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## **An Introduction - Vanadium Recovery Project**

10 December 2020



## VANADIUM RECOVERY PROJECT



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# VANADIUM RECOVERY

- Critical Metals together with its partner Neometals Ltd aims to recover vanadium from steel slag and process it into high-grade vanadium products used in the steel alloy, energy storage and aerospace industries (hereafter the “**Vanadium Recovery Project**” or “**VRP**”)
- The VRP has the potential for vanadium production in the lowest quartile of production costs globally due to the very high vanadium grade within the stockpiles, the proposed low energy – low emission – low throughput process and location of the stockpiles.
- The VRP expects to supply ~5% of global demand from 2025.



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# OPPORTUNITY

- Supply Europe with high-purity vanadium without opening a new mine.
- Recover metals from by-products in an environmentally friendly manner whilst consuming significant tonnages of CO<sub>2</sub>.
- Supply the European energy storage industry with responsibly sourced vanadium chemicals.
- Decrease Europe's reliance on China, South Africa and Russia for the supply of vanadium.



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# BACKGROUND

- Scandinavian steel giant SSAB has +1.75Mt of high-grade vanadium-bearing by-product (“Slag”) stored at steel mills in Sweden and Finland, and is continually adding to this supply.
- Critical Metals Ltd and Neometals Ltd have secured 2Mt of this high-grade vanadium via a supply agreement.
- Scoping study indicated potential lowest quartile position OPEX.
- City of Pori, Finland selected as location for the Vanadium Recovery Project.

# STOCKPILE LOCATIONS

Luleå	
Slag stored	+739kt
Vanadium Grade $V_2O_5$	+4%
Net Slag Added	100ktpa



Raahe	
Slag stored	+458kt
Vanadium Grade $V_2O_5$	+3%
Net Slag Added	80ktpa

Oxelösund	
Slag stored	+560kt
Vanadium Grade $V_2O_5$	+3%
Net Slag Added	90ktpa

## Agreement Volumes and Price

- Initial purchase of 700kt of Slag from Luleå post FID
- Purchase 200ktpa Slag post commencement of commercial production for 10 years
- Price linked to prevailing FeV80 vanadium price and vanadium content (reference grade 2.2%V (~ 3.9%  $V_2O_5$ ))

# PRODUCTION LOCATION

Tahkoluoto Port, City of Pori, Finland



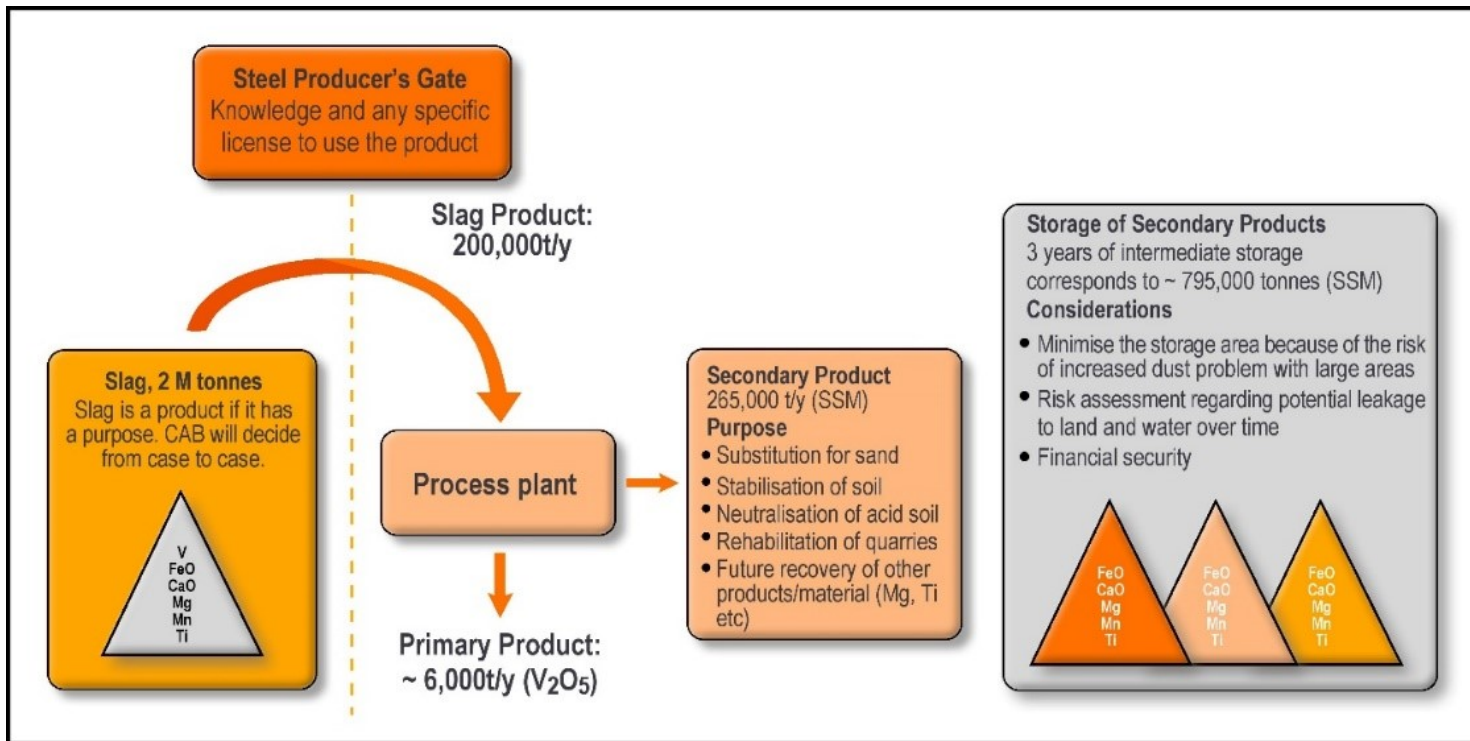
# EXISTING INFRASTRUCTURE

## Tahkoluoto Port, City of Pori, Finland

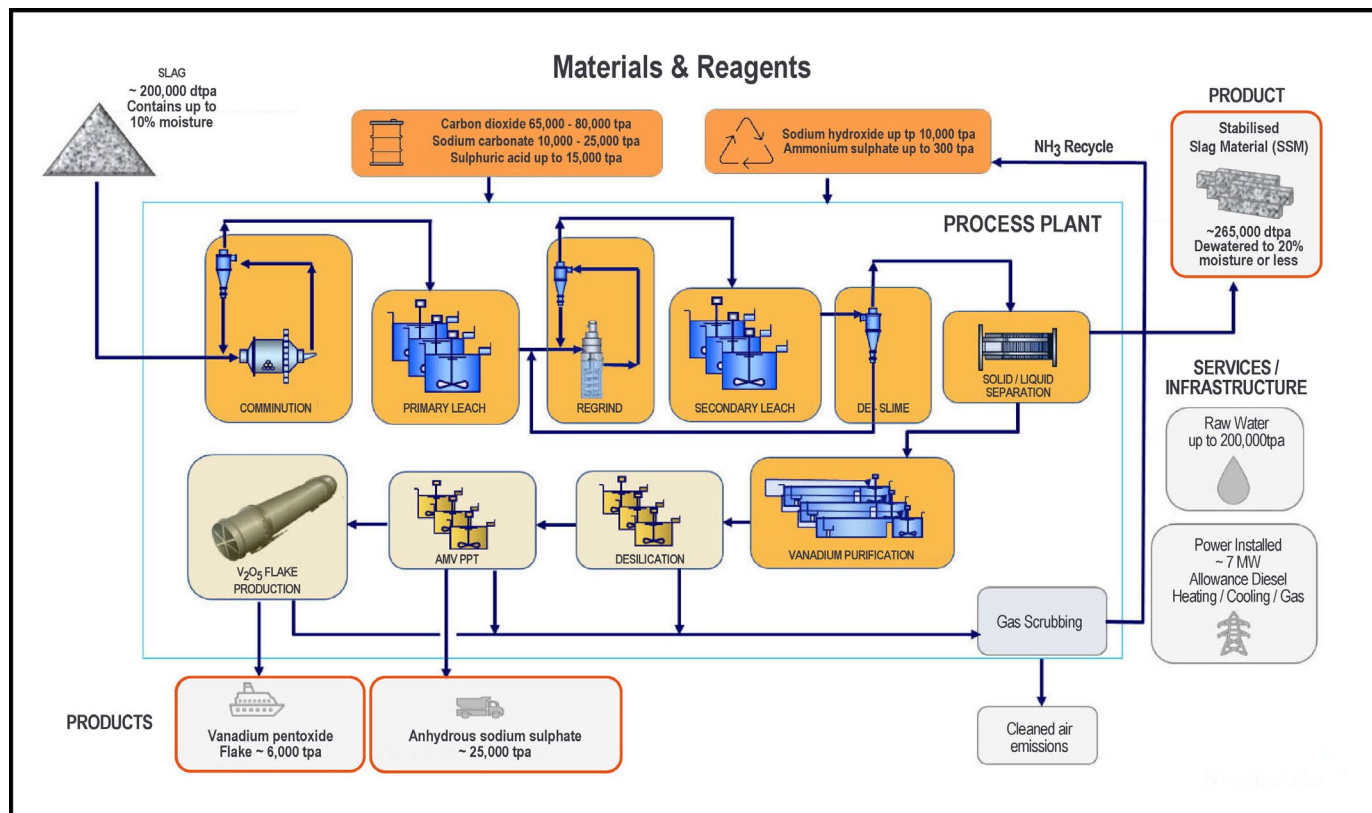




# MATERIALS FLOW

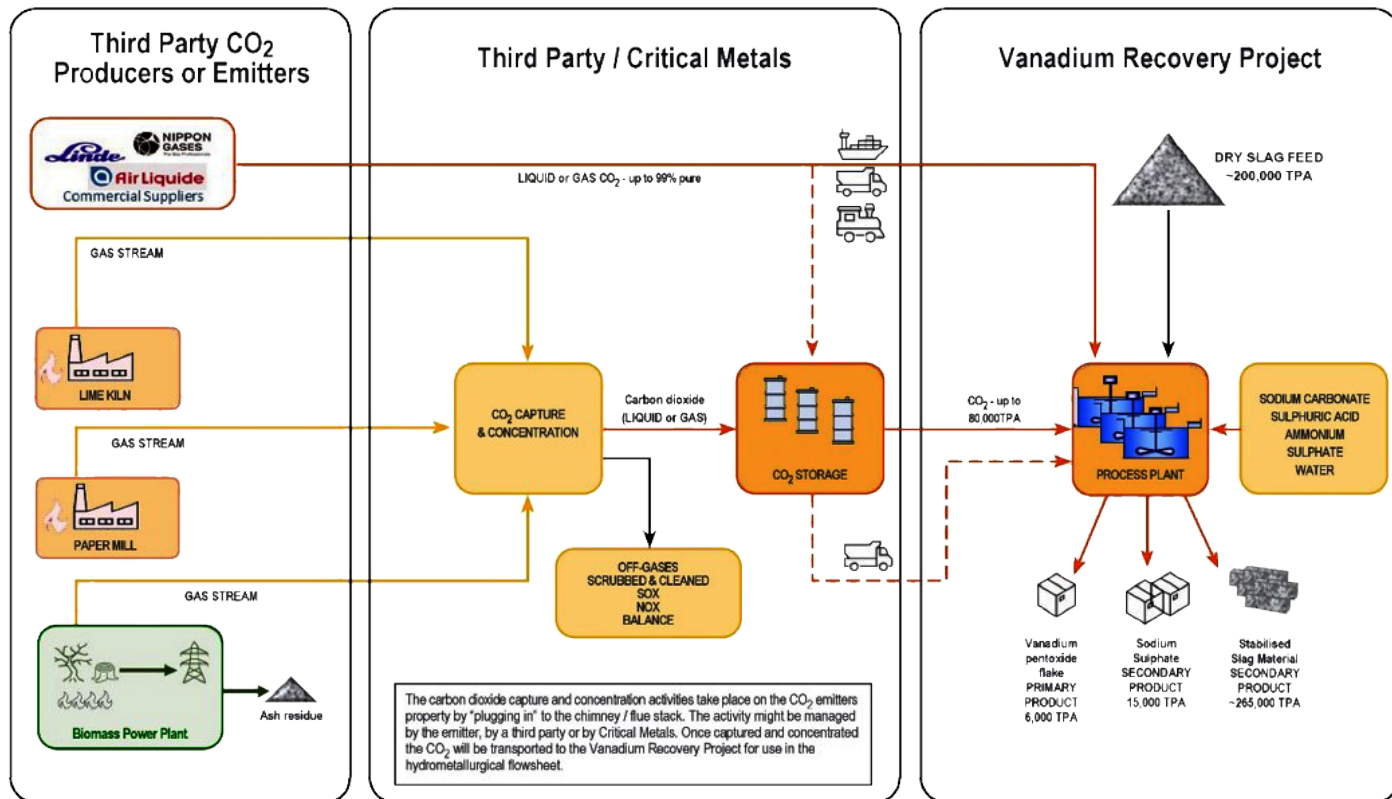


# PROCESS



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# CARBON CAPTURE



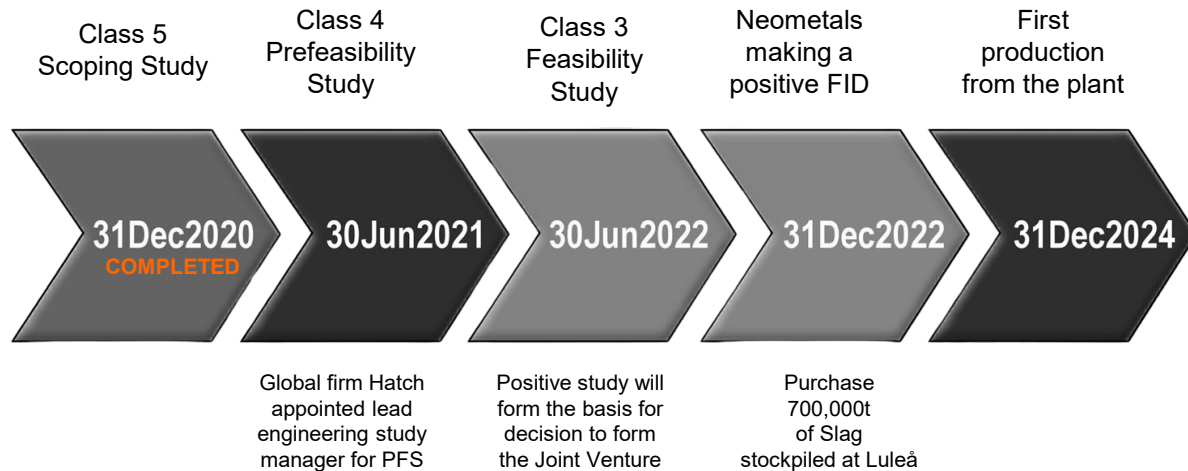
# PILOT PLANT

- 100kg of slag from Luleå processed in Mini Pilot Plant in September 2020
  - Exceptional product purity of 99.5%  $V_2O_5$
  - Vanadium recoveries exceeding 75%
  - Leach residence times reduced by 50% from scoping study estimates
  - Mini pilot constructed, commissioned and operated continuously through the campaign without any safety incidents or process challenges.
  - Mini Pilot Plant confirmed bench scale findings
- 45T of slag (15T each from Oxelösund, Raahe and Luleå) will be processed in Pilot Plant scheduled for mid 2021



# WORK PROGRAM

## Indicative Project Timeline



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# SCOPING STUDY RESULTS

Plant  
feed rate



**200,000tpa**

Vanadium Output



**12 m lbs p.a.  
high purity V<sub>2</sub>O<sub>5</sub>**

OPEX



**US\$3.92/lb**

Capital costs



**US \$159m**  
(inc 20% contingency)

Payback



**<5 years**

Pre tax NPV<sub>10</sub>



**US \$138m**  
(IRR 24%)



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# CONTACT DETAILS

For further information please contact:

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<p><a href="http://www.criticalmetals.eu">www.criticalmetals.eu</a></p>	<p>@CuAuNiFeLiCoC</p>

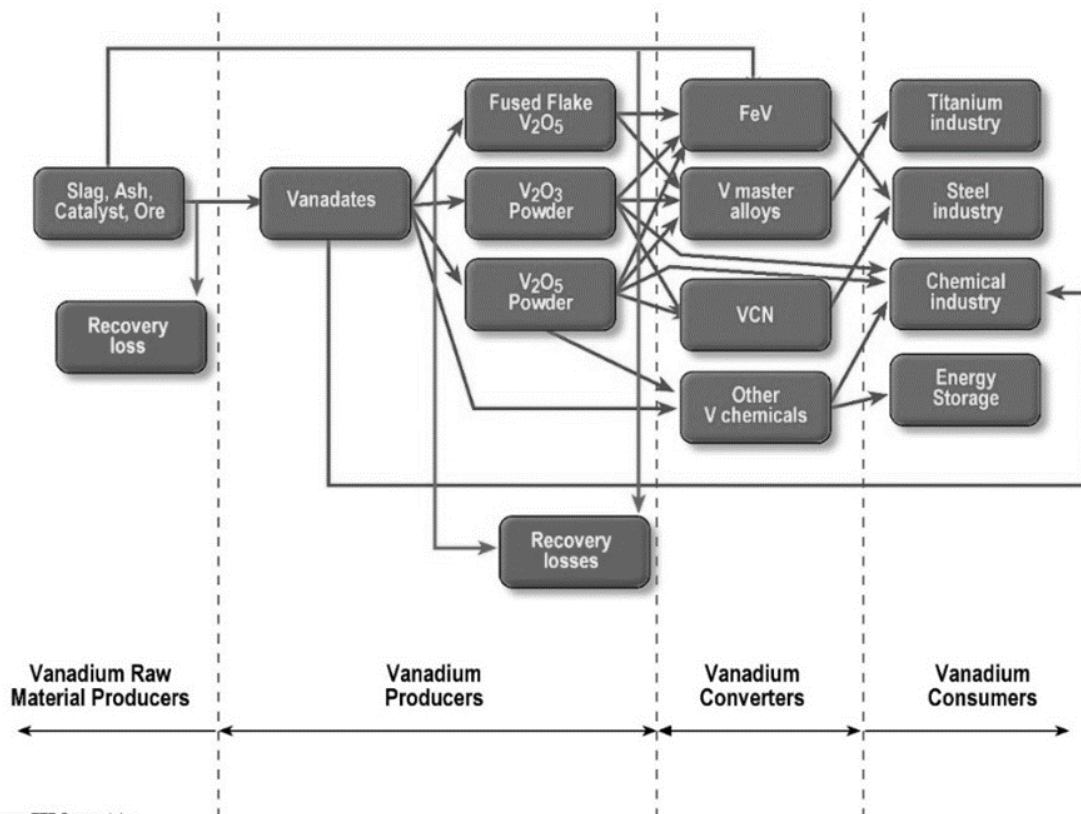
# APPENDICES



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# VANADIUM – MARKET



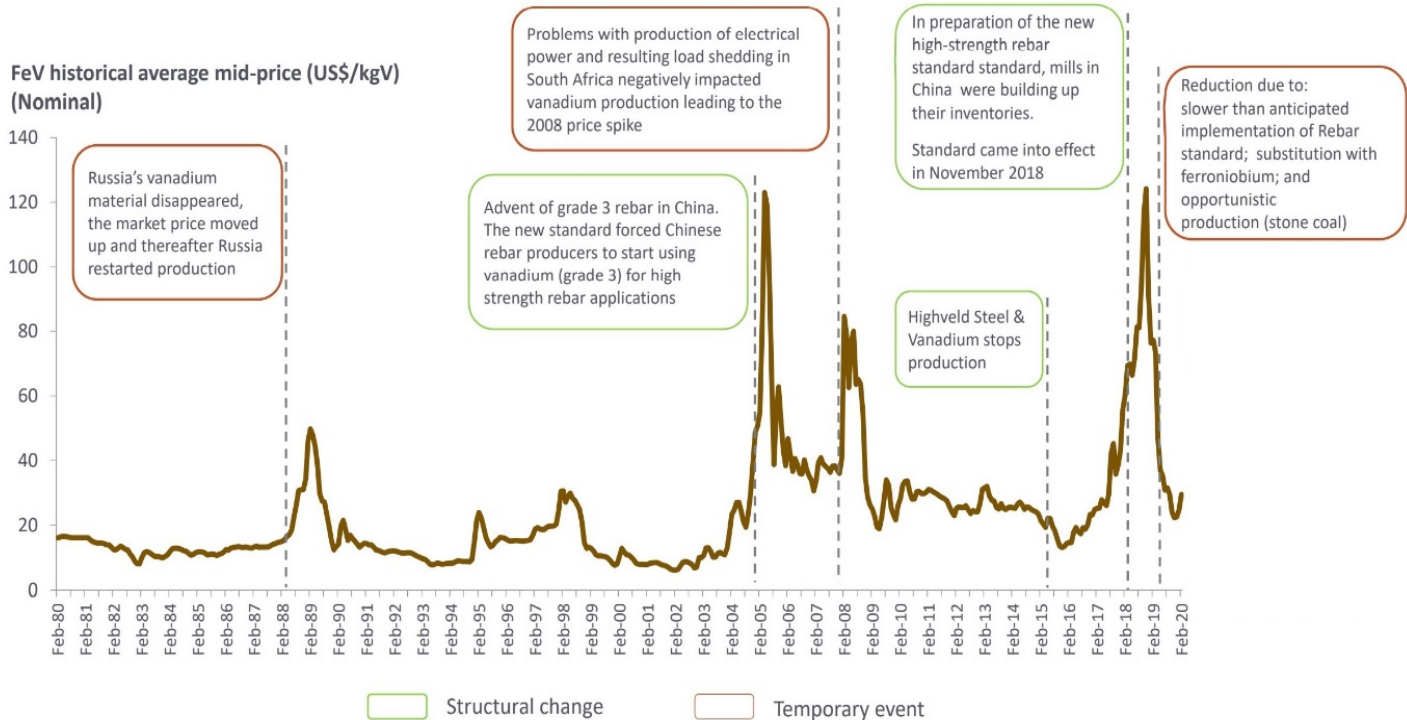
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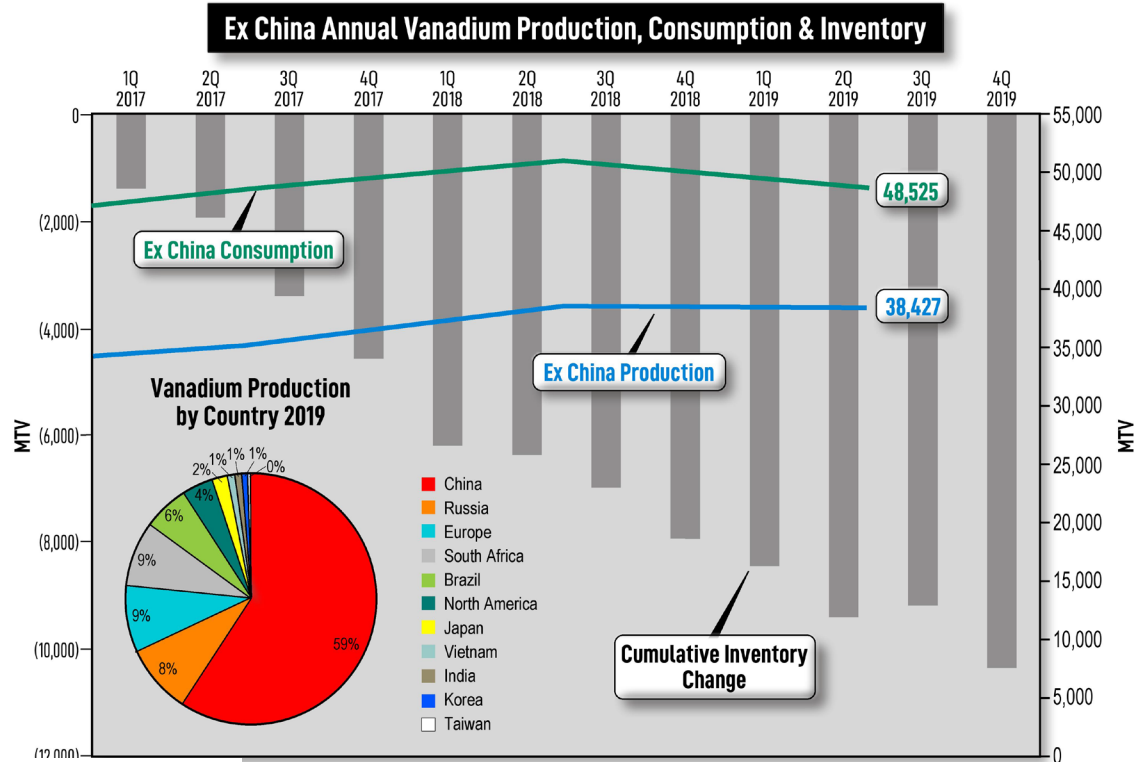
# VANADIUM – PRICE CHART

## Ferrovanadium price chart



# VANADIUM – SECURE EU SUPPLY CHAIN

Vanadium on European Union Critical Metals List since 2017



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# CRITICAL METALS GROUP – DIRECTORS

## **Jonathan Murray – Independent Non-Executive Chairman**

Resides in Perth, Australia

20 years experience as a corporate lawyer; Senior Partner of Steinepreis Paganin. Principal legal practice areas include equity capital markets, takeovers, project acquisitions and divestments, corporate governance, commercial law and strategy.

## **Amanda Scott – Non-Executive Director of Swedish Subsidiary Companies**

Resides in Malå, Sweden

Geologist with 15 years experience (8 years in Sweden). Extensive experience in Western Australia and northern Scandinavia generating new projects and exploring for lithium, gold, copper, nickel, PGEs, iron and manganese.

## **Markus Bachmann – Non-Executive Director**

Resides in Johannesburg, South Africa

Corporate finance professional with 20 years experience. Founder of Craton Capital. Craton Capital awarded Fund Manager of the Year at the Mining Journal's "Outstanding Achievement Awards" during December 2010.

## **Per-Olof Renling – Non-Executive Director of Swedish Subsidiary Company**

Resides in Malå, Sweden

Experienced in Power Generation and Power Distribution, particularly construction of power lines and operation and maintenance at thermal power generation and heat distribution plants. Currently Mr Renling is the site manager for several wind farms.

## **Kris Gram – Non-Executive Director**

Resides in Oslo, Norway

5 years Management Consultant and 10 years Investment Banking experience. Currently COO of Norwegian investment bank.

## **Olof Forslund – Non-Executive Director**

Resides in Malå, Sweden

Geophysicist with extensive international experience in the mineral exploration industry. Founder of Malå Geoscience. Commenced with Geological Survey of Sweden (SGU) in 1966 and during the period 2003 – 2007 was Regional Manager of the Mineral Resources Information Office in Mala, Sweden.

## **Damian Hicks – Executive Director**

Resides in Perth, Australia

15 years experience as Founder of resources companies in Western Australia (since 2002) and Sweden (since 2007). Financial, legal and compliance qualifications with principal responsibilities including strategy formulation, team development, deal origination & execution and capital raising. Director of all companies within the Group.



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# VANADIUM RECOVERY PROJECT – INPUTS

DESCRIPTION	CHEMICAL SYMBOL	VOLUME / MASS (TONNES/Y)	COMMENT
Slag		200,000	Feedstock currently stockpiled in Luleå, Oxelösund and Raahe.
Raw water	H <sub>2</sub> O	165,000	To be sourced from local supplier. Raw water storage tanks. Used as make-up for cooling tower and reagent mixing. First fill ~1,000m <sup>3</sup> .
Potable water	H <sub>2</sub> O	4,500	To be sourced from local supplier. Used in ablution facilities, safety showers and main buildings. Direct municipal pipeline assumed. No storage. First fill ~150m <sup>3</sup> .
Sodium carbonate	Na <sub>2</sub> CO <sub>3</sub>	25,000	Commercial supply, ~3 trucks per day.
Carbon dioxide	CO <sub>2</sub>	80,000	To be sequestered from industrial site currently emitting gas to atmosphere, delivered via pipeline or truck.
Sulfuric acid	H <sub>2</sub> SO <sub>4</sub>	15,000	Commercial supply, ~2 trucks per day.
Sodium (or potassium) hydroxide	NaOH / KOH	10,000	Commercial supply, ~2 trucks per day
Ammonia	NH <sub>3</sub>	300	Commercial supply, ~2 trucks per month – stored in steel tanks
Heat		250,000,000 MJ/year	Heat for building and plant.



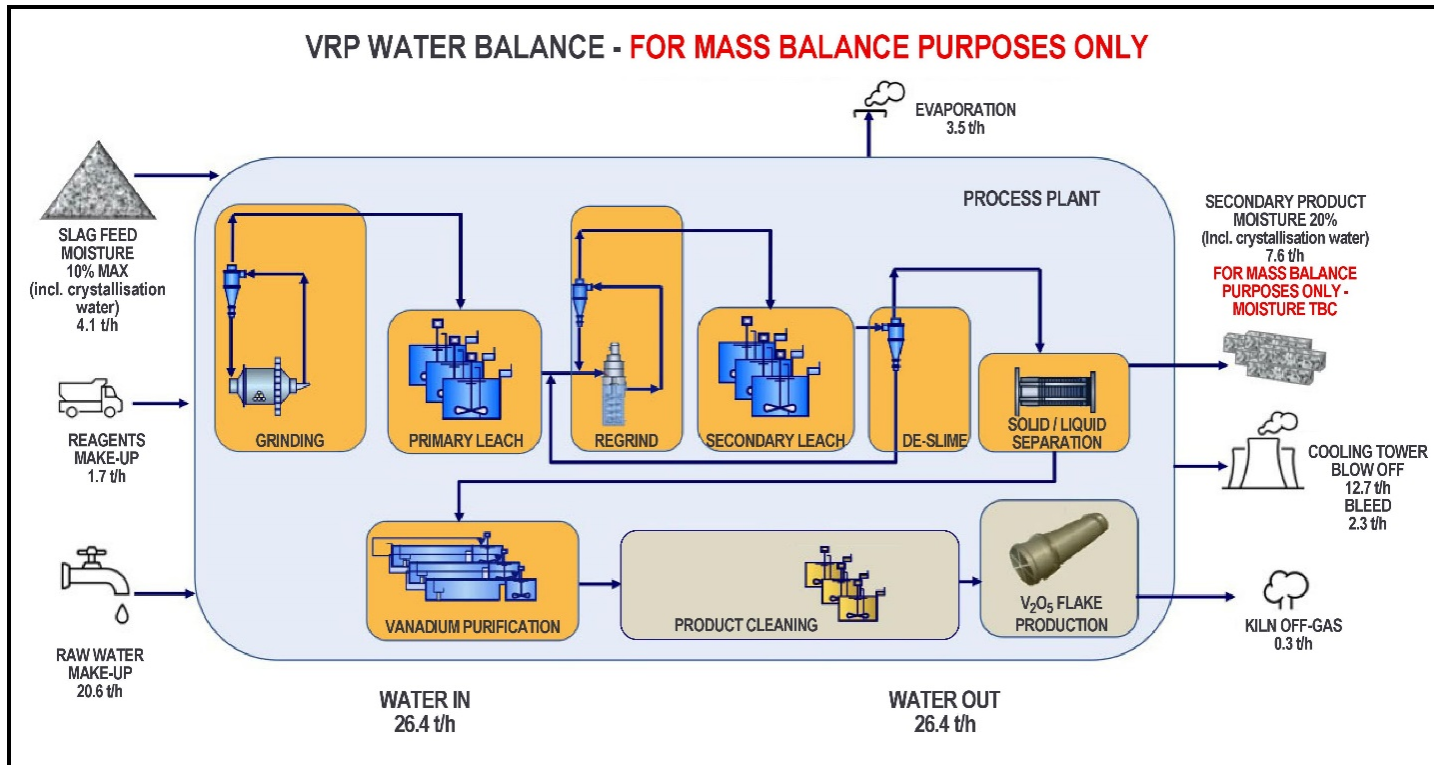
# VANADIUM RECOVERY PROJECT – OUTPUTS

DESCRIPTION	CHEMICAL SYMBOL	VOLUME (TONNES/Y)	COMMENT
Vanadium pentoxide	V <sub>2</sub> O <sub>5</sub>	6,000 tpa	Produced as a flake and stored in bulker bags and or sealed 44-gallon drums.
Stabilised slag material (SSM)		265,000	To be stored on site or sold.
Sodium (or potassium) sulphate	Na <sub>2</sub> SO <sub>4</sub> / K <sub>2</sub> SO <sub>4</sub>	25,000	Produced as crystallised material (likely anhydrous) ready for sale and distribution. Marketing pending.



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# VANADIUM RECOVERY PROJECT – WATER BALANCE



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# VANADIUM RECOVERY PROJECT - STABILISED SLAG MATERIAL

- One of the secondary products is stabilised slag material (SSM)
- SSM is considered inert and non-hazardous.
- SSM product is a filter cake of calcium carbonate rich particles, normally  $<20\mu\text{m}$  and with a water content of about 20% or less (depending on the filtration method and the level at which the material is dried during filtration).
- Annual production of the dried material is estimated at ~265,000 tons / year (291,500 - 307,400 tons / year wet filter cake).
- pH of ~11 and a liquid density of 1.02.
- Chemical composition is estimated to be calcium (~24%), iron (~14%), magnesium (~4%), silica (~3%), manganese (~2%), aluminum (~0.75%), titanium (~0.6%), vanadium (~0.4%), phosphorus (~0.2%) and chromium (0.1%).
- As the test work continues, more accurate information will be obtained.



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