

# ARE COBALT PRICES SUSTAINABLE?

## A MARKET ANALYSIS AND OUTLOOK

PRESENTED TO CREDIT SUISSE, 06 SEPTEMBER 2017



**Core  
Consultants**

Lara Smith | [lara@coreconsultants.org](mailto:lara@coreconsultants.org) | [www.coreconsultantsgroup.com](http://www.coreconsultantsgroup.com)

# Core Team



## Lara Smith

**Managing Director, Core Consultants**

Lara is an internationally recognized expert in the field of mining analysis and a well-known speaker at international conferences. In 2009 she funded Core Consultants, the first focused commodity consultancy in South Africa.



## John Parker

**Process Engineer**

John has over 30 years experience as a chemical and process engineer. During 2010/11 John provided process input to the Tenke Fungurume cobalt plant options study for Freeport McMoran and is currently working on ERG's Kolwezi's copper/cobalt retreatment plant and KCC.

## David Creamer

**Chief Executive Officer, Core Africa**

David's strengths lie in understanding the different regulatory environments, the key stakeholders and the cross border flow of funds between regulatory jurisdictions in Africa.



## Sofi Napier

**Geologist/Geotechnical Associate**

Sofi has over 20 years experience in the mining industry, specializing in providing technical and geological expertise from early stage exploration planning to evaluation and feasibility. She has worked in over 15 African counties including a recent project tin the DRC.



# Core Services

---



## Core Africa

A business risk consultancy focused on the African opportunity. Assists clients to define their strategy and structure in Africa



## Core Connect

An expert network. facilitates private conversations with industry experts to provide unbiased market insights,



## Core Consultants

A bespoke consultancy service, providing independent proprietary advice. Services include feasibility & prefeasibility studies, market evaluations, sourcing offtakes



## Core Insight

Industry studies focused on current market conditions and the potential outlook for these markets. These studies are available on subscription

# Presentation Outline



Description of Cobalt Supply Chain and Issues



Who is Adding Capacity



Potential for Substitution and Recycling



How Does the Outlook for Capacity Compare to Demand?

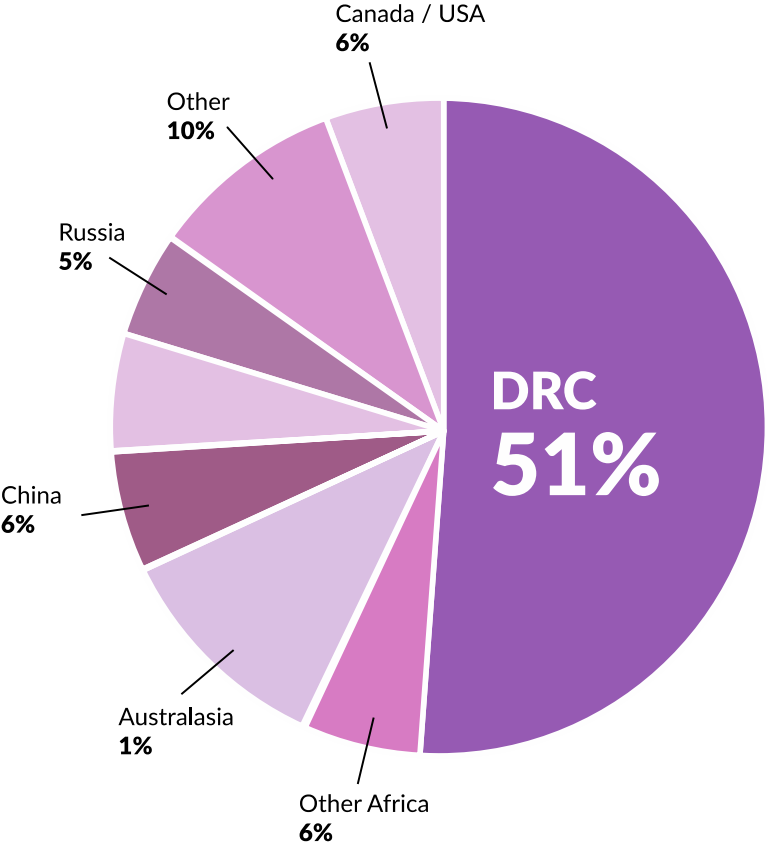


Conclusions

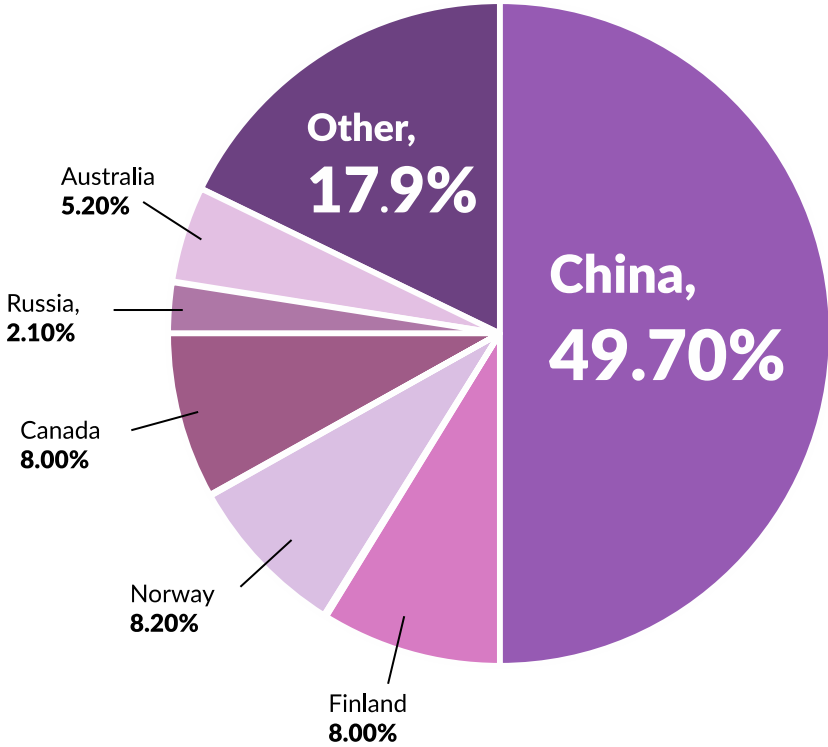


# Description of Cobalt Supply Chain and Issues

## Cobalt Mine Production

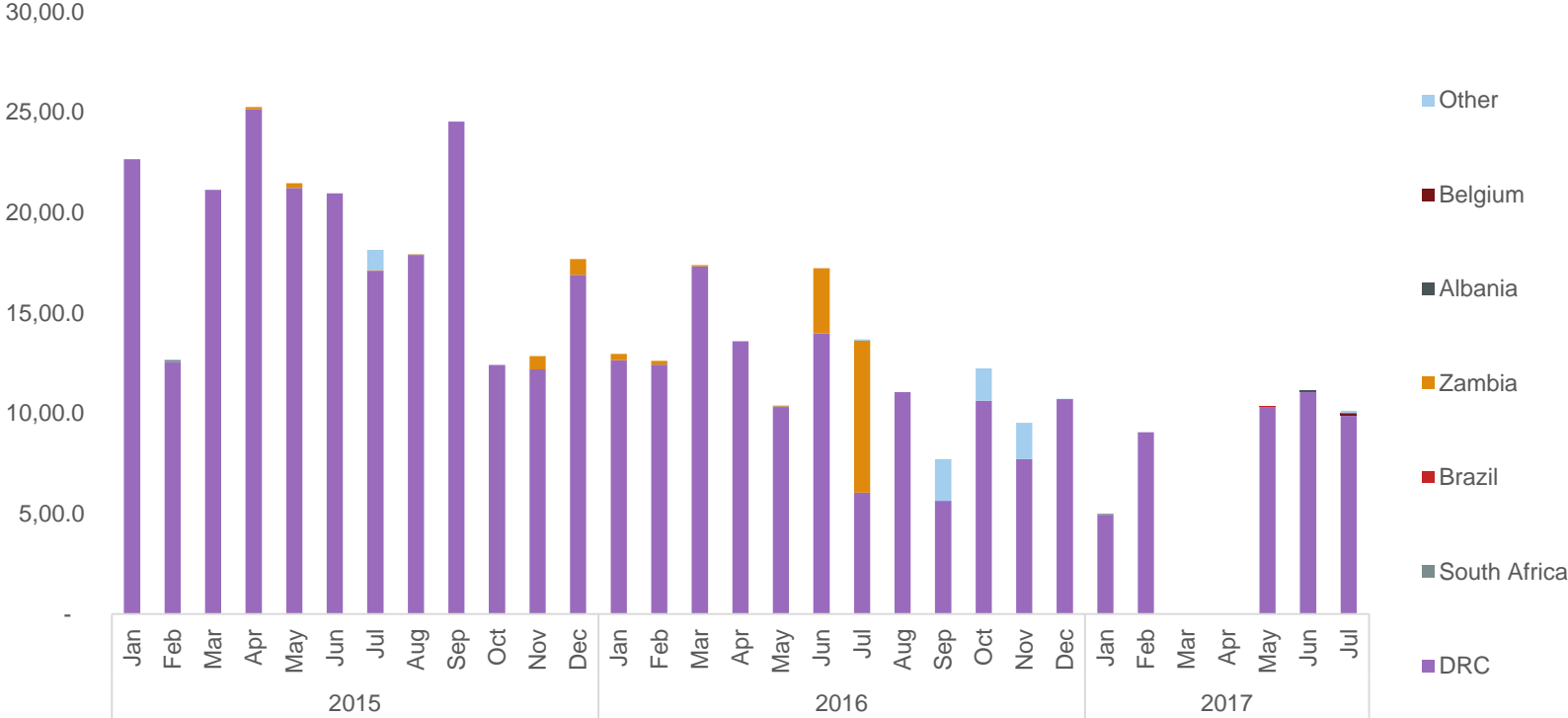


## Recipients of Cobalt



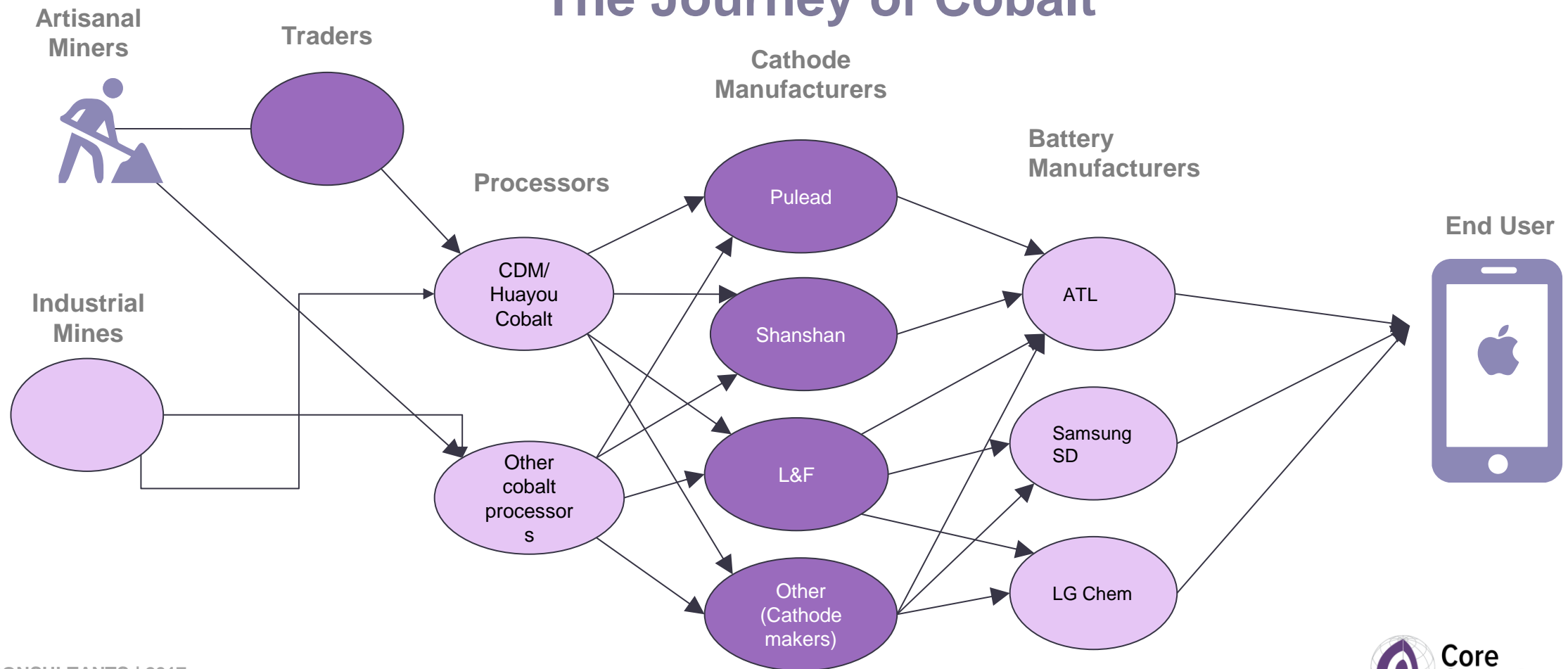
# Description of Cobalt Supply Chain and Issues

China Imports of Cobalt Concentrates by Country  
 (Note: Since the start of the year, only the DRC has supplied China)



# Description of Cobalt Supply Chain and Issues

## The Journey of Cobalt



# New legislation, consumer pressure forcing a change

---

## Efforts to improve supply chain transparency

- Volunteer Committee
- OECD
- NGOs

## Arguably, 2 publications became the game changer

- Amnesty International
- Washington Post

## Responsible Cobalt Initiative

- Tech giants have joined the initiative
- Pledges OECD guidelines



# Pledged to Join Responsible Cobalt Initiative

---

01

Tech giants join Responsible Cobalt Initiative

02

Pledge is to follow OECD guidelines for mining supply chains

03

It calls on companies to TRACE how cobalt is being extracted, transported, sold

04

The Initiative is led by Chinese business group, Chinese Chamber of Commerce for Metals and Chemical Importers and Exporters.

05

To date the traceability is one of the biggest stumbling blocks to overcoming the supply chain issues

06

Any solution requires industry buy-in and needs to be technology-based

# Responsible Cobalt Initiative - Positive Sign of Change

---



“

*The problem cannot be fixed  
by one company.*

**Bryce Lee**, Huayou Manager for responsible sourcing.

# Description of Supply Chain and Issues

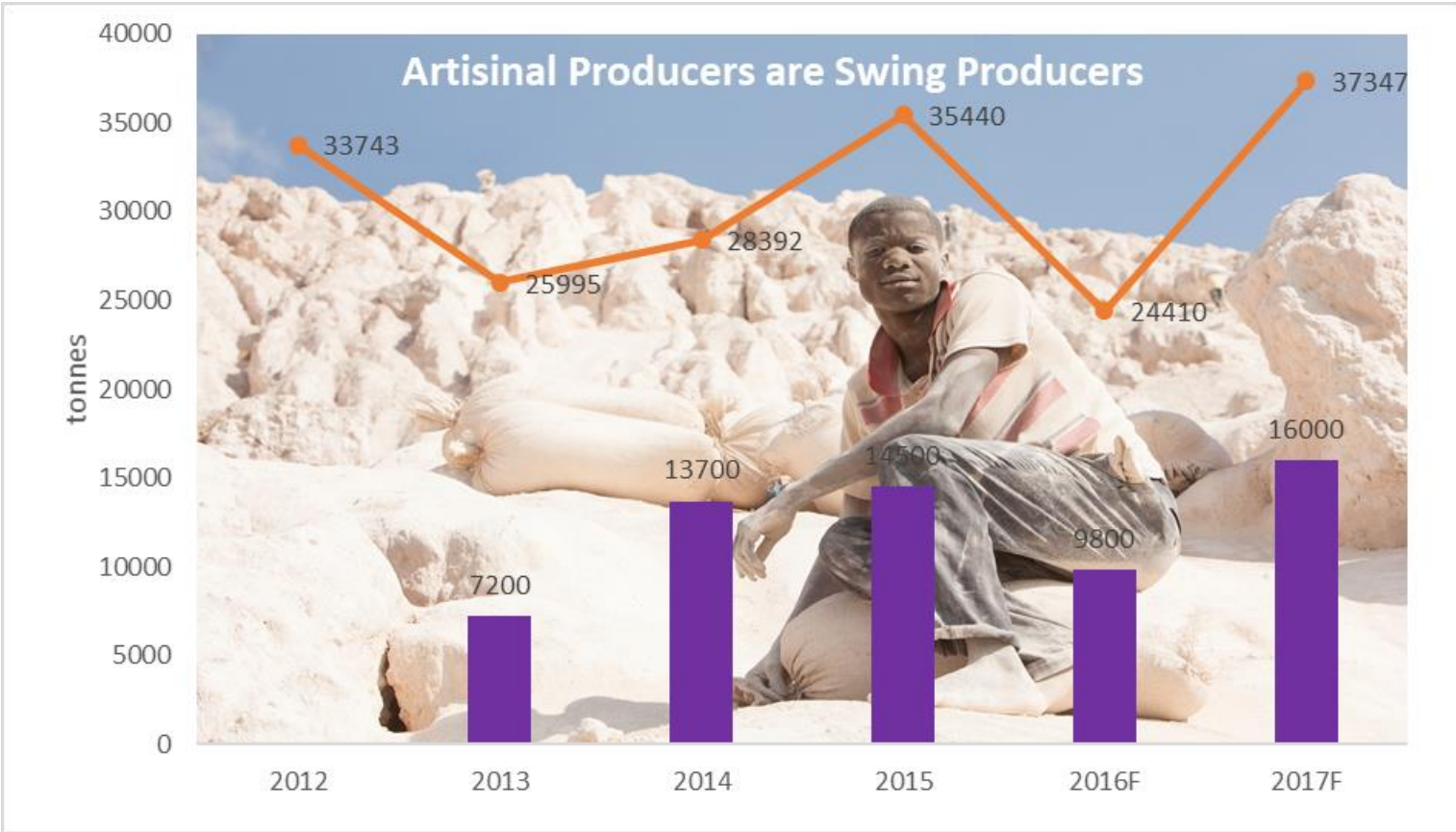


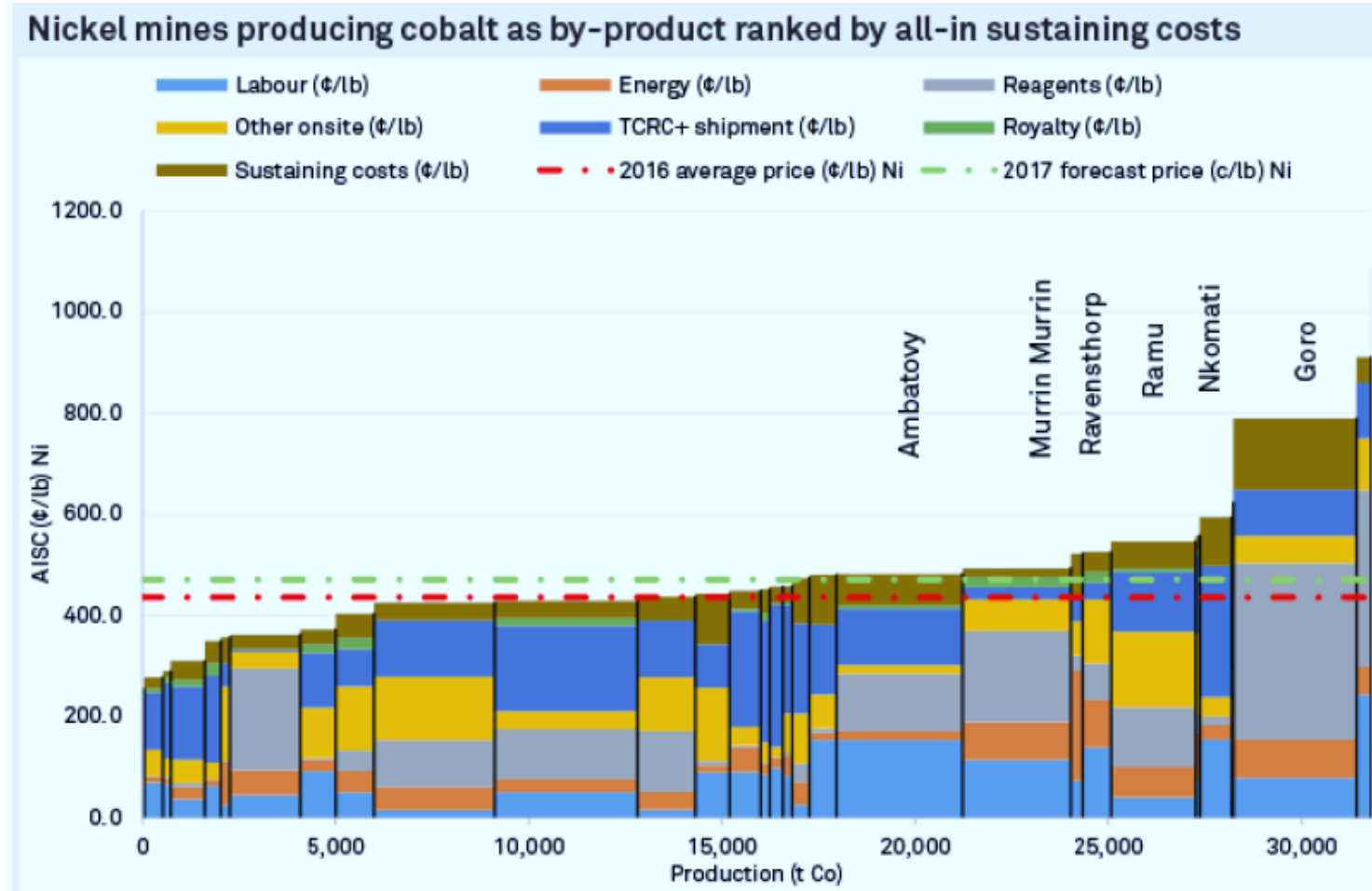
Image: Hugh Brown

# Who is Adding Capacity?

## Global Mined Cobalt Sources

Mine/Operator	Mine/Operation	Country	Type	2015	2016	Comments
Glencore	Katanga Mining	DRC	Cu	2 900	-	Ceased in 2015, but depending on mine plan will produce between 20,000-30,000tpa by 2H18, rendering it the biggest producer
	Sudbury/Raglan	Canada	Ni	800	1 000	
China Molybdenum	Tenke Fungurume	DRC	Cu	15 200	16 053	Expected to be maintained at current capacity
ERG	Boss Mining	DRC	Cu	3 500	6 210	Plans to increase production to 20,000 tpa by Dec 2018
Zhejiang Huayou Cobalt	CDM	DRC	Cu	7 000	7 000	June '15 signed a \$52m agreement with Gecamines to purchase copper/cobalt mine permit from CMSK (~62,903MT of contained cobalt). Company imported 7,000tpa of chinese concentrate and a further 4,40tpa of intermediary cobalt from the DRC
Metallurgical Corp of China (MCC)	Ramu NiCo	Papua New Guinea	Ni	2 400	2 191	Company's nameplate capacity is 3000tpa Investing in flotation concentrator and roaster which may assist it reaching an additional 3000tpa.
Shalina Resoures/Chemaf	Etoile/Usoko	DRC	Cu	2 300	1 821	
Vedanta Resources	Konkola Copper Mines	Zambia	Cu	1 600	3 888	Plans to increase by around 3000 tpa by next year
Gecamines	CMSK	DRC	Cu	1 400	800	Unclear as to whether the ores sold to CDM will be replaced by alternative feed sources
First Quantum	Ravensthorpe	Australia	Ni	1 300	1 500	Back at 2014 operating levels
<b>Total Mined Cobalt (net units)</b>	<b>Ni: 34%</b>	<b>Cu: 64%</b>		<b>116 020</b>	<b>116 858</b>	
<i>Before Adjusting for mining/semi refining yield loss</i>				<b>127 622</b>	<b>128 544</b>	
<b>Total from DRC</b>				<b>76 600</b>	<b>78 375</b>	

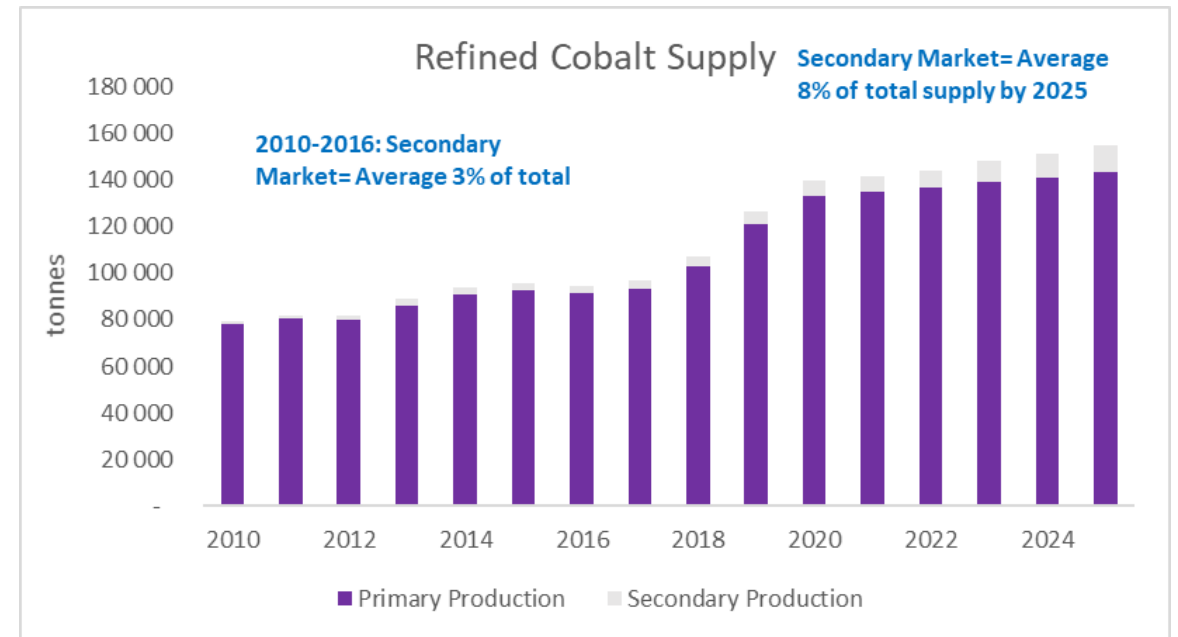
# Who is Adding Capacity?



# Potential for Recycling

Secondary supply not expected to grow until medium term when battery and catalyst recycling improves- aiming for 2025

- Lack of collection schemes to support Li-battery recycling efforts
- Transport and storage of Li-ion is subject to safety precautions
- Processing of Li-ion batteries is challenging as there is no uniformity with regards to battery shape, size composition. i.e. the variety of chemical processes make it challenging to develop a standardised recycling process.
- Electric vehicles are expected to retain 70-80% of their original storage capacity after end of life (~10 years) as such, these batteries may be sent to developing markets for a second life. In these markets the recycling efforts may not occur.
- If recycling comes through and accounts for 8% of total supply, then we are saved from a persistent deficit, but this is an unknown.



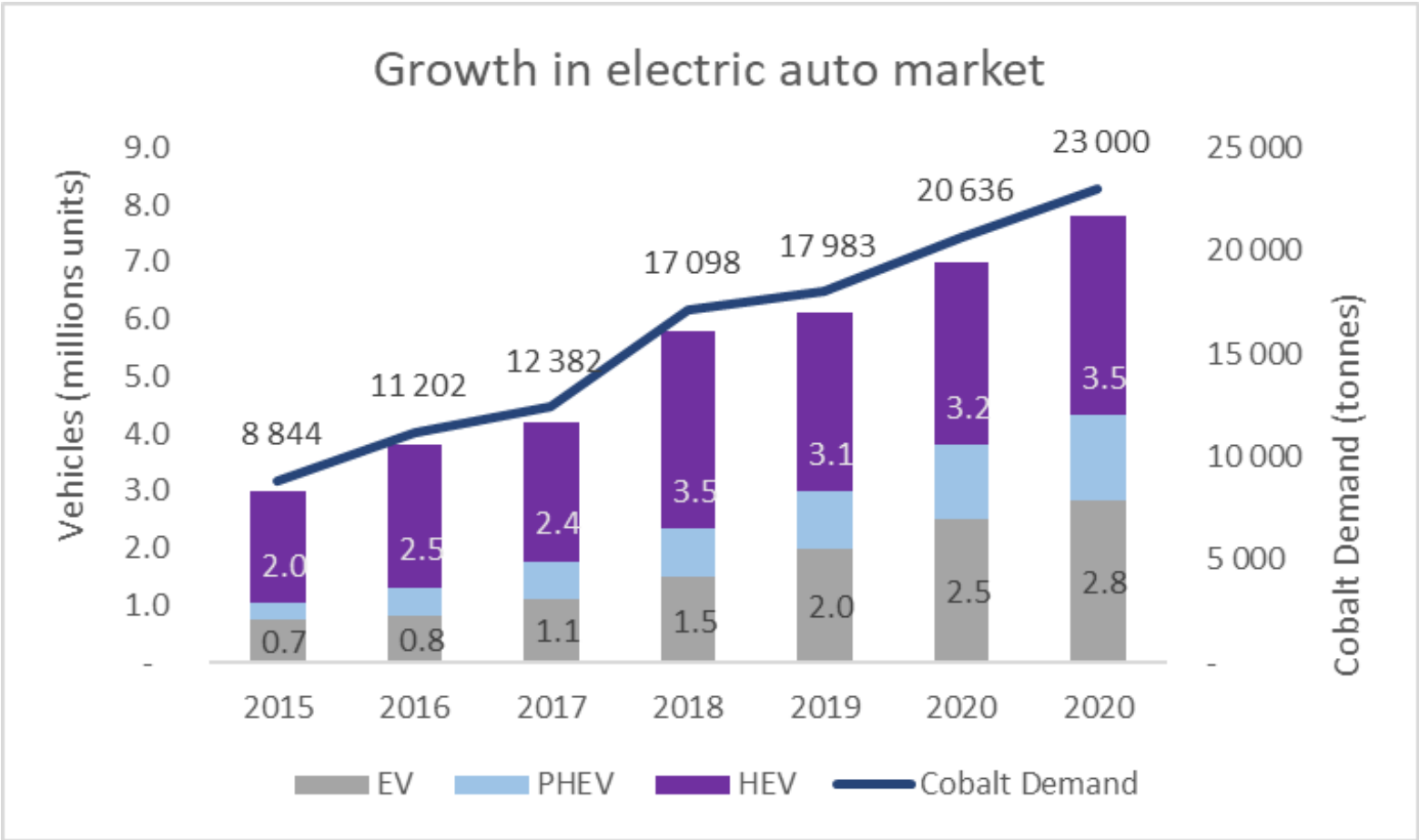
# How Does the Outlook for Capacity Compare to Demand?

## xEV Battery Technology by Manufacturer

Country	Manufacturer	Cathode Chemistry	Supplier to:	Country	Manufacturer	Cathode Chemistry	Supplier to:
Japan	Panasonic	NCA	Tesla, VW, Audi	China	ATL	LFP/NCM	BMW BYD, Daimler Chinese EV/PHEV Manufacturers:  BYD, Changan,  Chery, Dongfeng, Geely
	AESC	NCA/LMO	Nissan, Renault		BYD	LFP	
	PEVE	NCM	Toyota		Tianjin Kishen	LFP/NCM	
	Li Energy Japan	NCM	Mitsubishi, Daimler		Shenzhen Bak	NCM	
	Hitachi	NCM	Nissan, GM		Waltmar	LFP	
	Toshiba	LMO	Mitsubishi		Jiewei Power	NCM	
	Blue Energy	NCM	Honda		ZHLD	LFP	
Enax	NCM	Honda	Wanxiang	LFP			
Korea	LG Chem	LMO/NCM/NCA	Nissan, Renault, GM, Ford	Weihong Power	NCM		
	Samsung SDI	LMO/NCM/NCA	VW, Audi, Daimler, Volvo	Foster	NCM		
	SK Innovation	NCM	Hyundai, Tesla				
Europe/ US	Evonik	NCM	Ford, VW, Audi, BMW				
	A123	LFP	Daimler, Kia				
	Johnson Controls	NCM	Daimler, BMW				

**Cobalt Demand in Li-ion batteries said to grow from 42,360 tonnes in 2015 to 70,000 tonnes in 2020 CAGR:11% in five years**

# How Does the Outlook for Capacity Compare to Demand?





# How Does the Outlook for Capacity Compare to Demand?



### MOBILE PHONES: 16.2g CO

LCO battery (~Co: 1.35g/Wh)  
Can be substituted with NCM battery which can combine with a non-cobalt material such as Manganese



### CARBIDE STEEL CUTTING BLADE: 45g CO

Cobalt concentration is 9 wt%  
Substitution risk is nominal



### LAPTOPS: 22-77g CO

NMC/LCO battery (Co: 0.4g/Wh or 1.4g/Wh)  
As with Mobile Phones can be used with NCM or NCA batteries



### AIRPLANE/ JET ENGINES: 0.8t CO

Cobalt concentration: 10-15 wt%  
Minimal substitution risk.  
Note: Commercial and Military Aerospace accounts for 65% of total superalloy demand



### TABLETS: 30g CO

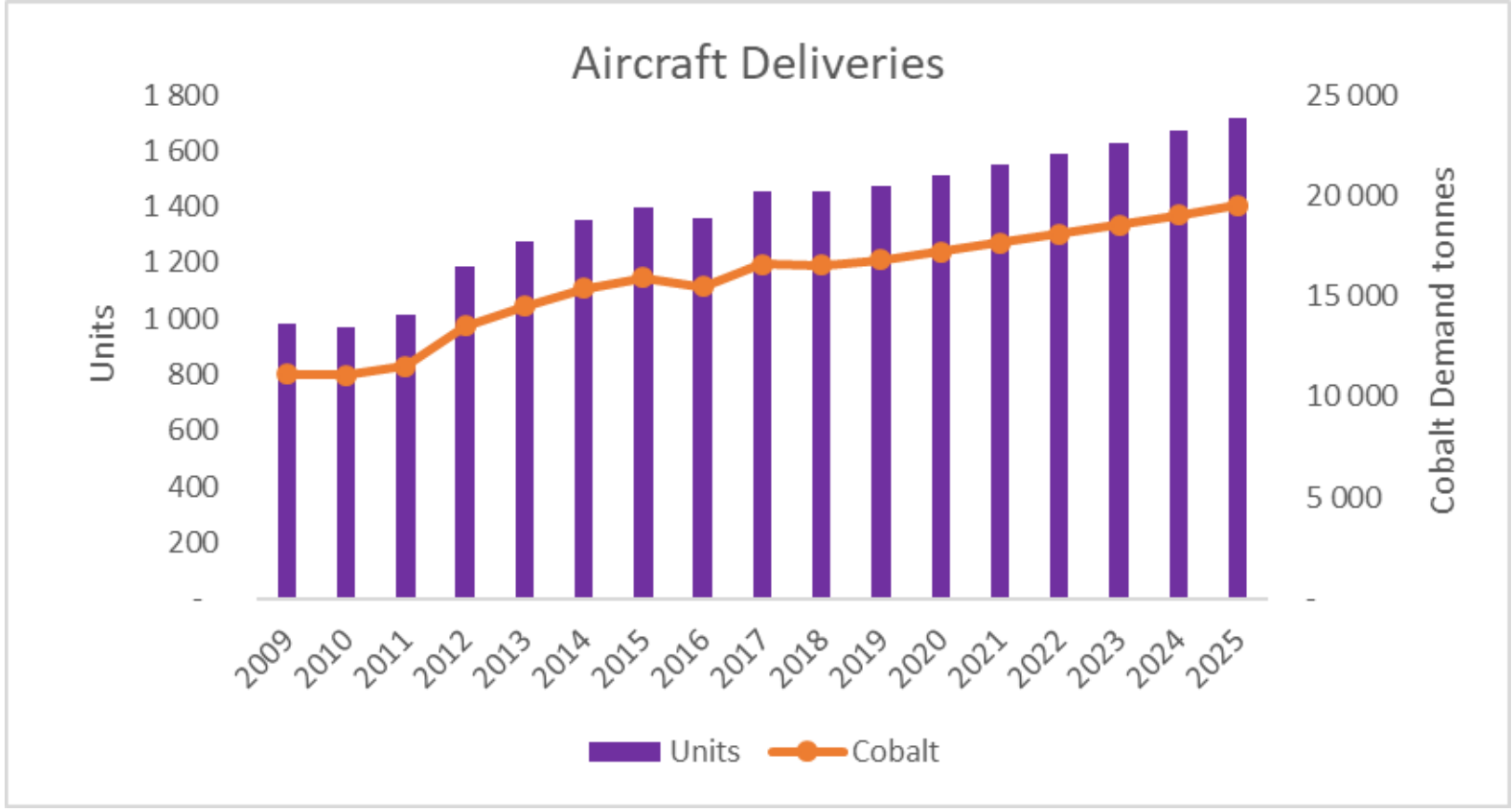
LCO battery (Co: 1.3g/Wh or 1.4g/Wh)  
As with Mobile Phones can be used with NCM or NCA batteries



### SUPERCritical COAL TURBINES: 100t CO

750 tonnes of superalloy in a rotor, shaft, inner castings, disks, blades etc  
Cobalt concentration: 10-15 wt%  
Substitution risk is nominal

# How Does the Outlook for Capacity Compare to Demand?



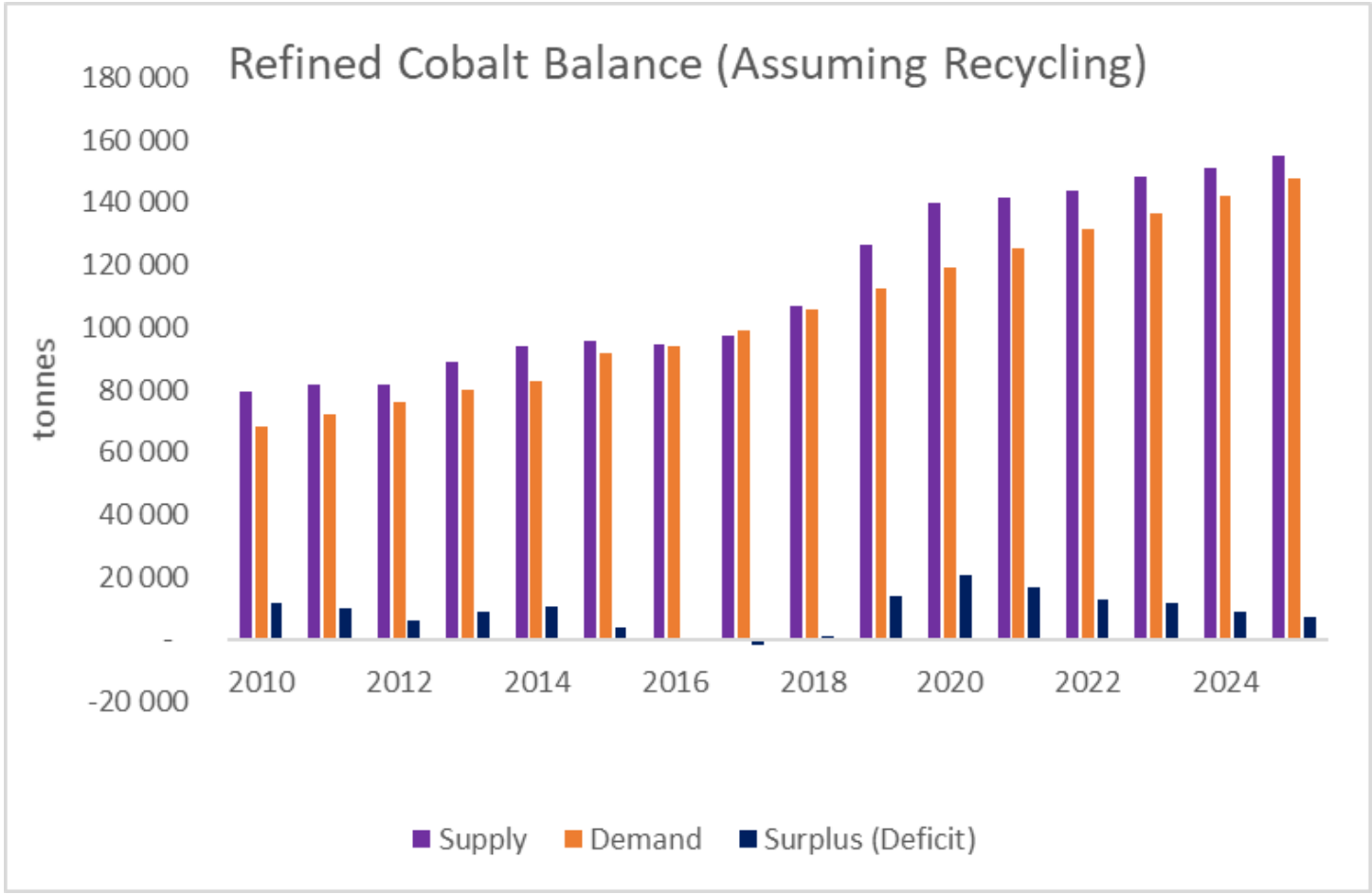
# How Does the Outlook for Capacity Compare to Demand?

---

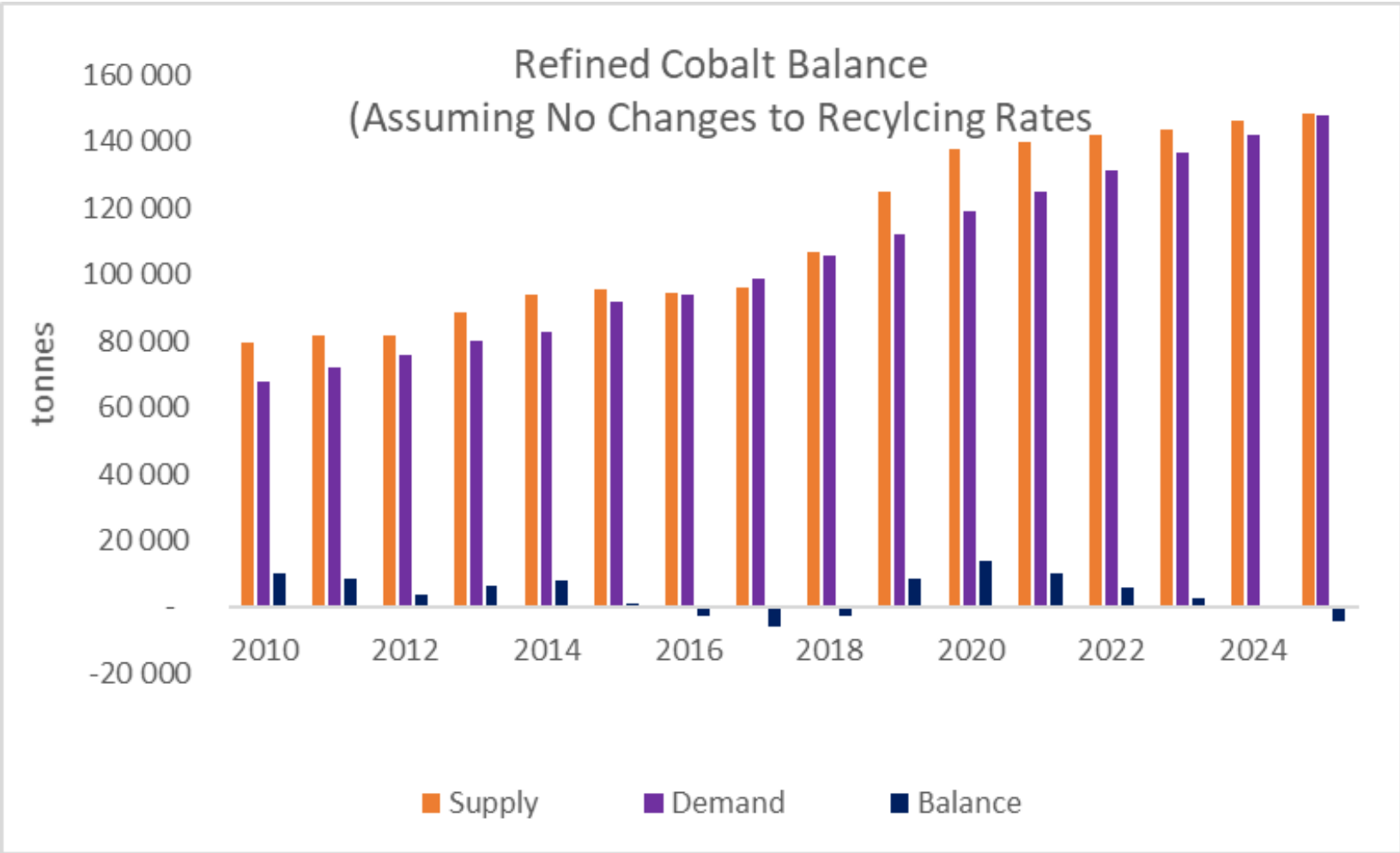
## Other Sectors

- ✓ 2015 Hard Metals/ Cutting down 3% y.o.y to 7,500 tonnes  
Fortunes of this sector dependent on mining/ oil/gas/drilling,  
so it is due to pick up now
- ✓ Catalysts, weaker due to weak oil market over the last  
few years. Cobalt used in hydroprocessing or  
desulfurisation of catalysts in Fischer Tropsh Process,  
also in the textile industry to produce polyester fibres (  
Some expansion there in China),
- ✓ Colouring agent in the pigment industry ~4,800 tpa **(here can  
have some substitution)**

# How Does the Outlook for Capacity Compare to Demand?

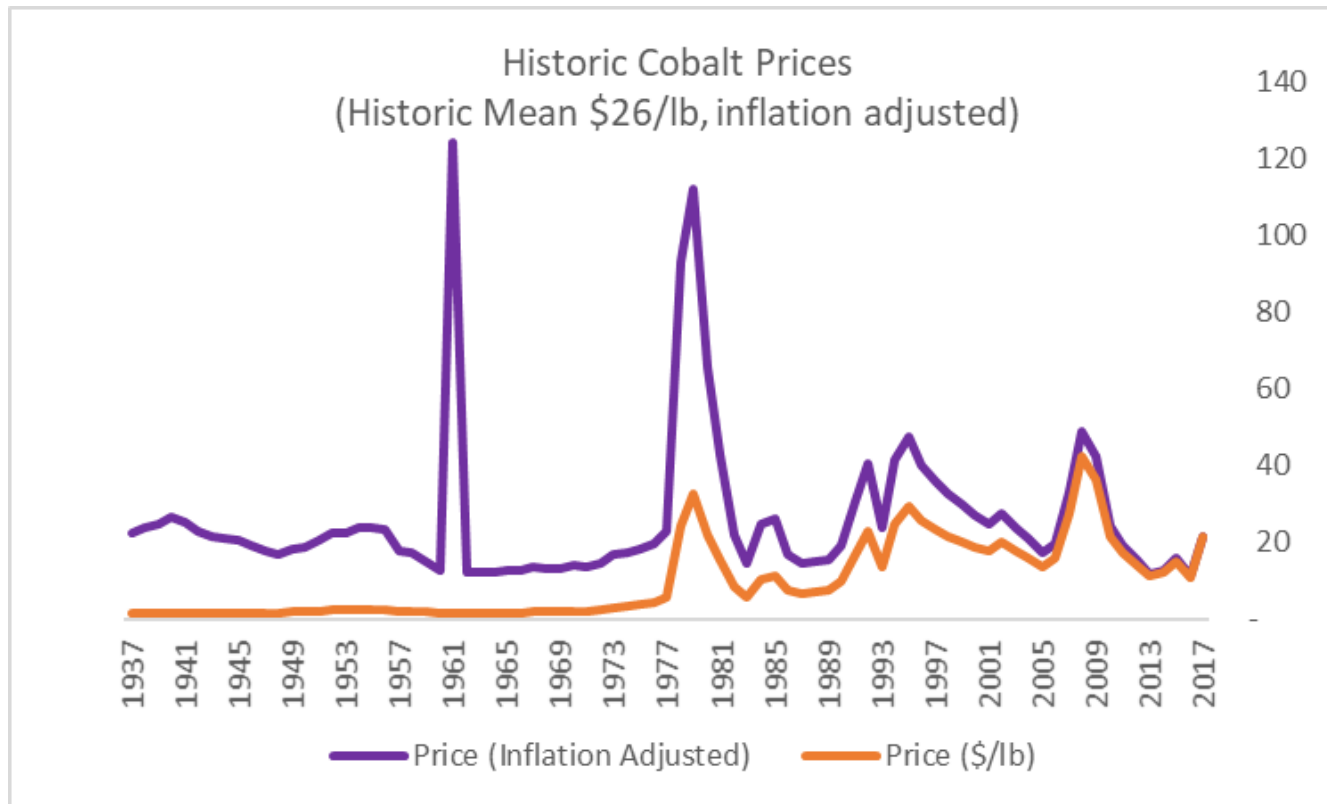


# How Does the Outlook for Capacity Compare to Demand?





## Conclusion



**Mean Reversion? Historic price of cobalt, adjusting for inflation is \$26/lb, unadjusted price is \$10/lb**

# Conclusion

---

## Obvious Risks to Supply:

- ✓ Highly dependent on DRC for production and China for refinement
- ✓ Potential for recycling, but we may not get the rates we want
- ✓ Volatility from the nickel producers

## Demand Side is Uncertain

- ✓ Limited ability to substitute
- ✓ EV penetration could happen even quicker under new Chinese legislations



# Core Consultants

[www.coreconsultantsgroup.com](http://www.coreconsultantsgroup.com)

[info@coreconsultants.org](mailto:info@coreconsultants.org)

+27 11 485 265

+27 79 504 6770

+972584852656

# Conclusion

---

However.....

- ✓ Cobalt not yet at its historic mean
- ✓ Industry could follow similar trajectory to nickel industry when before stainless steel sector rolled out electric arc furnaces → ultimately economics wins out
- ✓ However, in the case of EV's, even if cobalt price doubles from this level, can still pass price to consumer, especially if uptake becomes mandatory.



# Core Consultants

[www.coreconsultantsgroup.com](http://www.coreconsultantsgroup.com)

[info@coreconsultants.org](mailto:info@coreconsultants.org)

+27 11 485 265

+27 79 504 6770

+972584852656



# Information and Data We Track

African Insights	Ores	Ferroalloys	Steel/Stainless Steel
Political and Regulation Trends	Bauxite, Chrome, Iron, Nickel, Titanium, Zinc	Ferromanganese, Ferrosilicon, Ferrochrome, Ferronickel, Silicomanganese	Production By Country
Cross Border Flows	Global prices, Iron Ore: Baltic Index	Bidding and Tender Prices	Indian Capacity
Forex Liquidity	Chinese Trade Statistics	Chinese Trade Statistics, Import Prices and Domestic Prices	Stainless Steel Stocks In China
General Regional Outlooks	Vessels at Chinese Ports	Relevant Trade Data of Other Countries including Japan, EU, US	Tender Prices
Understanding Trapped Cash and How to Avoid it	Latest News and Trends	Latest News and Trends	Steel News in Asia with Respect to Regulations and Capacity
Highlighting Potential Risks	Chinese Production Statistics and Operating rates	Indian Domestic and Export Prices	Global Economic Indicators
Advising on What to Look for when Developing Key Partnerships	Risks to the Sector and Sector Outlook	Risks to the Sector and Sector Outlook	European Surcharges and Base Prices

# Information and Data We Track

Minor Metals	Rare Earths	Global Mega Trends
Antimony, Cobalt, Lithium, Tantalum, Tungsten, Vanadium	Heavy Rare Earths, Light Rare Earths, Rare Earth Oxides, Rare Earth Metals	Tracking General Trends that Influence Commodity Markets, Including:
Commodity Prices	Chinese domestic and FOB prices	PMI, GDP outlook, oil prices
Development and Changes to Regulations	Company News	Military spend, Infrastructure Spend
Battery Outlook, Smartphones, Electric Vehicle Market, Alternative Energy Solutions	Wind Power Capacity, EV Market Developments and the Impact on Rare Earths	Smartphone, Electric Vehicles, Wind/Solar Power Development
Company News and Developments	Sentiment Outside China	Urbanisation of Populous Nations, Population Growth Rates
Chinese Exports of High Tech Devices	Latest Chinese Regulations	Environmental Trends, Alternative Energies
Chinese Exports of Minor Metals	Magnet Exports; Chinese Exports of Rare Earth Products	Pertinent Regulations Including Subsidy Programmes, and Incentive Schemes

# Speak to Us About a Subscription Plan Tailored to Your Requirements



+27 (0) 79 504 6700  
+972 (0) 58 485 2656



[connect@coreconsultants.org](mailto:connect@coreconsultants.org)



**Core  
Consultants**