BUSHVELD MINERALS

VANADIUM 101

3 May 2018

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Introductory Points

- All attendees are on mute mode
- Questions can be submitted via the Questions box in your task bar on the left hand side of your screen
- Slides and recording will be available on the website in the next few days

Bushveld Minerals' Presenters

Experienced leadership team

Fortune Mojapelo
Chief Executive Officer

- Co-founder and Chief Executive Officer (CEO) of Bushveld Minerals
- Co-founder and director of VM Investment (Pty) Ltd, a principal investments and advisory company focusing on developing mining projects in Africa
- Founding CEO of Bushveld Minerals Limited where he has played a lead role developing and executing the company's vanadium strategy
- Played a leading role in the origination, establishment and project development of several junior mining companies in Africa including Greenhills Resources, Bushveld Resources
- Fortune's corporate career started at McKinsey & Company as a strategy consultant

Mikhail Nikomarov
Chief Executive Officer
Bushveld Energy

- Co-founder and Chief Executive Officer of Bushveld Energy, an energy storage solutions company, part of AIM-listed Bushveld Minerals, an integrated vanadium company
- Chairman of the South Africa Energy Storage Association (SAESA)
- Chair of the Energy Storage Committee of Vanitec, the global non-profit organisation of vanadium producers
- Previously worked for McKinsey & Company in Russia and across Africa, focusing on the power sector (strategy and plant operations) and economic development. Mikhail's corporate career started as a commercial banker in the USA

Webinar Agenda

Here are some of the questions we are hoping to answer in this session

- What is vanadium and what are the characteristics and resulting applications of vanadium?
- What are the key drivers of demand for vanadium and what is the outlook for these going forward?
- What impact can be expected for vanadium demand from Chinese regulations in the construction industry?
- How real is the energy storage opportunity for vanadium and how big is it?
- How big and how real is the surplus/latent capacity of vanadium slag producing steel plants?
- How sustainable are the current levels of vanadium prices going forward?
- How real are the substitution risks for vanadium in the current vanadium price environment?

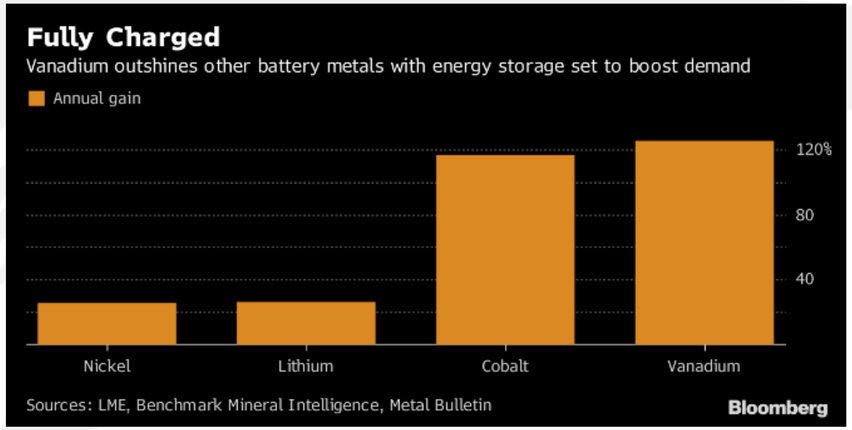
What is Vanadium?

“The best performing battery metal of 2017 was not cobalt, but VANADIUM”

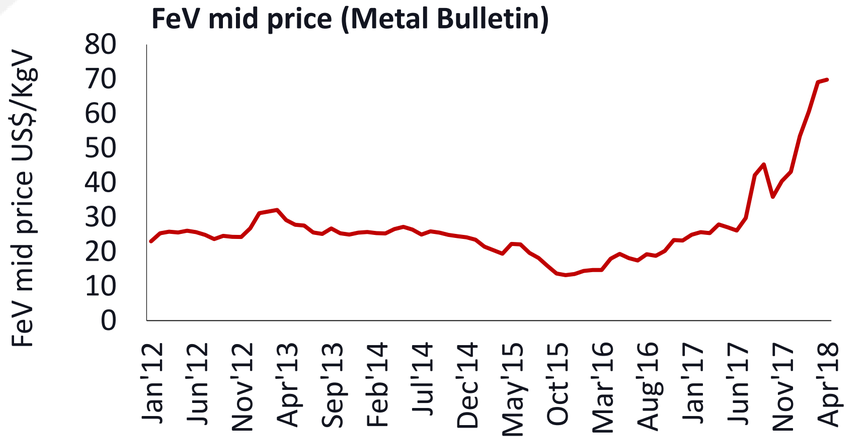
Bloomberg January 2018

“Vanadium has soared more than 130% in the past, outperforming better-known battery components like cobalt, lithium and nickel. Analysts are expecting a shift in uses of vanadium. The metal can be used in industrial-scale batteries, which help to even out daily peaks and troughs from renewables…”

Bloomberg, January 2018



- Vanadium’s price performance is even more stellar than that
- Vanadium price grew 72% in 2016, and has continued in 2018 up ~55% year to date
- Vanadium price has grown five-fold since November 2015

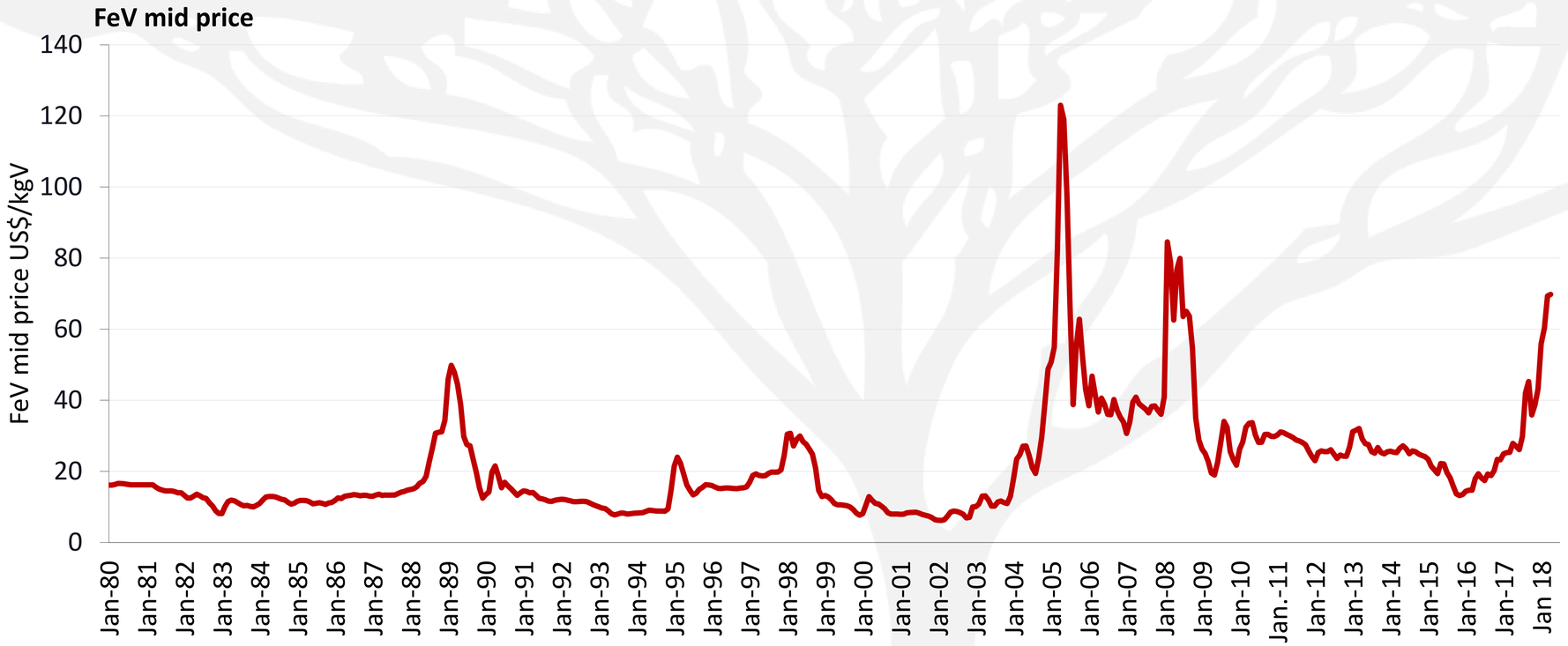


Hype or Fundamentals driven?

Source: Bloomberg, Metal Bulletin. 18 April 2018

We Have Been Here Before

What is different this time?



- Is the current price run any different from previous ones?

OR

- Is there a structural change to the market?

Source: Bloomberg. 18 April 2018, Metal Bulletin, TTP Squared

Vanadium Characteristics and Uses

Vanadium is a grey, soft, ductile high value metal with several unique characteristics that position it well in the steel, alloys and chemicals sectors

- Vanadium (V) is a rare chemical element, in pure form is a grey, soft, ductile element that does not occur in native form but as a component of minerals and as an impurity amongst hydrocarbons and bauxites
- It readily forms several stable oxidation states (II, III, IV, and V)

Characteristics

- High strength-to-weight ratio
- Corrosion resistance
- Weldability
- Fabricability

- Ability to exist in 4 different oxidation states
- Water-soluble
- Resistant to attack by alkalis, hydrochloric acid, sulphuric acid, and salt water

Steel

Construction steel - rebar

Alloys for aerospace industry

The steel industry accounts for **>90%** of total vanadium consumption

Chemicals

Long duration utility scale batteries

Vanadium electrolyte accounted for **~2%** of global vanadium consumption in 2017, projected to grow to **>20% by 2030** as VRFB deployments gain momentum

Source: Bushveld Minerals analysis, TTP Squared

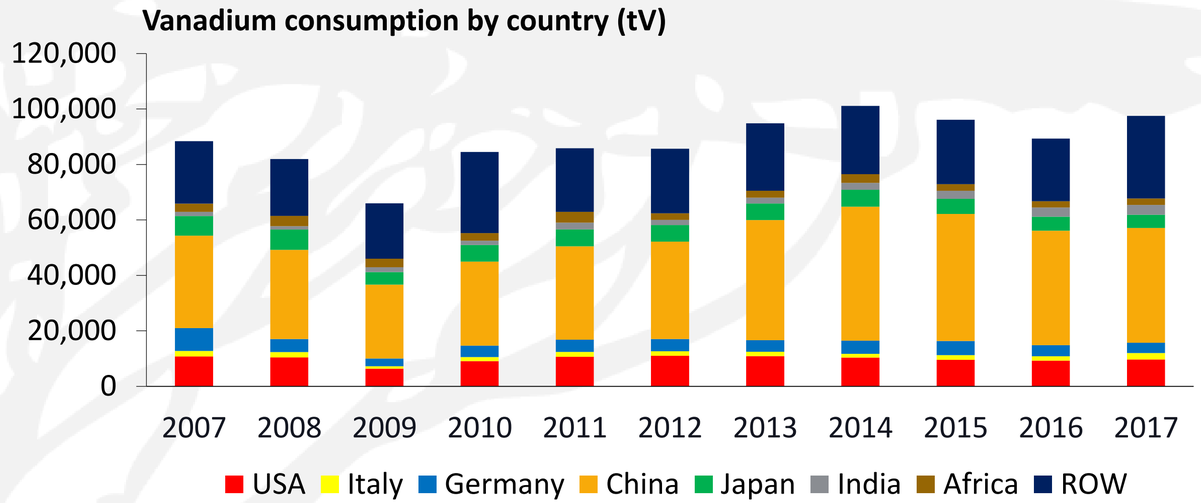
Vanadium Market Fundamentals

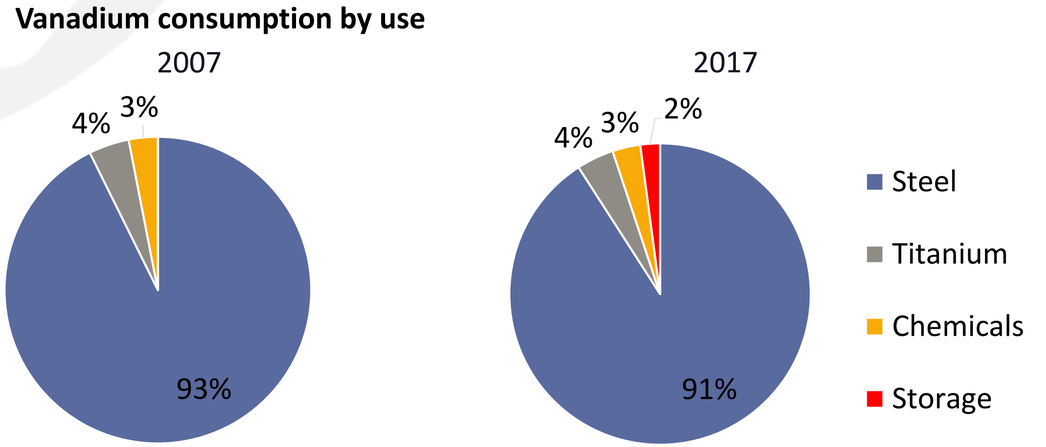
Understanding Vanadium Demand

Vanadium Consumption History

China has been the largest vanadium consumer, with consumption anchored to steel

- Vanadium consumption grew at a CAGR of 0.90% between 2007 and 2017
- China is the largest vanadium consumer with a market share of 42% in 2017
- China's market share is anticipated to rise due to a revision of the tensile strength of steel rebar products, used in the construction industry, announced in 2018
- Vanadium demand growth has been driven by steel production growth, and increased intensity of use of vanadium in steel
  - ➢ Steel production growth of 0.72% CAGR from 2007 to 2017





Source: Bushveld Minerals analysis, Roskill

Two Key Demand Drivers for Vanadium Demand

Vanadium consumption will be anchored to steel production and the growing adoption of VRFB

Steel

Energy storage

Demand Outlook

The Anchor - Steel

The steel sector will continue to anchor and drive vanadium demand growth

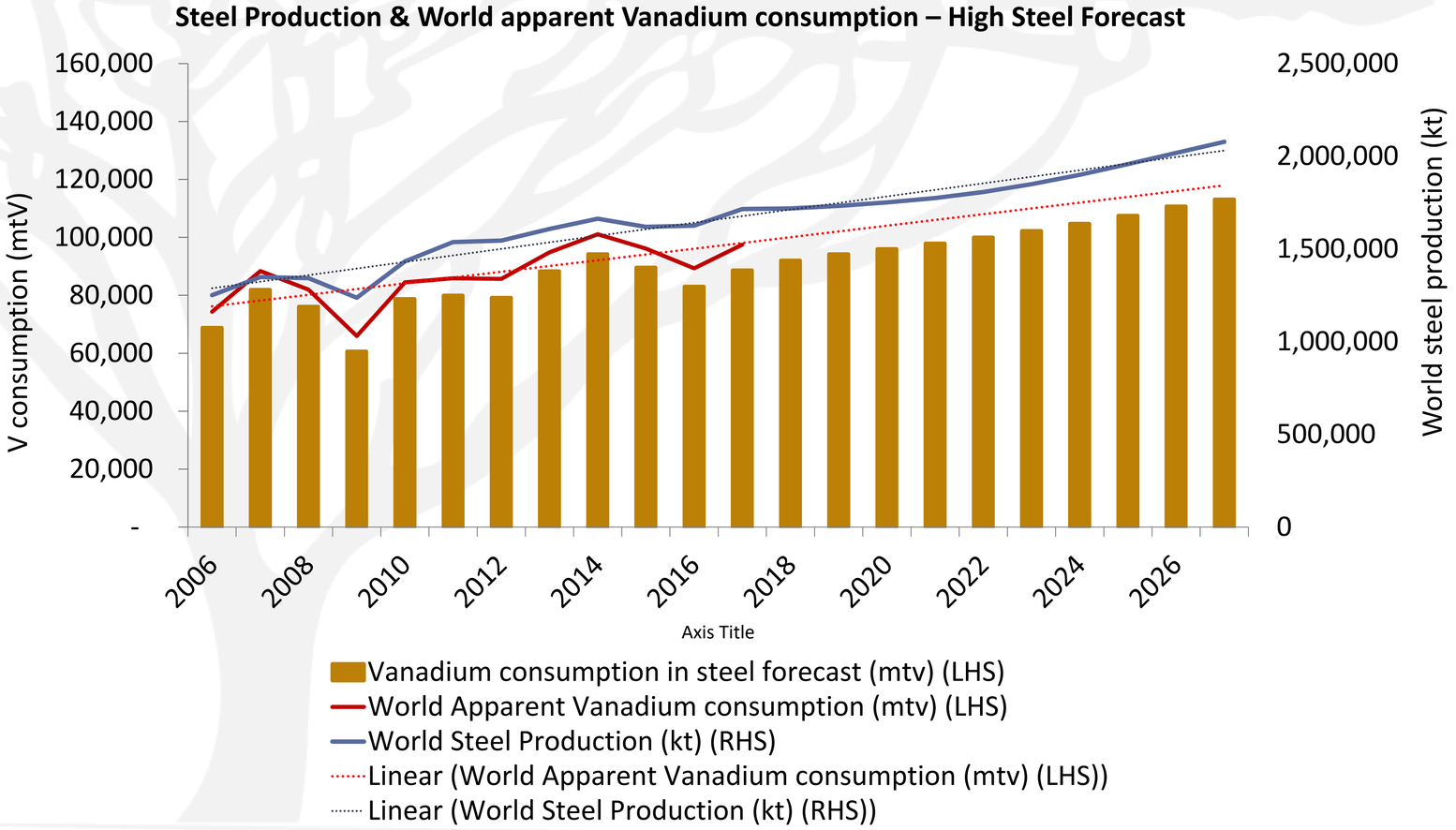
- **A** Growing global steel production which has strong positive correlation with vanadium consumption
- **B** Intensity of use of vanadium in steel in China and other developing countries is below the world's average
- **C** Greater enforcement in China of existing and new rebar standards driving greater vanadium intensity of use in steel

Demand Outlook

Steel Sector: Demand Drivers Are Robust

A Strong positive correlation between steel production and vanadium consumption

- Vanadium consumption and steel production are strongly correlated
- Vanadium demand is expected to grow as:
  - Steel production grows; and
  - Compliance with new Chinese rebar standards increases
- Demand will continue to be underwritten by the steel sector
- Regulatory prescriptions make it possible to estimate with relative certainty demand outlook for vanadium in steel sector

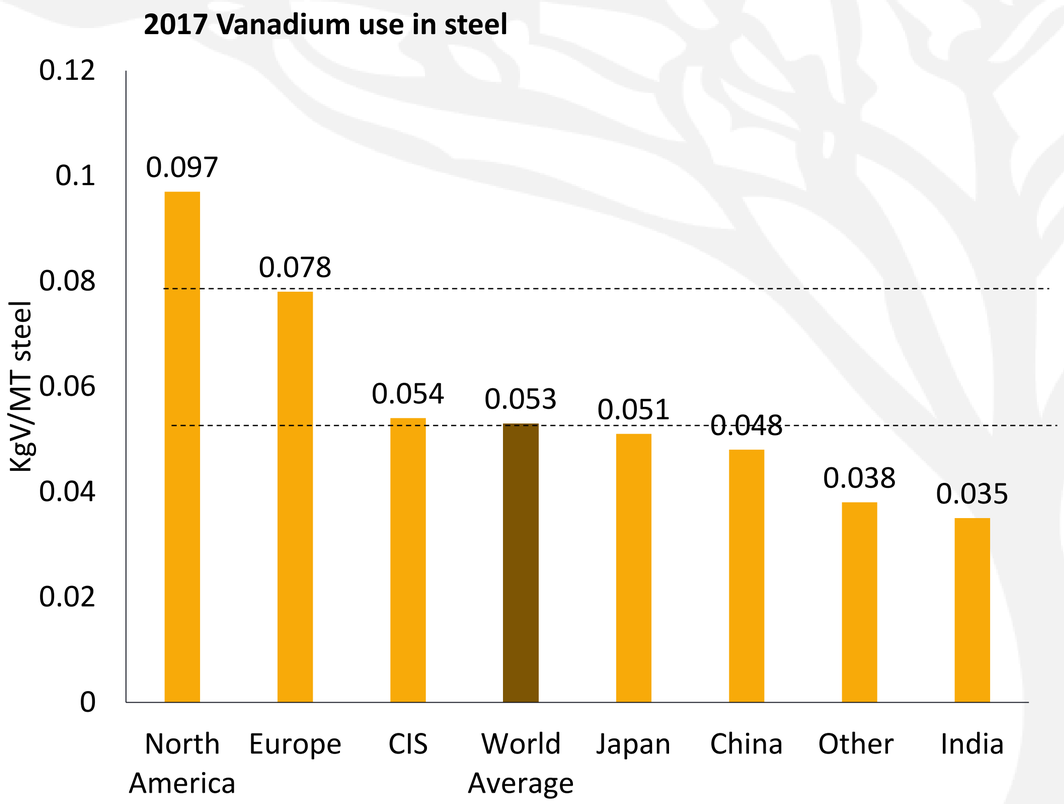


Source: Bushveld Minerals analysis, Roskill, World Steel Association

Demand Outlook

Steel Sector: Demand Drivers Are Robust

B **Intensity of use of vanadium in steel in China and other developing countries is below the world's average**



- Strong correlation between economic development and vanadium intensity of use in steel
  - The steel sector accounts for ~90% of the vanadium consumption
- Industrialised economies, such as the USA, typically use more vanadium per tonne of steel than emerging economies such as India and China.
- Greater enforcement of rebar standards will drive up specific vanadium consumption rates in China, bringing it closer to the levels of developed economies
- Implications of closing the gap between emerging economies and the developed world:
  - Steel production in China in 2017 = 797,483,000 t
  - Improving Chinese specific vanadium consumption from 0,048 to 0,078=> 0,03kgV/t additional vanadium demand = 23,924mtV
  - From 0,048 to 0,053 =>3,987 mtV

Source: Bushveld Minerals analysis, TTP Squared

Demand Outlook

Steel Sector Demand Drivers Are Robust

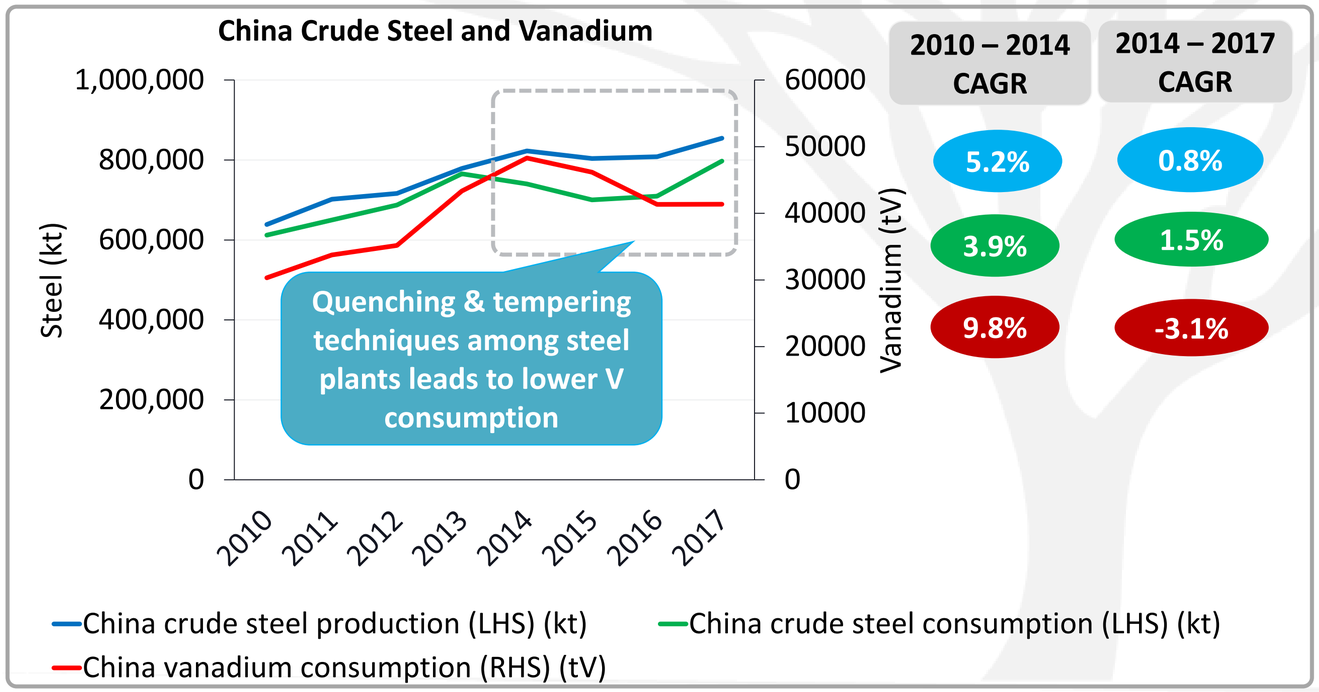
C **Greater enforcement in China of existing and new rebar standards driving greater vanadium intensity of use in steel**

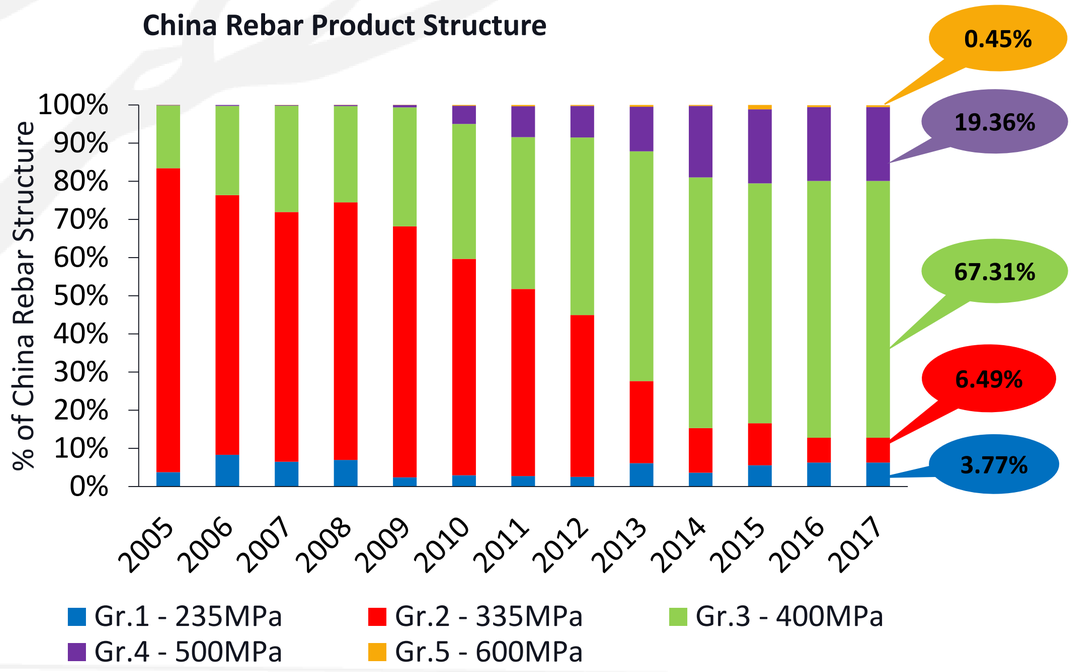
2010 Code for Design of Concrete Structures (GB50010-2010) issued in August 2010 and took effect from 1 July 2011

2011 Update of Code for Construction Quality Acceptance of Concrete Structures (GB 50204 – 2002) – issued in December 2010 and took effect from 1 August 2011

2015-2017 Quenching and tempering techniques used by rebar producers to minimise use of alloying elements, thus blunting impact of codes on vanadium demand

2018 China's new high-strength rebar standard introduced in January 2018, **effective November 2018**





Source: Bushveld Minerals analysis, TTP Squared

Demand Outlook

Steel Sector Demand Drivers Are Robust

C **Greater enforcement in China of existing and new rebar standards driving greater vanadium intensity of use in steel**

New rebar standard estimated to lift Chinese vanadium demand by ~30% over the next 10 years

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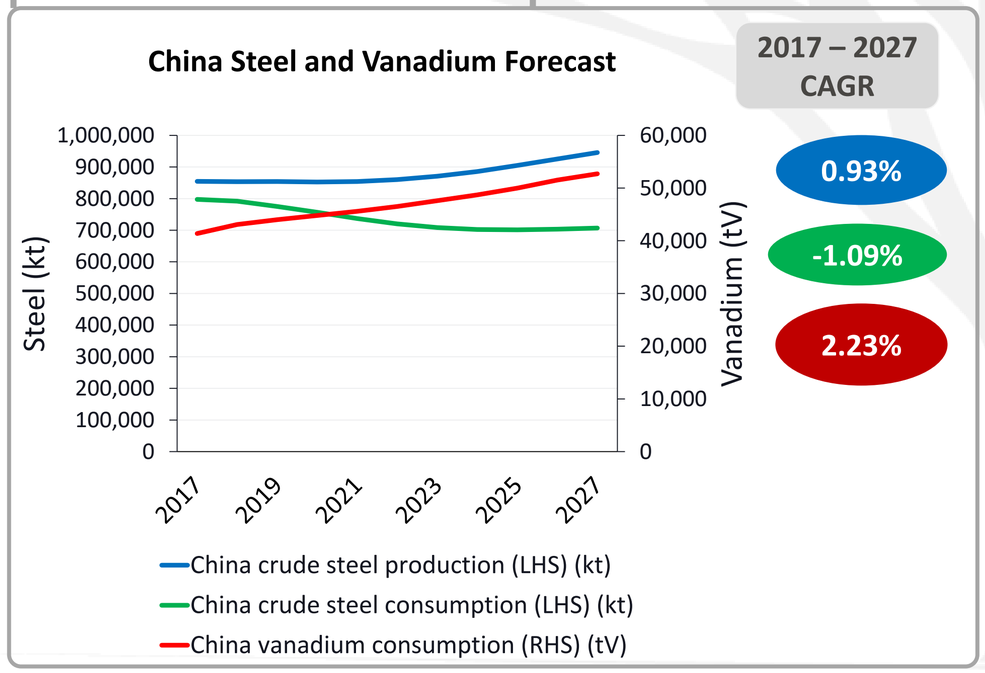
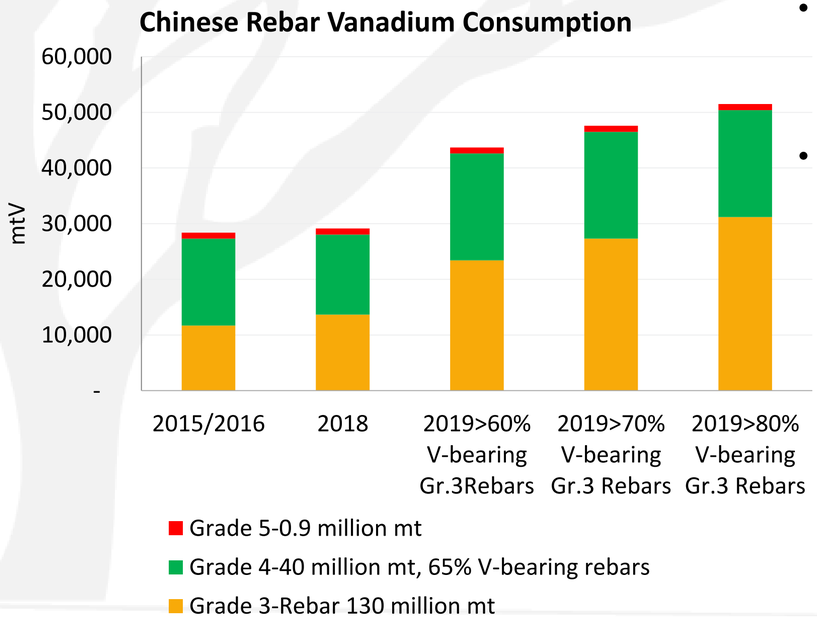




- China's new standard is designed to limit and eliminate the use of inferior steels in construction (Grade 2 rebar)
- It sets out specifications for three different high strength standards: Grade 3 (400MPa), Grade 4 (500MPa), and Grade 5 (600MPa). These will require 0.03% V, 0.06% V, and more than 0.1% V respectively

➢ **It could lead to an increase in Chinese vanadium demand of over 30% or 10,000 tpa in 2018**

Source: Bushveld Minerals analysis, TTP Squared

Two Key Demand Drivers for Vanadium Demand

Vanadium consumption will be anchored to steel production and the growing adoption of VRFB

Steel

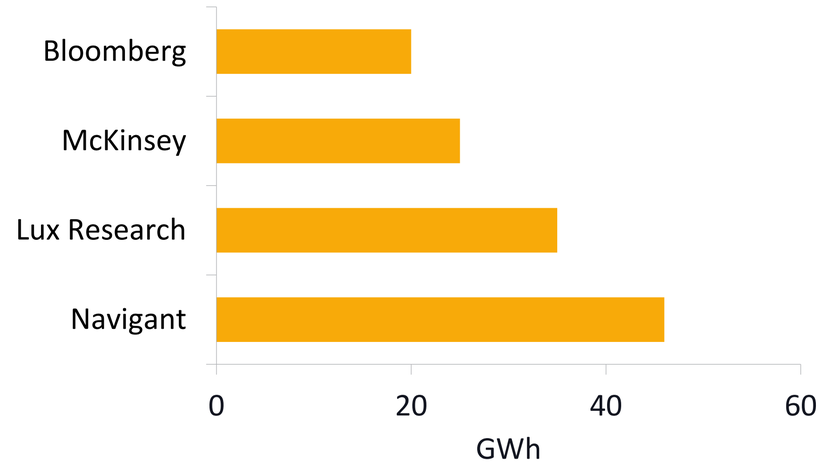
Energy storage

Demand Outlook

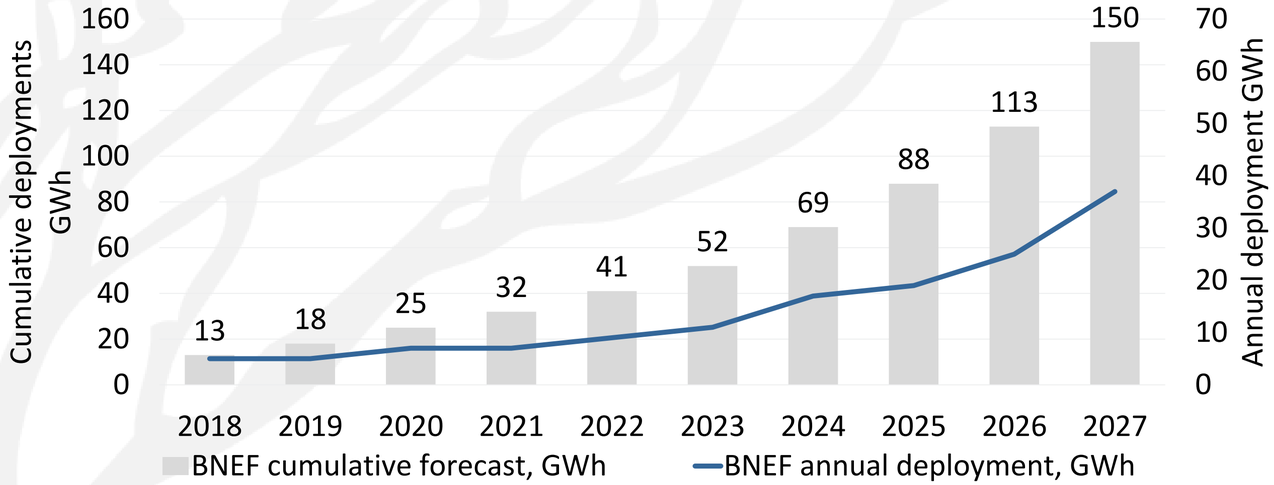
Why Energy Storage Matters for Vanadium Demand

Although there are several energy storage market forecasts, they remain massive in the medium to long term

Total Gigawatt hours (GWh) deployed[1] - 2025



Global cumulative storage deployments, GWh



- Stationary energy storage demand is growing rapidly and will exceed 300GWh by 2030
- Most projects point to 20-40GWh of storage deployed by 2025
- Annual additions are forecast to reach 10-20GWh by 2025
- Past forecasts from Navigant and Boston Consulting Group expected VRFBs to capture 15-25% of the market
- Growth may appear excessive, but it is similar to solar PV growth over the past 10 years

1 Where only capacity numbers reported, a ratio of 2.5 GWh per GW was used

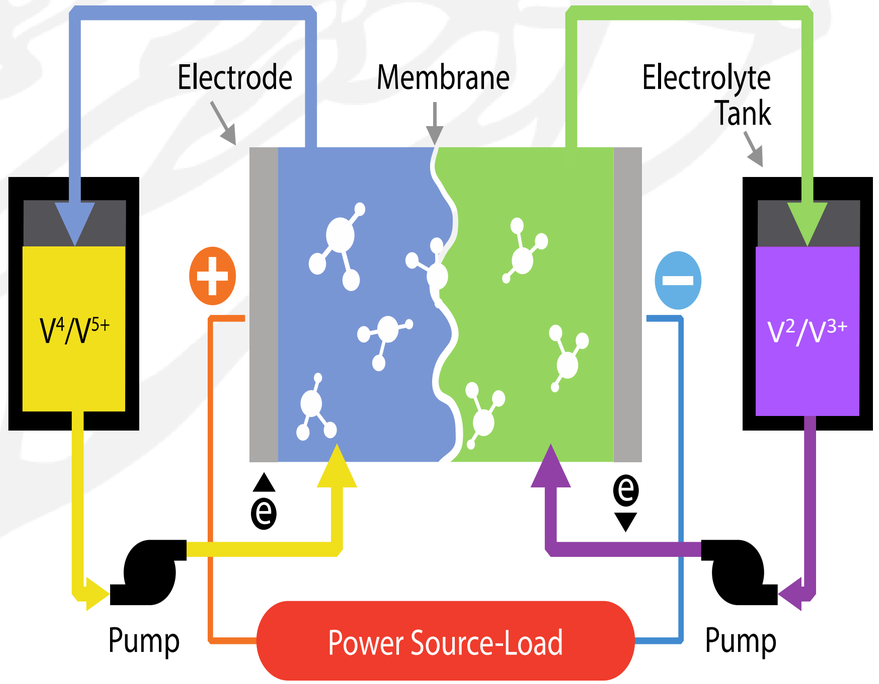
Source: BCG, Bloomberg New Energy Finance (BNEF), Lux Research, McKinsey & Company, Navigant Research

Demand Outlook

What is a Vanadium Redox Flow Battery (VRFB)

Vanadium's access to the huge energy storage market through VRFB

- VRFB is the simplest and most developed flow battery in mass commercial operations
- Vanadium can exist in four different states, allowing for a single element to be used to store energy
- The flow battery, unlike conventional batteries, uses a liquid vanadium electrolyte to store energy in separated storage tanks, not in the power cell of the battery
- During operation these electrolytes are pumped through a stack of power cells, or membrane, where an electrochemical reaction takes place and electricity is produced



Source: IEEE Spectrum: "It's Big and Long-Lived, and It Won't Catch Fire: The Vanadium Redox-Flow Battery", 26 October 2017

Demand Outlook

Advantages of a VRFB

The unique features of VRFBs make them ideal for utility scale, long duration stationary energy storage applications

Characteristics

1. **Long lifespan cycles:** Ability to repeatedly charge/ discharge over 35,000 times for a lifespan of over 20 years
2. **100% depth of discharge:** Without performance degradation is unique to VRFBs
3. **Lowest cost per kWh** when fully used at least once daily makes VRFBs today cheaper than Li-ion batteries
4. **Safe,** with no fire risk from thermal runaway
5. **100% of vanadium is re-usable** upon decommissioning of the system
6. **Scalable capacity** to store large quantities of energy (MW- range)
7. **Flexibility:** Allows capture of the multi-stacked value of energy storage in grid applications
8. **Very fast response time** of less than 70ms
9. **No cross-contamination:** Only one battery element, unique among flow batteries

Applications of VRFBs

- **Driving grid efficiency – operational and capital expenditure**
  - Peak shaving or peaking capacity
  - Regulating load frequency and providing other ancillary services
  - Balancing PV and wind intermittency
  - Reducing and deferring capex for transmission and distribution lines
- **Driving grid independence**
  - Storing electricity from solar PV for use at night
  - Lowering system costs for micro grids and islands by displacing diesel and other liquid fuel generators

Source: IEEE Spectrum: “It’s Big and Long-Lived, and It Won’t Catch Fire: The Vanadium Redox-Flow Battery”, 26 October 2017; International Renewable Energy Agency

Demand Outlook

Advantages of a VRFB

Safety: Technically, a VRFB is intrinsically safer than solid state batteries because it has no “thermal runaway”

Fire safety is an inherent risk of solid state batteries


30MW Kahuku project, Hawaii


Tesla Model S


Engie 20MWh battery, Drogenbos

Unsurprisingly, VRFBs are safer across a broad range of factors, when compared to lithium-ion (or other technologies)

Analysis of typical hazards by ESS Type

Risk	Lithium-ion	Flooded Cell	Sodium Sulfur	VRB Flow Battery
Voltage	X	X	X	
Arc-Flash/Blast	X	X	X	
Toxicity	X	X	X	X
Fire	X	X	X	
Deflagration	X	X		
Stranded Energy	X	X	X	

ENERGY RESPONSE SOLUTIONS

“It is clear that Vanadium flow battery systems offer significant safety advantages to li-ion”

- Fire Captain Matthew Paiss[1]

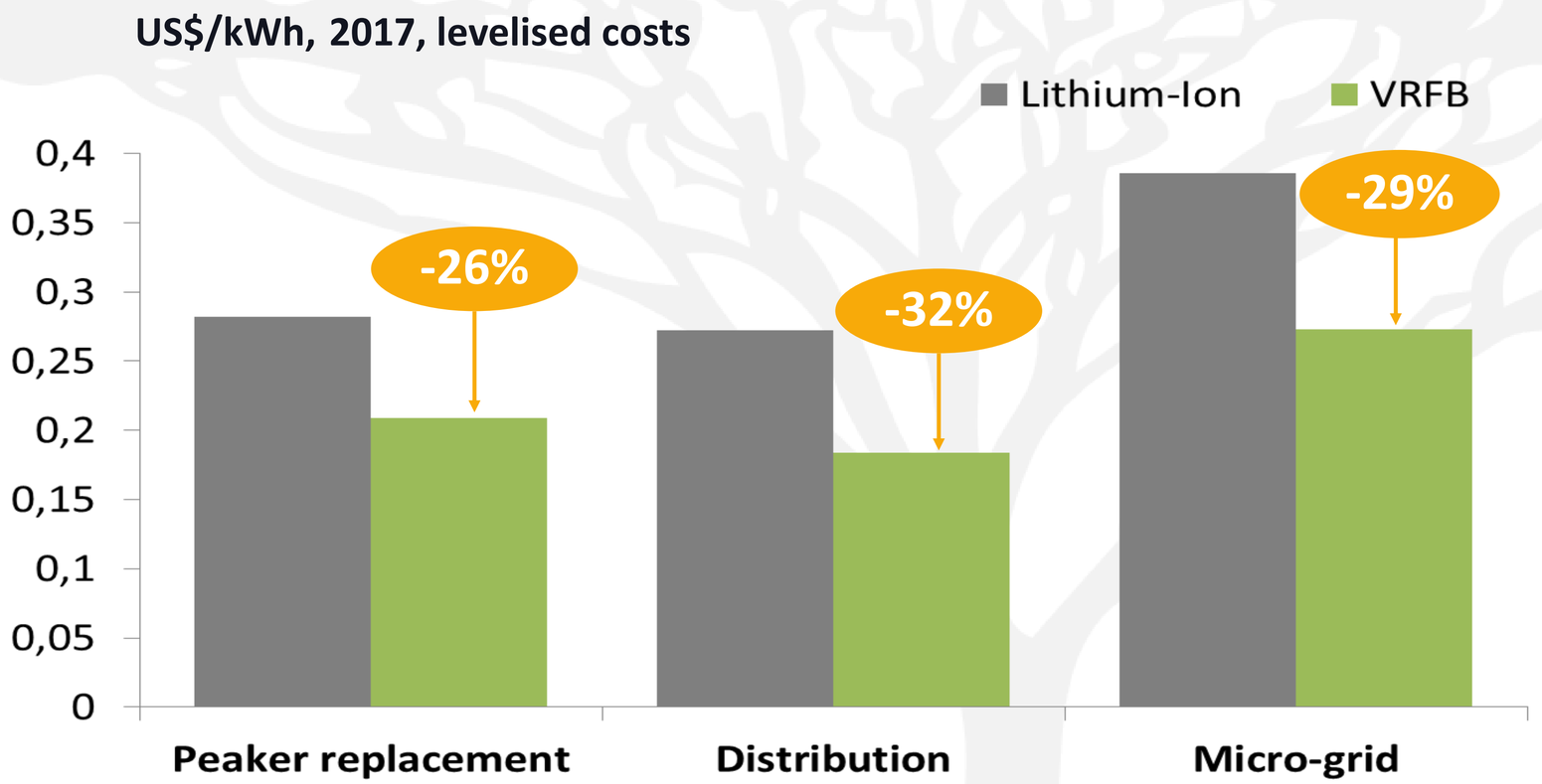
1 Captain Paiss is a 21-year veteran of the San Jose Fire Department and the primary representative of the International Association of Fire Fighters (IAFF) to NFPA 70 (NEC) and NFPA 855 ESS standards

Source: “Energy Storage System Safety: Vanadium Redox Flow Vs. Lithium-Ion,” June 2017, Energy Response Solutions, Inc., energyresponsesolutions.com

Demand Outlook

Advantages of a VRFB

Cost: For many applications, VRFBs can yield the lowest levelised[1] cost of energy storage



Lazard's analysis shows that VRFBs already have the lowest costs in the industry

[1]Levelized cost is total lifetime cost of ownership

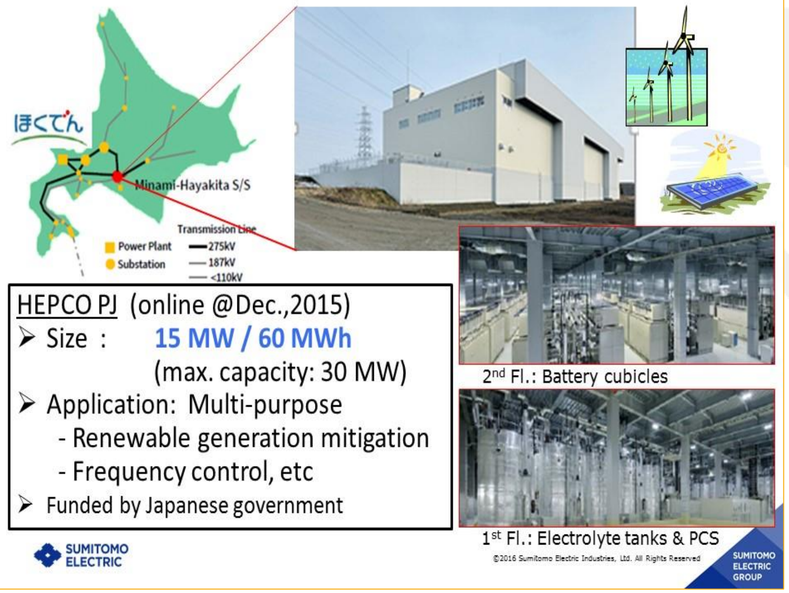
Source: Bushveld Energy analysis, Lazard's Levelised Cost of Energy Storage Analysis – Version 3.0 (November 2017)

Demand Outlook

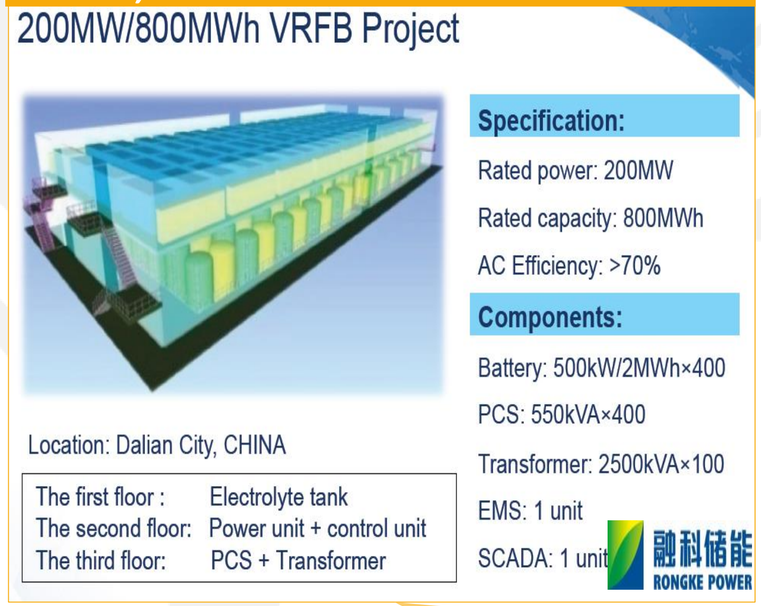
VRFBs Deployment Gaining Momentum (1/2)

These technical and economic fundamentals are leading to large deployment of VRFBs – especially in Asia

I. 60 megawatt hour (MWh) VRFB from Sumitomo in Hokkaido, Japan



II. 800 MWh VRFB by Rongke Power in Dalian, China



III. 400 MWh VRFB from Pu Neng in Hubei, China

- Project to be finished by 2020
- Cornerstone of a new smart energy grid in Hubei Province.
- Will serve as a critical peaker plant, deliver reliability and reduce emissions

PU NENG
THE FUTURE OF ENERGY STORAGE

- These large VRFBs are part of China's new National Development Plan's "focus includes 100MW-grade, vanadium redox flow battery energy storage stations"
- A total of four 400-800MWh VRFBs are currently in development in China (with two already procured)

Source: No.1701 (2017) of the National Development and Reform Commission and the National Energy Administration, Pu Neng, Rongke Power, Sumitomo

Demand Outlook

VRFB Deployment Gaining Momentum (2/2)

Strong industry sentiment towards VRFBs supports growing Vanadium demand

- In North America, industry sentiment towards VRFBs is also strong
- In Greentech Media's 2017 Energy Storage Summit poll of 500 professionals on the next 5 years for energy storage, flow battery technology achieved the most support

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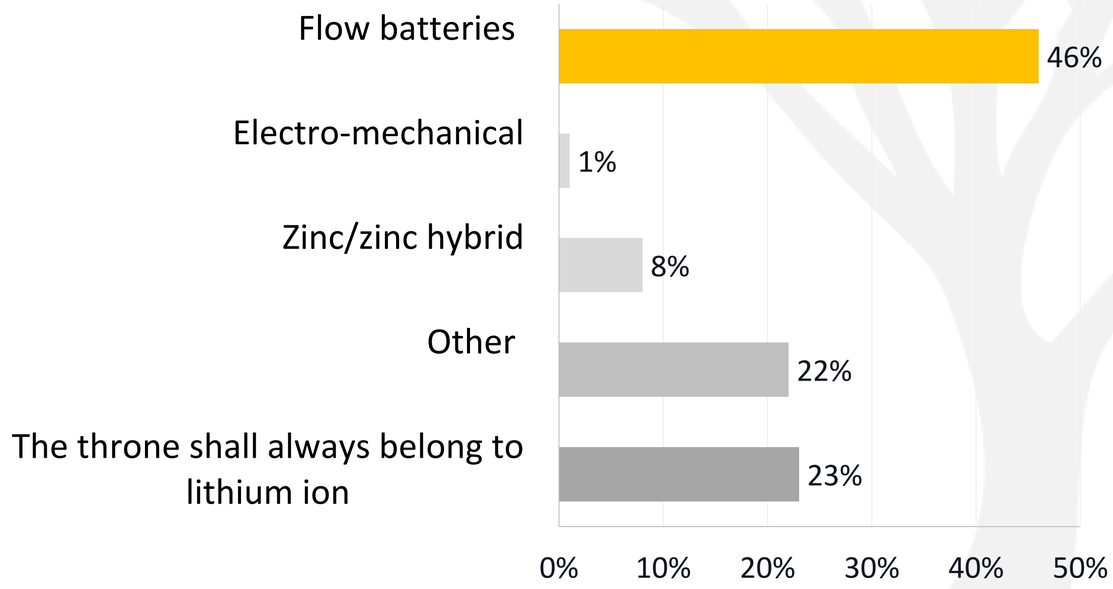
What technology has the best chance of supplanting lithium-ion as the dominant utility-scale advance technology?



Observations:

- Just 1 in 4 respondents believe that lithium ion technology will remain dominant in utility scale storage
- 3 in 5 of the remaining participants believe flow batteries would become dominant

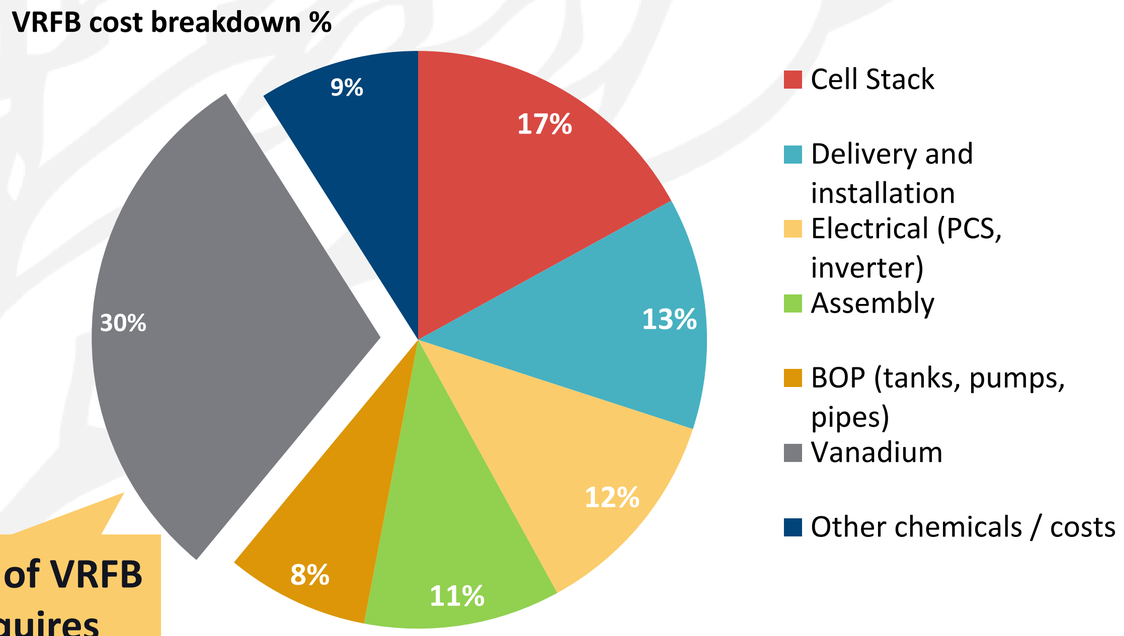
Source: Bloomberg New Energy Finance, Greentechmedia.com, TTP Squared

Demand Outlook

VRFBs Impact on Vanadium Demand

Vanadium is very important to the VRFB cost structure

- Vanadium makes up the largest cost in a VRFB
- Vanadium contributes more than 30% to the cost of a VRFB
- This presents a challenge for the technology but an opportunity for vanadium suppliers
- Strategies for countering impact of high vanadium prices will be key for success



Each GWh of VRFB storage requires 5,500tV

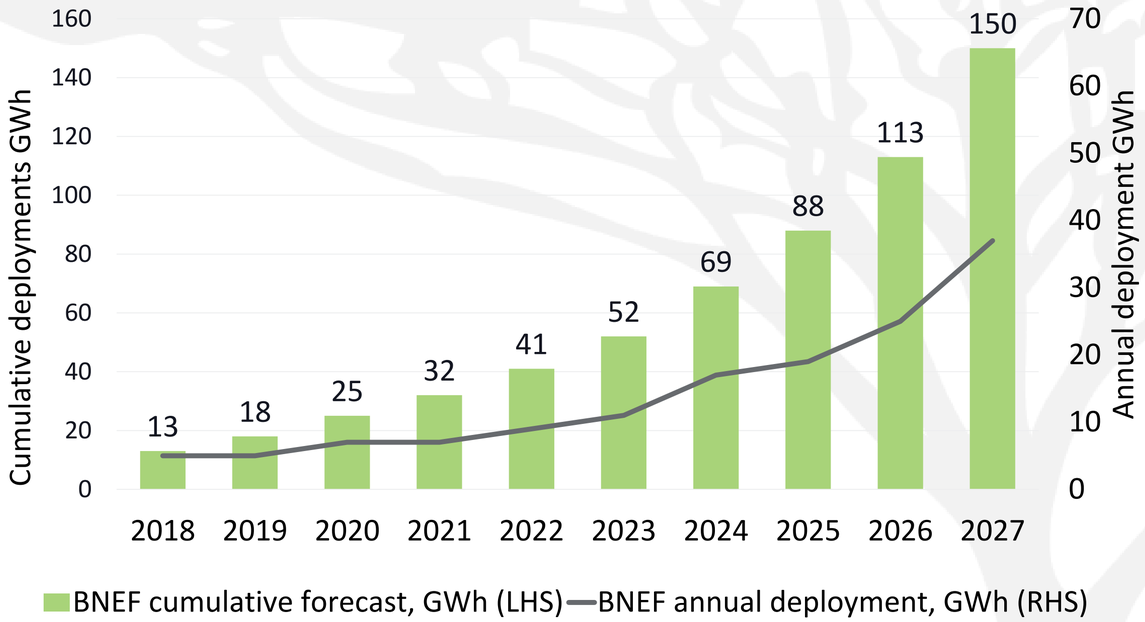
Source: Bushveld Minerals analysis, EPRI – Vanadium Redox Flow Batteries (1014836)

Demand Outlook

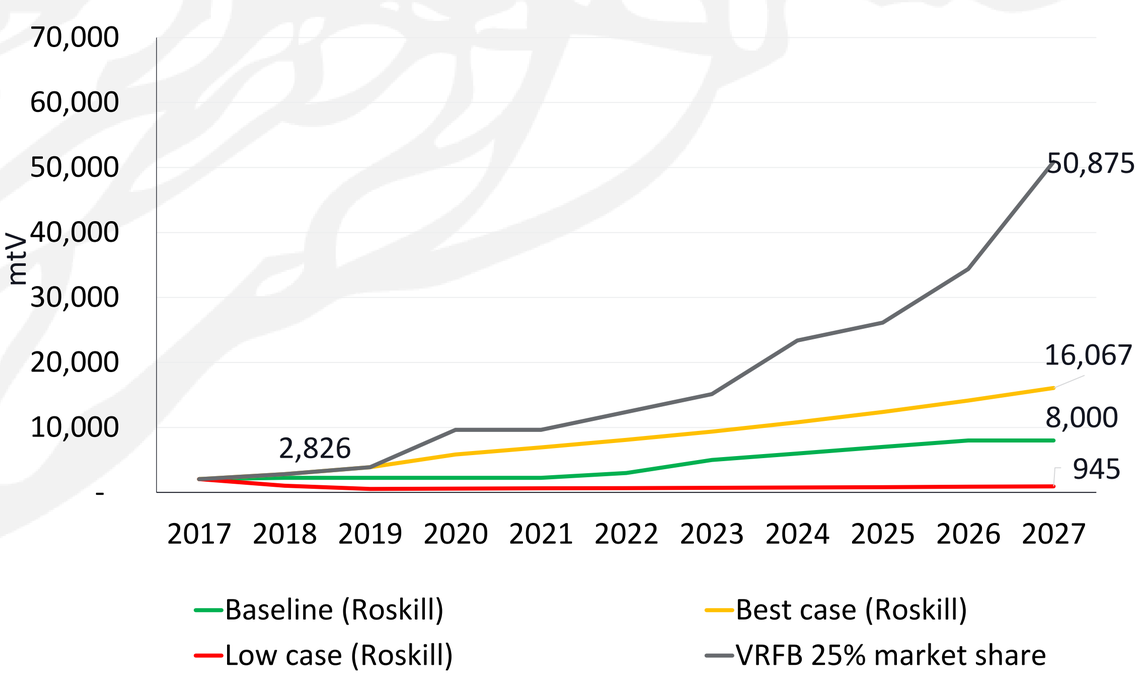
VRFBs Demand Outlook

Energy storage offers significant upside for medium term vanadium demand

Global cumulative and annual storage deployments, GWh



VRFB Vanadium Demand Forecast



- In 2018 and 2019, the deployment of the Rongke Power 800MWh VRFB alone will require >4,000 mtV alone. If supplied in one year, it would be 1.4 times the best case vanadium demand for 2018
- 25% share of deployment in 2027 implies 50,875 mtV annual demand, about 3 times Roskill's best case forecast of 16,067 mtV and equal to nearly 40% of Roskill's baseline 2027 production forecast

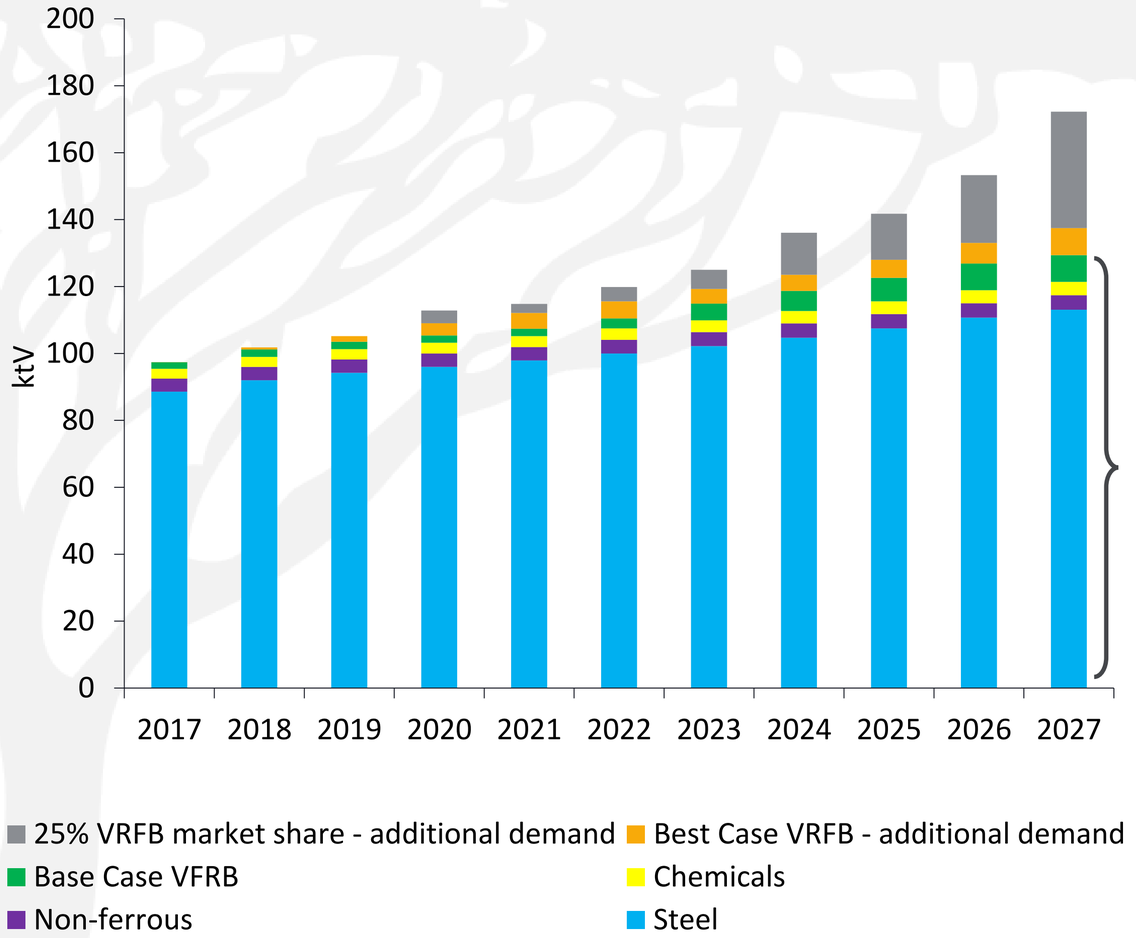
Source: Bloomberg New Energy Finance (BNEF), Bushveld Minerals analysis, Roskill, TTP Squared

Demand Outlook

Vanadium Demand Summary

- Vanadium demand has for decades been underwritten by the steel market, which accounts for >90% of vanadium consumption
- Steel market set to continue supporting robust vanadium demand, growing by 2.24% CAGR from 2017 to 2027 through
  - Growing global steel production of 1.76% CAGR between 2017 – 2027 with a strong positive correlation to vanadium demand
  - Increasing intensity of use in steel in emerging markets, especially in China due to improved enforcement of regulations
- Significant demand upside from growing applications of vanadium in energy storage industry via VRFBs
  - VRFBs in commercial deployment globally (just one Rongke Power VRFB under construction uses approximately 5% of annual global vanadium produced)
  - Clear advantages to alternatives – sets it apart in large scale stationary applications
  - Current forecasts expect VRFBs to account for 20% of vanadium consumption by 2030; however significant upside of as much as 50,000 mtV demand by VRFBs if they capture 25% of the energy storage market

Vanadium demand forecast by application



Roskill base case forecast of overall demand = **~129,000 mtV by 2027**

Source: Bloomberg New Energy Finance, Bushveld Minerals analysis, Roskill

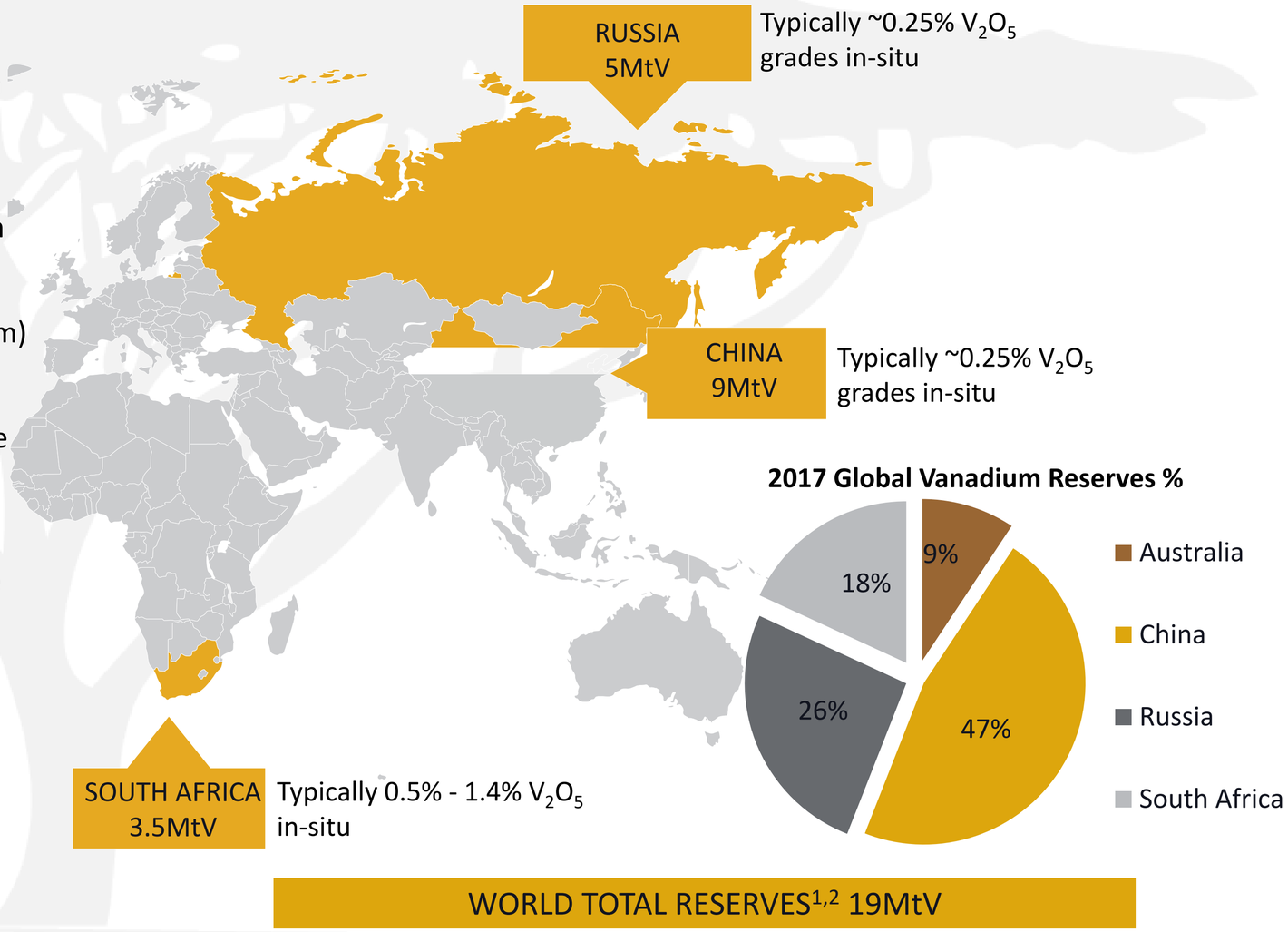
Vanadium Market Fundamentals:

Vanadium Supply: The Real Story

Vanadium Occurrences

Significantly abundant reserves with concentrated geographic distribution[1,2]

- Vanadium is mined mostly in South Africa, north-western China and eastern Russia, with over 90% of the reserves held in this regions
- South Africa is host to the largest high grade primary vanadium resources
- World resources of vanadium exceed 63Mt (contained vanadium) according to the US Geological Survey (USGS)
  - ➤ This data is not fully indicative of available supplies because vanadium is often produced as a co-product that is not recorded in resource statements by the owners of deposits
  - ➤ Further, vanadium resources in crude oils and tar sands are difficult to estimate. Vanadium that is contained in these form is often not incorporated into resource estimates
- Other regions have vanadium resources, e.g. Canada, USA, Sweden, but these are relatively small and low grade (except Brazil)



[1] USGS and Roskill data for the Americas limited to the US only. Note the USGS data reflects contained vanadium not ore.
[2] Largo has a reported ore reserve of 19Mt and 47.6Mt

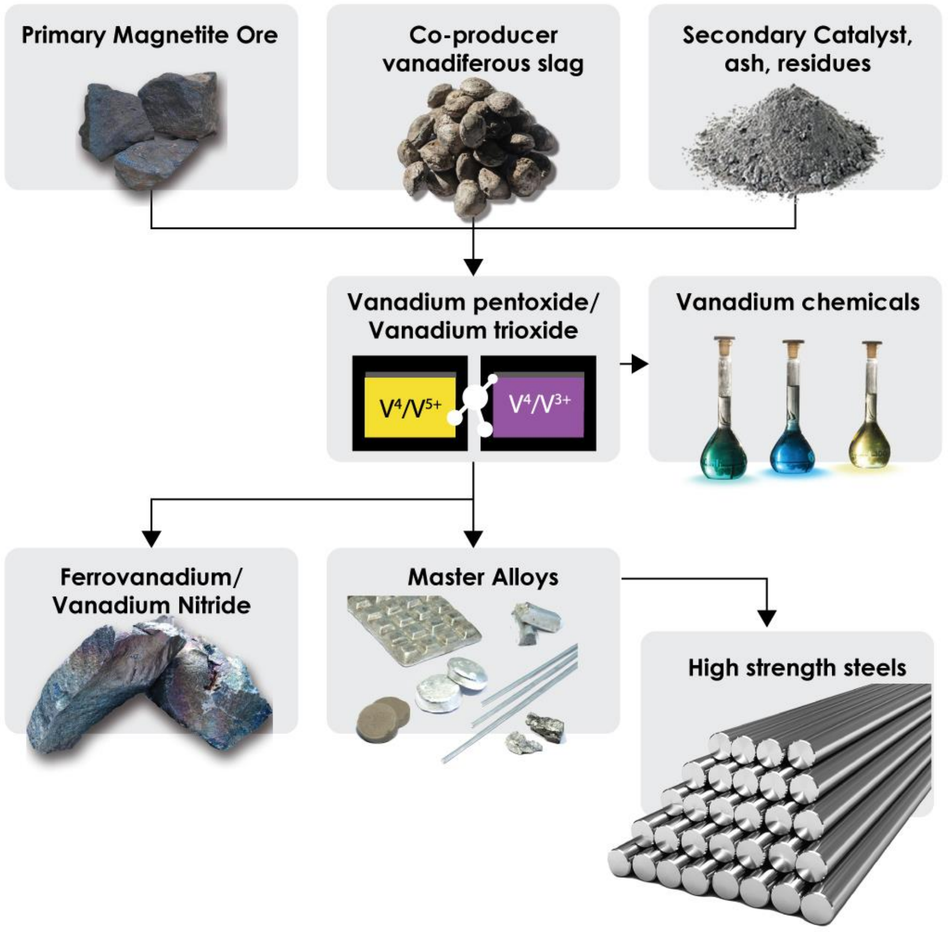
Source: Roskill

Vanadium Occurrences

Co-product slag currently accounts as source of most vanadium supply

- >88% of vanadium occurs in the form of vanadiferous magnetite ores, with the balance mainly in sedimentary form such as oil residues or shales
- The vanadium bearing magnetite ores are typically processed through either smelting producing vanadium bearing slag ("co-production") or the primary processing using a salt roasting and leaching operation, called Salt Roast process
  - ➤ **Co-production** typically involves smelting (EAF / BOF) magnetite ore/concentrate during which titanium slag is eliminated while vanadium and iron ore report together in hot metal from which vanadium is recovered in the form of a slag with enhanced vanadium grades

    The vanadium slag is then further processed into final vanadium product through a salt roast and leaching process ("The Salt Roast process"). Co-production is the most common source of vanadium supply and accounted for 74% of supply in 2017
  - ➤ **Primary production** directly from vanadium bearing magnetite iron ores. The magnetite is processed, after concentrating through magnetic separation, directly using a salt roasting and leaching process called Salt Roast. Primary production accounted for 14% of supply in 2017
- **Secondary production** from sedimentary vanadium is largely found in oil residues or shales is recovered from catalysts used during the refining of some crude oils or ash. Sedimentary vanadium is also found in stone coal geological settings. About 12% of vanadium occurs in sedimentary form
- Vanadium is extracted from these sources is converted into vanadium pentoxide (V_2O_5) and trioxide (V_2O_3). Most pentoxide is converted into ferrovanadium or nitride for use in the production of several different types and grades of high strength steel



Source: Bushveld Minerals analysis, Roskill

Vanadium Production Methods

Co-product slag currently accounts as source of most vanadium supply, but the future lies with primary vanadium ore feedstock

Ore

Smelting

Magnetite concentrate

STEEL PLANT CO-PRODUCTION FLOWSHEET (74% of Global Vanadium Feedstock Production)

Hot metal (Fe, V)

DRI + EAF/ Blast furnace

V recovery - Ladle furnace

Hot metal (Fe)

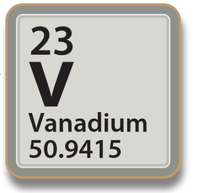
BOF + Steel Casters

Steel

TiO_2 slag

Vanadium slag

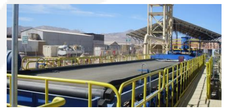
Salt Roast Processing



SALT ROAST FLOWSHEET (14% of Global Vanadium Feedstock Production)

Salt Roasting

Salt roasting of concentrate with sodium salts at ~1200°C to form water soluble sodium vanadate material



Leaching & purification

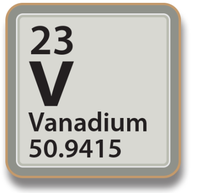
Leaching, filtration, desilication, precipitation followed by reaction to form vanadium pentoxide

Calcine tailings (Fe, Ti)

V_2O_5 / MVO

FeV/NV production

Vanadium pentoxide/modified vanadium oxide is converted into FeV or NV



There are several greenfield vanadium projects exploring hydrometallurgical processing methods to produce iron, vanadium and titanium. None of these is yet in commercial production

Source: Bushveld Minerals analysis

Supply Outlook

A Market Structure

- Concentrated supply structure with short term supply reductions

B Questionable overcapacity

- Scope for unused capacity, largely amongst co-producers, filling the market deficit
- Vanadium cost curve limitations in predicting supply responses

C Greenfield production

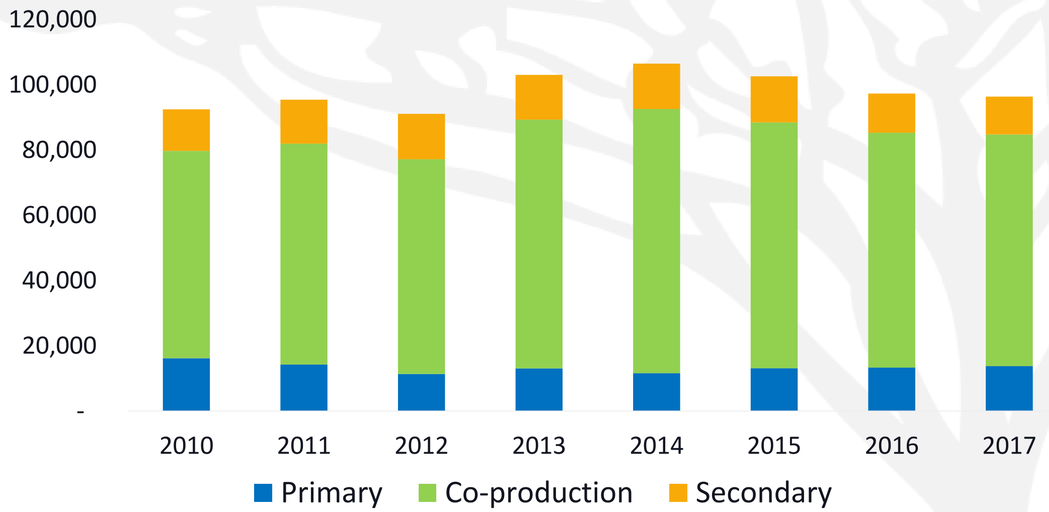
- New production dominated by co-production with significant hurdles

Supply Outlook

Vanadium Production

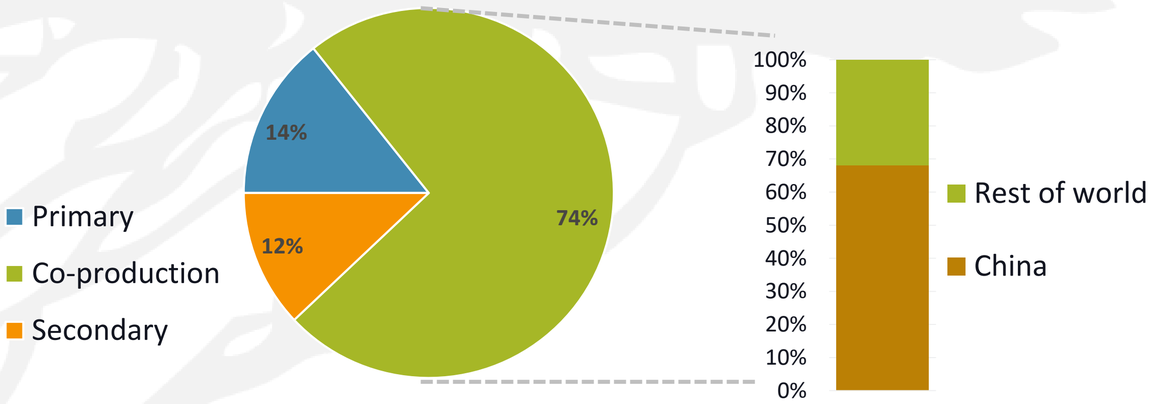
Vanadium production history

Production of vanadium feedstock (tV)

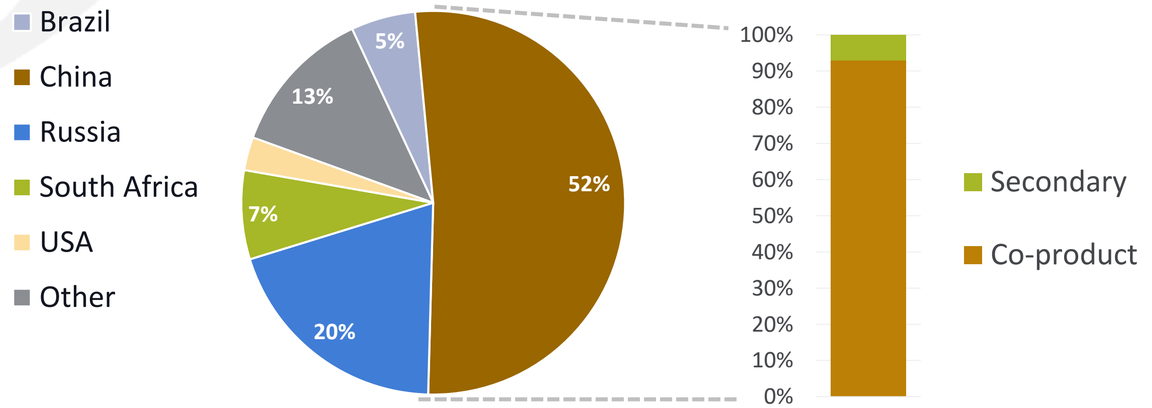


- China is the largest producer of vanadium feedstock producing 93% of its vanadium through co-production
- Co-production accounts for 74% of total vanadium feedstock production, 68% of which is in China
- Most of the co-production capacity is in China, accounting for 68% of total co-production and 48% of total vanadium feedstock production

Vanadium feedstock production by source 2017



Vanadium feedstock production by country 2017



Source: Bushveld Minerals analysis, Roskill

Total production (2017) = 92,392 mtV

Supply Outlook

A Global Supply Decrease Over the Past 4 Years …

Decrease in production not entirely driven by vanadium – related events

Region	2014 production	2017 production	mtV	%
China	54,362	50,035	-4,327	-8%
Russia	15,125	19,096	3,971	+26%
South Africa	19,445	7,222	-12,223	-63%
Brazil	578	5,239	4,661	806%
USA	3,600	2,700	-900	-25%
Other Europe	2,550	2,710	160	6%
Oceania	1,211	1,350	180	11%
Other Asia	4,920	4,040	-880	-18%
Other	861			
Total	**102,652**	**92,392**	**10,260**	**-10%**

Lower production in China driven by stone coal mine closures and environmental controls

In South Africa, Highveld Steel & Vanadium (HVSV) shut down due to adverse economic performance, leading to Vanchem also shutting down (Vanchem was dependent on the same ore as HSV)

Despite a significant new entrant in Brazil-based Largo Resources and smaller additions in Russia and Europe, global supply fell by 10%

In North America, vanadium volumes recycled from Venezuelan oil ash has fallen due to lower oil output

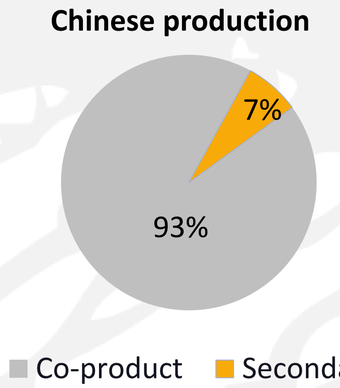
Source: Bushveld Minerals analysis, Roskill, TTP Squared

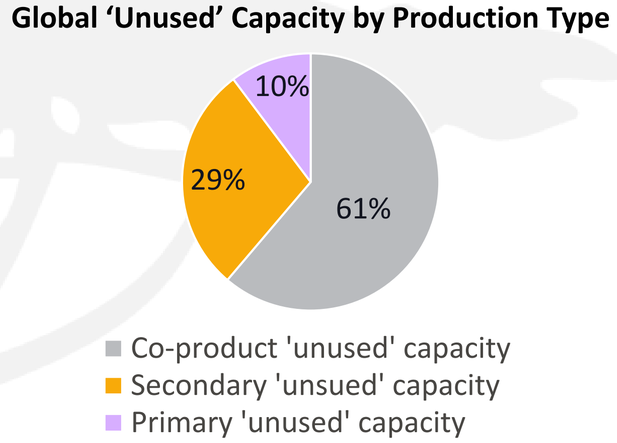
Supply Outlook

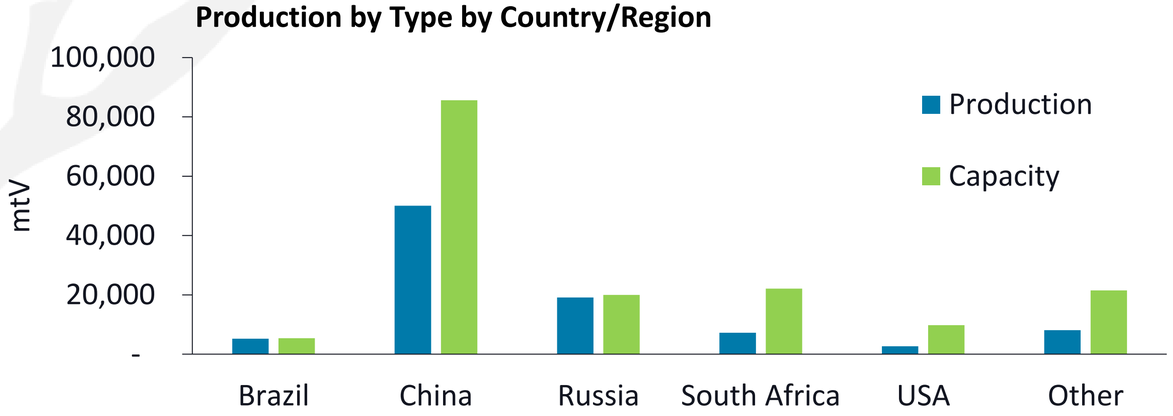
… Amidst Significant ‘Unused’ Capacity …

Unused capacity is dominated by Chinese co-product capacity

- As of 2017, total feedstock nameplate capacity was estimated to be around 164kt, implying global capacity utilisation of ~ 56% (2017 vanadium production **= 92,392mtV)**
- 61% of the unused capacity is co-production and mostly in China may be uneconomic as it relies on steel production economics - 49% of total unused capacity)
- This co-production capacity is largely unresponsive to current high vanadium environment, on account dependence on steel market economics – poor plant economics and minimal influence on steel prices
- Some of the unused capacity in China is from stone coal secondary producers characterised by high cost and high degrees of environmental pollution
- South Africa unused capacity linked to Highveld Steel & Vanadium and Vanchem Vanadium Products both of which do not have captive ore feedstock for processing following the auction of Mapochs Mine
- **Keys to additional production lie with primary and secondary producers**







How real is this unused capacity, especially in China?

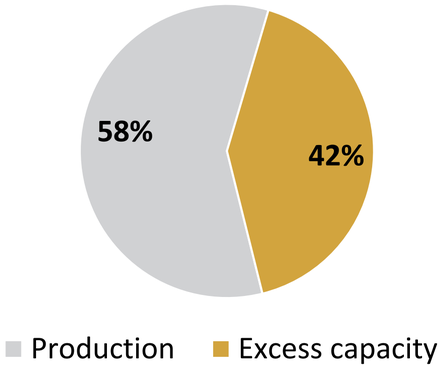
Source: Bushveld Minerals analysis, Roskill

Supply Outlook

… How Real Is The ‘Unused’ Chinese Co-production Capacity?

Vanadium co-production supply facing significant production constraints emanating from the steel industry

China’s 2017 production and excess capacity



Total capacity = 85 600 mtV

1 High input costs

- Low Fe grade <30% deposits, require concentrating to ~60% Fe
- Higher input costs than steel plants processing haematite ores

2 High operating costs

- Complex steel plant design
- Inferior Fe grade
- Additional processing steps to remove Ti and V

3 No leverage on steel prices

- Such plants make up small share of steel production – too small to influence steel prices
- Improved margins from cheaper seaborne iron ore not available

4 Environmental constraints

- Being mostly co-producer steel plants, their environmental footprint is negative
- In the firing line of the Central government’s crackdown on pollution

Three response options

- **Switch** – to haematite ores to blend and upgrade magnetite feed (e.g. Chengde)
- **Curtail** – reduce production (e.g. Panzhihua)
- **Stop** – production (e.g. Highveld)

Significant reduction in V supply and limited scope for new production from co-producers

Source: Bushveld Minerals analysis, Roskill, TTP Squared

Supply Outlook

… What will it take to bring this ‘unused’ Chinese co-production capacity online

Co-production plants’ economics are driven by steel market economics and require the following to be viable

	What would need to happen?	Reality
1 Higher iron ore prices	• Iron ore raw material costs account for >35% of cost of steel making • A significant rise in global iron ore prices likely to drive steel prices higher and reduce incentive to blend for co-producers	• Seaborne iron ore prices set to continue at low levels of ~US$60/t[1] for short to medium term according to analysts, driven by substantial over capacity in Australia and Brazil
2 Higher steel prices	• Stronger steel demand growth in China driving steel prices higher • Trade war driving higher domestic steel prices	• Steel demand growth projected to be less than 2% p.a • Over-capacity in steel sector unlikely to see significant steel price increases even in the event of greater demand; Chinese government efforts to eliminate as 50Mt of high cost unprofitable, polluting plants • Global trade war likely to suppress overall steel demand
3 Grow share of steel production	• Vanadium co-producers grow their production to a significant share of global steel production to influence prices	• Co-producers account for only 5% of steel production • They are the targets in a central government led consolidation programme aimed at eliminating up to 50Mt in high cost, loss making steel making capacity
4 Environmental constraints	• Softening in enforcement of environmental compliance • Easing of environmental regulations	• Chinese government recent direction towards tightening enforcement of regulations, including criminalising non-compliance • More regulations being introduced not less • Improving the environment a core pillar of Chinese government policy
5 Sustained high vanadium prices	• Vanadium prices high enough for co-production to be profitable	• A >US$100/kgV price would be required on a sustained basis, which is not precedented

[1] Bloomberg average consensus as at 23 April 2018

Source: Bushveld Minerals analysis, Roskill, TPP squared

Supply Outlook

Chinese Co-product Steel Plants Have No Leverage On Steel Prices

They account for less than 5% of the steel market, however for ~50% of the vanadium supply

- Chinese co-product steel plants capacity of 40Mt is less than 5% of total global steel
- They thus have no leverage on steel prices, which are the primary drivers of economic performance needed to stimulate conversion of the existing 'unused' capacity
- Meanwhile, they account for ~50% of Vanadium production (2017 Global production of 92,392 mtV)

	Annual Steel Production Capacity (T)	Annual Vanadium Production Capacity (mtV in final product)
Panzhihua Group – Panzhihua City	7 000 000	11 000
Panzhihua Group – Xichang City	7 000 000	11 000
Chengde Iron & Steel	6 000 000	9 500
Jianlong Steel Chengde	4 000 000	5 100
Jianlong Steel Heilongiiang	3 000 000	3 400
Chuan Wei Steel	3 000 000	2 500
Kumming Steel	7 000 000	1 100
Desheng Steel	3 000 000	2 000
	40 000 000	**45 600**

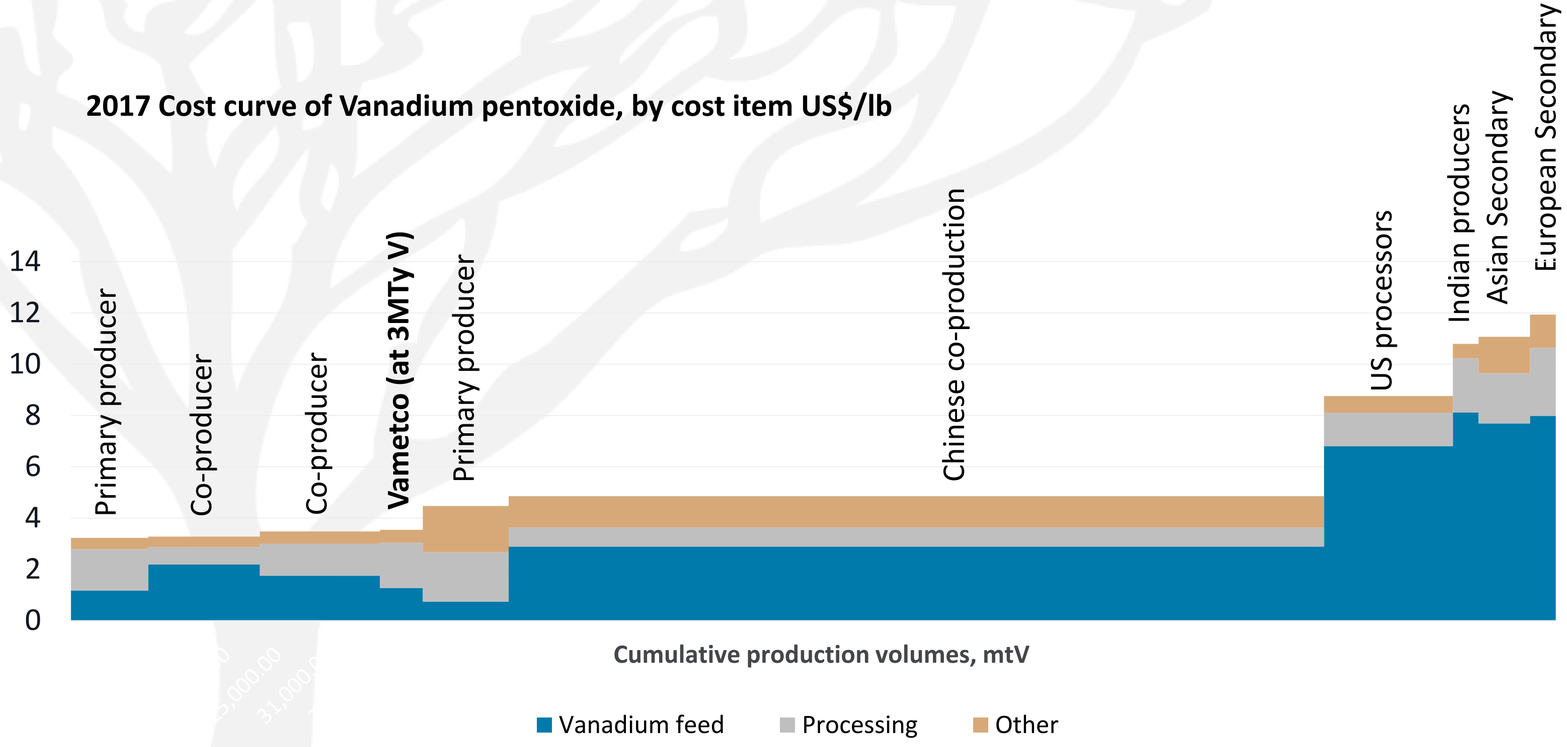
Source: Bushveld Minerals analysis, TTP Squared

Supply Outlook

Chinese Co-product Steel Plants Have No Leverage on Steel Prices

Why the vanadium cost curve is not a good predictor of supply behavior

- Chinese co-producers are low cost vanadium producers and have the most ‘unused’ capacity
- Yet they are incapable of taking advantage of high vanadium prices and low cost curve position
- Co-production dependent on primary steel plant viability
- Opportunity to respond to current vanadium price environment lies with primary producers
- However, primary producers’ share of unused capacity is marginal (less than 20%)
- And while capacity utilisation among the primary producers is just over 50%, among operational producers, this is 86% with limited head room apart from capacity expansions
- >70% of the unused primary capacity is constrained by unavailability of captive ore supply or poor quality magnetite ore



Source: Bushveld Minerals Analysis, Roskill

Supply Outlook

Even greenfield production has significant challenges

Even quality primary vanadium projects face funding challenges

1 Steel market drivers

- A significant number of the new projects that have been announced are co-producers, driven by steel prices, or multi-commodity producers
- Co-producer greenfield vanadium projects depend as much if not more on other commodities (Fe and Ti) to be viable
- Face the same steel market challenges as existing co-producers: low steel prices in a market with excess capacity

2 Capital markets understanding of Vanadium

- Financing for greenfield vanadium projects remains challenging (e.g. Mokopane Vanadium project, 1.75% V_2O_5, US$300m capex for 5,500mtV/yr)
- Capital markets understanding of vanadium relatively nascent

3 Vanadium Market

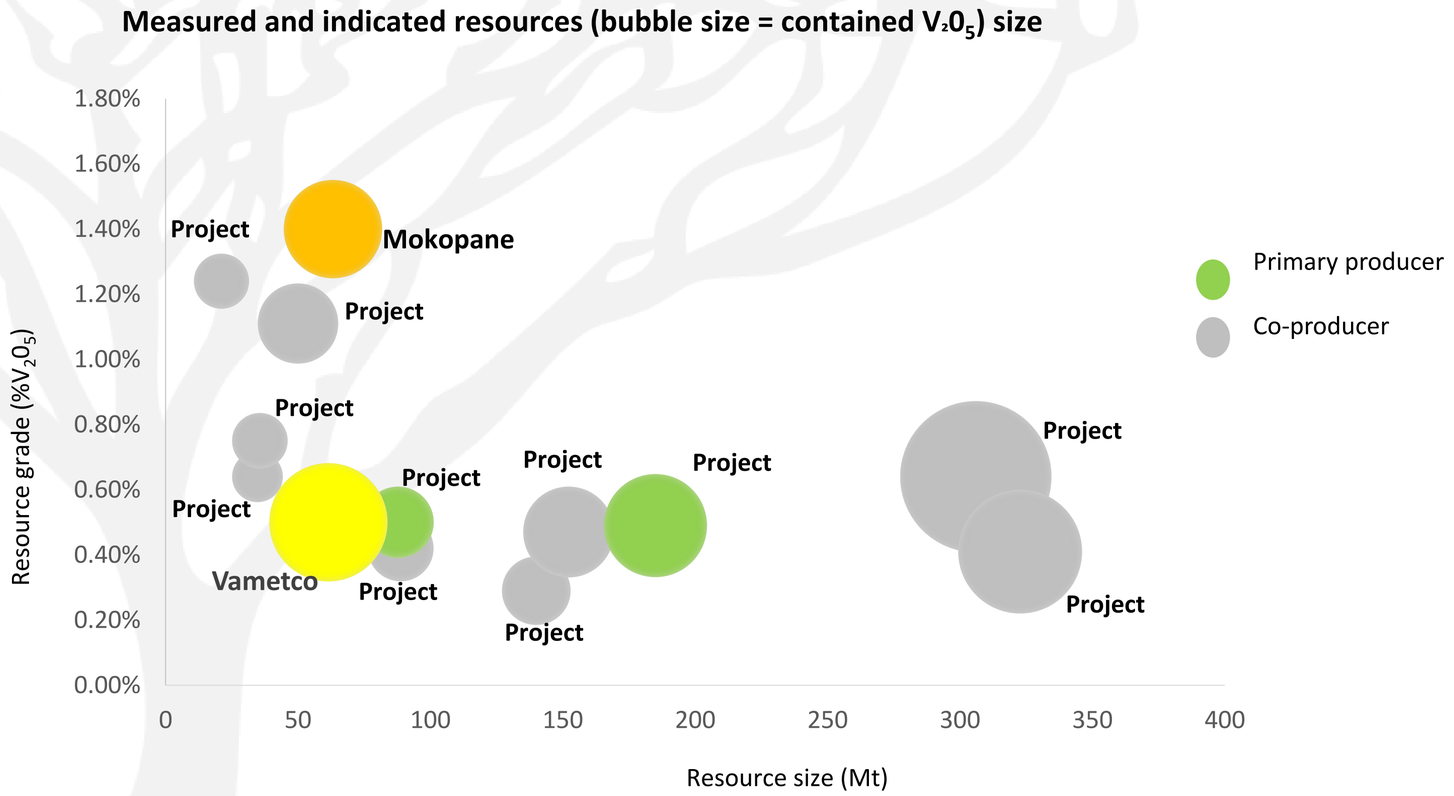
- Vanadium historical price volatility makes it difficult for lenders to model future prices for debt deals
- Limited technical capability for specific requirements of developing and operating vanadium mining and processing

Supply Outlook

Example of a Primary Vanadium Producer Economics

Mokopane Vanadium Project

Item[1]	Unit	Value
Production		
Mineral Resource	Mt	300[2]
Ore Reserve	Mt	28
Grade (in-situ)	%	1.4%
Grade (in-magnetite)	%	1.75%
Life of Mine	Years	30
V_2O_5 Production	tpa	9,525
Project Economics		
Assumed Vanadium Price	\$/lb V_2O_5	7.50
Initial Capital Costs	US\$ m	298
NPV @ 9% real	**US\$ m**	**418**
IRR real	**%**	**25%**



1. Based on the Pre Feasibility Study (PFS) completed in 2016
2. The Mokopane Vanadium Project PFS was based on the MML only which is 63Mt even though the overall project resource is 300 Mt

Supply Outlook

Example of a Primary Vanadium Producer Economics

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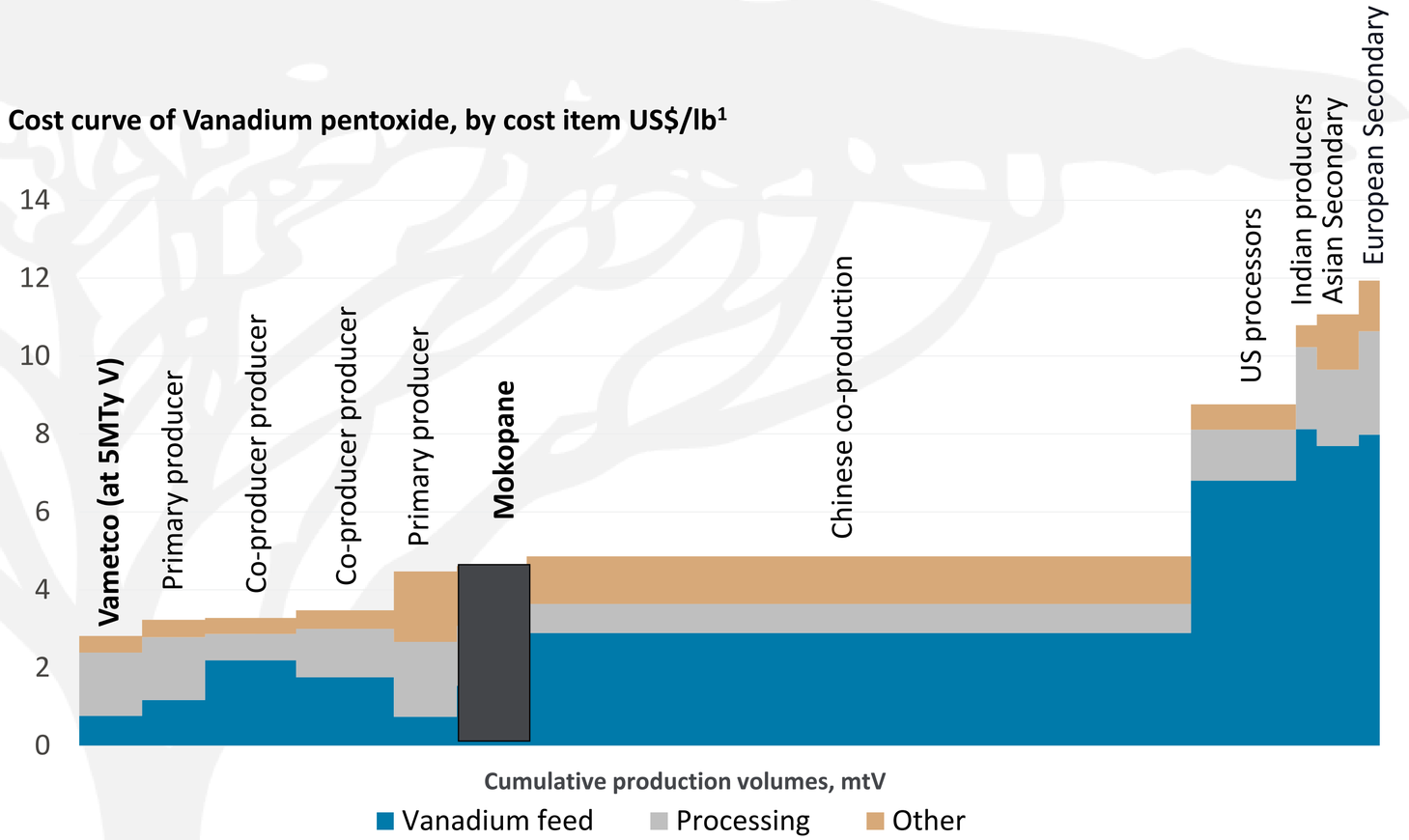


[1] The Mokopane Vanadium Project PFS was based on the MML only which is 63Mt even though the overall project resource is 300 Mt

Notes: Vametco at 5Mtpy. Mokopane costs based on operating costs and capital expenditure as estimated in pre-feasibility study. Mokopane project shown for illustration purposes only and does not imply judgement on Roskill's behalf of the likelihood of Mokopane being commissioned, nor does it imply a judgement of Mokopane's economics as compared to other brownfield and greenfield expansion projects not included in this cost curve

Source: Bushveld Minerals analysis, Roskill

Supply Outlook

How Much Of The Projected Supply Will Be Realised?

Total production of 46,000 is 88% of identified new production

								Based on a Feb 2018 prices		Based on Roskill's long term prices	
Region	Type	Stage	Measured & estimated resources (Mt)	Production date	Production capacity (tpy)	Capex (US$'m)	Grade (%V2O5)	NPV (US$'m)	IRR (%)	NPV (US$'m)	IRR (%)
Mokopane	Primary	Pre-feasibility complete	63	2022	5 800	286	1.4	685	36.7	125.9	17.7
Canada	Co -producer	Feasibility complete	152	2019	4000	732	0.47	984	22.2	467.2	17.0
Australia	Co-producer	Feasibility complete	306	2020	5,600	1,818	0.64	-640	5.1	-1,369	-8.8
South Africa	Co-producer	Feasibility complete	50	2018	191	15.8	1.11	4,9	15.8	0.9	12.70
Australia	Co-producer	Feasibility complete	140	2020	11,200	1,397	0.29	2,681	45.5	1,379.3	31.50
Australia	Primary	Mineral discovery	35.6	2020	5,300	N/A	0.75	N/A	N/A	N/A	N/A
Australia	Co-producer	Early exploration	185	2020	4,800	132	0.49	1,262	80.3	545	46.8
Canada	Co-producer	PEA complete	N/A	2023	9,331	265	N/A	271	23.0	246	22

Source: Bushveld Minerals analysis, Roskill

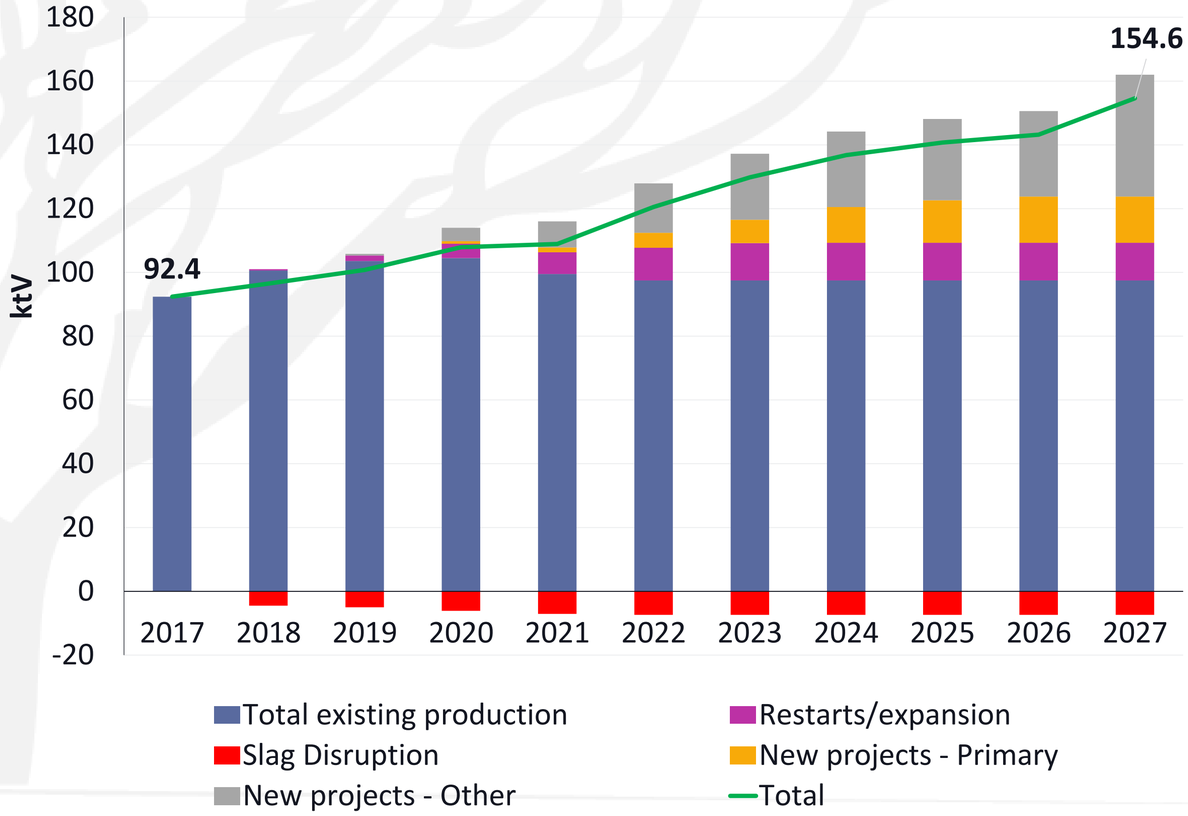
Supply Outlook

Summary Supply Outlook

Assuming all new projects are delivered, in an optimistic scenario supply would grow at a CAGR of 5.3% between 2017-2027

- New projects: includes all new projects that have been announced
  - ➤ New projects dominated by co-producer steel plants or hydrometallurgical plants
- All assumed restarts are co-producers steel plants
  - ➤ Includes an assumed Highveld Steel & Vanadium restart in 2019 ramping up to 6.6ktV by 2023

Global supply outlook assuming all new projects come online



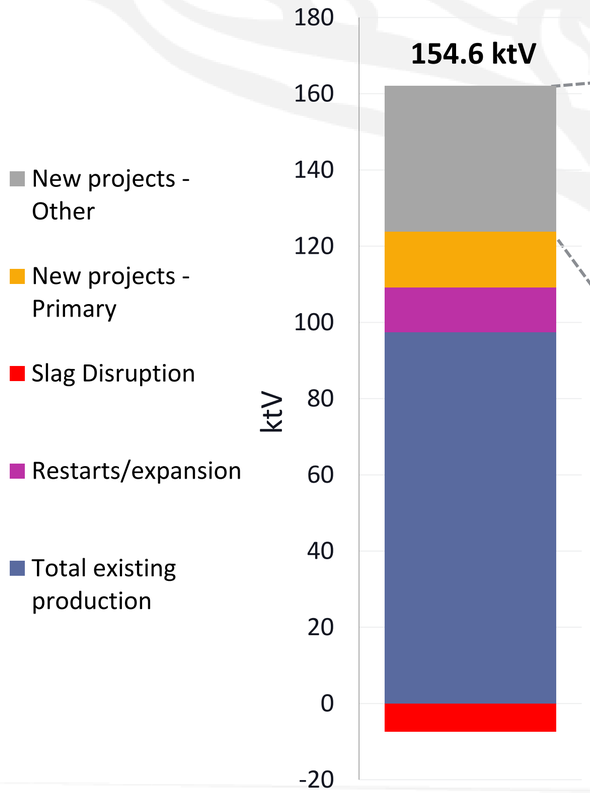
Source: Bushveld Minerals Analysis, Roskill

Supply Outlook

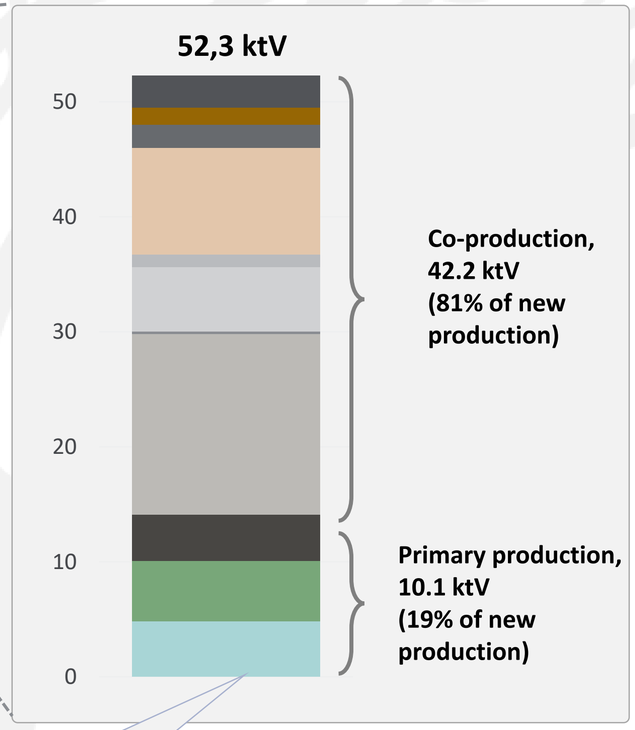
Majority Of New Supply From Co-production Projects

Vanadium co-production supply facing significant production constraints with faltering material contributions

Global supply outlook assuming all new projects come online



Total new projects by production type



Mokopane Vanadium Project (5.3 ktV)

Of this new production, Roskill expects 46% (23.9 ktV) of this production not to develop into production

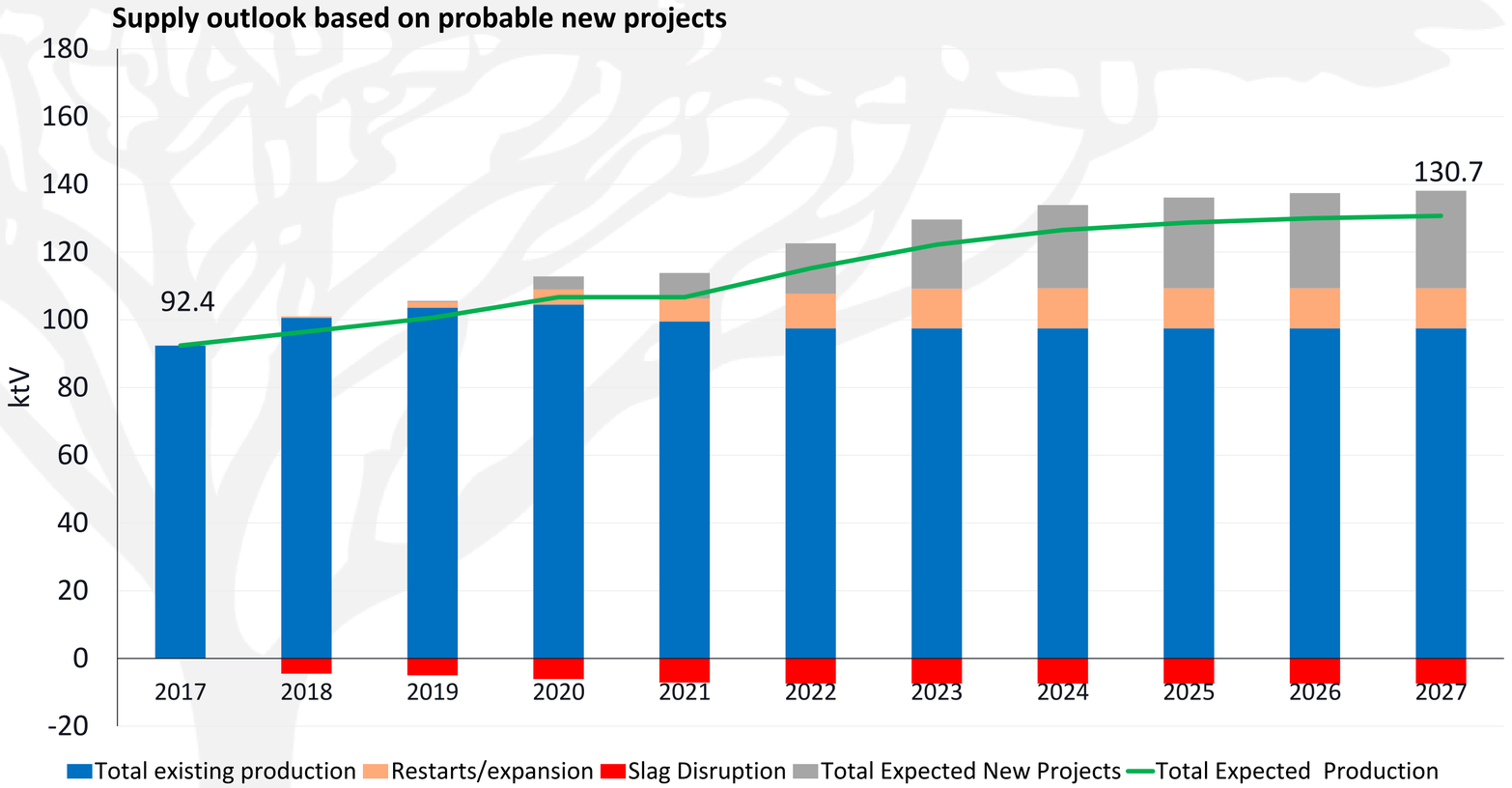
Source: Bushveld Minerals Analysis, Roskill

Supply Outlook

Probable Supply Evolution

Probable supply scenario sees supply growth of an additional 38.3 ktV over 10 years

- Adjusting total new supply to reflect probability of new production materialising, leads to a lower 130,700 mtV supply by 2027, down from 154,300 mtV, reflecting a CAGR of 3.5%
- Slag disruption reflects reduction in slag imports



Source: Roskill

Supply Outlook

Key Supply-side Take-aways

Market Structure

- Geographic concentration of supply with Northern China, Russia and South Africa hosting over 90% of the reserves
- Over 70% of vanadium produced is through co-production which is driven by steel fundamentals
- China accounts for the most production (52%) most of which (93%) is through co-production

Questionable overcapacity

- Global utilisation of ~56% (est. for 2017) suggests excess capacity that should respond to vanadium market deficit and high vanadium prices yet:
  - 61% of this unused capacity is co-production (and is mostly in China – 49% of total unused capacity) and is largely unresponsive to current high vanadium environment, on account dependence on steel market economics – poor plant economics and minimal influence on steel prices; and
  - Primary production unused capacity is constrained by unavailability of ore, and/or inferior vanadium feedstock grade
- Significant reduction in supply among mainly co-producers (especially given consensus low steel price forecasts) underscores vulnerability of this vanadium supply, even in a context of rising vanadium prices
- In South Africa, Highveld Steel & Vanadium going into business rescue eliminated >10% of vanadium feedstock supply from the market

New production

- Greenfield new production also constrained:
  - Co-product or multi-commodity (hydrometallurgy) plants require high capex and vulnerable to steel market economics
  - Primary production projects, even with good vanadium grades, may face significant funding challenges
- Consequently only 28,400 mtV of a total possible 52,300 mtV is deemed probable by 2027 (reflecting a CAGR of 3.5% supply growth)
- **Pure-play vanadium producers best suited to to deliver significant new supply**

Market Balance Outlook

Four cases presented to help understand potential vanadium demand and supply pathways going forward

Scenario 1

- Based on supply and demand forecasts as presented by Roskill

Scenario 2

- Assumes Roskill supply forecasts and a 25% VRFB market share in energy storage

Scenario 3

- All new supply projects identified are delivered and a 25% VRFB market share

Scenario 4

- Assumes Roskill supply base case forecast and zero uptake for VRFB in energy storage post 2020

Source: Roskill

Supply Outlook

Market Balance Scenarios

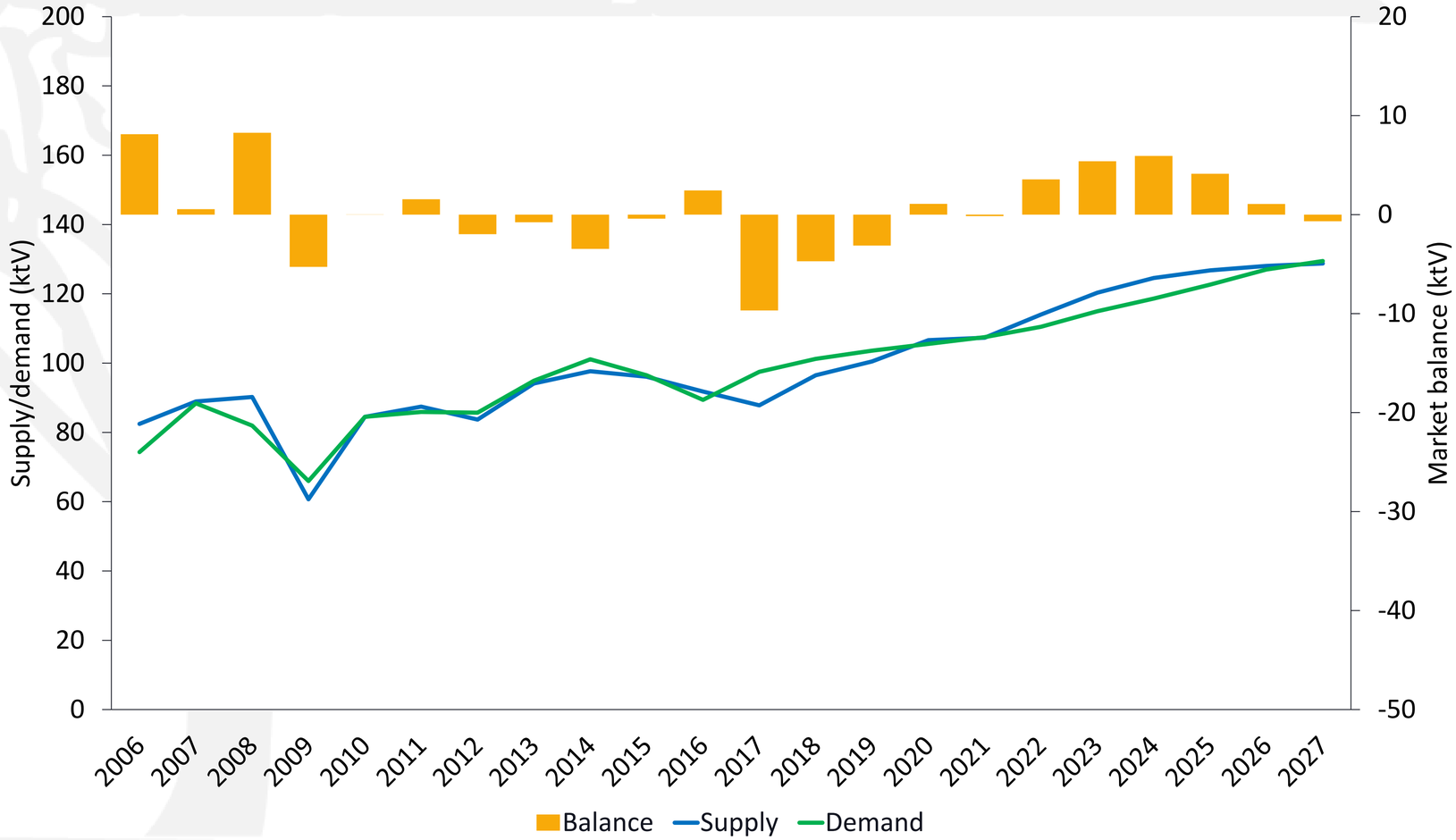
Scenario 1: Vanadium supply and demand per Roskill base case

Demand and supply volumes based on Roskill estimates and adjusted as follows:

- Demand includes Roskill base case demand for Vanadium in VRFBs, capped at 8,000 mtV by 2027 compared with a potential 50,875mtV
- Supply projections based on all new projects being adjusted down to reflect 54% volumes being delivered by 2027

Outcomes

- Results in a marginal market surplus of less than 5% at the most during the forecast period
- Supply and demand grow at 3.5% and 2.6% CAGR respectively from 2017-2027



Source: Roskill

Supply Outlook

Market Balance Scenarios

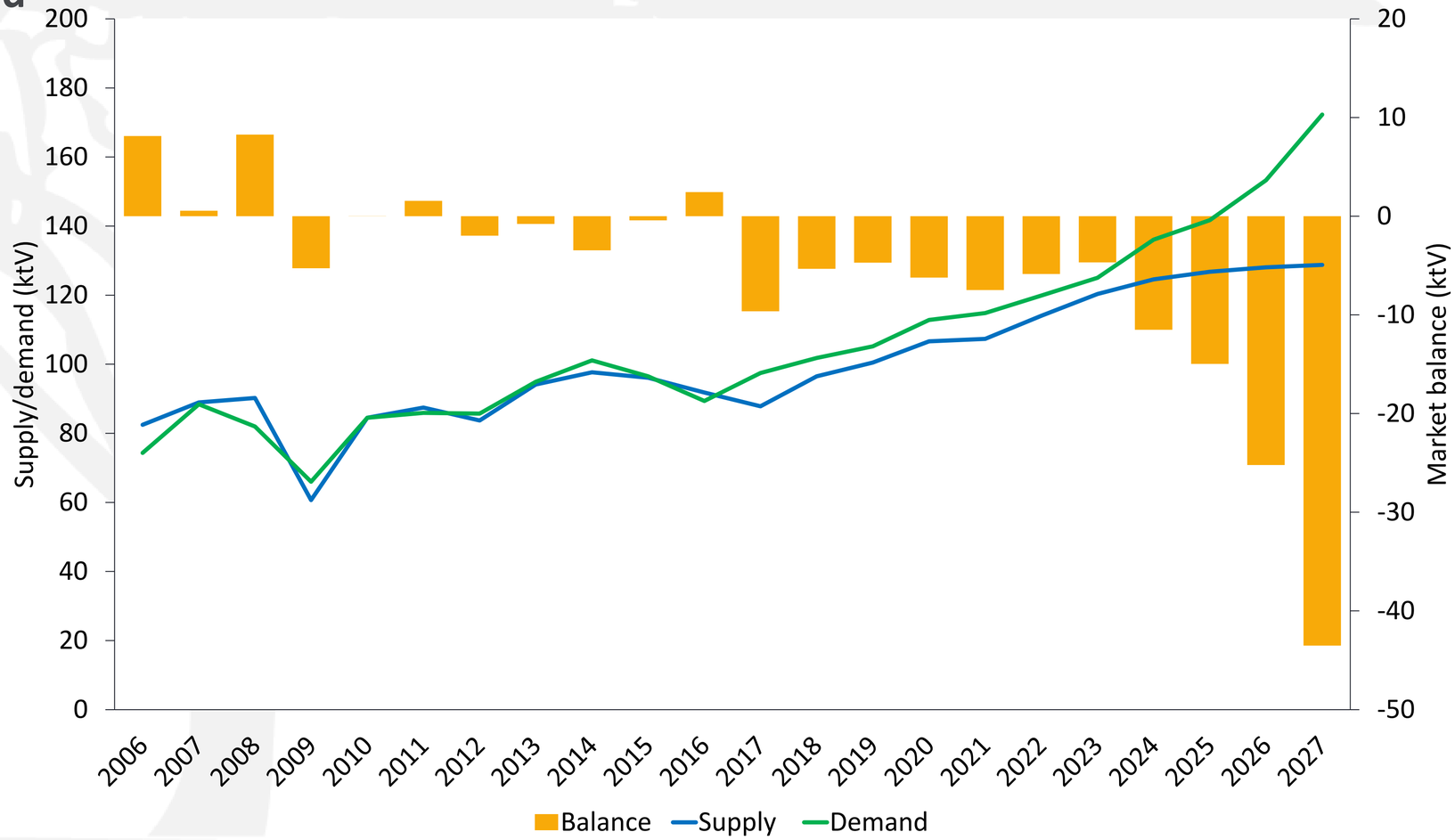
Scenario 2 :Demand assumes 25% market share for VRFBs in energy storage market and Roskill estimate of new supply projects actually delivered

Demand and supply volumes based on Roskill estimates and adjusted as follows:

- Vanadium demand assumes that VFRB's take up 25% of the energy storage market
- This is consistent with the anticipated energy storage requirements as per quoted research houses

Outcomes

- A significant increase in demand far exceeding supply in 2027 compared with base case
- 3.5% CAGR in supply from 2017-2027, and a 5.6% CAGR growth in demand over the same period



Source: BCG, Bushveld Minerals analysis, IHS Navigant Research, Roskill

Supply Outlook

Market Balance Scenarios

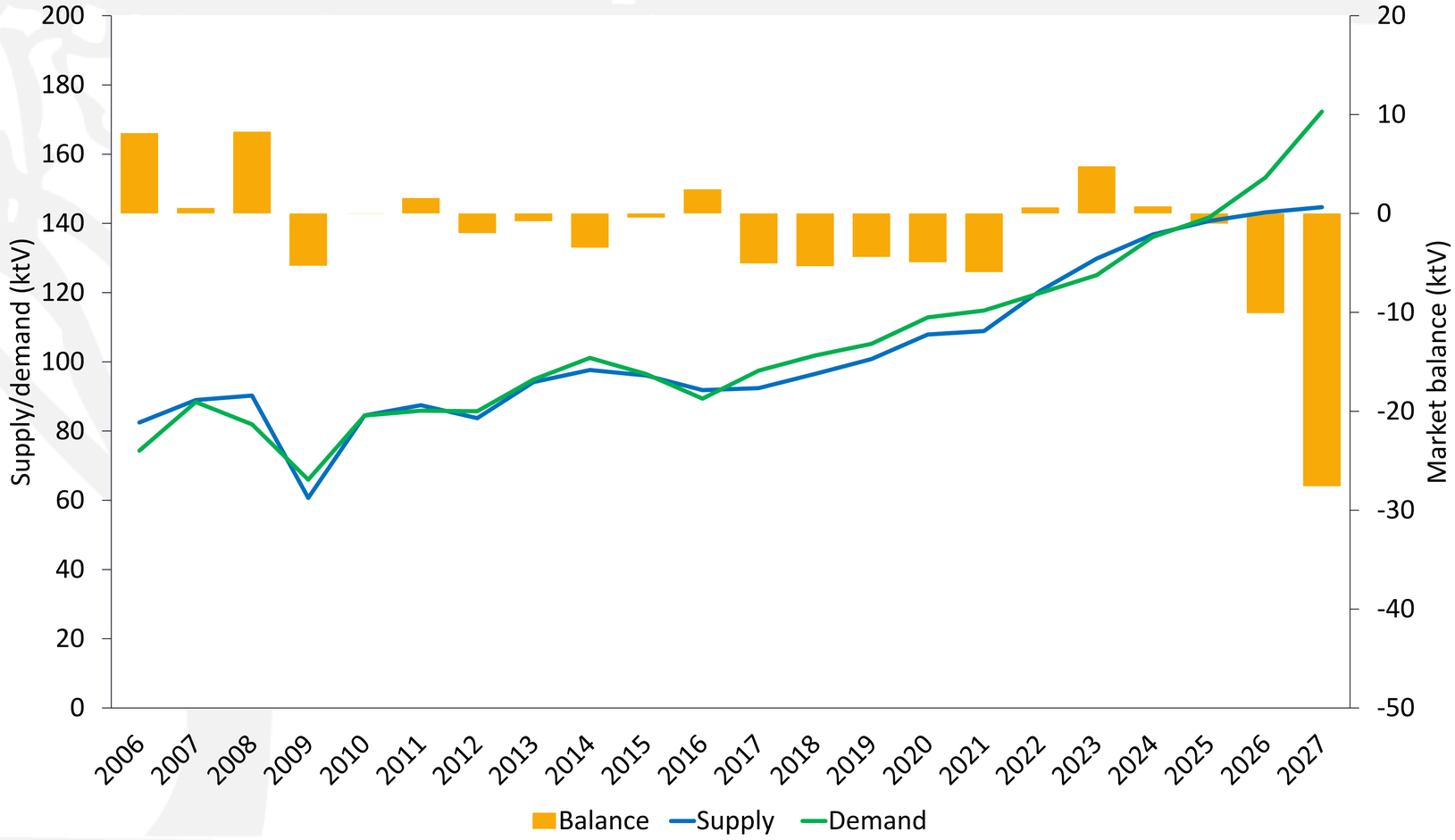
Scenario 3: 25% market share for VRFB in energy storage and all new supply projects delivered

Demand and supply volumes based on Roskill estimates and adjusted as follows:

- Vanadium demand adjusted for VFRB's taking up 25% of the energy storage market
- VRFBs market share based on analyst research on energy storage market developments
- The supply outlook assumes new production from all announced projects coming into production

Outcomes

- Market balanced through 2025 but a deficit widening to over 20% in 2027
- Results in a 4.2% CAGR in supply from 2017-2027, and a 5.3% CAGR growth in demand over the same period



Source: BCG, Bushveld Minerals analysis, IHS, Navigant Research, Roskill

Supply Outlook

Market Balance Scenarios

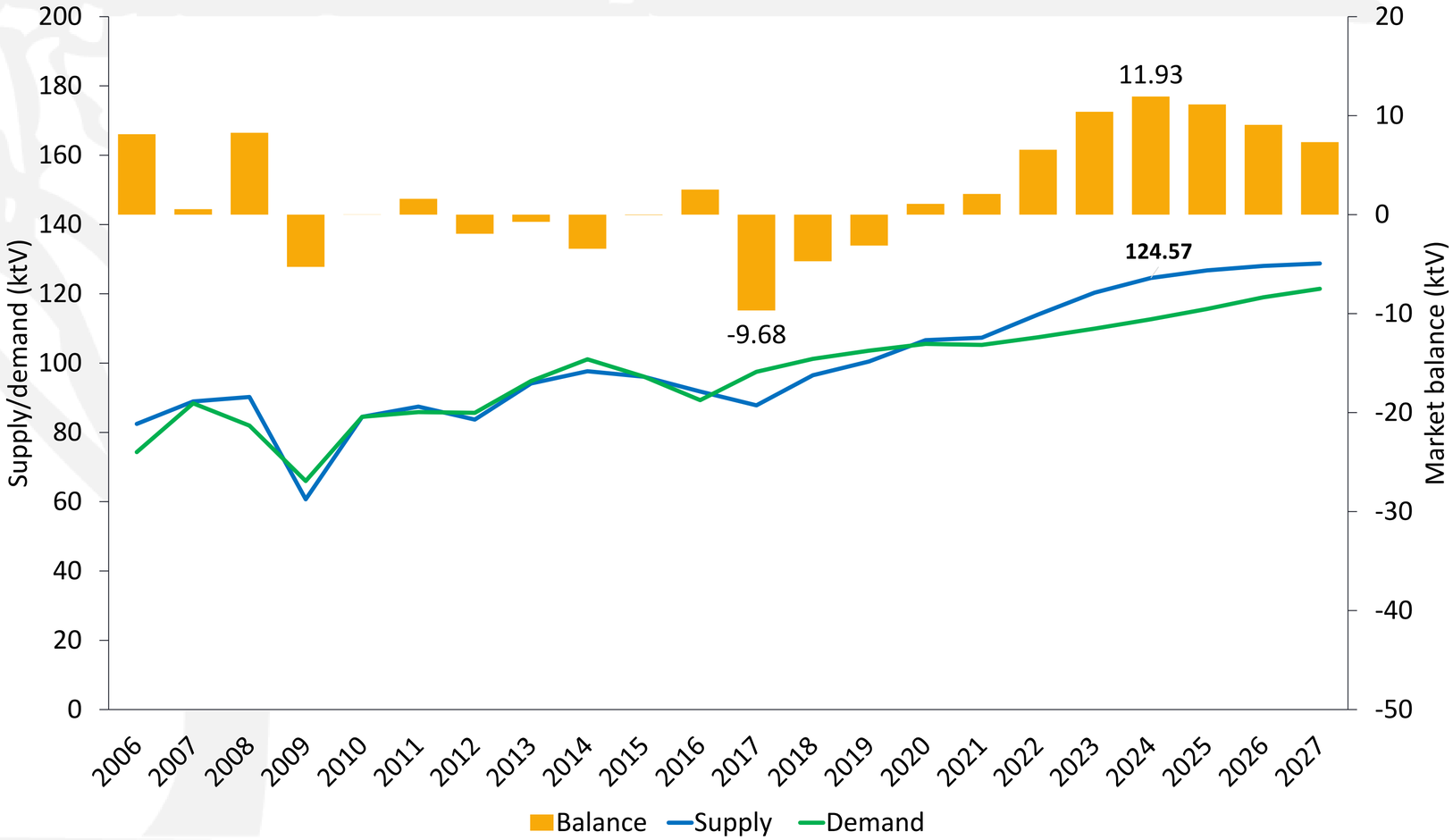
Scenario 4: Assumes Roskill supply base case forecast and zero uptake for VRFB in energy storage post 2020

Demand and supply volumes based on Roskill estimates and adjusted as follows:

- Vanadium demand adjusted for uptake being limited to only the current announced projects
- Zero VRFB uptake post 2020 assumed
- Supply forecasts based on Roskill base case

Outcomes

- Short term deficit
- Surplus develops peaking by 2024 at 11.93 kt vanadium, or less than 10% of supply before tapering down in second half of the decade



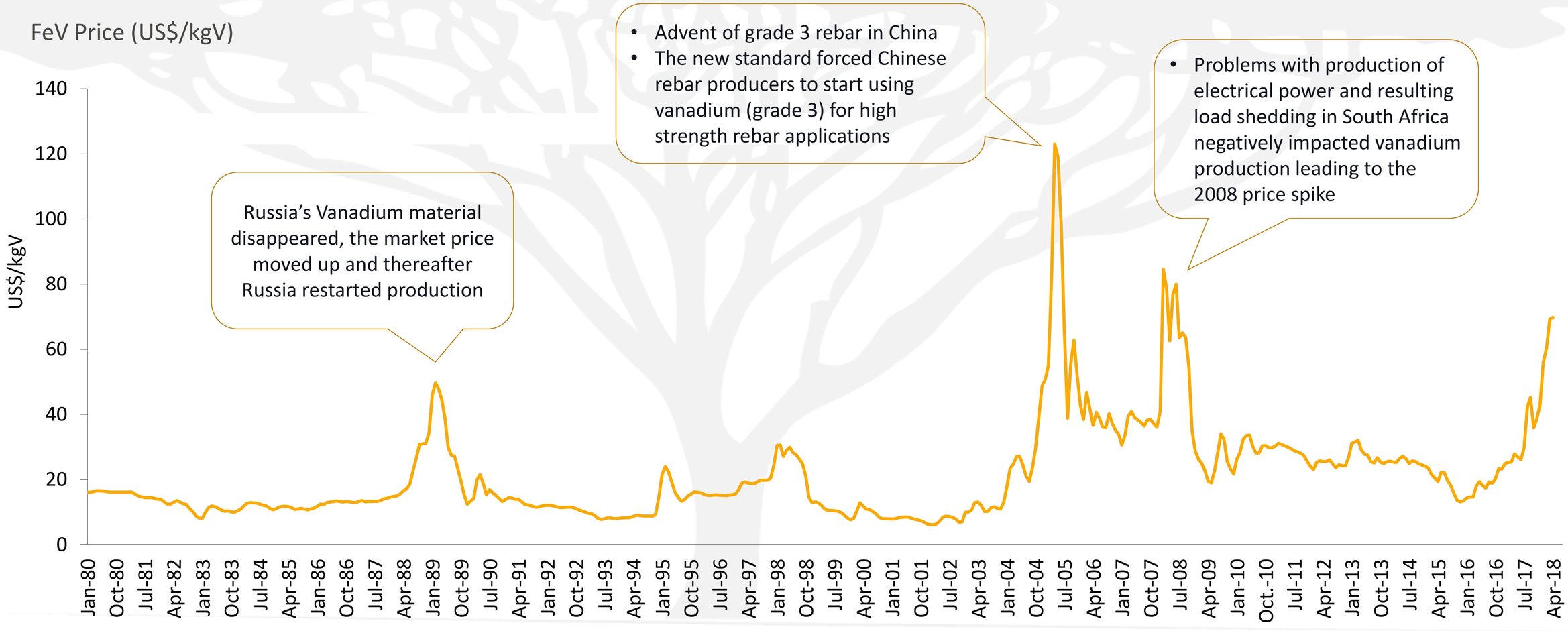
Source: BCG, Bushveld Minerals analysis, IHS, Navigant Research, Roskill

Vanadium Market Fundamentals:
Price Outlook

Price Outlook

Significant Price Increase with Further Upside

The current vanadium price rise driven by structural changes in the vanadium, iron and steel markets



Source: Metal Bulletin, TTP Squared

Price Outlook

Price Drivers

1 Market Balance

- Deficit likely to continue in the short to medium term driven by:
  - ➤ Demand robust anchored in steel market where greater intensity of use is expected to drive greater vanadium consumption growth than steel production
  - ➤ Growing adoption of vanadium redox flow batteries presents step change upside in demand profile
  - ➤ Supply the biggest driver of market balance – significant reductions in supply in the past 3 years combined with modest likely new supply

2 Project Pipeline

- 33% of potential new production likely to not materialise, resulting in supply growth of 3.2% CAGR, insufficient to match demand growth
  - ➤ Majority of potential new supply is co-product supply and is thus capex intensive and primarily dependent on steel economics primarily
  - ➤ Financing challenges for even quality greenfield primary vanadium projects, which are also capex intensive, can be expected in the short term
  - ➤ Significant question marks remain over several assumed operations re-starts

3 Substitution

- Short term switches between vanadium and niobium in steel making not practical given the required technical adjustments required in steel plants to switch
- Price elasticity of vanadium in steel suggests some capacity to absorb significant upswings in vanadium prices
- At current prices substitution risks while real are not considered large, although sustained higher vanadium prices will magnify these risks

4 Self cannibalization of VRFBs

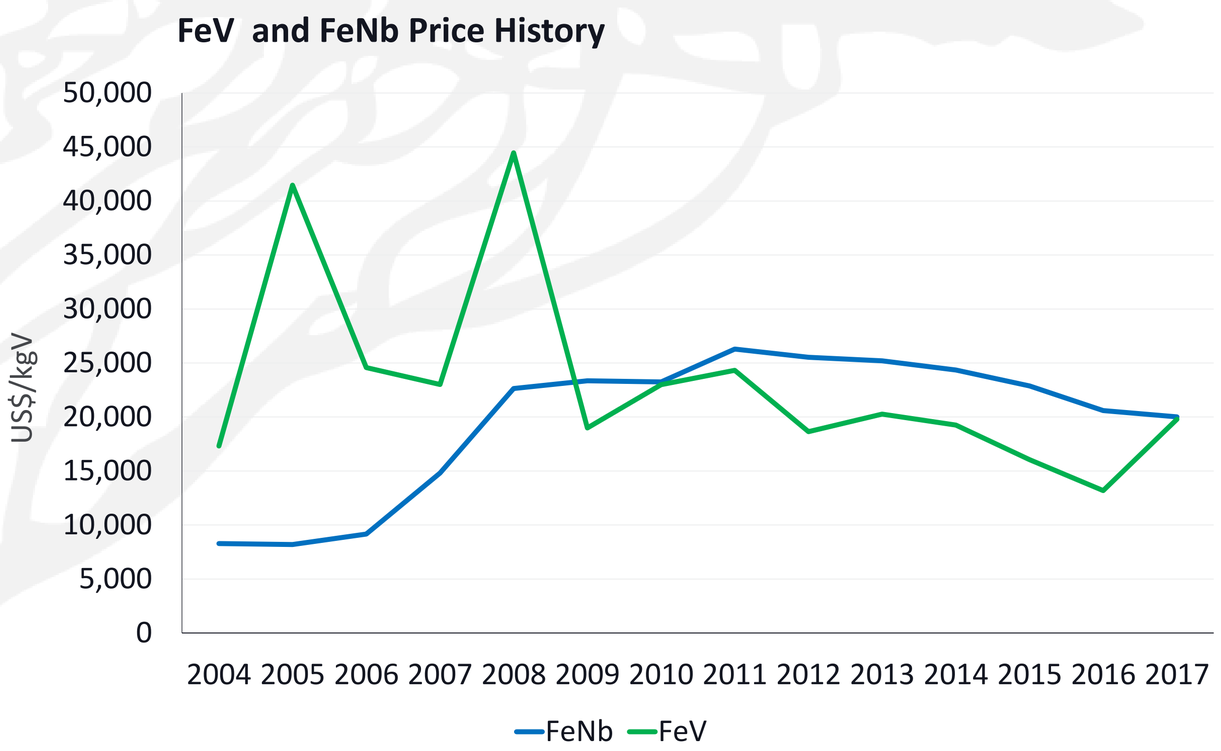
- Vanadium price contribution to VRFB costs significant, so high vanadium prices not ideal for promoting adoption
- However, design of VRFBs that separate energy unit (electrolyte) and power unit (stacks) allows for innovative business models to be developed around vanadium electrolyte cost to preserve cost competitiveness
- Such business models will take advantage of above described architecture and re-usability of electrolyte at end of life
- Thus risk of self-cannibalisation while real in a high vanadium price environment, can be mitigated

Price Outlook

Substitution Consideration

How real is the substitution threat from Niobium?

- **Factors working against substitution:**
  - Replacement of ferrovanadium requires technical adjustments to steel production, to ensure that product specifications and quality are not compromised
  - Vanadium is generally considered to require lower rolling pressures and temperatures than niobium to give equivalent steel properties
  - Less energy is thus consumed in the production process when vanadium is used
  - Niobium supply significantly more concentrated – CBMM controls >80% of supply with significant additional capacity
- These factors combined mean that substitution is normally not considered for short-term changes in market conditions because of the considerable effort needed to implement the changes
- **Factors supportive of substitution:**
  - Sustained high vanadium prices
  - Vanadium price volatility
  - Long term niobium contracts provide reasonable price stability for steel plants
  - Concentration in niobium supply means supply response better coordinated



Source: Bushveld Mineral analysis, Roskill

Key Takeaways

DEMAND

- Steel market set to continue supporting robust vanadium demand through:
  - Growing global steel production – strong positive correlation
  - Growing intensity of use in steel in emerging markets, especially in China where it is driven by improved enforcement of regulations
- Consumption of vanadium in steel set to grow by 2.24% CAGR from 2017 to 2027
- Growing applications of vanadium in energy storage industry via VRFBs set to bring step change to demand
  - VRFB Expected to account for 20% of V consumption by 2030. Strategies for countering impact of high Vanadium prices will be key for success

SUPPLY

- Over 70% of Vanadium produced is through co-production which is driven by steel fundamentals
- The steel market structural changes are expected to continue adversely impacting the economics of vanadium co-producers going forward:
  - excess iron ore supply resulting in low iron ore price outlook in the medium term,
  - excess steel production capacity in a context of subdued steel consumption growth expected to see steel prices forecasts remain at subdued levels Limited scope for existing unused capacity (~565) being brought into production
- Limited scope for supply growth from existing co-producers:
  - 49% of the global excess capacity is in China and consists mostly of co-producers, which are driven by the steel market economics
- Significant challenges facing greenfield vanadium production
  - Most of the new production that have been announced are co-producers or multi-commodities producers, facing large capex, driven by factors outside vanadium resulting in a significant share of them not coming online
  - **Quality primary vanadium projects are best suited to meet the growing demand of vanadium**

There is more upside in vanadium demand growth being realized than there is downside in the form of surplus production materialising

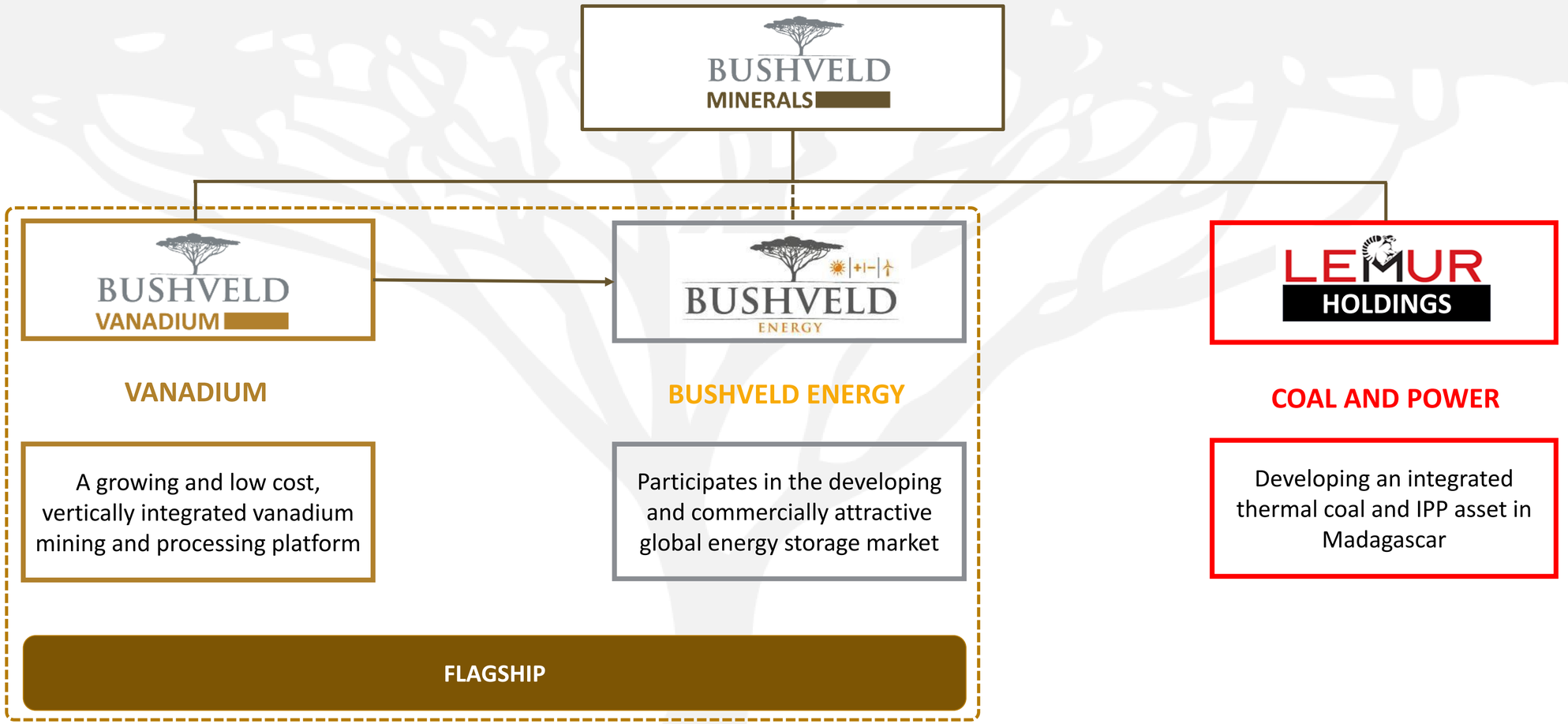
BUSHVELD MINERALS

THE LEADING INTEGRATED VANADIUM PRODUCER

3 May 2018

Company Overview

An integrated vanadium platform with investments in coal and power



Note: The Company holds a 17.48% shareholding in AIM-listed AfriTin Mining Limited

Key Market Metrics

Strong share price performance since March 2018

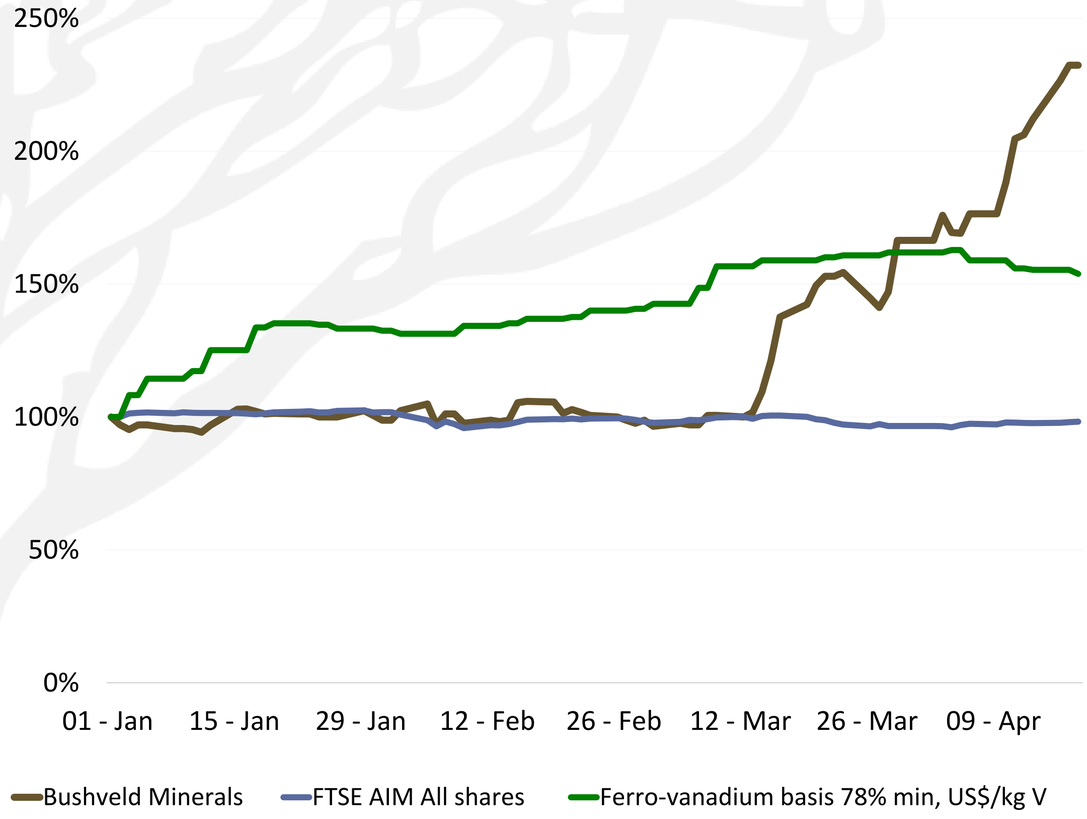
BMN Share Price (01 May 2018)	23.30p
Basic Ordinary Shares	1,067,755,966
52-Week Hi-Lo	23.30 – 7.60p
Market Capitalisation	£248,787,140
Warrants in issue	26,743,696

Source: Bloomberg. 1 May 2018

	Bushveld Minerals Top 10 Shareholders	# shares	% ownership
1	Hargreaves Lansdown Nominees	143,754,723	13.55
2	Interactive Investor Sharedealing	100,717,685	9.50
3	Halifax Share Dealing	86,136,790	8.12
4	Acacia Resources Limited	85,598,644	8.07
5	Yellow Dragon Holdings Limited	79,766,364	7.52
6	Pictet Asset Mgmt	63,692,075	6.00
7	Jose Roy Hernandez Borromeo	37,969,130	3.58
8	Selftrade - Talos Securities	35,049,737	3.30
9	A J Bell Securities	27,547,806	2.60
10	Barclays Wealth and Inv. Management	26,686,450	2.52

Source: Link Asset Services. As at 30 March 2018

YTD Share Price Performance (indexed)
AIM:**BMN**



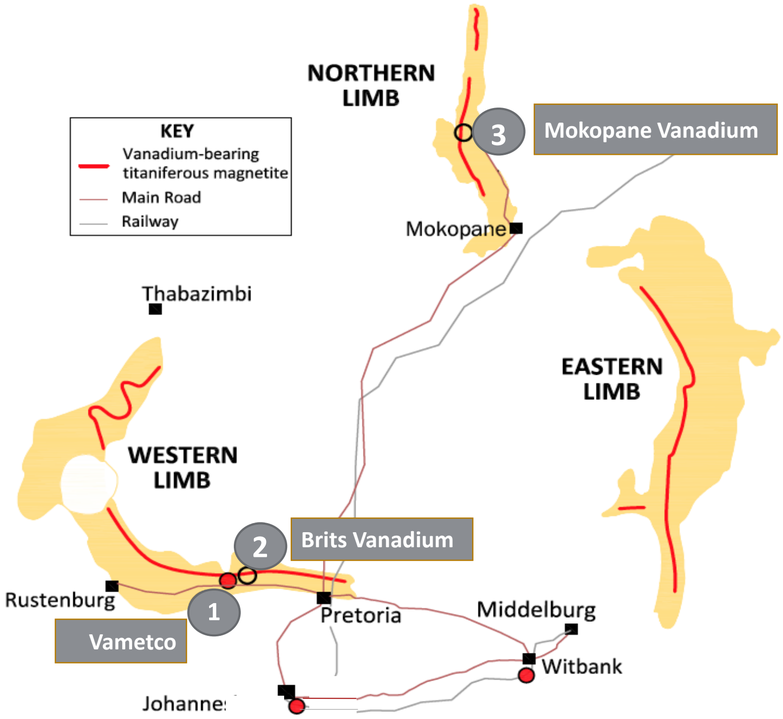
Source: Bloomberg. 18 April 2018

BUSHVELD VANADIUM

Bushveld Vanadium aims to become a significant, low cost, integrated primary vanadium producer globally

Bushveld Minerals' Investment Proposition

A leading, low cost, vertically integrated primary vanadium mining and processing platform



1

Large, open cast deposits **439.6Mt** combined resource (including **~55 Mt** combined reserves)

2

Some of the highest primary grades in the world **~2% in-magnetite V_2O_5 grades**

3

One of the **lowest primary** vanadium producers

4

Vertical integration with **low cost base** presents opportunity for entry into the multibillion-dollar energy storage industry

5

Experienced leadership team with over 100 years of experience

6

Established brownfield infrastructure

allows for low capex scale-up to up to significant share of V supply

7

Concentrated global supply with **South Africa as the largest host of high-grade primary vanadium resources**

BUSHVELD VANADIUM

Vametco

Vametco Overview

Vametco enjoys a significant, c. 3% market share of the global vanadium market with expansion plans underway to increase this to more than 5%

- Open-pit mine along 3.5km strike with in-magnetite V grades of c.2% V_2O_5, among the highest in the world
- 26 Mt, 26.79% magnetite, 1.96% V_2O_5 reserve and 142.4 Mt resource, 29.44% magnetite, 1.96% V_2O_5
- Utilises well-established salt roast processing method to produce refined vanadium in the form of Nitrovan™ and modified vanadium oxide (MVO)
- Three-phase capacity expansion underway:
  - **Phase I:** completed in Q3CY17, raised production capacity to 3,035 mtV, through a self-funded capex of US$0.5m
  - **Phase II:** will take capacity to 3,750 mtV by June CY18, through a self-funded capex of US$2.5m
  - **Phase III:** to increase capacity to 5,000 mtV by the end of CY19, through a self funded capex of ~US$15m
- 483 employees (including contractors)
- Management with over 100 years of vanadium mining and processing experience in South Africa

Positive Key Performance Drivers For Vametco

Vametco's strong cash position

- **Production capacity**

  CY18 production guidance of 3,680 mtV[1], supported by the second phase of the expansion project

  Expansion project to grow Vametco's share of global market from more than 3% to over 5% by 2019

- **Vanadium Price**

  Strong start of CY18 with a price increase of circa 55% YTD[2]:

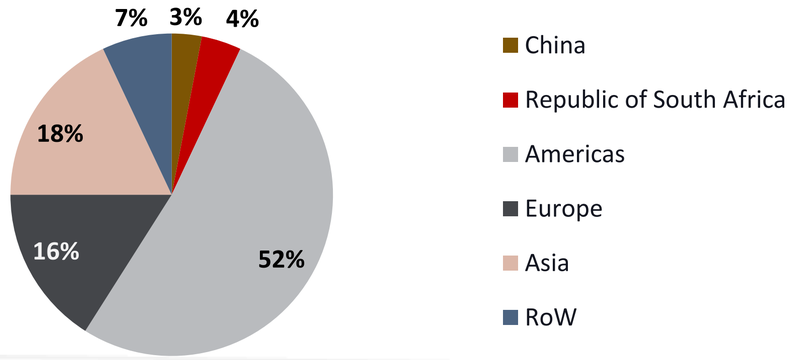
  - FeV trading at a price of ~US$70/kgV in April 2018
  - Vametco's realised price is based on an average one-month prior to sale

- **Cost**

  CY18 production cost expected to decrease by 7% from ZAR221/KgV to ZAR205/KgV, mainly due to economies of scale

Bushveld Vametco results[3]	(100%)	CY17	CY16	CY15
Vanadium produced	(mtV)	2,649	2,856	2,419
Vanadium sold	(mtV)	2,721	2 ,810	2,340
FeV LMB price	US$/Kg V	32.6	18.5	18.6
USD/ZAR exchange	$=ZAR	13.3	14.7	12.8
Revenue	ZAR'm	1,090.3	760.0	629.3
EBITDA	ZAR'm	315.6	48.3	16.7
Production costs[4]	ZAR/kg V	220.7	189.8	185.8
Production costs[4]	USD/kgV	16.6	12.9	14.6

Bushveld Vametco's Global Customer Base (CY17 Sales)



1. Consisting of 3,050 mtV Nitrovan® and 630 mtV FeV
2. Ferro-vanadium basis 78% min, US$/kg V, price as at 18 April 2018
3. Following the completion of the acquisition of the remaining 55% share in Vametco in December 2017, Bushveld's net attributable interest is 59.1%, and will be consolidated on a 100% basis from the December 2017 financials
4. Excludes depreciation, royalties, selling, general, and administrative expenses

Source: Bloomberg, Company records

BUSHVELD VANADIUM

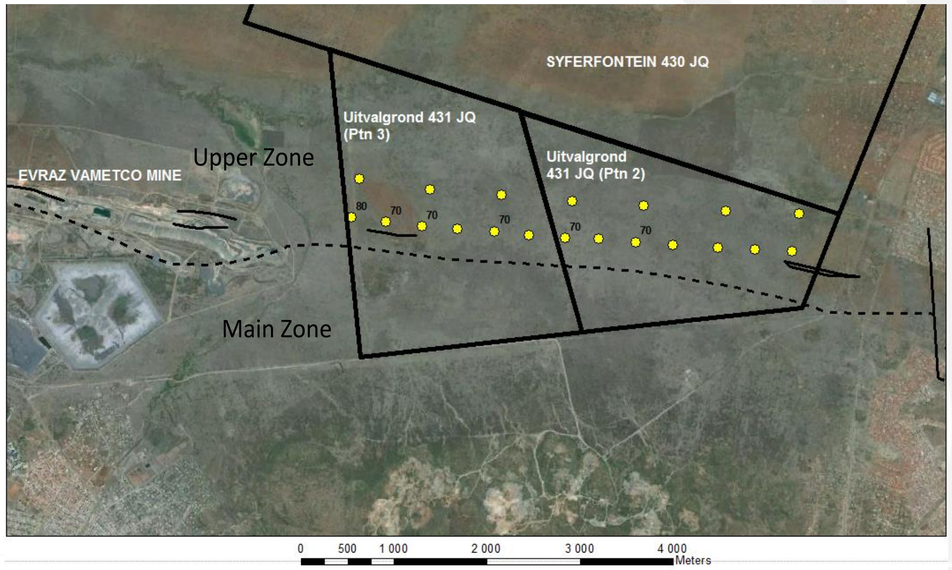
Brits Vanadium Project

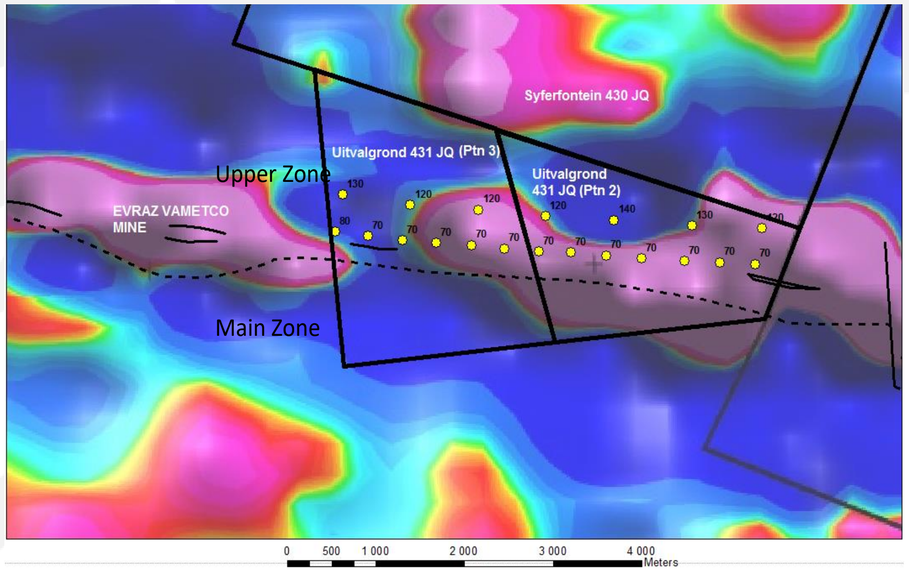
Mokopane Vanadium

Brits Vanadium Project

Large high-grade primary vanadium resource base

- Outcropping, strike extension of the Vametco mine
- Exploration programme commenced in Q1CY18, with the aim of delineating a maiden Mineral Resource Estimate
- Positive results from a soil geochemical sampling programme and ground magnetic survey has led to several drilling targets being delineated
- Historical drilling showed in-magnetite grades of as much as 2.6% V_2O_5





Mokopane Vanadium Overview

Key project statistics compared to other vanadium projects

Item	Unit	Value
Production		
Mineral Resource	Mt	300[1]
Ore Reserve	Mt	28
Grade (in-situ)	%	1.4%
Grade (in-magnetite)	%	1.75%
Assumed Vanadium Price	$/lb V_2O_5	7.50
Initial Capital Costs	US$ m	298
NPV @ 9% real	**US$ m**	**418**
IRR real	**%**	**25%**

Development strategy options:

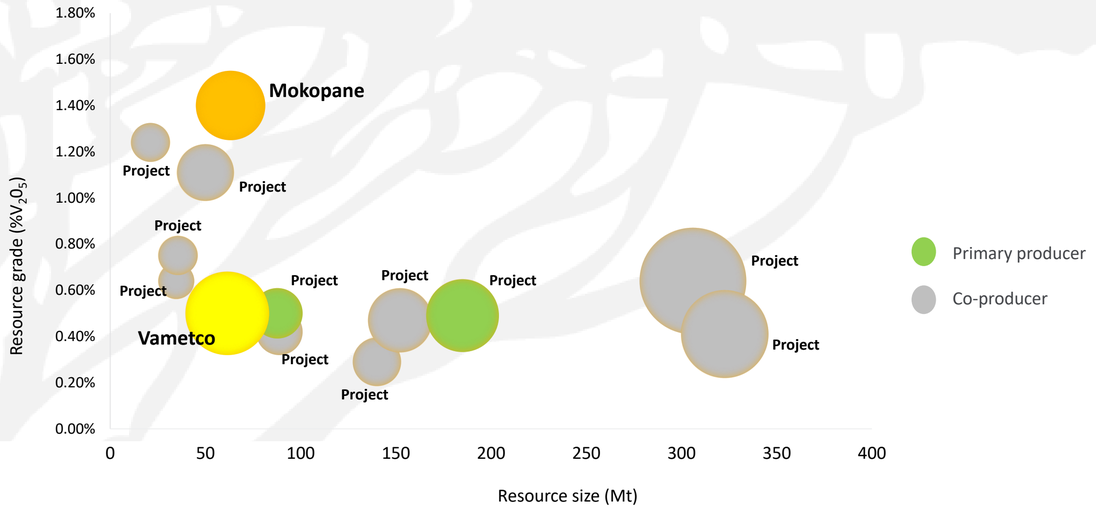
- Secure mining right
- Supply ore to China
- Supply ore to other brownfield mines
- Develop greenfield integrated mine & processing plant producing 5.3 ktV tpa of a >99% purity V_2O_5 product

1. The Mokopane Vanadium Project PFS was based on the MML only which is 63Mt even though the overall project resource is 300 Mt

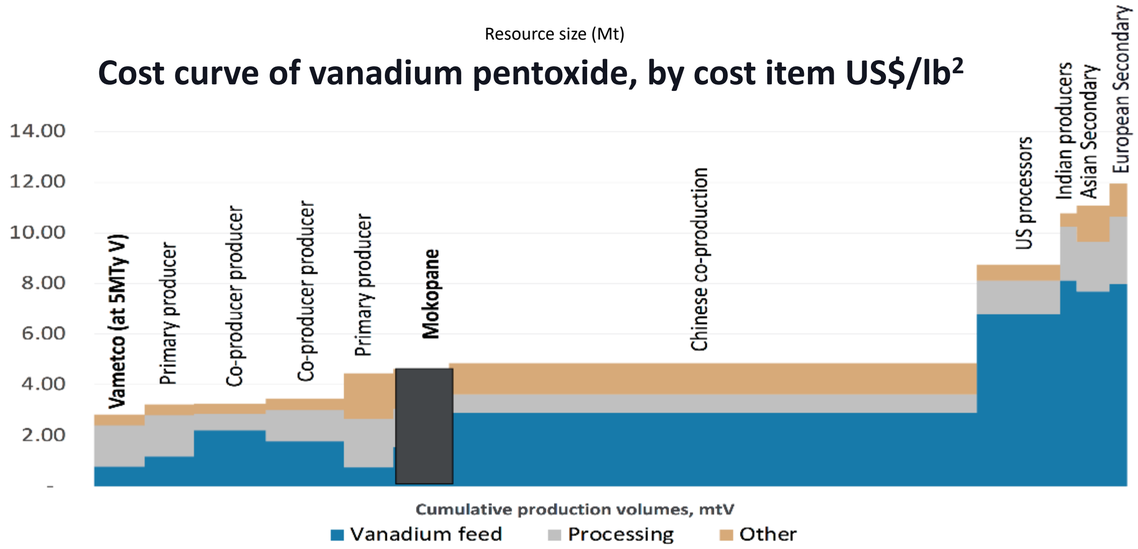
2. Vametco after two stage expansion from 3Mtpy to 5Mtpy. Mokopane costs based on operating costs and capital expenditure as estimated in pre-feasibility study. Mokopane project shown for illustration purposes only and does not imply judgement on Roskill's behalf of the likelihood of Mokopane being commissioned, nor does it imply a judgement of Mokopane's economics as compared to other brownfield and greenfield expansion projects not included in this cost curve

Source: Bushveld Minerals analysis, Roskill

Measured and indicated resources (bubble size = contained V_2O_5) size



Cost curve of vanadium pentoxide, by cost item US$/lb[2]



Growth Strategy

As an integrated vanadium producer we are focused on enhancing growth horizontally and vertically

Horizontal Growth

Organic growth

- Leverage its high quality vanadium resources
- Existing global vanadium market share of more than 3%, expected to grow to over 5% with the completion of the three-phase expansion project by 2019:
  - Phase I: completed in Q3CY17, raising production capacity to 3,035 mtV, with capex of US$0.5m
  - Phase II: will take capacity to 3,750 mtV by June CY18, through self-funded capex of US$2.5m
  - Phase III: to increase capacity to 5,000 mtV by the end of CY19

Targeted brownfield opportunities

- Continued focus on enhancing value through targeting brownfield opportunities
- Diversify product portfolio

Vertical Growth

- Portfolio diversification through the supply of electrolyte for vanadium redox flow batteries (VRFBs) for energy storage
- Bushveld Energy established to promote use of vanadium in energy storage by:
  - Exclusively focusing on VRFB technology (potential US$70bn addressable market for VRFBs)
  - Marketing and developing utility-scale projects using VRFB-based energy solutions across Africa
  - Partnering with UniEnergy Technologies (UET), a US-based leading VRFB manufacturer
  - Signed agreement with Eskom for the installation of a VRFB with a peak power of 120kW and peak energy of 450 kWh
  - Working with the IDC to establish vanadium electrolyte production in South Africa

Vertical Integration Illustrated

Bushveld Energy's vertically integrated business model is designed to maximise the share of the vanadium value chain in VRFBs

- Large high grade low cost primary vanadium mining and processing

- Electrolyte manufacturing
- Scope to co-locate in Vametco process => significantly lowering costs

- VRFB Assembly and manufacturing

- MW scale energy storage project development
- Deployment models include PPAs, leasing models

~US$5 Bn market

Potential >US$70 Billion addressable market for VRFBs

Source: BCG, Bushveld Minerals analysis, Citi, Roskill, TTP Squared

Bushveld Energy Overview

A significant opportunity to drive the adoption of VRFBs throughout the African continent

Bushveld Minerals is well positioned to address the two major hurdles to VRFB adoption

	Global challenge	Bushveld's opportunity
Security of supply	• 1,000 MWh of VRFB-based energy storage requires ~6% of global vanadium supply • VRFBs estimated to contribute 20% of vanadium consumption by 2030	• Extensive vanadium resource in South Africa of roughly 440 Mt • High grade of vanadium resources in Bushveld complex allow for low cost, primary vanadium production
Stability of vanadium input cost	• Vanadium input costs contribute 30%-40% of the cost of the VRFB systems • Vanadium prices have risen >200% in the past 12 months	• Bushveld vanadium projects are well positioned with a lower first-quartile cash cost to mitigate security of cost risk • New business models for electrolyte supply are now being developed

STRATEGY

- An energy storage solutions company, and integrated part of Bushveld Minerals
- Exclusively focusing on VRFB technology, including marketing and project development across Africa
- In process of delivering a VRFB 450kWh into Eskom's RT&D facility by Q2CY18
- Objective is to establish a global VRFB supply chain in South Africa, starting with vanadium electrolyte

Progress

We Have Delivered On Our Commitments…

Developing each of the Company's platforms

- Acquisition of Bushveld Vametco Limited with 100% ownership completed in 2017
- AfriTin Demerger completed in 2017
- Lemur: Signed a 30 PPA with JIRAMA and a technical partnership with Sinohydro

Asset/project development

- Successfully completed the first phase of the expansion project at Vametco
- Vametco is one of the lowest cost producers, positioned in the first quartile
- On track to deliver first VRFB project with Eskom in Q2CY18

… And We Will Continue To Deliver On Our Objectives

Vametco

- On track to complete on time and within budget the second phase of the expansion project which will take production capacity to 3,750 mtV
- Complete the third phase of the expansion project which will take production capacity to 5,000 mtV
- Continuously striving to reduce cost

Brits

- Commenced an exploration programme in Q1CY18 which has shown positive drilling results. The aim is to establish a positive maiden Mineral Resource Estimate

Mokopane

- Expect to be granted a New Order Mining Right
- Develop the project along the Company's broader vanadium portfolio

- Deliver the first VRFB project with Eskom in Q2CY18
- Grow the VRFB project pipeline across Africa
- Supply electrolyte samples to VRFB OEMs and secure interest in electrolyte offtake globally

- Obtain the concession for the project
- Conclude the SEIA Study
- Pursue funding and credit enhancement options for the project, which have already been initiated

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