

## Battery Metals Index February 21, 2017

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## Battery Metal Stocks Are Powering Up, But Can This Surge Last?

Battery metals are enjoying a growth story unlike most other commodity these days, with lithium and cobalt mining companies garnering significant capital market activity and investor interest. Increased demand for these metals is due to the widespread need for lithium-ion batteries; emergence of the electric vehicle (EV) market, increasing demand for high-capacity energy storage solutions, and consumer preferences for multiple handheld devices. The Ubika Battery Metals Index, comprised of 10 lithium and 10 cobalt companies, has rallied 82% over the past year, with some company valuations surging over 100%. With an implied shortage of lithium and cobalt in the market, we examine which producing companies are best positioned to rise on this battery frenzy. In this edition of the Ubika Battery Metals Index report, we examine the battery industry and the future state of the supply/demand balance to see if this bubble is set to burst!

### Industry Highlights

- On January 27th, AltaGas Ltd. announced the opening of its Pomona Energy Storage Facility in Southern California (SoCal). At 20 megawatt hours (MWh) of electricity storage capacity, it is currently the largest battery storage facility in North America. The facility will help alleviate stress on the power grid by offsetting periods of peak power with 80MWh (over 4 hours) from battery storage. By storing power when production exceeds consumption, the battery power eliminates the need for power plants to come online intermittently and allows for more efficient production planning, which not only reduces energy costs but also greenhouse emissions. The success of Pomona is expected to be a precedent for other power-constrained regions to adopt battery power solutions. Currently, Tesla has won a contract to provide 80MWh of battery capacity to SoCal Power Company, meaning AltaGas may not hold the crown for long!
- Tesla announced that it is initiating pilot production of its Model 3 cars on February 20th at its assembly facility in Fremont, California. After failing to meet production guidelines for its two prior models, the S and X, Tesla is on schedule with the Model 3 to begin production as planned—maybe even earlier—ramping up towards its 500,000 annual cars target for 2018. Coupled with Tesla's earlier announcement of commencing battery production at the Gigafactory, the news bodes well for producers as it highlights strong demand for battery metals such as nickel, lithium, cobalt, and aluminum for the foreseeable future.
- Samsung publicly revealed the root cause for the Galaxy Note 7 smartphone double-recall was defective lithium-ion (li-ion) batteries. Customers had reported fires and

explosions of their phones, which Samsung traced to a manufacturing defect from its suppliers. Missing insulation tape and a design flaw in the corner of the batteries made electrodes prone to bending, which could lead to a separation and short-circuit. A change in battery design is expected industry-wide in addition to more stringent quality-control inspections, as Samsung releases its next generation Note 8 and S8 smartphones.

- The Democratic Republic of Congo, the world's largest cobalt producer accounting for more than half of the world's cobalt supply, has recently been scrutinized for claims of widespread child labour. A major investigative report by the Washington Post found an estimated 100,000 workers, many of them children, use hand tools in harsh and dangerous conditions to dig hundreds of feet underground. Companies operating in the region risk operational disruptions, elevated costs from reputational damage and need of providing additional reporting, as well as heightened regulation in the US over conflict materials.

### Upcoming Events

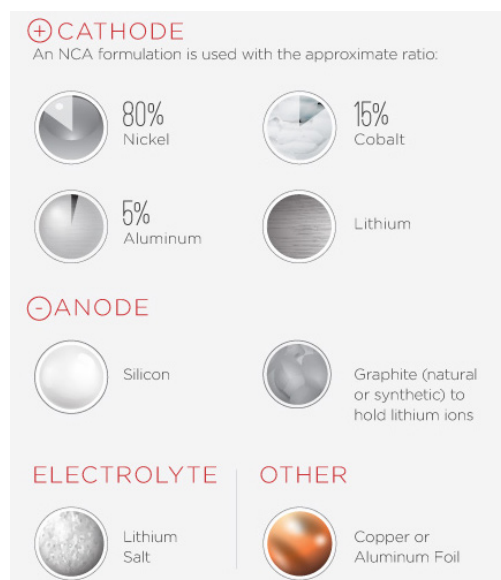
- 8th International Rechargeable Battery Expo: Battery Japan: March 1st-3rd, hosted by Reed Exhibitions Japan Ltd at the Tokyo Big Sight, Tokyo, Japan.
- International Battery Seminar and Exhibit: March 20th-March 23rd, hosted by Cambridge Enertech at the Fort Lauderdale, Florida, United States of America
- Lithium Supply and Markets Conference: May 31st-June 1st, hosted by the American Metal Market at the Hyatt Regency Hotel, Montreal, Canada.

## Batteries 101: The Lithium-Ion Advantage

There has been a lot of research around battery technology over the years as limited energy storage has been the shortcoming of devices such as smartphones (talk-time) or electric vehicles (range). However, it appears that improving one aspect of a battery compromises another. For instance, a battery might be more efficient, but may suffer from a smaller capacity. With no substantial way to increase energy storage, it is more economical for battery producers to improve lithium-ion batteries at a slow and steady pace than to invest money in research and development of new disruptive technology. Thus, the Li-ion battery industry has shifted its focus on achieving economies of scale to lower costs of production, while improving Li-ion batteries by 5% a year via advancements in research, development, and technology. Over a 10-year period, this 5% compound annual growth rate amounts to an energy storage increase of 160%!

Lithium is the lightest of all metals, yet has the greatest electrochemical potential providing the largest energy density pound-for-pound. Cobalt has been increasingly used in the anodes and/or cathodes of li-ion batteries and has been key in quick-charging technology. Interestingly, despite its name, lithium-ion batteries, such as the 18-650—used in Tesla cars—actually contain significantly more cobalt than lithium! In fact, Elon Musk has gone on record stating that lithium only accounts for less than 2% of a battery packs mass (Figure 1)! Tesla batteries are comprised of lithium, nickel, cobalt, and aluminum, referred to as the NCA formulation (notice no L in NCA).

Figure 1: Breakdown of Tesla’s NCA Compliant 18-650 Battery Composition

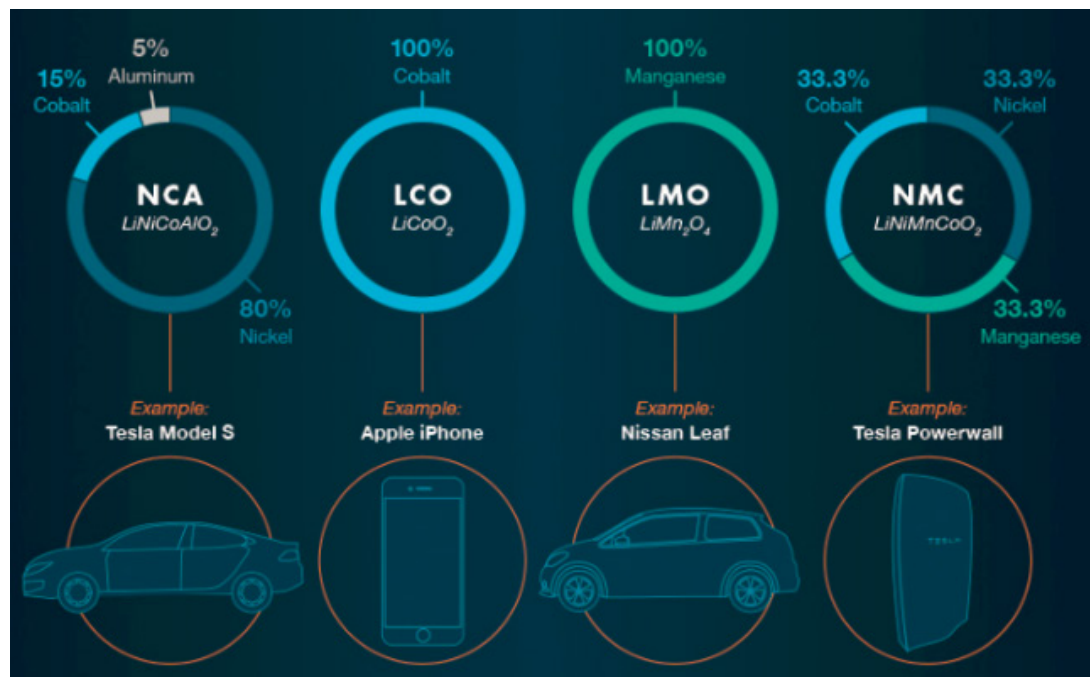


Source: Battery University

Lithium-ion batteries promise the same safe discharging and load characteristics of conventional nickel-cadmium batteries but have twice the energy density—saving space and weight. Additionally, li-ion batteries are low maintenance, meaning there is no memory or scheduled cycling required to prolong the battery’s lifespan; an advantage no other battery shares. Although aging via capacity deterioration and high manufacturing costs are limitations of li-on batteries, both are expected to improve with time.

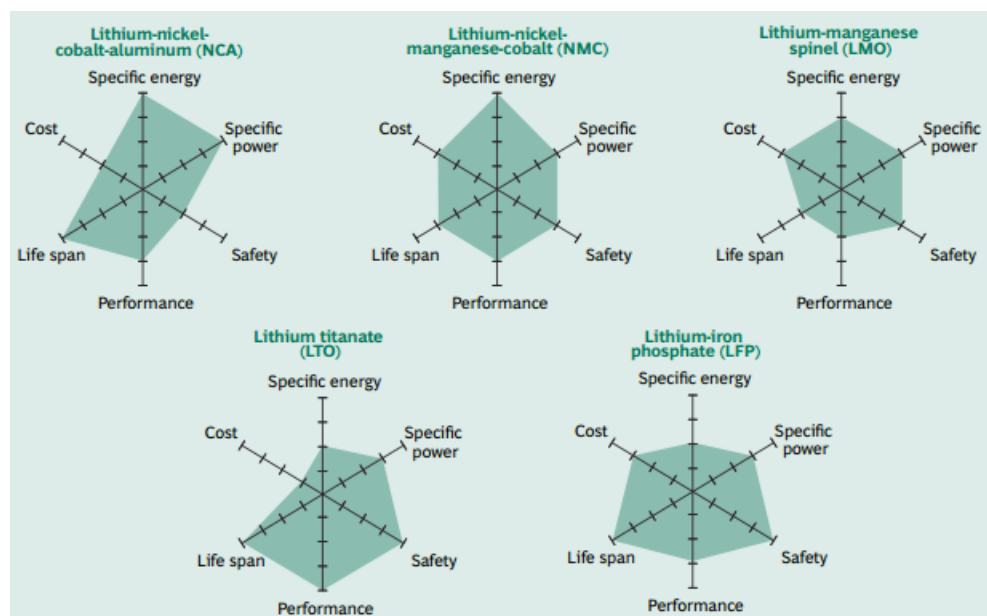
Where lithium-ion batteries differ is in their cathodes; cathodes composed of varying metals provide different performance trade-offs for a multitude of uses (see Figure 2). A study by the Boston Consulting Group (BCG) compared various lithium-ion technologies with their relative trade-offs in cost, life-span, specific energy, specific power, and performance. The study found NCA technology to be the best overall battery with an optimal lifespan, specific energy, and specific power—parameters that cannot easily be improved. As mentioned prior, cost, safety, and performance are expected to improve with the advancement of research and technology.

Figure 2: Different Battery Cathodes for Different Uses



Source: Electrek

Figure 3: Trade-offs Amongst Lithium-Ion Technologies



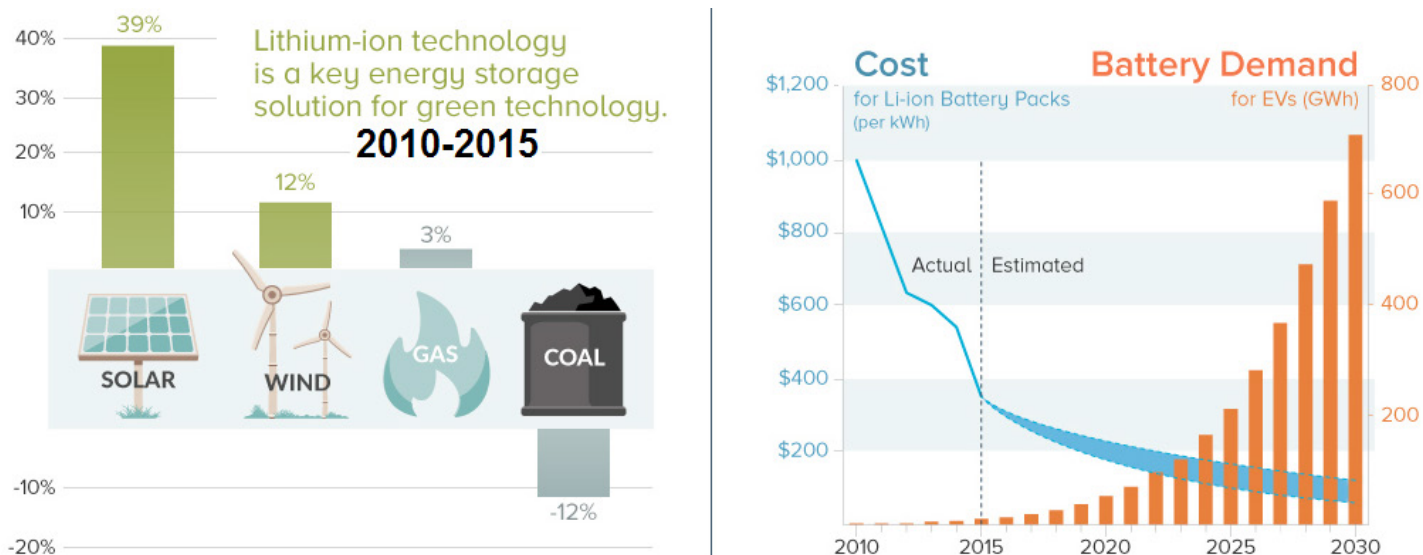
Source: BCG Research

With no significant competing technology or replacement, and the increasing trend towards electric vehicles and renewable, sustainable energy, it appears that lithium-ion batteries are here to stay. As the race towards clean energy solutions continues, it appears the best investment strategy to take advantage of this trend is to focus on the common element: batteries. Presently, there is ample existing supply of nickel and aluminum, however there appears to be a shortage in the supply of cobalt and lithium. Instead of investing in capital intensive and procurement-risky battery manufacturing companies, it may make more sense to invest in cobalt and lithium producers, as they are to benefit most from increasing prices from the supply shortage.

## Battery Energy Storage Market and Outlook

Lithium-ion technology is touted to be the fuel of the green revolution! As this battery technology continues to improve and production costs continue to taper, more and more uses for Li-ion batteries are expected. The world is shifting towards renewable and sustainable energy, with green power becoming a reality now that we have the technology to harness the power. According to Reuters, China is investing over US\$350B into renewable power generation by 2020 and targeting 800,000 green vehicle sales in 2017! The US and Canada are quickly retiring coal power plants and are adopting battery energy storage solutions to reduce the need of intermittently firing up power plants during peak times. The growth in green energy and demand for electric vehicles are two of the main drivers behind the surge in lithium-ion battery demand (Figure 4).

Figure 4: Growth in Renewable Energy and Battery Demand



Source: EIA and Bloomberg

The green revolution is a worldwide joint effort with countries coming together to sign environmental agreements and companies racing to refine and improve technology. Tesla, for example, expects to half its Li-ion battery costs to US\$100 per Kilowatt hour by 2022 with its Gigafactory while it continues to improve and expand its charging infrastructure globally. The strong demand in electric vehicles is enabling manufacturers to increase production to achieve economies of scale while scaling-up the energy storage market. By 2040, a recent Bloomberg industry analysis predicts the energy storage market to grow to a US\$250B industry! With li-ion batteries becoming more affordable and EV charging more convenient, more and more consumers will have access and adopt this green technology. At its current rate, McKinsey and Company predict by 2030, renewable energy solutions to be more economical than purchasing petrol and electricity to power your vehicle and home, respectively.

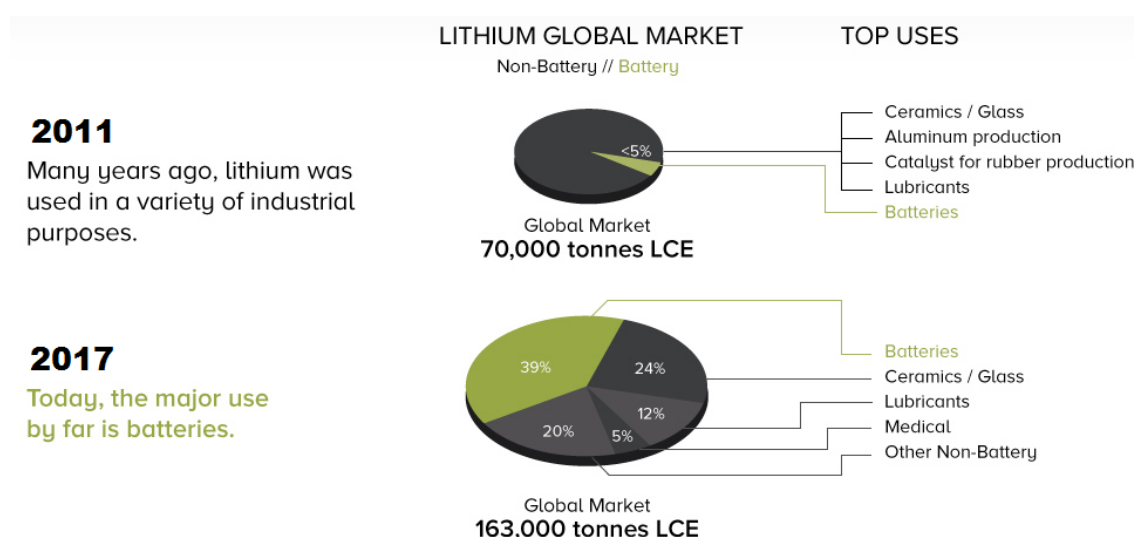


## Ubika Battery Metals Index

### The Bubble Index Radar: Supply vs. Demand

In 2011, nearly all of lithium was consumed globally to produce ceramics, glass, polymers and alloys (see figure 5). Fast forward to 2017, the global market demands 163,000 tonnes of lithium carbonate due to its use in batteries. With lithium-ion battery production to skyrocket by over 400% in the next 5 years, it is expected that the technology and energy sectors will become the primary consumers of lithium. So why not invest in mining companies with lithium assets?

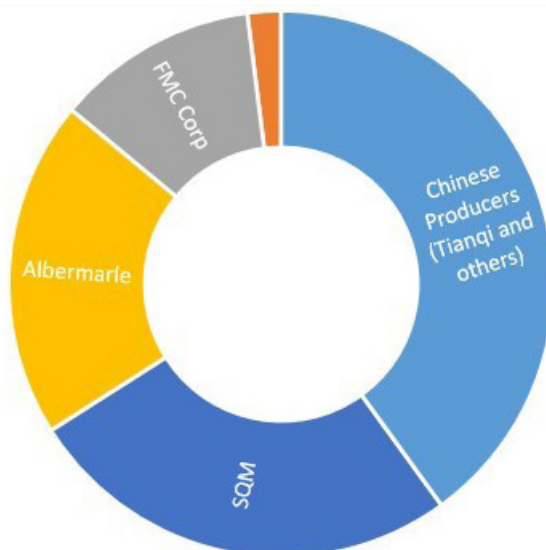
Figure 8: The Geography of Lithium



Source: EIA and Bloomberg

Five years ago, the supply shortage in the market had been controlled by a handful of producers with assets in Australia and the lithium triangle; Chile, Bolivia, and Argentina—home of the highest quality lithium deposits in the world. These big 3 producers, including Albermarle Corp., FMC Corp., and SQM of Chile had provided nearly two-thirds of the world’s lithium supply. However, there are new emerging exuberant investors in China that are now rushing to acquire lithium assets and bring additional supplies online (see figure 6). China is set to become the centre of the lithium sphere with the largest EV market and Li-ion battery production. Companies such as Tianqi Lithium of China and Ganfeng Lithium have acquired significant market share from the Big 3 players and appear willing to engage in a price-war to protect, or even gain market share.

Figure 6: Current World Lithium Market Share



Source: Corporate presentation, Sociedad Quimica Y Minera De Chile

With a host of emerging players racing to get into the lithium sphere, there is the risk of established companies flooding the market with increased output. Some research firms, including the Macquarie Group and Golden Dragon Capital, warn that lithium prices are already in bubble territory and expect a dramatic correction as early as Q2/2017 as additional supplies come online. While there was a lithium deficit in 2016, Macquarie expects a surplus this year that will last through 2021. Supply is expected to grow 30% in 2017, outpacing demand gains of 10%. Junior lithium producers may not survive long enough to build economical projects if a low-price environment ensues, which would also serve as an entry barrier for other newcomers.

### Lithium Index 10

A number of new entrants have seen exponential stock-price growth in a very short time frame, such as Millennial Lithium Corp (TSXV: ML), which has skyrocketed 1,566% since its debut. In regards to our Lithium Bubble index, it appears the apparent lithium supply shortage already seems priced into the shares, as each of our 10 stocks is trading well above their book value. Altura Mining, for example, is trading at a Price to Book multiple of 10.3x compared to its Bubble Index peer average of 4.6x. Market conditions such as these imply the lithium producing industry may be in bubble territory with a market correction in the near term. This tone is also echoed by leading industry experts and market researchers.



Figure 7: Lithium 10 Constituents

Identifier	Company Name	Price Close (CAD)	Market Cap (CAD)	52-week Price PCT Change	Price to Book	Lithium Resources (million tonnes LCE)
ALB.N	Albemarle Corp	120.78	13,584,829,291	75.1%	3.2x	10.90
FMC.N	FMC Corp	75.58	10,116,046,052	52.7%	3.9x	6.90
SQM.SN	Sociedad Quimica y Minera de Chile S	47.07	6,724,670,373	39.4%	3.6x	8.50
GXY.AX	Galaxy Resources Ltd	0.54	982,465,416	200.0%	3.9x	7.75
ORE.AX	Orocobre Ltd	3.68	800,924,976	53.8%	3.2x	7.20
PLS.AX	Pilbara Minerals Ltd	0.48	598,710,409	37.1%	5.5x	3.38
NMTC.TO	Nemaska Lithium Inc	1.45	456,086,415	276.6%	4.1x	1.26
LAC.TO	Lithium Americas Corp	1.24	374,113,390	230.7%	5.9x	7.70
AJML.AX	Altura Mining Ltd	0.18	279,475,497	111.8%	10.3x	0.86
NMT.AX	Neometals Ltd	0.35	192,844,124	75.7%	2.1x	2.36

Source: Ubika Research

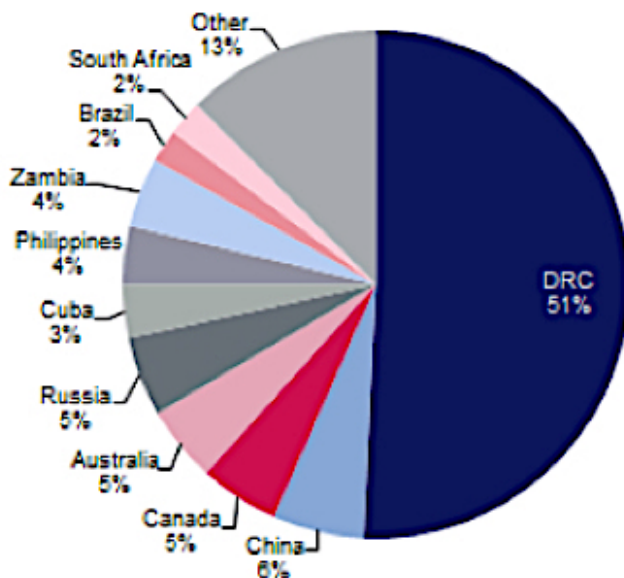
Elon Musk had stated that lithium is as prevalent as salt in the sand and instead directed the likely bottleneck for battery supply to be cobalt. In 2015, 40% of global cobalt supplies were used to produce rechargeable batteries, and is expected to increase by 5-8% a year as there is a shift in demand to the non-metallurgical sector.

Since cobalt is a relatively abundant material (No. 33 in the world) and occurs in small concentrations, cobalt has been mined as a by-product of copper and nickel. With its production tied to the market price of nickel and copper, the recent downturn in these metals has results in a shortage of supply and increase to cobalt's value. As a result, sole operations specializing in cobalt have begun in Congo, Canada, USA, and Cuba. Presently, over half of the global supply of cobalt comes from the Democratic Republic of Congo (see Figure 7), which presents significant production risks as a result of political instability, rebel activity, and use of child labour. Uncertainty surrounding DRC's mining code reform and heightened regulation in the US over 'conflict minerals' may lead to elevated costs for companies due to increasing supervision and reporting requirements. Unlike the lithium carbonate supply, the current cobalt supply chain is in a fragile state and consequently, a bottleneck to battery production at least in the short term.

### *Cobalt Index 10*

Unlike the Lithium Bubble Index, the Cobalt 10 Bubble Index does not appear to be overvalued as many stocks are trading at a Price to Book multiple of below 1x. In the past two years, copper and nickel witnessed their market prices fall, and as a result, output was curtailed as mines were closed down due to uneconomical extraction. Since cobalt is mined as a by-product of both of these metals, the supply of cobalt had also decreased as a side effect, which pushed the price of cobalt up higher. For instance, in Q1 2016, Congolese cobalt production fell 19% to 16,396 tonnes Y/Y, which tracks the fall in copper production of 22%.

Figure 8: Cobalt Production by Country



Source: Benchmark Mineral Intelligence (BMI)

Interestingly, there appears to be a correlation between market capitalization and the P/B values of the stocks, as large-cap companies enjoy higher market valuations. This may be due to the fact that they are diversified miners that have operations outside the troublesome DRC and cobalt production comes as a by-product of their existing operations. The only caveat to this trend appears to be eCobalt Solutions Inc. which, having a market capitalization of \$1.2mm, has the highest P/B multiple in the group trading at 2.1x. With no revenues to date, eCobalt solutions seems to be defying fundamentals and may be in bubble territory.

Additionally, since many of the constituents of our index have interests in the Democratic Republic of Congo, perhaps the political instability and risks to production operations have been factored into the market values of our index. Nonetheless, both Katanga Mining Ltd. and Sherritt International Corp. are trading well below their Cobalt Bubble Index peers at P/B multiples of 0.5x and 0.3x, respectively. Katanga Mining has suffered a poor evaluation as a result of underperformance and missing production guidelines. Last September, Katanga announced an 18-month suspension of operations as the low price environment for copper no longer made mining feasible. The shutdown reduced Congo's copper production by 15% overnight. Just last week, Glencore PLC acquired a 10.25% stake in Katanga Mining, as it plans to restart the mine in 2018, with the potential to be Africa's largest copper producer and the world's largest cobalt production company.

Figure 9: Cobalt 10 Constituents

Identifier	Company Name	Price Close (CAD)	Market Cap (CAD)	52-week Price PCT Change	Price to Book	Cobalt Resources (million lbs)
LUN.TO	Lundin Mining Corp	8.45	6,132,827,407	116.1%	1.6x	27.7
IGO.AX	Independence Group NL	4.28	2,612,496,624	54.9%	1.6x	24.3
LMI.L	Lonmin PLC	3.54	1,000,714,226	67.6%	0.3x	
KAT.TO	Katanga Mining Ltd	0.41	781,607,358	110.3%	0.5x	388.7
ALS.TO	Altius Minerals Corp	12.08	523,494,700	43.0%	1.5x	
S.TO	Sherritt International Corp	1.31	385,486,685	89.9%	0.3x	339.5
ECS.TO	Ecobalt Solutions Inc	1.23	131,865,824	1,194.7%	2.1x	35.7
TGS.AX	Tiger Resources Ltd	0.05	98,837,629	11.4%	0.6x	111
HIG.AX	Highlands Pacific Ltd	0.08	80,144,579	50.0%	n/a	25
FT.TO	Fortune Minerals Ltd	0.26	70,396,039	1,200.0%	1.1x	69.5

Source: Ubika Research

In conclusion, the stocks in our Lithium 10 Bubble Index appear to be in bubble territory, especially with new mines coming online in 2017 to boost production. On the other hand, key holdings in our Cobalt Bubble Index 10 appear to be undervalued, which has been substantiated with Glencore's recent stake in Katanga. Although cobalt appears to be short in supply for the near term, rising copper and nickel prices as a result of increased global infrastructure spending could change that. To de-risk cobalt investments, perhaps it would make more sense to invest outside of the Democratic Republic of Congo, in companies operating in countries with more stable political environments and clear mining standards, away from rebels and child labour.

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