



VANADIUM MARKET

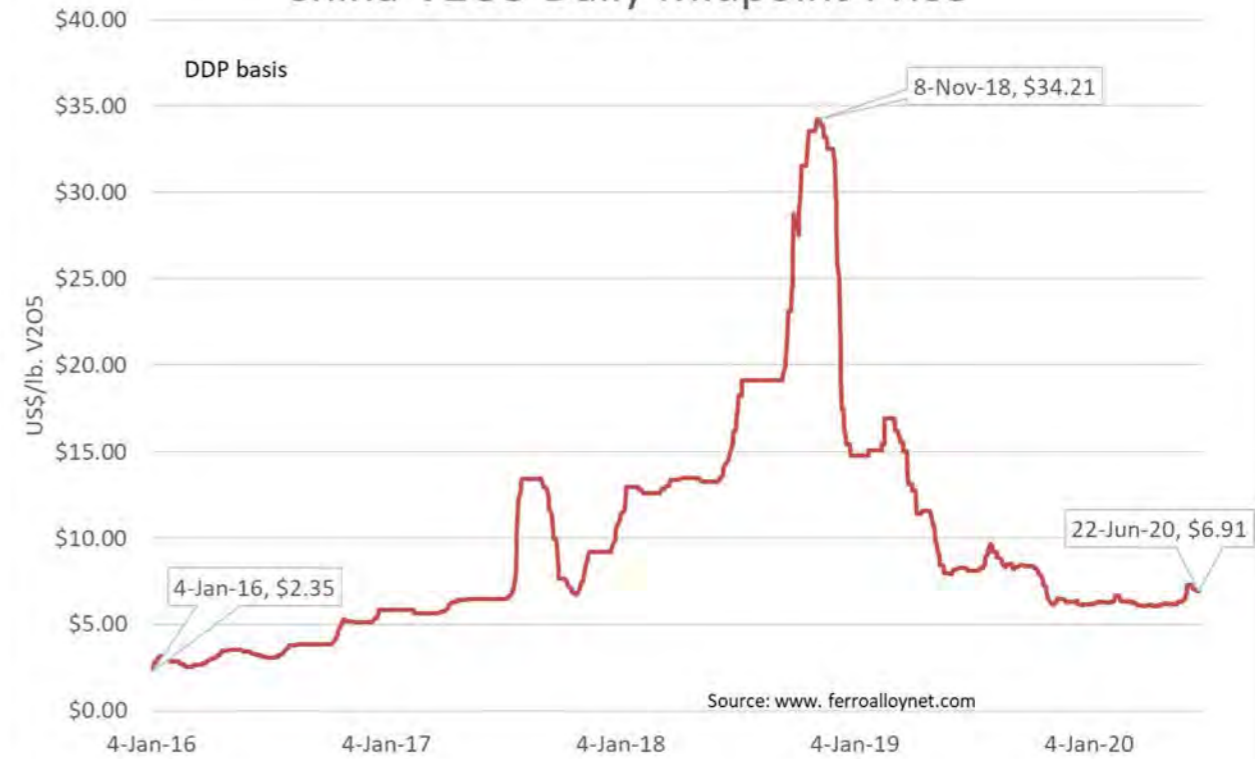
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Historical Price Data

Metal Bulletin V2O5 Daily Average Midpoint Price History



China V2O5 Daily Midpoint Price



V2O5 Published Prices Metal Bulletin Vs China

Monthly average published prices for commodity grade fused flake V2O5

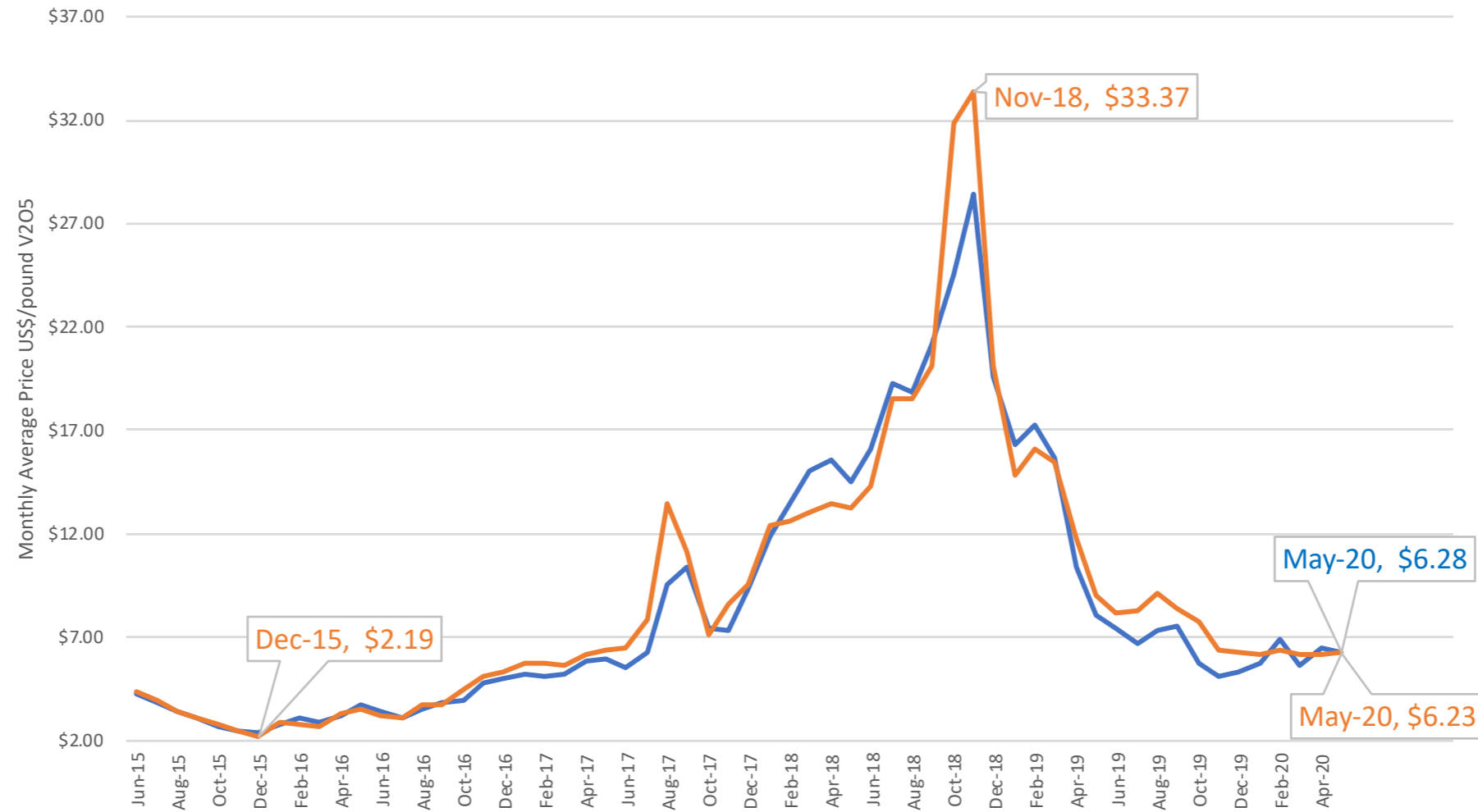


Source: Metal Bulletin Publication and www.ferroalloy.net

— MB — China

V2O5 Published Prices Metal Bulletin Vs China

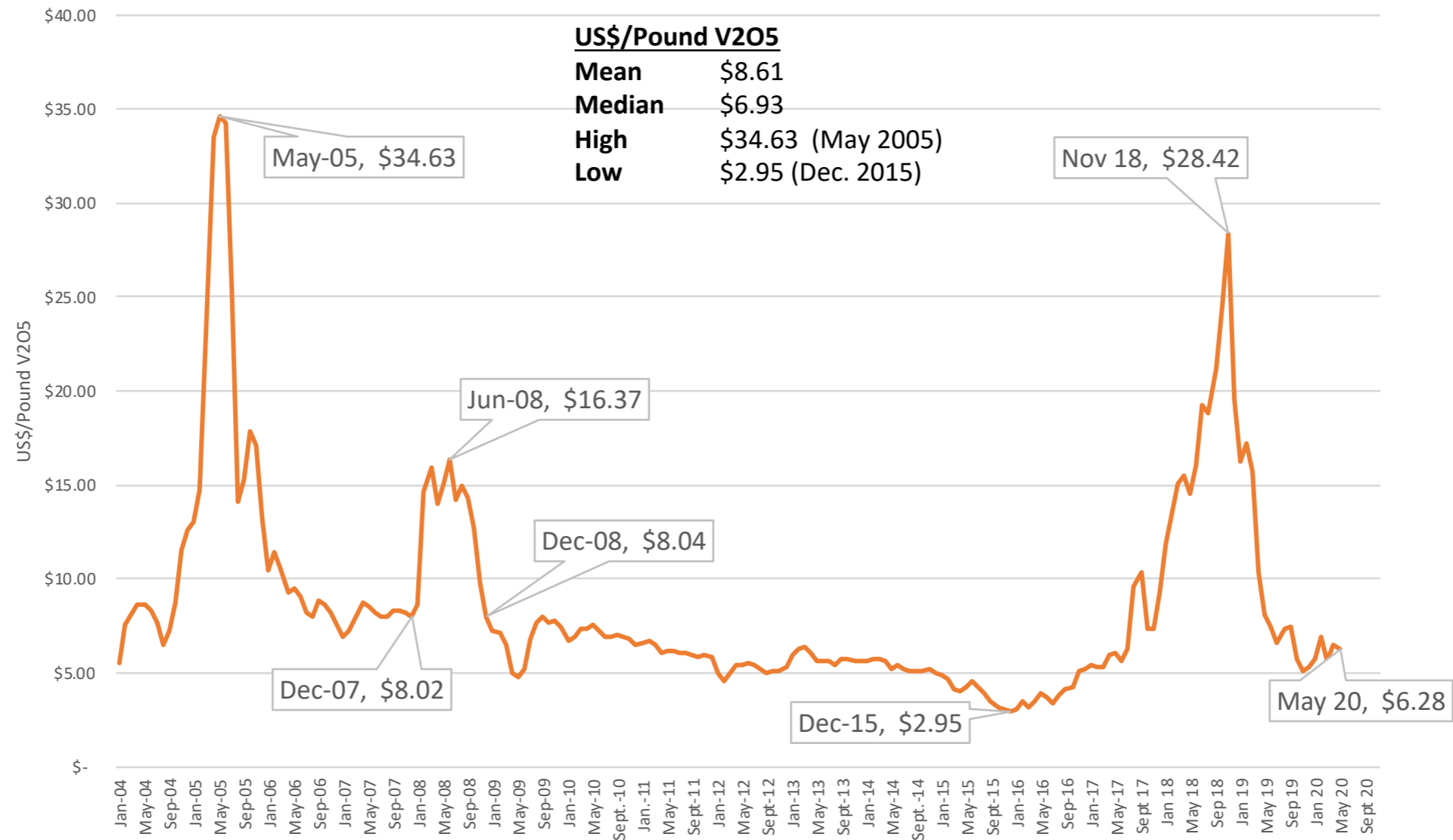
Monthly average published prices for commodity grade fused flake V2O5



Source: Metal Bulletin Publication and www.ferroalloy.net

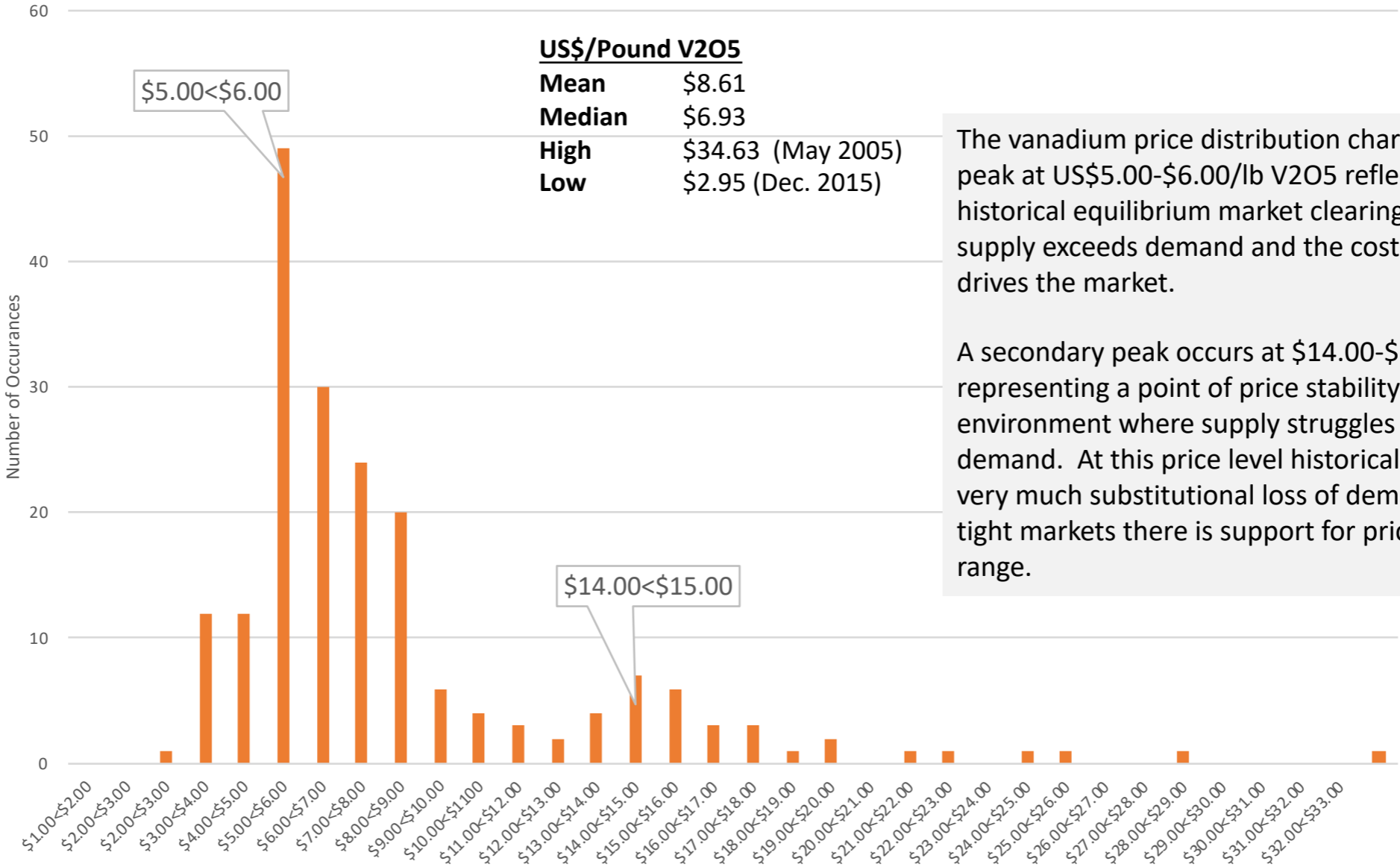
— MB — China

Metal Bulletin V2O5 Monthly Midpoint Average Price
 Jan. 2004 - May 2020
 Inflated to Nov. 2017 US\$



Source: Metal Bulletin, TTP Squared, Inc.

V2O5 Distribution Chart
 Jan. 2004 - May 2020
 Inflated to Nov. 2017 US\$



US\$/Pound V2O5	
Mean	\$8.61
Median	\$6.93
High	\$34.63 (May 2005)
Low	\$2.95 (Dec. 2015)

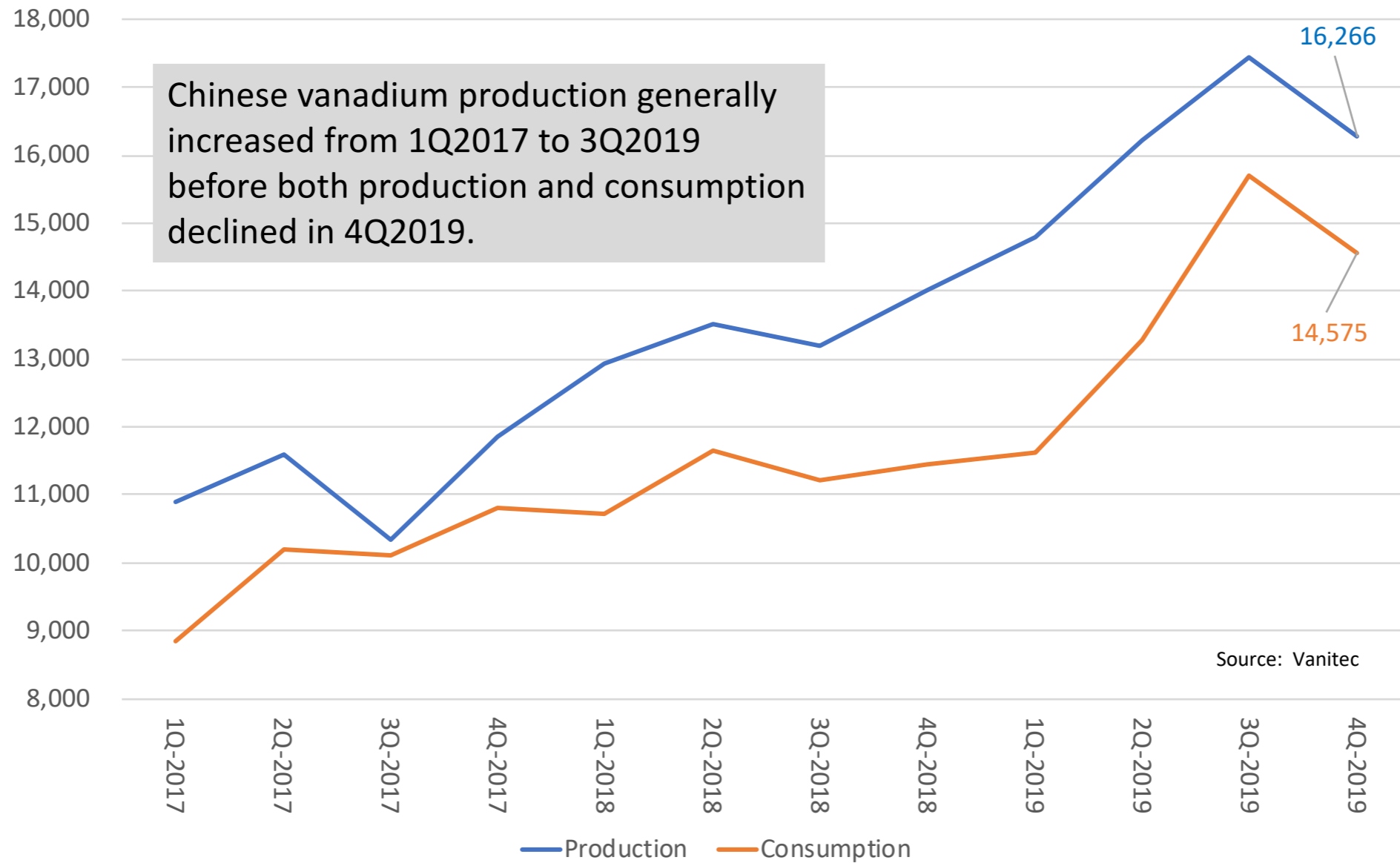
The vanadium price distribution chart shows a clear peak at US\$5.00-\$6.00/lb V2O5 reflecting the historical equilibrium market clearing price when supply exceeds demand and the cost of production drives the market.

A secondary peak occurs at \$14.00-\$15.00/lb V2O5 representing a point of price stability in an environment where supply struggles to meet demand. At this price level historically we don't see very much substitutional loss of demand and so in tight markets there is support for prices in this range.

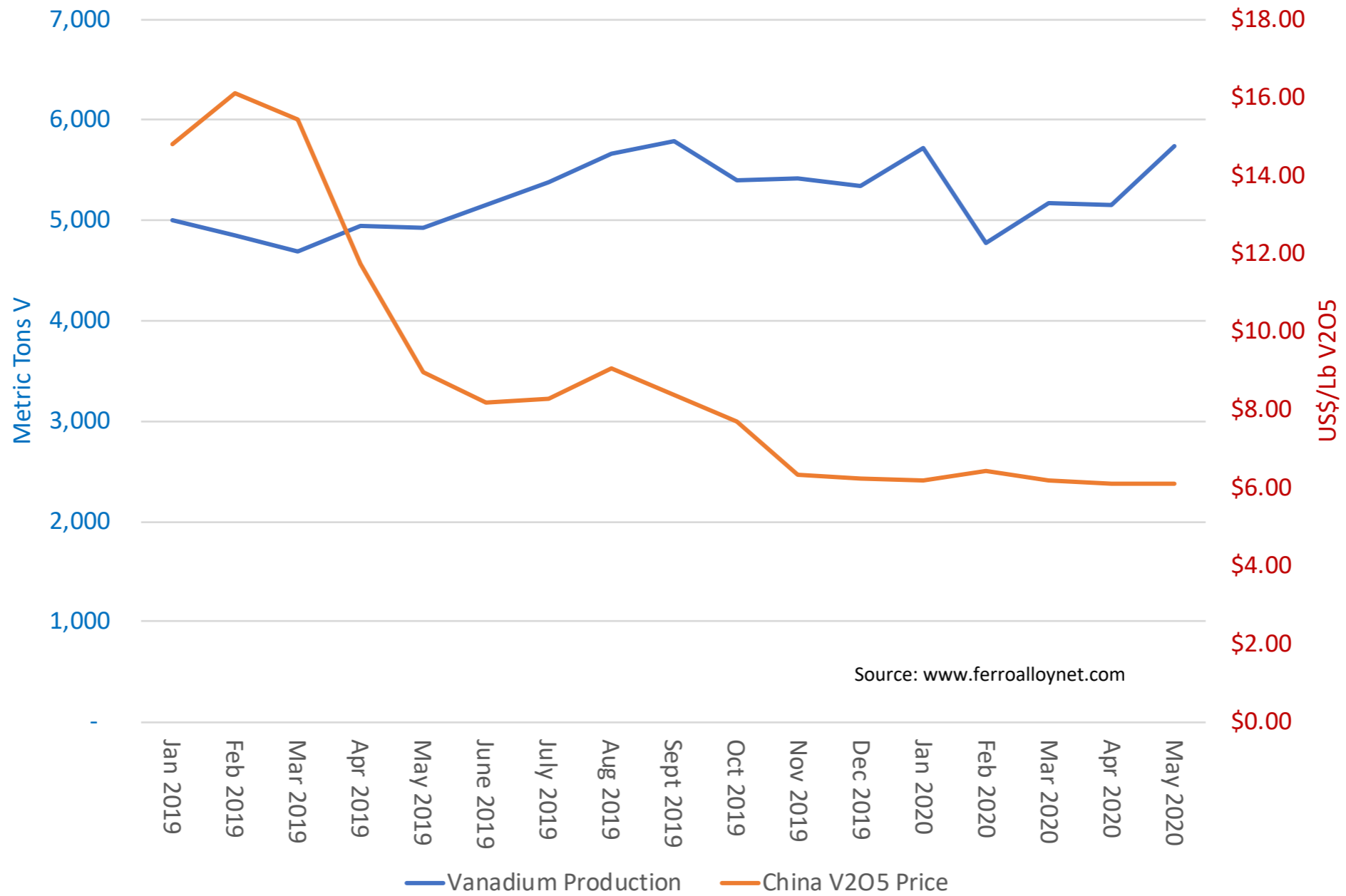
Source: Metal Bulletin, TTP Squared, Inc.

Vanadium Production and Consumption

China+Taiwan Quarterly Vanadium Production and Consumption



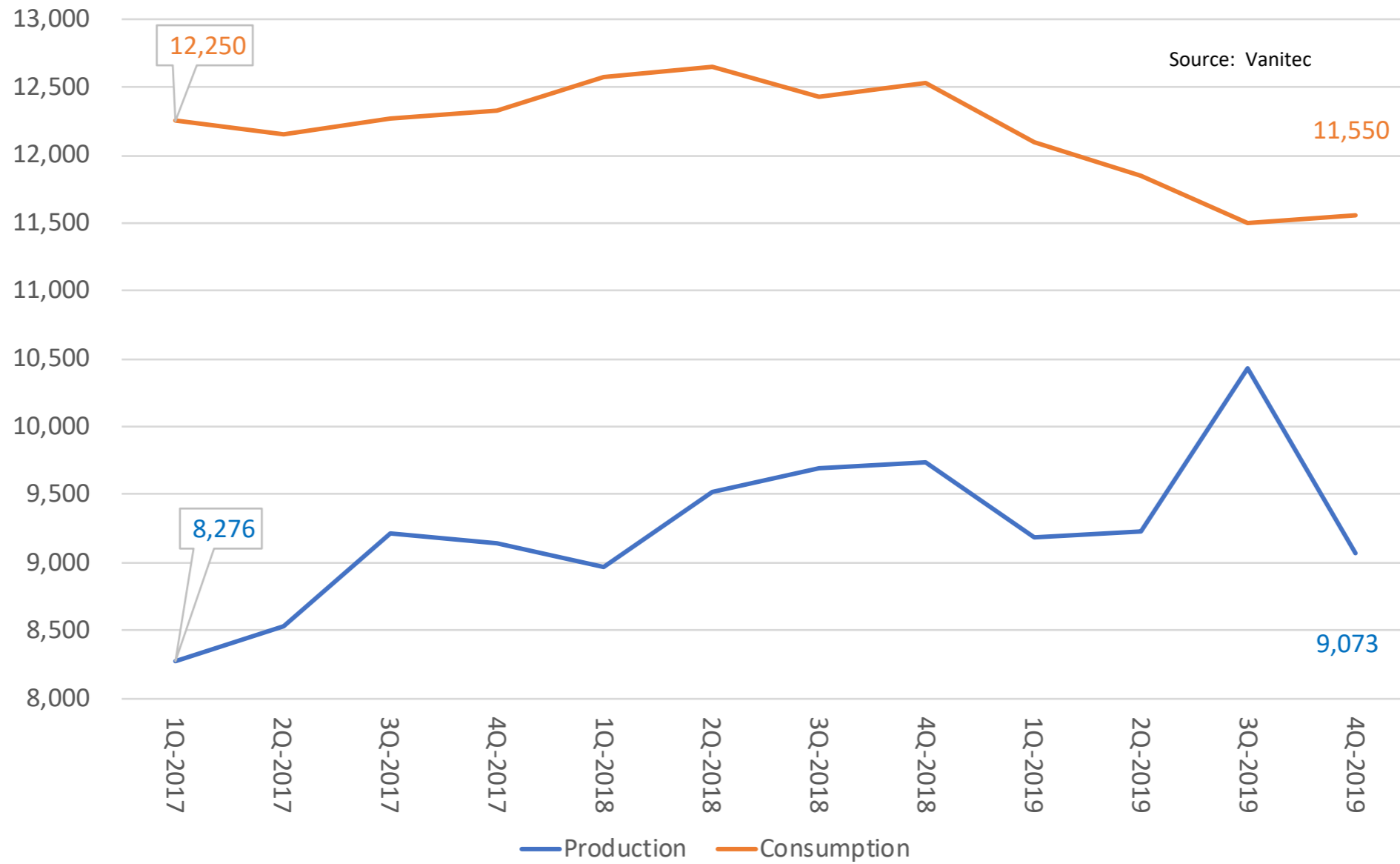
China Monthly Vanadium Production vs Price



China Vanadium Production and Consumption

- Chinese vanadium production grew from 10,900 MTV in 1Q2017 to 17,440 MTV in 3Q2019 for a Compound Annual Growth Rate (CAGR) of slightly more than 20% on the back of rapidly rising prices in 2018.
- 1Q2020 we have seen some reductions in production and consumption compared to 4Q2019 as a result of COVID-19.
- Steel production in China has returned to late 2019 levels and vanadium consumption continues to grow with growing steel production and stronger adherence to the new rebar standard in China.

ex China+Taiwan Quarterly Vanadium Production and Consumption



Ex China Vanadium Production

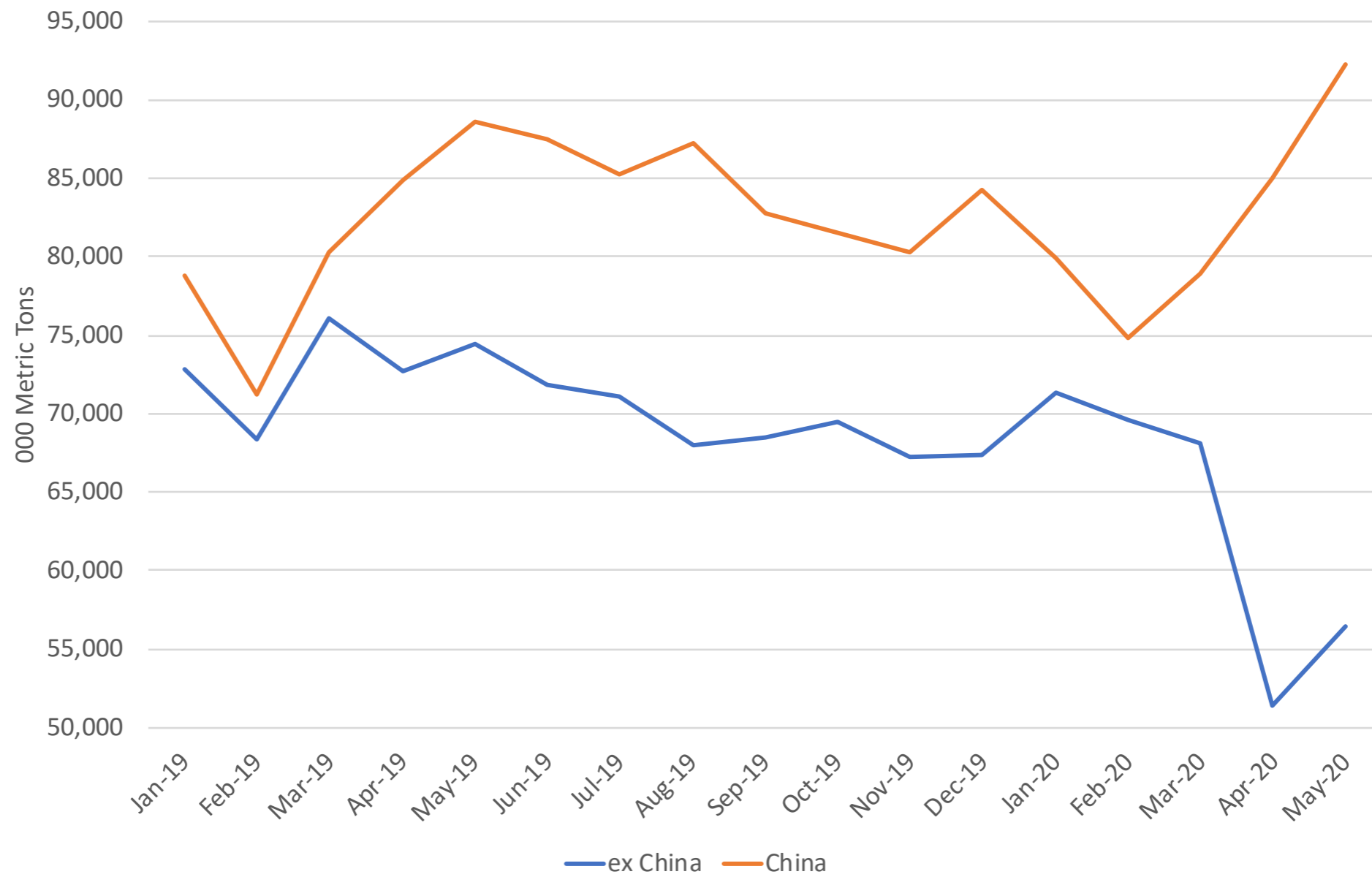
- Vanadium consumption ex China has decreased over the past three years as a result of substitutional loss of market to niobium during times of high prices
- Vanadium production ex China grew through 3Q2019 before falling back in 4Q2019
- 1Q2020 we have seen some minor reductions in production compared to 4Q2019.
 - Glencore Rhovan mine production down by 51 MTV as a result of the COVID virus disruption
 - Largo mine production down by 100 MTV as a result of maintenance being pushed forward in 2020 due to slow demand resulting from the virus.
- Otherwise we don't see much change in ex China vanadium production from 4Q2019 to 1Q2020.

Steel Production

Global steel production ex china has been severely impacted from April 2020.

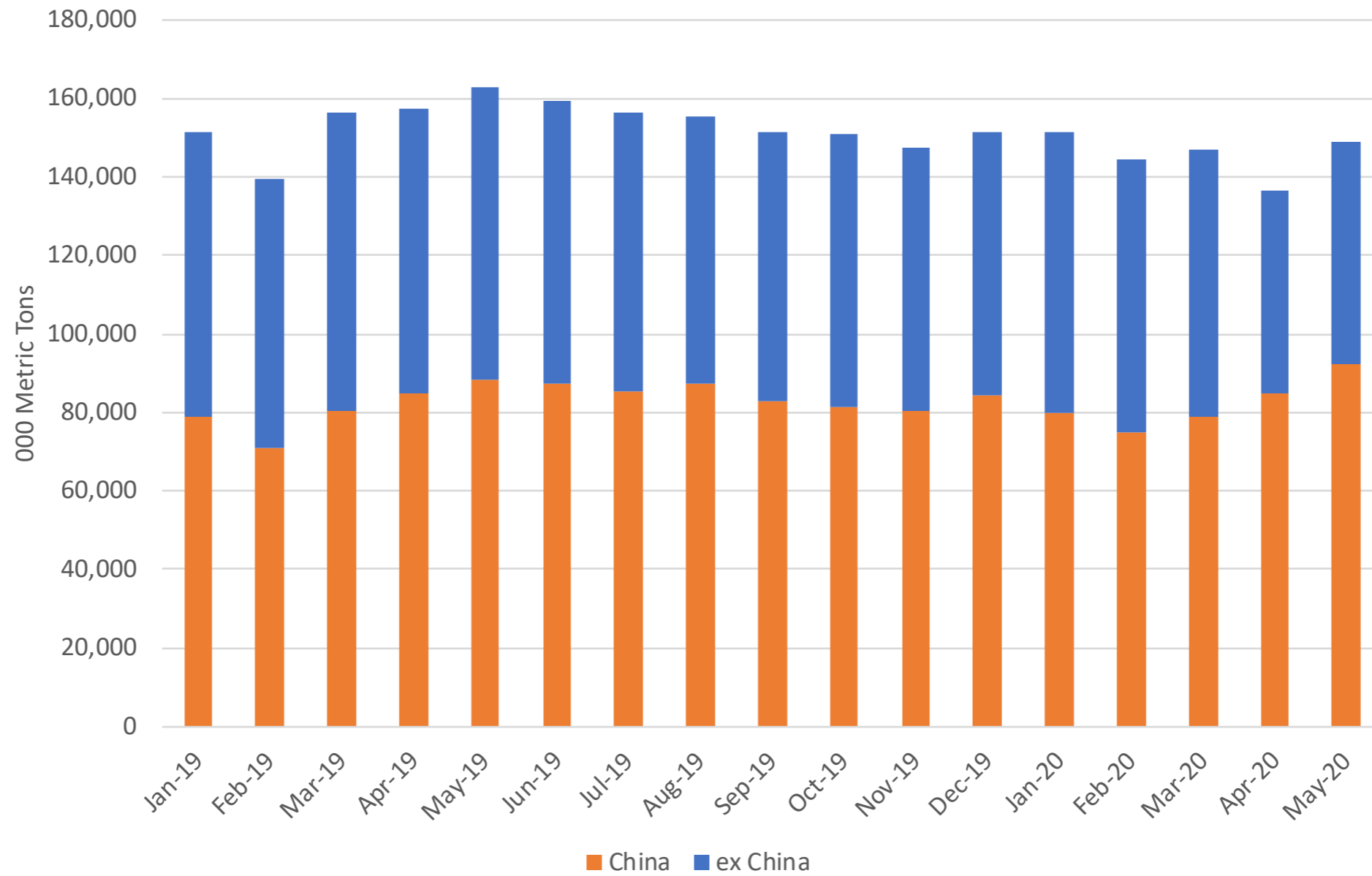
Global Steel Production

China vs ROW



Global Steel Production

China vs ROW



Ex China Vanadium consumption

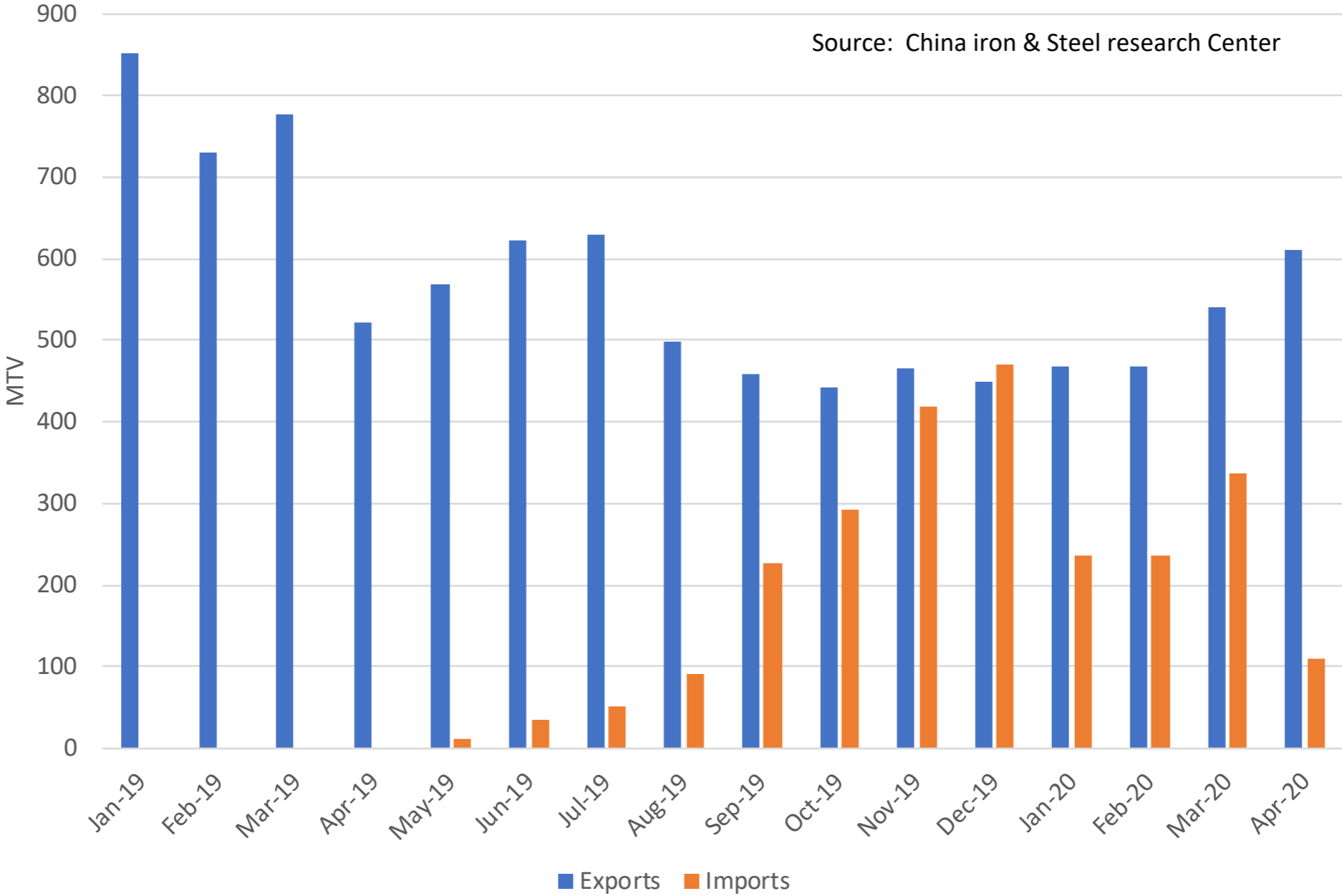
- Outside of China approximately 90% of vanadium consumption occurs in the steel industry.
- Steel production ex china decreased by 24% in May 2020 vs May 2019.
- A 24% decrease in ex China steel production equates to a decrease in vanadium demand of 11,400 MTV per year.
- We do expect to see a recovery of industrial activity and steel production in the coming months but its hard to forecast a time-line.

Summary

- Prior to the pandemic our forecast for 2020 indicated outside of China vanadium consumption at 52,900 MTV and vanadium production of 42,300 MTV, leaving a shortfall of 10,600 MTV.
- If 2020 steel production ex China continues at the May pace demand ex China decreases by 11,400 MTV in 2020.
- We expect weak demand from the titanium industry to decrease ex China vanadium demand by 1,000 MTV in 2020 vs 2019.
- So the forecast pre COVID indicates western markets will need 10,600 MTV exported from China. With the assumption global steel production does not recover and the titanium industry demand remains weak this would suggest that ex China vanadium production in 2020 will be 1,800 MTV above consumption
- Availability and price of exports from China will drive the international market – if China remains a net exporter of vanadium, we have an oversupply in the market. If China requires more than 1,800 MTV per year in net imports, then we see the market becoming very tight.

China Monthly Vanadium Imports and Exports

Source: China iron & Steel research Center



China Monthly Net Vanadium Exports

