the DRC will be in production within 2 -4 years. And little of the cobalt will be from sources other than by-a product of copper production.

The bull case for cobalt is easier to portray. A much stronger growth in EV's than the consensus view, and the use of storage batteries in conjunction with the recent boom in renewable energy alternatives (especially solar and wind). Match this with an unreliable supply of cobalt from the DRC, and a slow emergence of new mines in more acceptable mining jurisdictions, and it's easy to imagine an extended period of supply tightness.

Cobalt is an unusual commodity and one for which new sources outside of the DRC are not immediately apparent. In our view it is hard not to be moderately bullish prospects for cobalt going forward.

We are forming a view that long term cobalt prices in the range US\$80 - 90,000/t (US\$36 – 41/lb) are required to incentivise new non-by-product cobalt production.

We make the following observations:

- The DRC is a difficult environment to (1) attract capital and (2) develop mining operations. Nothing has changed in our 20-30 years of viewing the DRC.
- Artisanal production out of the DRC (which might make up 20% of production) has come under scrutiny, due to child labour issues. A “Better Cobalt” initiative is likely to deliver a more visible supply chain, but over what time frame?
- Glencore, which produces some 22% of the world’s cobalt is a mining company characterised by its opportunistic behaviour.
- Approximately 90% of global cobalt production currently is as a by-production of copper and nickel. Growth of cobalt production from these sources is likely to be linked to global GDP (a few percent per annum) and will therefore be unable to deliver into a double-digit growth environment.
- Very few of the ‘new’ cobalt projects outside the DRC have attracted our attention as ‘no brainer’ mine developments.
- Several of the new projects are associated with lateritic nickel resources. These will require complex HPAL (high pressure acid leach) metallurgical solutions. Historically, the nickel HPAL industry usually demonstrated troublesome ramp-ups.
- On the positive side, most (if not all) geologists we talk with have never been exposed to pure cobalt exploration, except very recently. So who knows what remains to be discovered.

Given these issues nothing to us suggests that the supply/demand equation for cobalt is about to ease any time soon. Higher prices will certainly incentivise new production, but this will take time. New production is coming out of the DRC, but the battery makers will be reluctant to rely on this for 100% of new supply.

There were a number of important news items over the last quarter which are likely to have driven perceptions of short-term demand and supply.

These included:

- Glencore (one of the world’s largest cobalt producers) locked in around a third of its next 3 years of production with Chinese GEM, a cobalt refiner and recycler.
- Nissan announced that it would be moving the production of EV’s from around 163,000 to 1 million vehicles by 2022. Consultants, Benchmark Mineral Intelligence estimate this could add 5-8,000t of cobalt demand.
- The DRC (which produces over 60% of global cobalt) brought into law a much tougher royalty regime for cobalt, ranging from 2 to 10% of gross revenue.
- In April, DRC state-owned miner Gecamines started legal proceedings to dissolve its Kamoto copper-cobalt operation with Glencore’s Katanga Mining. The dispute was resolved in June, but it is not yet clear what will be the impact on short term metal production.
- Statements by battery maker Panasonic and end-user Tesla, that new technologies will halve the use of cobalt in battery cathodes. And then, we saw statements from the normally secretive battery manufacturers that cobalt will be eliminated from cathode going forward.



In the last few weeks we have seen an important story from Reuters (25/7/18). Japan's automakers aim to set up a joint procurement body by end-March to secure stable supplies of cobalt. Japan's Ministry of Economy, Trade and Industry unveiled the plan at a committee set up by the ministry to map out the country's plans for the auto industry, which includes Toyota Motor Corp, Nissan Motor Co Ltd and Honda Motor Co Ltd. The ministry and automakers will discuss details of the new organisation which is designed to help battery users secure long-term supplies of cobalt and buy clean materials with no issue of conflict minerals or child labour, it said. It is still not clear which companies, car companies, battery manufacturers and trading companies, will join the scheme.

## APPENDIX 1. GEOLOGY OF THE THACKARINGA COBALT DEPOSITS

The Thackaringa deposits, Pyrite Hill, Big Hill and Railway are hosted within the so called Himalaya Formation, of the Thackaringa Group. These are made up of a series of strongly deformed and metamorphosed sedimentary rock types, sitting beneath the rocks of the Broken Hill Group, which hosts the world class Broken Hill silver-lead-zinc deposits.

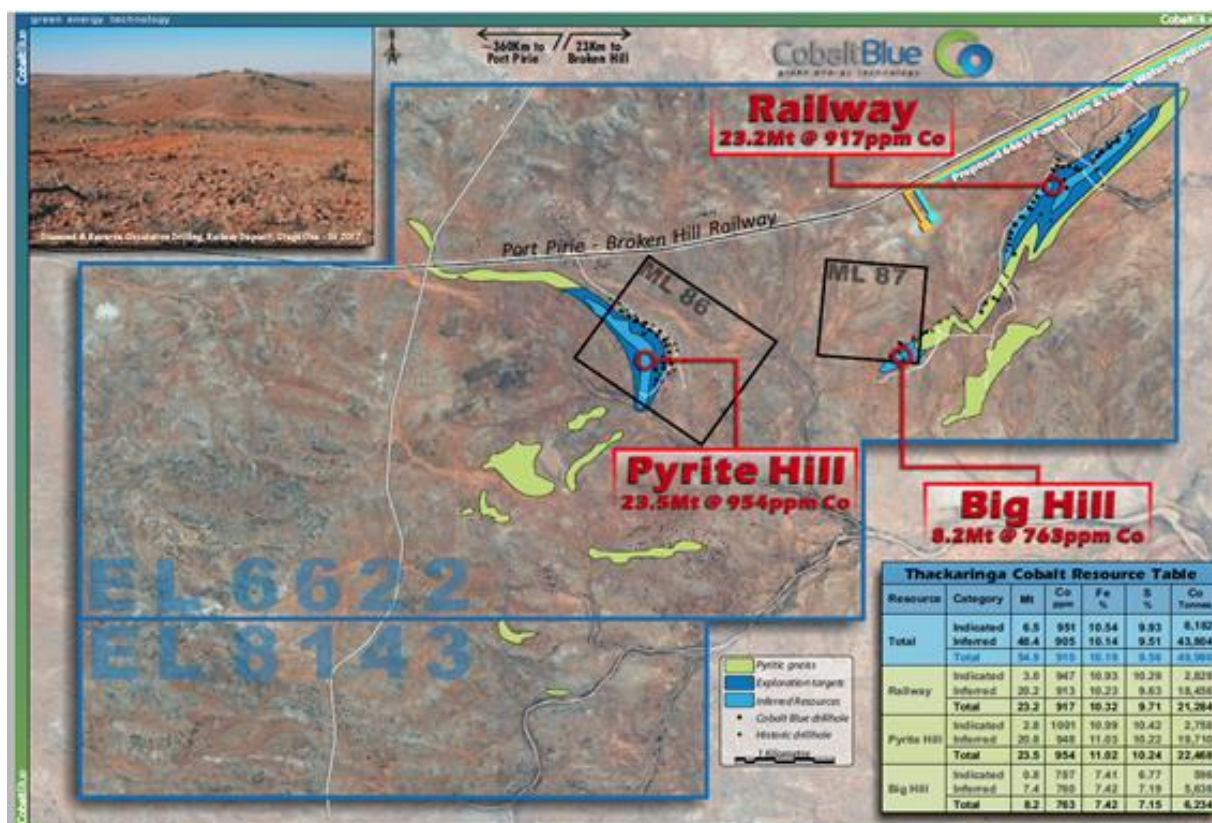
Thackaringa ore is made up of 10-35% sulphides (mainly pyrite) with cobalt occurring within the lattice of the pyrite.

In summary, the three deposits are characterised as follows:

**Pyrite Hill**, around 1.2km in strike length, varying in width between 10 and 100m and extending down dip by around 300m, the deposit dips at around 50 degrees to the NE.

**Railway**, which is seen over a 2.5km strike length, varying in thickness from 20 to over 300m. It is steeply dipping.

**Big Hill**, which is effectively a strike extension of railway and is the smaller of the deposits. Also steeply dipping it is observed over a ca. 400m strike with an average width of 30-40m.



See the table below for the latest resource statement for Thackaringa

## Mineral Resources

Mineral Resource Estimate 72Mt at 852ppm cobalt (Co), 9.3% sulphur (S) and 10% iron (Fe) for 61.5Kt contained cobalt (at a 500ppm cobalt cut-off).

### Mineral Resource estimates for the Thackaringa Cobalt deposits

*Note: minor rounding errors may have occurred in the compilation of this table*

Category	Mt	Co ppm	Fe %	S %	Pyrite %	Contained Co (t)	Py Mt	Density
<b>Railway Deposit (at a 500ppm Co cut-off)</b>								
Indicated	23	954	10.1	9.2	17	19,400	4	2.85
Inferred	14	901	10.4	9.2	17	11,100	2	2.85
<b>Total</b>	<b>37</b>	<b>842</b>	<b>10.2</b>	<b>9.2</b>	<b>17</b>	<b>30,800</b>	<b>6</b>	<b>2.85</b>
<b>Big Hill (at a 500ppm Co cut-off)</b>								
Indicated	7	712	7.2	6.9	13	5,200	1	2.77
Inferred	2	658	6.7	6.3	12	1,500	0	2.76
<b>Total</b>	<b>10</b>	<b>697</b>	<b>7.1</b>	<b>6.7</b>	<b>13</b>	<b>6,700</b>	<b>1</b>	<b>2.77</b>
<b>Pyrite Hill (at a 500ppm Co cut-off)</b>								
Indicated	22	937	10.9	10.3	19	20,300	4	2.87
Inferred	4	920	11.2	10.8	20	4,000	1	2.89
<b>Total</b>	<b>26</b>	<b>934</b>	<b>10.9</b>	<b>10.3</b>	<b>19</b>	<b>24,200</b>	<b>5</b>	<b>2.88</b>
<b>Total (at a 500ppm Co cut-off)</b>								
Indicated	52	969	10.0	9.3	17	44,900	9	2.85
Inferred	20	910	10.1	9.2	17	16,600	4	2.85
<b>Total</b>	<b>72</b>	<b>852</b>	<b>10.0</b>	<b>9.3</b>	<b>17</b>	<b>61,500</b>	<b>13</b>	<b>2.85</b>

These Mineral Resources were first announced in ASX announcement 'Thackaringa – Significant Mineral Resource Upgrade' on 18 March 2016. The Company is not aware of any new information or data that materially affects the information included in the relevant announcement and, that all material assumptions and technical parameters underpinning the estimates in the relevant announcement continue to apply and have not materially changed.

Source: SRK

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