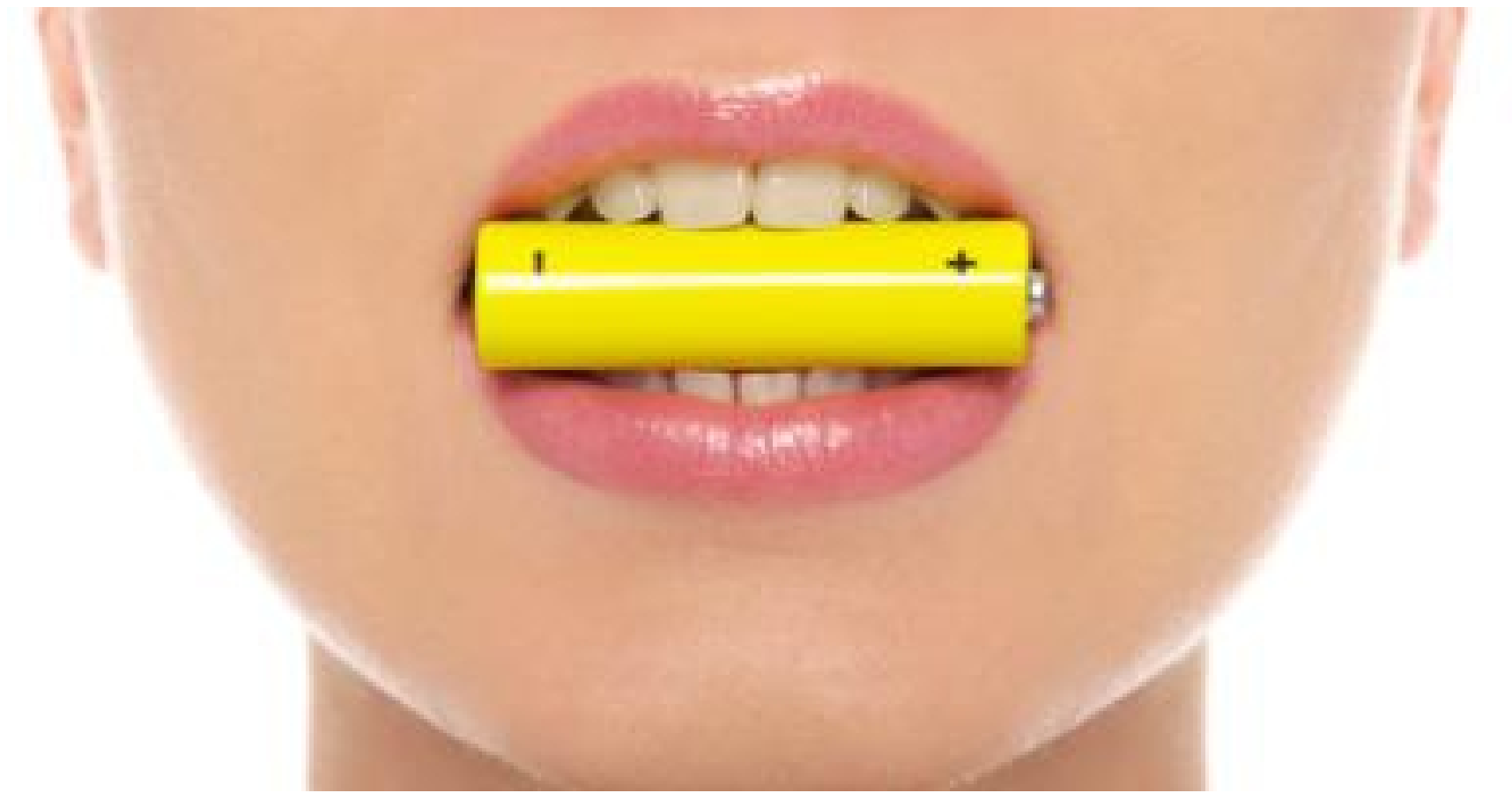


CRITICAL METALS





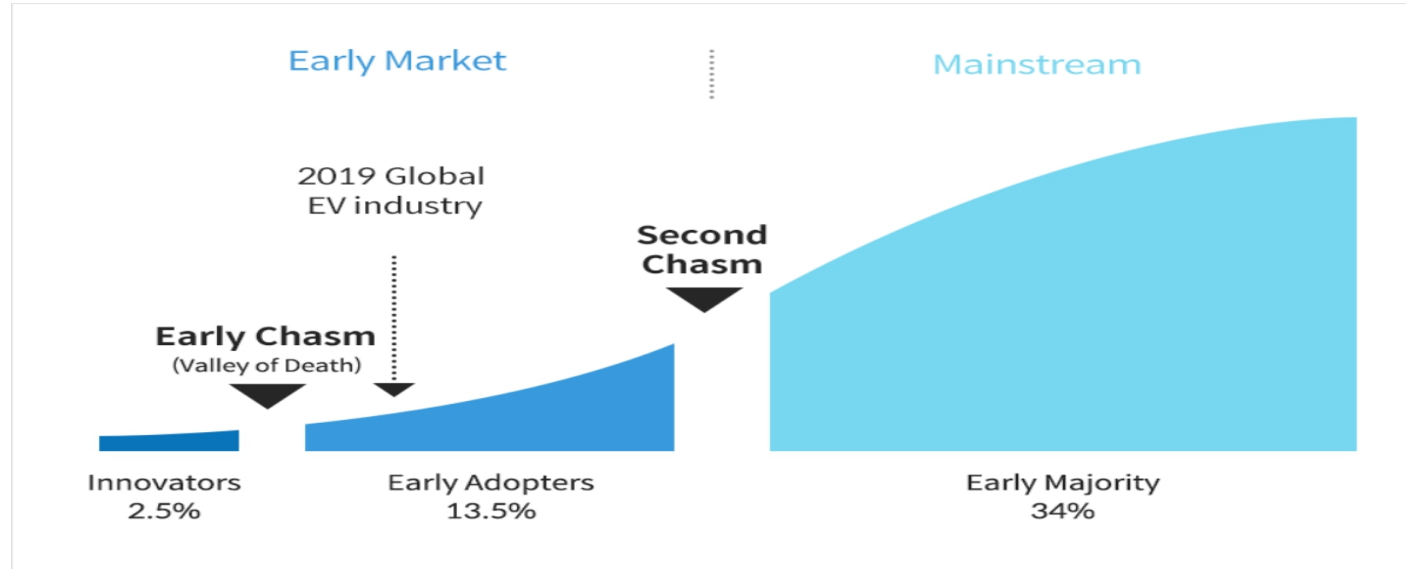
- US short term interest rate had dropped to zero was after the 1930 stock market crash and the Global Financial Crisis GFC in 2008.
- A wealth disconnect occurred, those with money became richer on the cheap money, while the middle class and poor became poorer, leading to a rise in nationalism in the 1930's and now.'

Global Manufacturing & Services PMIs

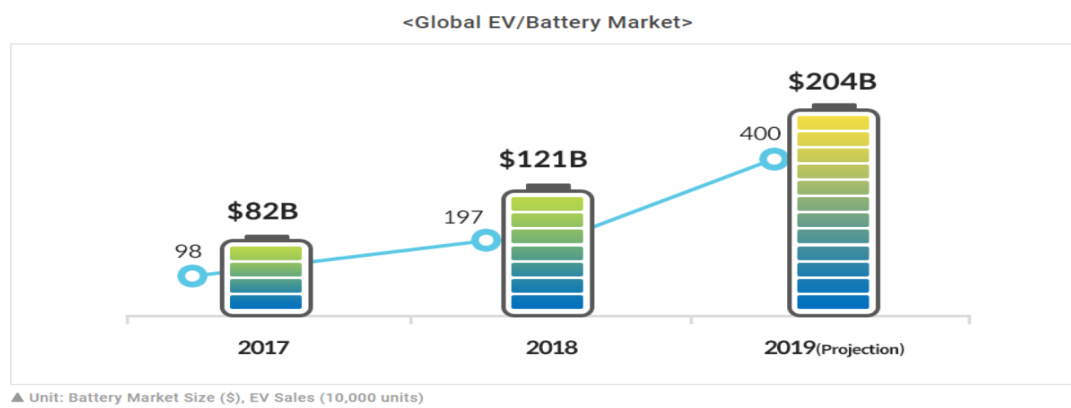


Global Electrification transformation is underway for the global energy sector

- Policy choices made by governments will determine the shape of the energy system of the future.
- Globalization of natural gas markets due to a surge in LNG exports
- Asian coal power stations have an age of 15 years against 40 years in the developing countries
- Solar PV will overtake coal by 2040 due to lack of investment
- The other renewables require government help
- Rising incomes and an extra 1.7 billion people, mostly added to urban areas in developing economies by 2040
- In 2017, for the first time, the number of people without access to electricity dipped below 1 billion
- USA averages over 20 hours per day of electricity, the EU has 8 hours, Africa has 1 hour. More than 700 million people are projected to remain without electricity
- in 2040, Malaria remains a major problem. DDT blanket spraying was banned by the EPA in 1972, was partially rescinded in 2006. In 2015 there were 219,000 deaths from malaria, mostly children
- Natural gas and oil continue to meet a major share of global energy demand in 2040
- Petrochemicals are the largest source of growth in oil use
- Trade in LNG more than doubles in response to rising demand from developing economies, led by China and Russia
- The share of generation from nuclear plants stays at around 10%.
- Some two-thirds of today's nuclear stations in advanced economies is more than 30 years old
- **The EV global adoption is expected at around 1.5% of world refined copper consumption, and unlikely to grow more than 3% five years out**
- **You can't have an electric vehicle revolution without infrastructure in place**



- THE VALLEY OF DEATH
- Global auto sales projected for 2019 is 92.5 million
- The year 2019 with EVs exceeding 4% might be the year when the electric vehicles cross over the valley of death



BATTERY MARKET

- 184 different batteries available in Australia, 62% are lithium ion
- Electric Vehicle / Grid Storage Batteries / Laptop, Mobile Phones, Games Fierce Competition over Market Dominance
- The EV battery market expects an acceleration toward oligopoly global companies
- Reaching the production capacity of 50GWh an effective entry barrier against the latecomer
- Global EV companies seeking partners in related industries
- Development is in place for solid-state battery, an evolved version of currently dominant lithium-ion batteries
- Companies are interested in metal-air batteries and lithium-sulfur batteries to complement or replace lithium-ion

WHICH METAL IS GOING TO BE THE BIGGEST
BENEFICIARY?



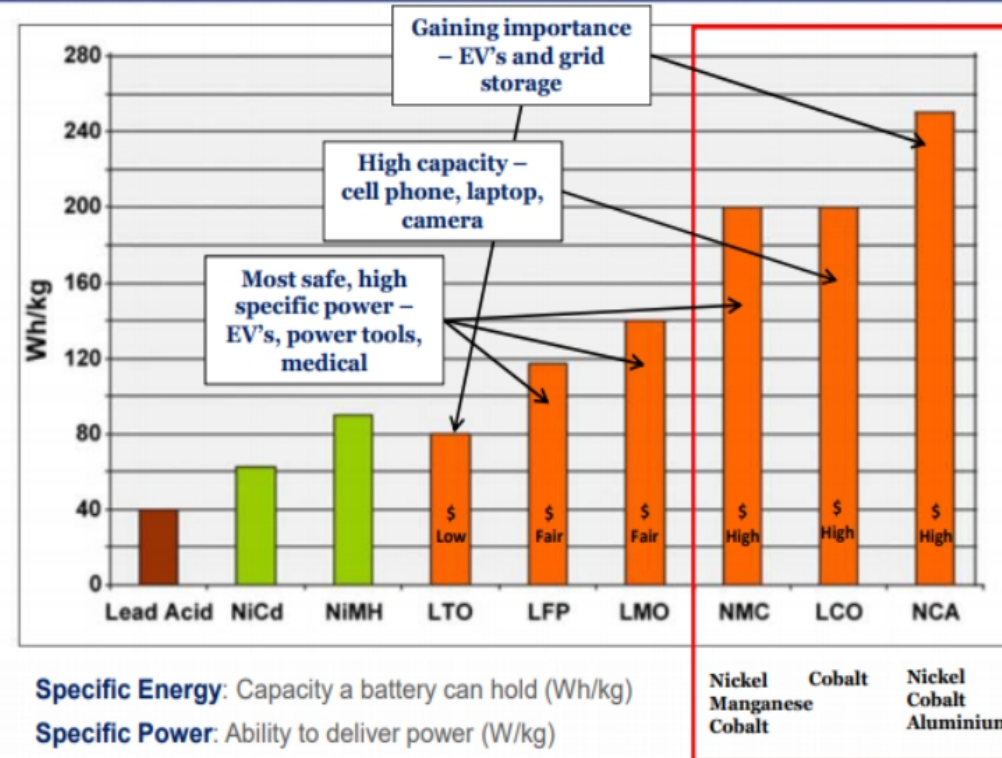
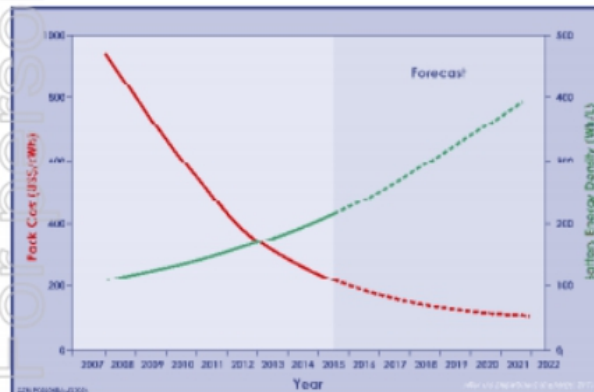
Lithium Ion – Battery of Choice

LITHIUM ION (Li-Ion) – BATTERY OF CHOICE

- Better specific energy and power density qualities.
- For EV's, the relationship between power delivery and specific energy density is critical for the performance.

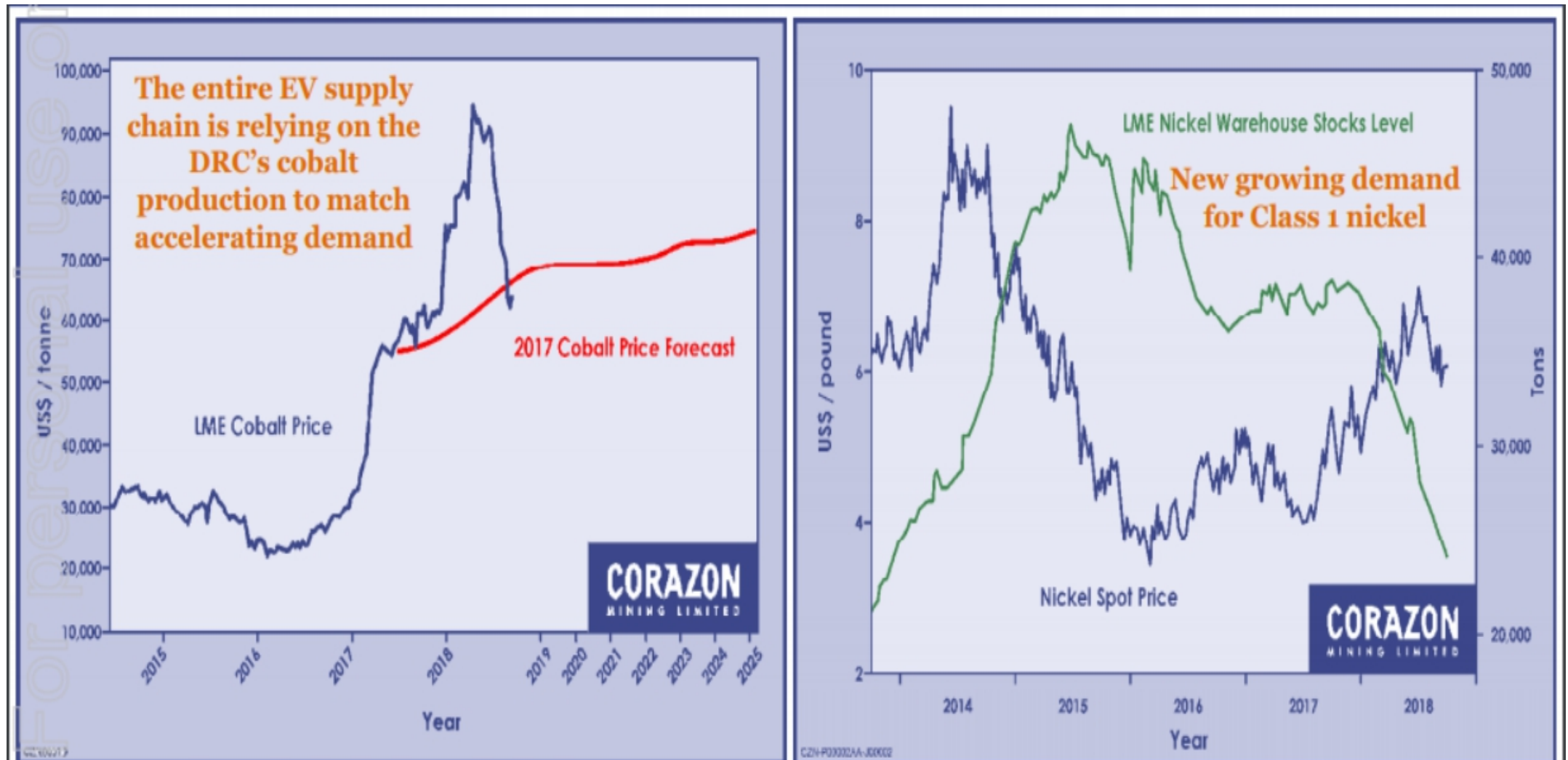
BATTERY COSTS RAPIDLY FALLING

- Less cost for more energy



Cobalt and Nickel prices

Class One Nickel is battery gradeNickel Sulphate



COBALT

SMALL MARKET, PRICES CAN BE DRIVEN UPWARD, FOLLOWED BY DEMAND DESTRUCTION

- 2000 Motorola disruption technology initiated the \$20 billion pa portable electronics market using lithium cobalt batteries
- 2015 Cathode manufacturers were making Lithium Cobalt Oxide LCO batteries with 60% cobalt in the batteries for the portable electronics market with normal orders being 3000 tonnes cobalt per annum
- 2017 With proposed 1000GWh EV megafactories, individual orders jumped to over 10,000 tonnes tpa prices leapt to \$40/lb (\$90,000/t)
- The difficulty for battery makers to complete competitively priced deals, forced them away from LCO batteries to nickel-cobalt-manganese NCM 111 – equal proportions of each metal – and then standard of NCM 523 and NCM 622, which used 10% and 20% cobalt and then to substitution of cheaper metals
- Tesla reduced its cobalt consumption per EV by 60% in three years. Elon Musk: “We use less than 3% cobalt in our batteries & will use **none** in next gen”
- **Electric vehicle manufacturers do not like the supply chain risks cobalt poses. They want these risks eliminated**
- They do, however, like the safety properties cobalt brings to an EV battery

COBALT

2027 DEMAND FORECAST TO 312,000 TONNES COBALT FROM 118,000 TONNES IN 2018

SECURING A STABLE TRANSPARENT SUPPLY OF ETHICALLY MINED COBALT IS A CONCERN FOR BATTERY MAKERS

- Over 60% of cobalt comes from the Democratic Republic of the Congo (DRC), 71,000 tpa in 2018
- Glencore is expecting to produce 63,000 tpa of cobalt by 2020
- Mutanda in the DRC is the largest cobalt mine in the world with 25,000 tpa
- Australian production is 5,000 tpa, with Murrin Murrin producing 3,000 tpa
- Papua New Guinea produces 3,200 tpa cobalt from the Ramu nickel laterite deposit.
- Ramu is a tropical laterite deposit, soft digging with 0.9% nickel and 0.1% cobalt grades higher and more uniform than the Australian nickel cobalt laterite deposits
- The cost of a single High Pressure and Temperature Autoclave line is A\$1 billion
- Nearly all cobalt production is obtained as a low grade by-product of copper
- Lack of production, low recoveries and high price has restricted cobalt usage, It is the last product to come out of a refinery electro-winning circuit, so in periods of low prices, much goes into the tailings dump

NICKEL THE PRODUCERS SWAGGERED BUT THEIR SHARES LANGUISHED

GROWING DEMAND IN ALL SECTORS PARTICULARLY NICKEL PIG IRON (NPI) DRIVEN BY STAINLESS STEEL GROWTH

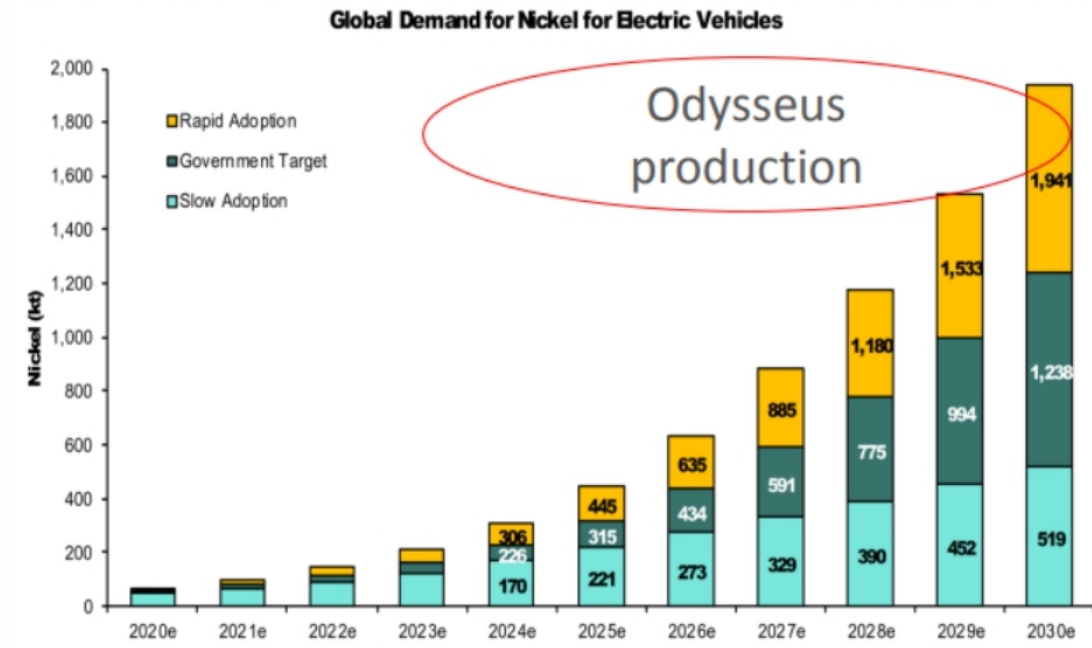
2018 NICKEL DEMAND 2.35 MT Q1 GROWTH 9.5% UP FROM 6% IN 2017

- There is a lack of investment into battery grade nickel sulphate refineries
- Refined nickel decreased as stainless steel producers preferred lower cost nickel pig iron (NPI) sourced from tropical nickel laterites
- Nickel sulphide concentrates are derived from high grade lava tube type in ultramafic rocks or disseminated in ultramafic rocks that are commonly sheared creating difficult mining conditions
- Disseminated nickel deposits generally need a high grade nickel basal zone to kick start production
- Historically when the nickel prices rises, sulphide ore grade declines

EV BATTERIES COULD TAKE ALL THE CURRENT NICKEL PRODUCTION

FUTURE ELECTRIC VEHICLE DEMAND FOR NICKEL

- Potentially very significant incremental demand versus a current nickel market size of c.2,200kt
- Research indicates NCM 811 will be the fastest growing battery combination by 2025!



Nickel based cathodes (NMC and NCA) are forecast to account for around 80% of the total cathode market by 2025

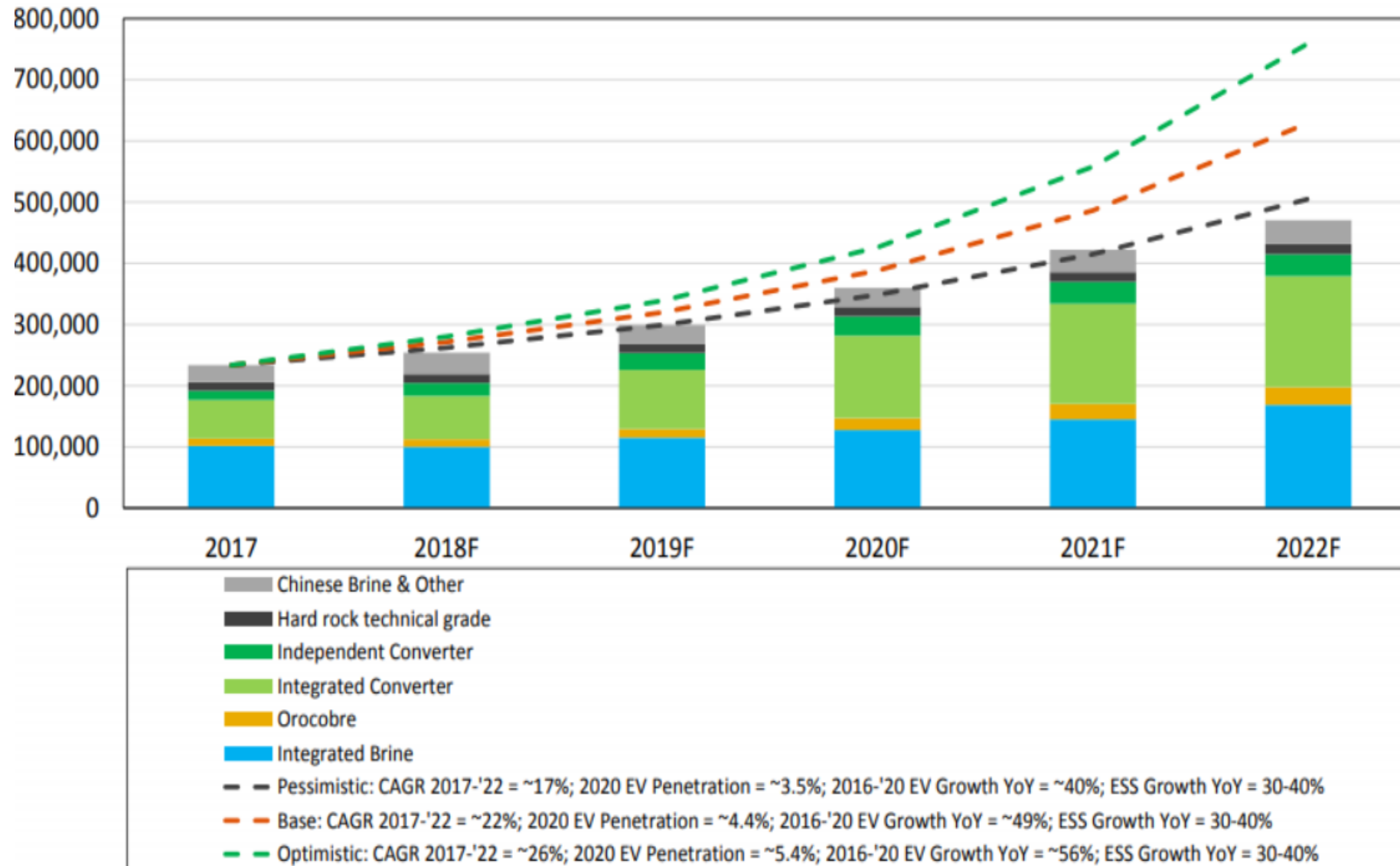
Research also indicates the NCM 811 battery will become the fastest growing battery by 2025

NCM 811 nickel:cobalt:manganese at a ratio of 8:1:1

LITHIUM

- Production of lithium metal was 38,000 t in 2016, 69,000 t in 2017 and grew to 85,000 t in 2018
- Usage was batteries 56%, ceramics and glass 23%
- The price surged to nearly \$20,000 per tonne of lithium carbonate before falling back to \$10,000 per tonne in 2018 and this year the price had dipped below \$10,000 per tonne lithium carbonate
- Long term battery grade hydroxide prices are forecast to maintain \$2500 per tonne premium to battery grade carbonate
- There is no shortage of lithium in the world.
- The dominant producers have focused on maintaining market share

Orocobre Forecasted Lithium Market Supply & Demand (t LCE)



Lithium Mines

- The Lithium Triangle comprising Chile, Argentina and Bolivia holds the bulk of the world's lithium resources
- The salars, are salt lakes, rich in lithium, potassium, boron and magnesium
- The brines are pumped from aquifers over 100m deep for evaporation on surface
- The salars are located in the Andes Mountains at high altitudes, are enclosed basins with high wind levels enhancing evaporation
- The salar brines have low lithium levels, that are enriched by evaporation
- A Li:Mg ratio of < 10 is preferred
- A salar will take 3 to 4 years to be brought into production
- However the world's greatest lithium mine is the Greenbushes spodumene pegmatite mine in Western Australia

PEGMATITE SPODUMENE HARD ROCK MINES

- Spodumene is mined from pegmatites, concentrated to lithium oxide that is shipped to China for conversion to lithium carbonate (LCE) and then refined to battery grade lithium hydroxide
- The concentrate grade needs to be over 6% or penalties occur. Also magnetite and magnesium can attract penalties
- The spodumene has to be coarse grained since fine grinding causes recovery problems
- Greenbushes is a spodumene mine but has an exceptionally high grade of 3.5% lithium, while other mine grades are around 1% lithium

Lepidolite, Petalite and Zinnwaldite and lithium clay minerals

- Pegmatites with lithium rich lepidolite and petalite minerals are important in the ceramic and glass industry. The largest deposit of this type is the Bikita mine located in Zimbabwe, Africa
- Pollucite a cesium rich mineral, is associated with lepidolite is used in high temperature / pressure oil wells. A 20,000 tonne pod was mined south of Kalgoorlie and sold this year for A\$20 million by Pioneer Resources
- Zinnwaldite is a lithium rich mica mineral and other lithium ionic clay deposits can be processed using high pressure autoclaves. Pilot plants have been run, but none are in production
- The lithium clays and salts commonly have a high boron content. Rio Tinto has a virtual monopoly on boron and selling boron can be a problem and may have to be stockpiled

Lithium Routes

- The Australian hard rock miners are currently shipping lithium oxide concentrates to China that have to be converted to 99.5% lithium carbonate battery grade has to be converted from oxide to carbonate at a cost of \$1500 per tonne of concentrate.
- The salars produce lithium carbonate but it does not meet battery standards require refining.
- The ionic clay miners using high pressure and high temperature autoclaves can directly sell into the battery market
- Lithium hydroxide is the preferred battery grade product

WATCH OUT FOR THE FREE LOADER

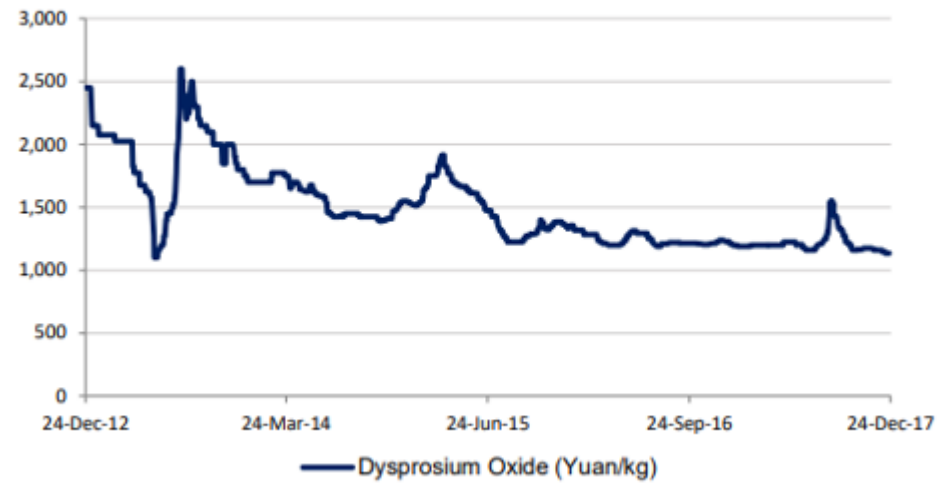


RARE EARTHS

- World Production TREO 138,900 tonnes in 2017
- China 36%, Vietnam 18%, Brazil 18%, Russia 15%, Australia 3%
- USA proposed trade sanctions were cancelled September 2018
- China heavily reliant on USA lanthanum and cerium
- Focus on
 - Light REO NdPr Neodymium/Praseodymium
 - Price \$38.5/kg production 30,400 tpa
 - Heavy REO Dysprosium
 - Price \$180/kg production 1,700 tpa

China produces 98% of world dysprosium oxide (DyO) production

Figure 10: Dysprosium price



Pricing Update

Chinese rare earth prices remained stable and flat during the last Quarter. Recently a weaker US dollar against the yuan pushed export prices up.



Figure 5: NdPr Prices China in US\$/kg since November 2016. Source Asian Metal (China Domestic)

REO April 2019 Prices

Comparison of REO Distribution & Basket Value Between Hastings and Major Light RE Producers						
RE Oxide/TREO	Unit	Hastings	China		Outside of China	
			Baotou	Sichuan	Mt Weld	Mountain Pass
Lanthanum	%	9.99	25.94	36.50	25.16	33.22
Cerium	%	39.59	50.69	47.90	46.36	49.10
Praseodymium	%	8.01	5.15	4.10	5.38	4.30
Neodymium	%	33.80	15.90	10.00	18.79	12.00
Samarium	%	3.88	1.21	0.70	2.27	0.80
Europium	%	0.84	0.22	0.08	0.47	0.12
Gadolinium	%	1.80	0.39	0.23	0.85	0.17
Terbium	%	0.15	0.05	0.04	0.06	0.04
Dysprosium	%	0.50	0.11	0.06	0.16	0.07
Yttrium	%	1.14	0.25	0.31	0.45	0.10
Other	%	0.29	0.10	0.08	0.05	0.09
Economic Value Factor		1.90	1.00	0.73	1.14	0.81
Basket Price USD/kg		25.00	13.25	9.65	15.05	10.75

- Nd-Pr /TREO composition is validated by customers in the MREC
- Economic Value Factor calculated on individual % of REE in the ore body x REO prices
- Yangibana: high Nd-Pr content of 41%
- Last 12 mths avg basket price - USD25.00

Neodymium Iron Boron Magnets

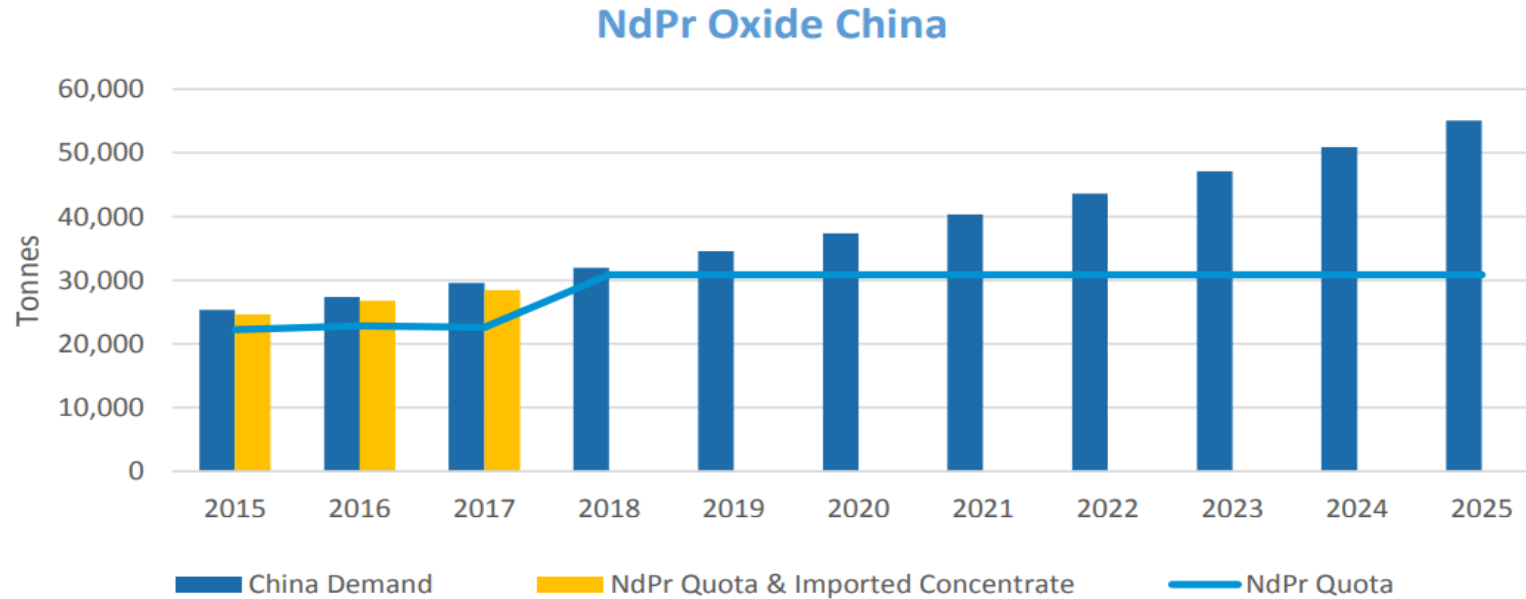
- China has produced over 98% of world HRE dysprosium oxide (DyO) production
- Demand destruction occurred in the 2011 price spike for dysprosium
- The Chinese found they could spray paint the dysprosium onto the magnet
- The Japanese found they could melt the dysprosium onto the magnet
- Rare Earth supply is currently driven by demand for NdFeB magnets
- A reduction in dysprosium content used in certain grades of NdFeB magnets, however was balanced by increased demand for batteries/magnets
- China has continued to crack down on illegal mining the bulk of DyO

Projected major growth in NdFeB magnets

Used in the EV Power Train

NdFeB magnetic motors offer greater torque and more power by weight
90% of all electric vehicles will have a NdFeB permanent magnet motor

- Increased NdPr consumption combined with constrained supply could result in China moving from being the world's major source of NdPr to a net importer by the early 2020's



Source: ACREI, Adamas Intelligence, Asian Metal and Shanghai Metals Market

Chinese companies control 96% of the world's magnet metal production.

Their view is that there are the 60-70 rare earth projects around the world and that for one reason or another few are likely to succeed.

Source: Various public domain reports



So we asked them what they wanted



They explained that rare earth processing is very complex and highly capital intensive ...they were not interested in supporting a new project that was going to become a competitor.

However they are under pressure from international EV customers to diversify their supply chain away from China and so they wanted to know can we supply them with an NdPr concentrate?

HASTINGS HAS JUST RAISED ANOTHER A\$16 MILLION ISSUING 97 MILLION SHARES PLUS OPTIONS GIVING IT A DILUTED CAP OF A\$160 MILLION

Hastings Equity Statistics (HAS:ASX)

Steady growth in market cap since May 2017

- Market Cap ~ **A\$130m**
- ~ 1250 Shareholders
- Top 10 shareholders (Malaysians) owns ~ 70%
- **A\$75m** raised since 2014
- **Cash: A\$12m** as reported on 31st Dec 2018
- **No Debt**
- Included in the **ASX All Ordinaries Index**



LYNAS

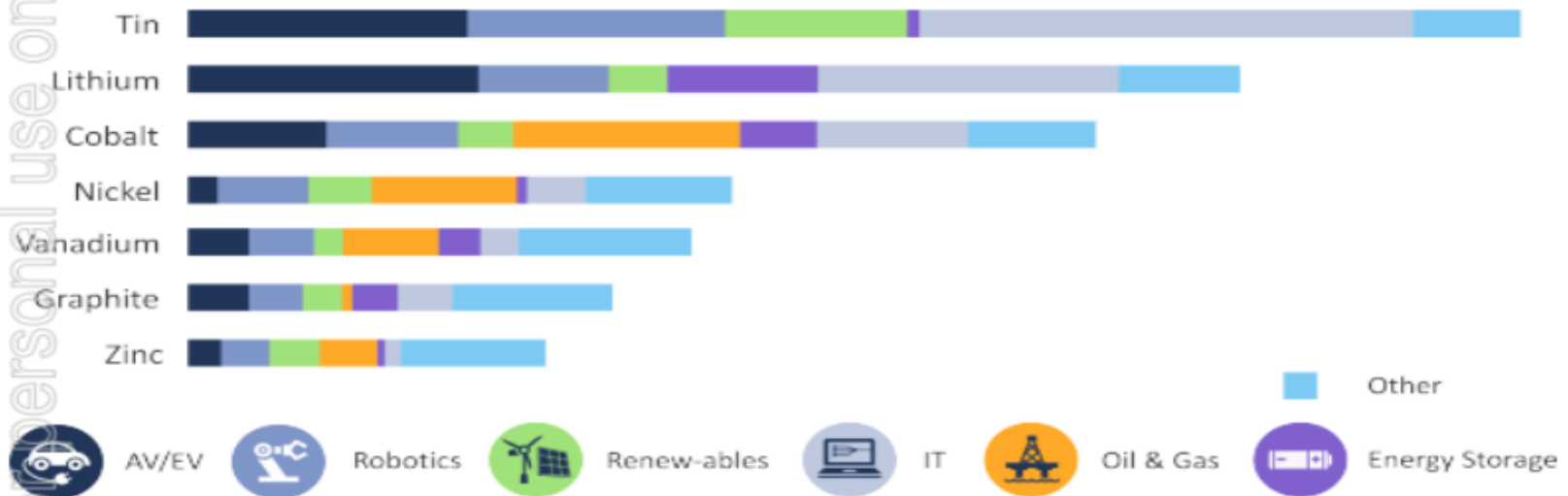
- Lynas made a gross profit in 2018 of A\$81 million and an after tax profit of A\$53.4 million after financing costs of A\$49.6 million
- Lynas NdPr price has dropped to US\$38.5/kg Q3/19
- Their price for TREO was US\$14.5/kg
- Lynas other revenue based on the Chinese published price for NdPr for other TREO is 16% of sales
- Renewal of its operating licence in September was conditional on low-grade radioactive residue being removed from its ore concentrate before being shipped to Malaysia from WA

TIN

Tin is THE technology metal



METALS MOST IMPACTED BY NEW TECHNOLOGIES



ELT is in the RIGHT COMMODITY

Data from MIT & Rio Tinto

Mine production in 2018 was 230,000 tonnes of which recycled tin contributed 128,000

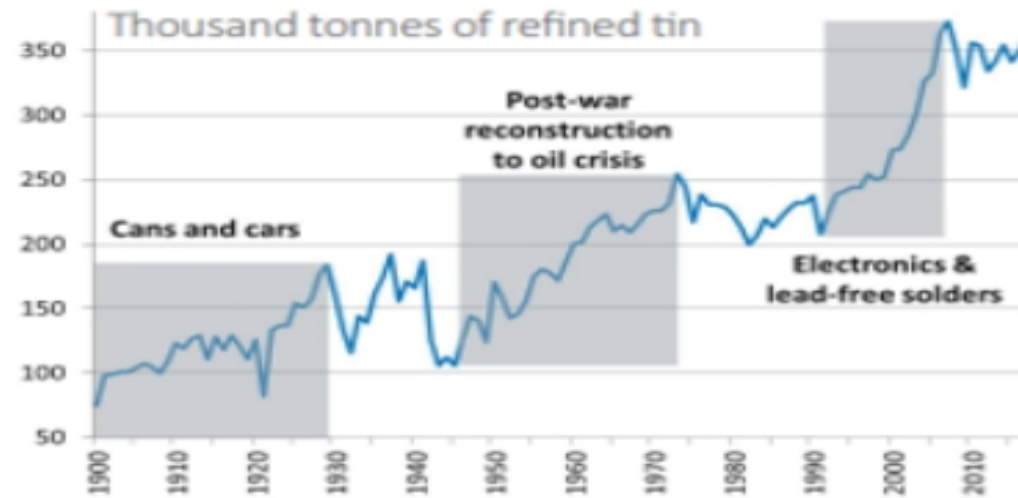
Global Tin Market Overview

Tin is critical to quality of life in the modern world

Tin applications by usage, 2017



Long-term tin demand



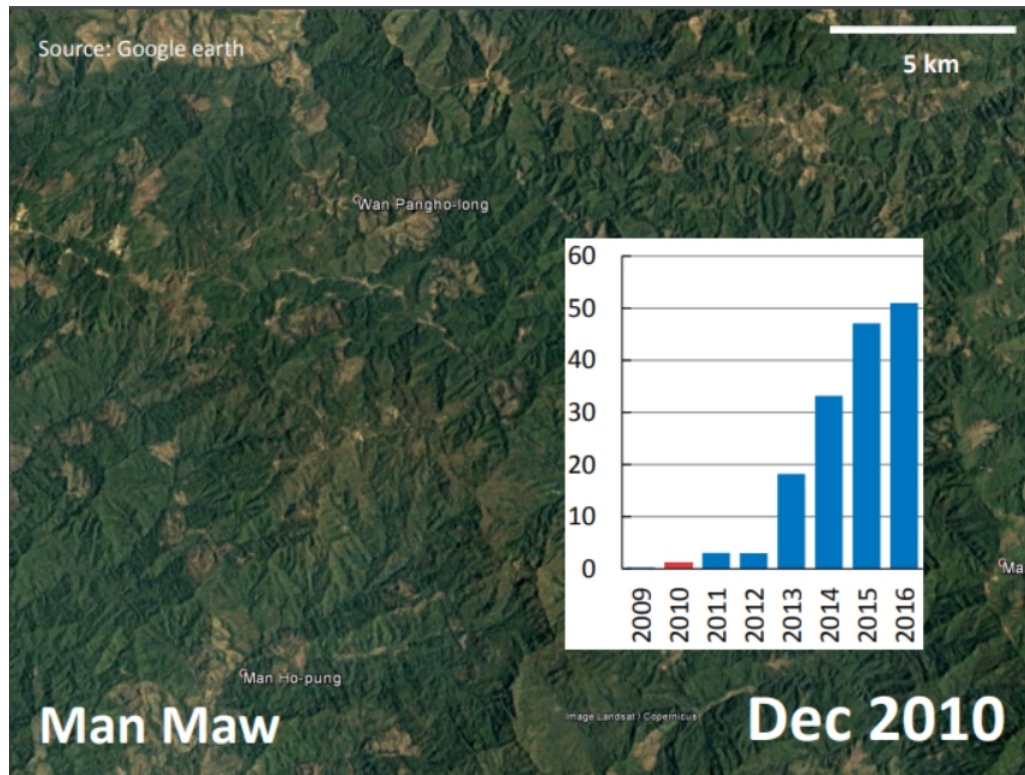
Energy and technology will drive future tin demand

TIN SUPPLY

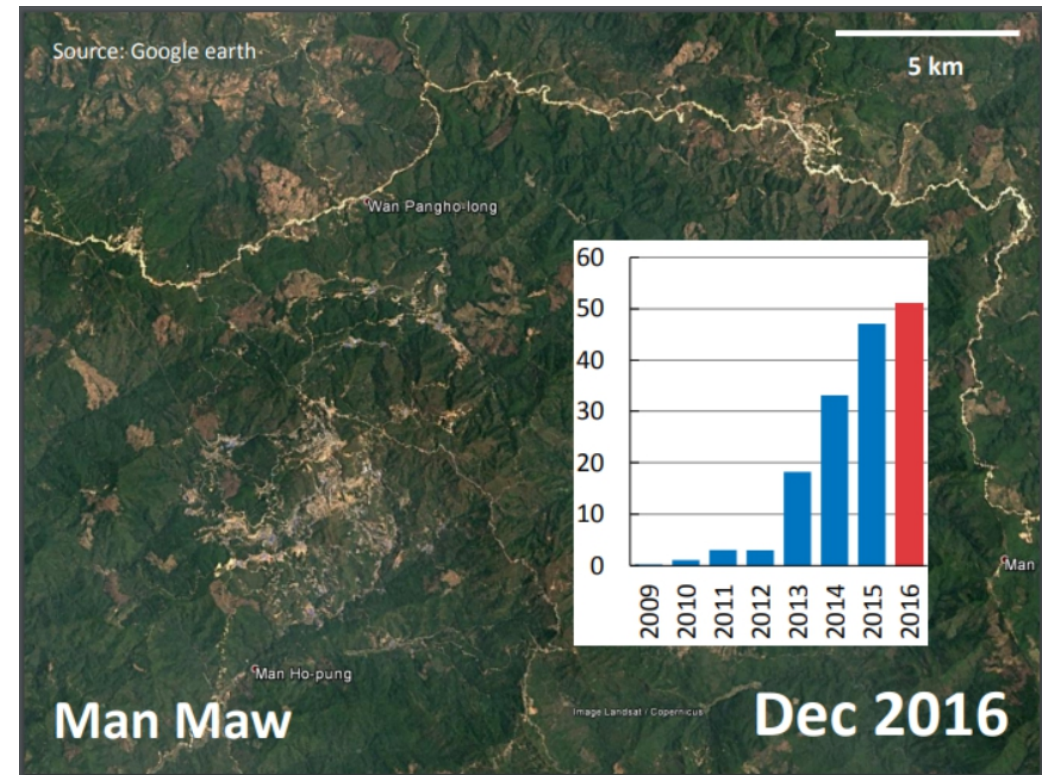
- Refined tin in 2017 was 360,000 tonnes
- Recycled 128,000 tonnes (31%) from refined tin, solder, bronze and other scrap / alloy
- Mine production was 232,000 tonnes tin.
- China produces 100,000 tpa, Indonesia 55,000 tpa, Myanmar 50,000 tpa, Peru 18,000 tpa and Australia 9,000 tpa
- Production and price surges has been in decade time spans
- Malaysian price and production quotas in the seventies and eighties led to an explosion of alluvial production from Brazil and the re-smelting of tin bearing slags from Thailand and Indonesia

Development of a tin province on the Chinese Border

- Dec 2010



- Dec 2016



Myanmar has been the big story in Tin

- In 2010 tin production from Man Maw on the Chinese border in Shan Province produced less than 1000 tonnes tin
- In 2017 production had grown to over 50,000 tonnes of contained tin
- The surge in production has come from a new mining area, known as Man Maw, possibly a Geiju or Renison Bell skarn type of deposit.
- The region is controlled by the Wa State Party, which has an armed wing and has a close political and economic ties to China
- There has been a drop off in 2018 and rumours are that the easy open cut and has been worked out and the mines are now going underground.
- There is no published geology but the signs are it could be a major

Man Maw note the open cut where photo taken

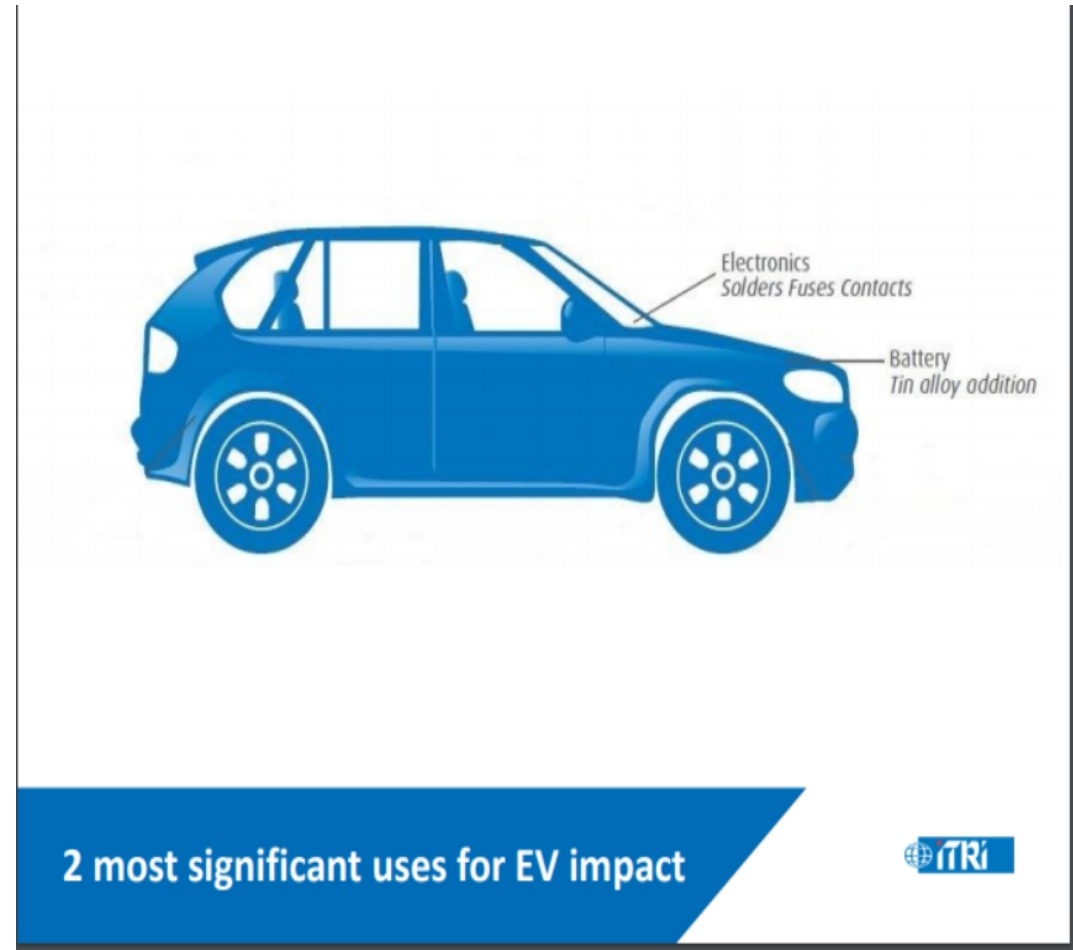
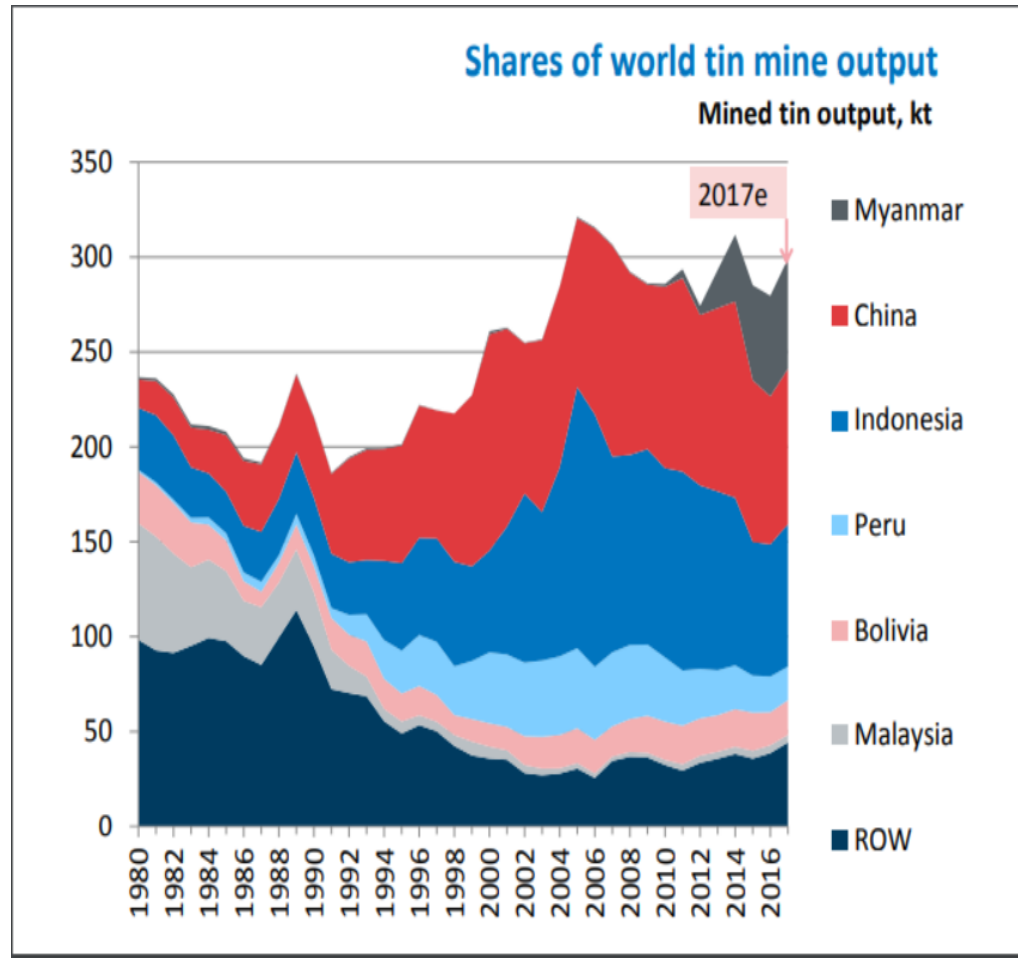


Tin mine seen in Man Maw at ethnic Wa territory in northeast Myanmar October 5, 2016. REUTERS/Soe Zeya Tun

Few world class tin deposits sitting in the wings

- Alphamin's Bisie Mine a world class tin mine in the DRC will commence production at 30,000 tpa tin Q3/19 discovered by Rwandan refugee artisan workers
- Underground mine with head grades of over 4% tin
- Potential to double production
- This year the mining method was changed from open stoping to cut and fill, signaling more difficult mining conditions and may not meet production schedules

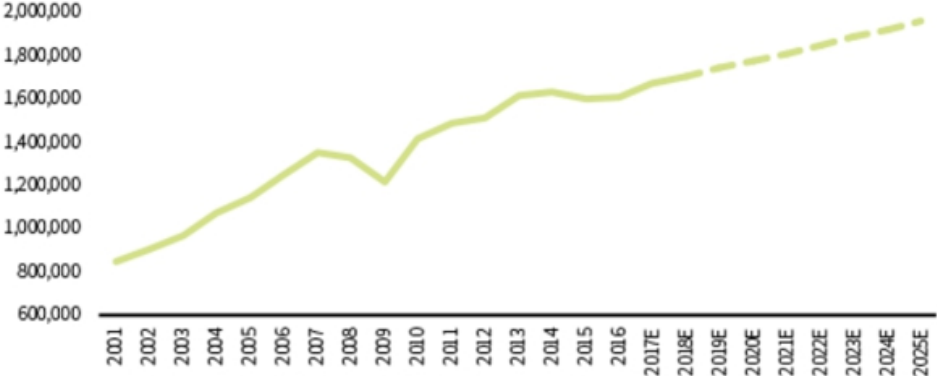
Tin Production and EV Car Usage



VANADIUM DEMAND DRIVEN BY CHINESE STEEL PRODUCTION

Steel Production 2001–2025E

Steel Production (000 MT)



Market Outlook

(Metric Tons V per Year)



Redox Battery Flow Chart

- Uses

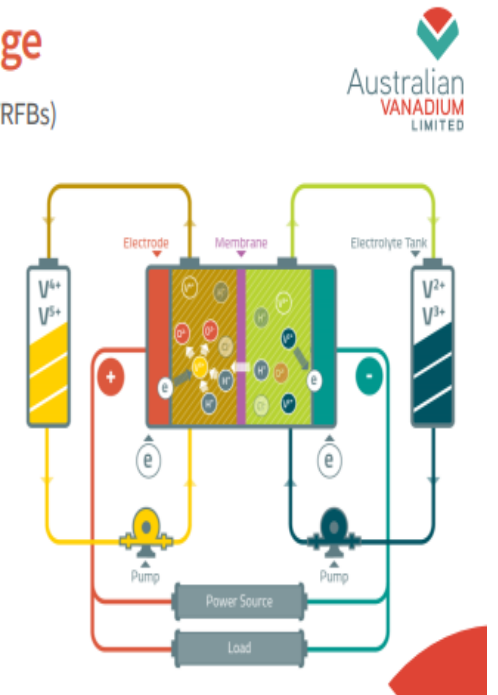
- Vanadium is important in steel because a low level of V_2O_5 in the steel considerably enhances its strength
- Principally used for rebar steel rods in concrete
- Vanadium Redox Flow Batteries which uses the three oxidation states of V_2O_5 to hold charges for long periods of time

- Vanadium Redox Flow Batteries (VRFB)

Vanadium Markets – Energy Storage

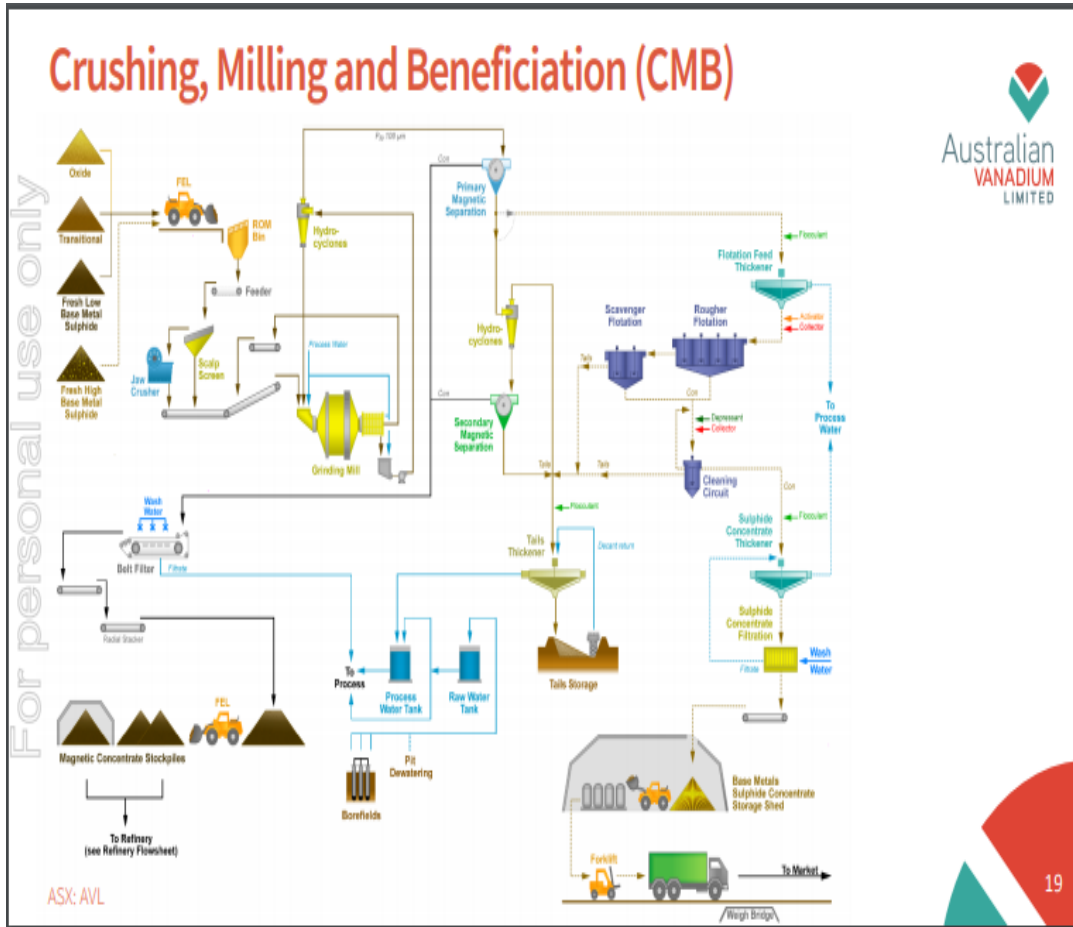
Unique characteristics of Vanadium Redox Flow Batteries (VRFBs)

- VRFBs provide a way to store and re-supply renewable energy. Their very high capacity is ideal for large-scale energy storage applications, unlocking the full potential of renewables while maintaining grid security
- VRFBs have unique advantages over other batteries:
 - Easily scaled into large MW scale solutions
 - Lifespan of 20 years with very high cycle life and no capacity loss over time
 - A key feature of using only one element in electrolyte, V_2O_5 which can be recycled
 - Immediate and rapid energy release
 - Non-flammable
 - Suitable for grid connection or off-grid use
 - Can discharge 100% with no damage

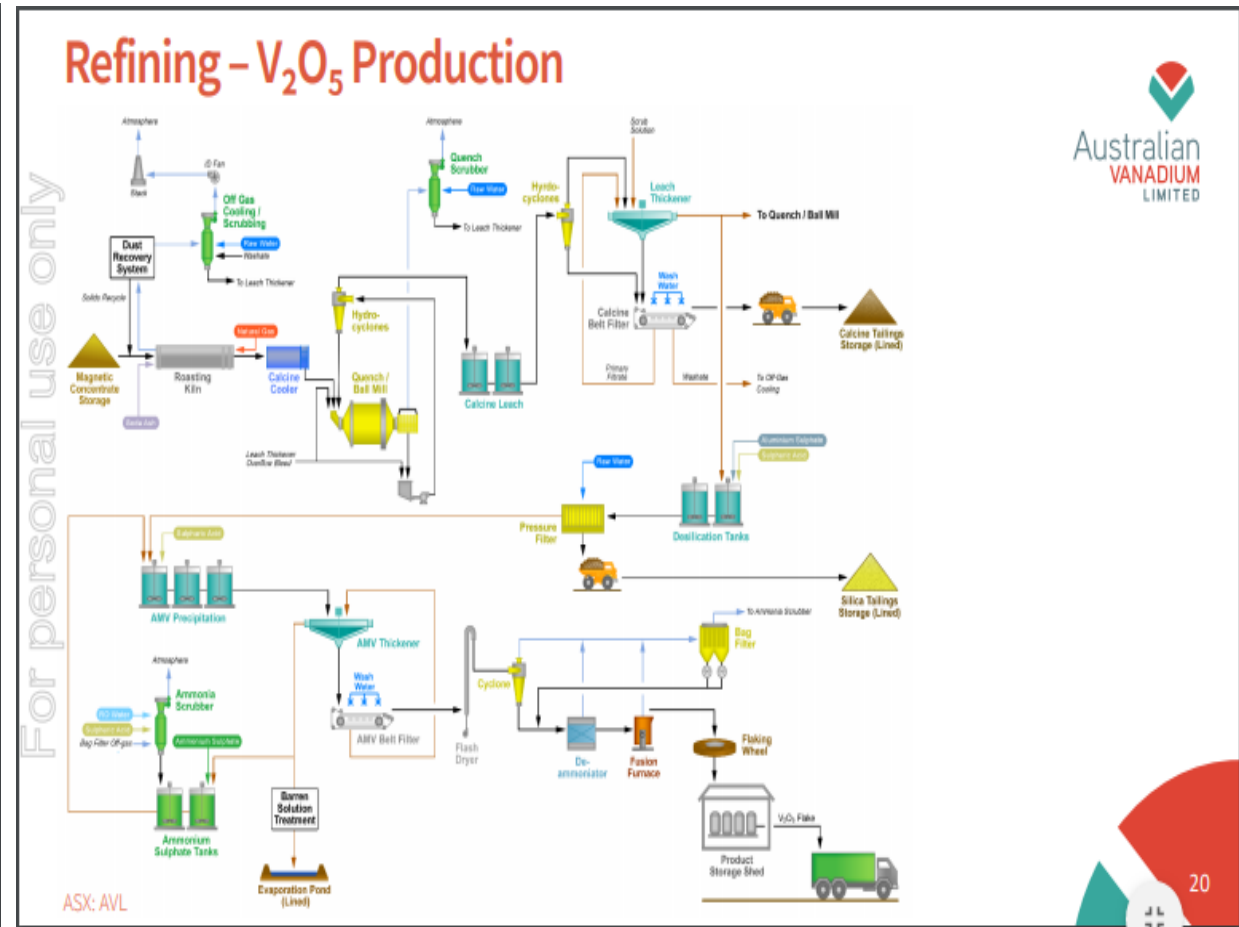


COMPLEX BENEFICIATION AND REFINING

- Concentrate Plant

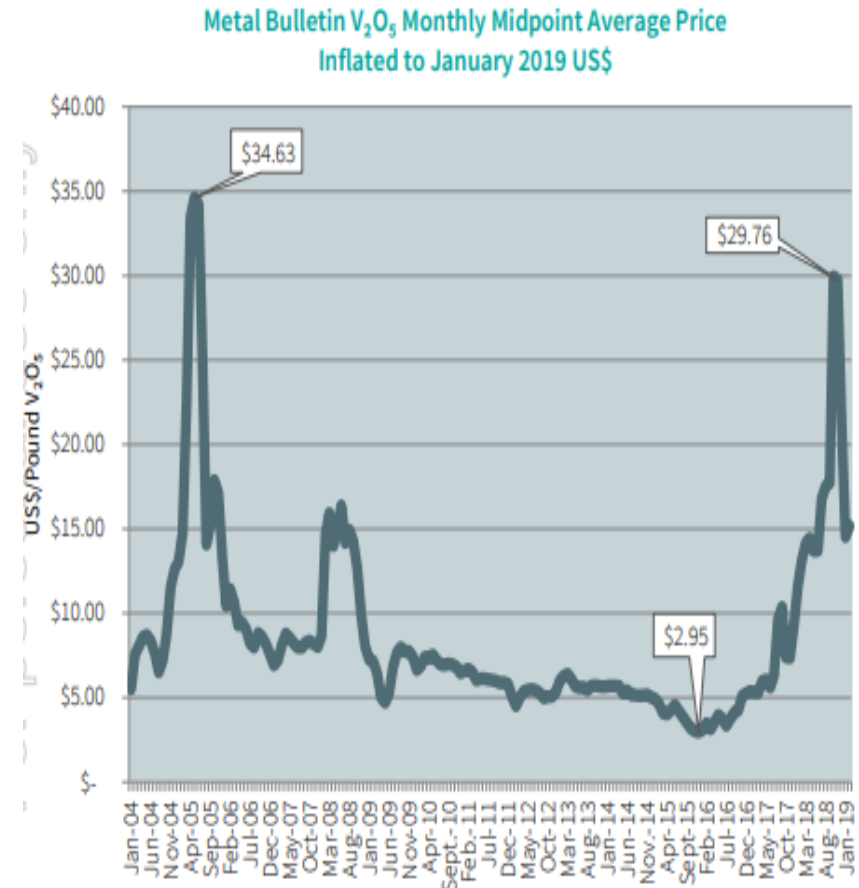


- Refinery



Supply Disruptions set the stage for the vanadium price rise

- Mapochs mine in RSA went into liquidation
- That removed 11,000 t from the market of high purity V₂O₅
- China banned vanadium bearing slag
- Chinese steel mill rationalization
- New Chinese rebar standards in late 2018
- Now prevents the use of grade 2 rebar 40 million tonnes
- Some niobium substitution occurred



Source: Metals Bulletin publication

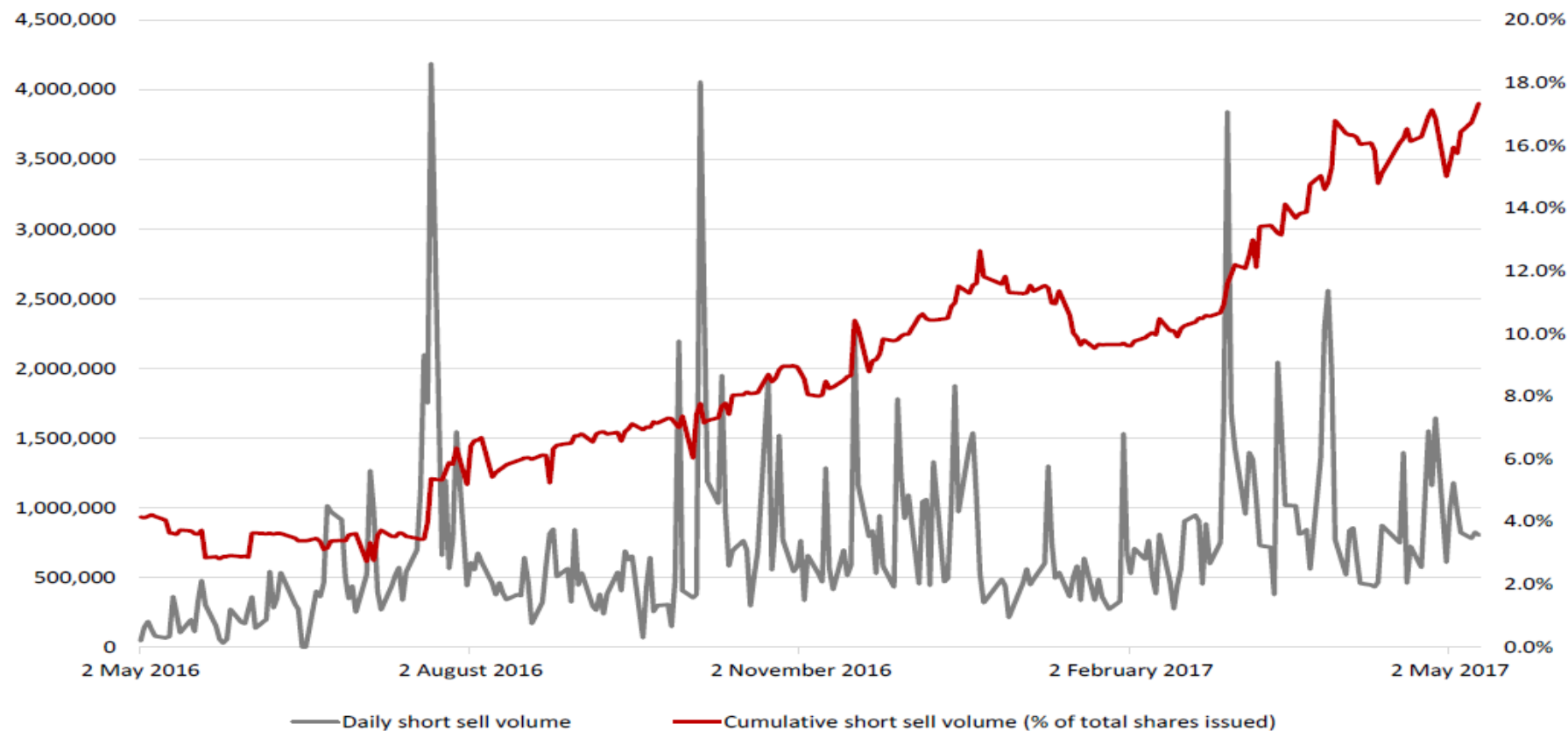
SYRAH - THE GORILLA IN THE ROOM

- Syrah has the largest natural graphite mine in the world
- Graphite market in a phase of disruption as Syrah ramps up
- Syrah has failed to meet production targets, meet deliveries schedules, poor shipping schedules, stocks stacked on docks and also mine staff have a high incidence of malaria
- Syrah has cash of US\$57 million and net loss outgoings of US\$20 million Q1/19
- Syrah needs to stop the cash drain to survive

Syrah Graphite Prices

- Received graphite price of US\$600/t
- Company predictions of over \$1000/t
- Graphite mix 70% fines, 30% coarse flake
- Battery anodes are generally graphite
- Spherical graphite plant moving ahead in the USA

Short sell volume over the last 12 months



Source: Bloomberg

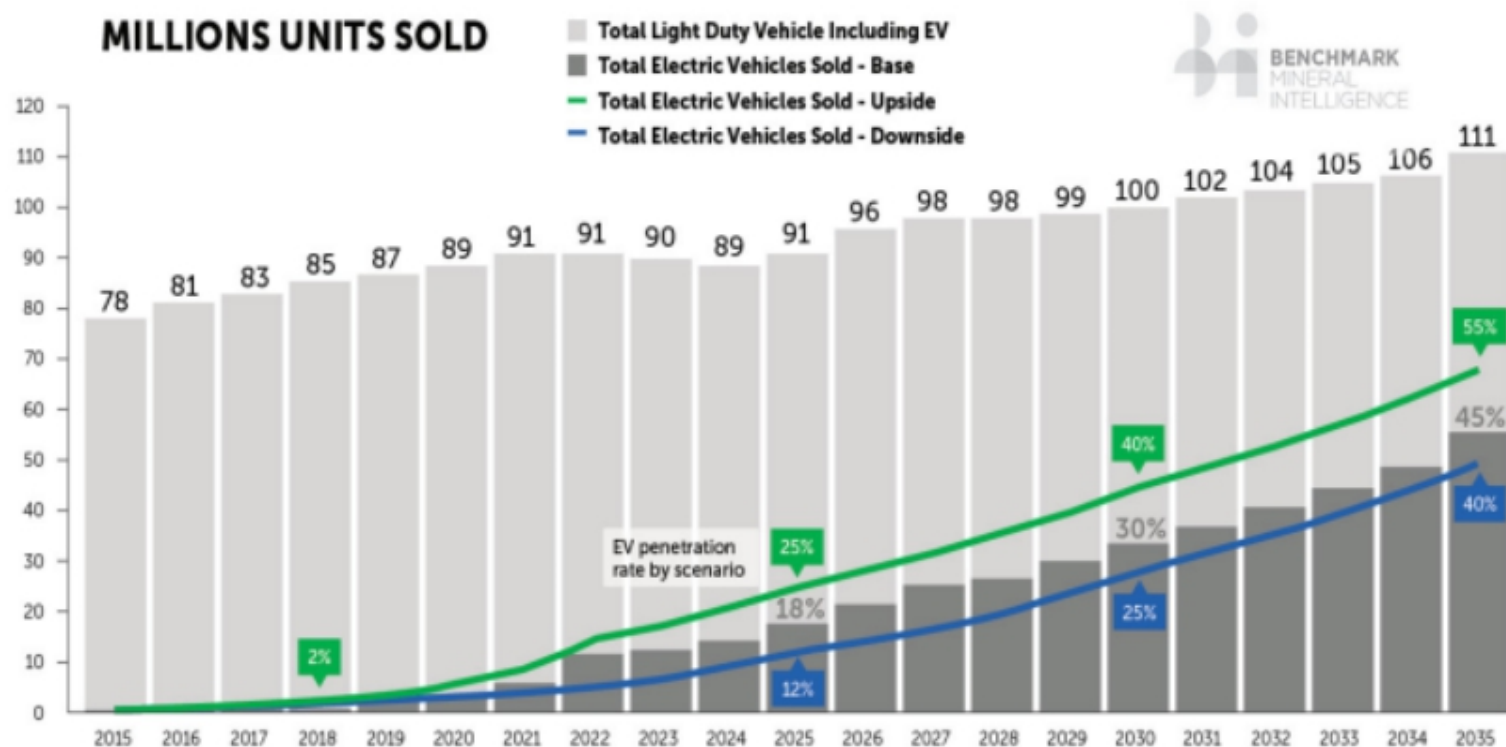


SYRAH RESOURCES

INCREASING GRAPHITE DEMAND DRIVEN BY EV SALES

EV penetration rates increasing from 2% in 2018 to 25% by 2025 Roskill, UBS

Global expansion of electric vehicle markets forecast to drive a 700% increase in annual natural graphite demand by 2025, Roskill, UBS



Source: Benchmark Mineral Intelligence

WHO ARE THE WINNERS?

The impact of this growth in demand for metals has implications across the value chain



Generation and grid infrastructure (kt)

	2020	2025	2030
Cu	40	170	536



Grid storage (kt)

	2020	2025	2030
Cu	24	86	180
Ni	20	71	150
Co	7	26	55



Charging infrastructure (kt)

	2020	2025	2030
Cu	23	115	392



Non-ICE vehicles (kt)

	2020	2025	2030
Cu	304	1,068	2,972
Ni	66	299	985
Co	17	80	259

Leading to additional metal demand by 2030

Copper
4.1 Mtpa

18% of 2017 global supply

Nickel
c.1.1 Mtpa

55% of 2017 global supply

Cobalt
314ktpa

332% of 2017 global supply