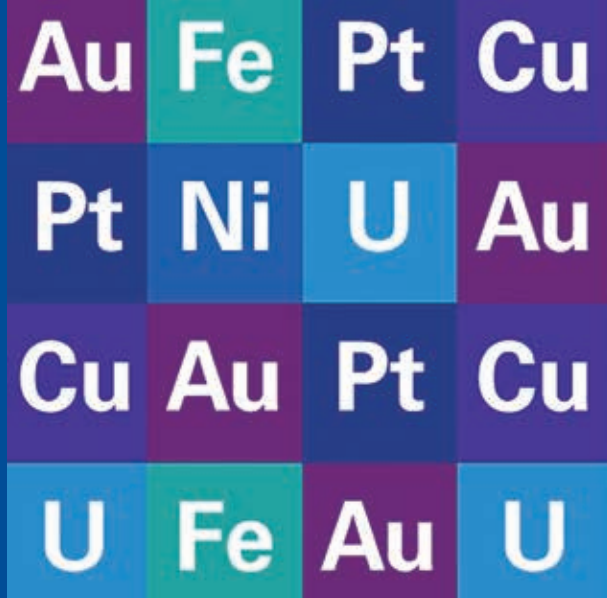




KPMG commodity insights bulletin – chromite

November 2018



Introduction

This bulletin is part of a series focusing on key mining commodities. Each bulletin aims to provide insights into trends within different commodity sectors.

Specifically, this bulletin provides an outlook on chromite, including recent macroeconomic and geopolitical developments. A jurisdictional overview of chromite is presented for the most relevant geographies. The market forecast of stainless steel, the principal end product for chromite, is also discussed. Actual and forecasted pricing are included, as well as key drivers for supply and demand of ferrochrome and chrome ore. Finally, recent M&A activities are highlighted to assess recent market movements.

Summary

- China’s market slowdown in 2015 reduced stainless steel demand and in turn impacted closely related commodities including ferrochrome and chrome ore. Since then, the Chinese demand for stainless steel has recovered. South Africa continues to supply the majority of chrome ore to meet global stainless steel demand.
- It is expected that the demand for stainless steel will see steady growth over the next 5 years, but less than the previous 5 years. As chrome ore and ferrochrome are inputs to stainless steel, it is expected they will also see steady growth over the next 5 years.
- In the short term, China is expected to continue playing a dominant role in the supply and demand of stainless steel. In addition, China’s commercialization of integrated nickel pig iron offers a cheaper substitute of pure nickel, in turn lowering the cost of stainless steel, which may be influencing market prices and tilting the global market toward Chinese production.

Commodity outlook

Chromite

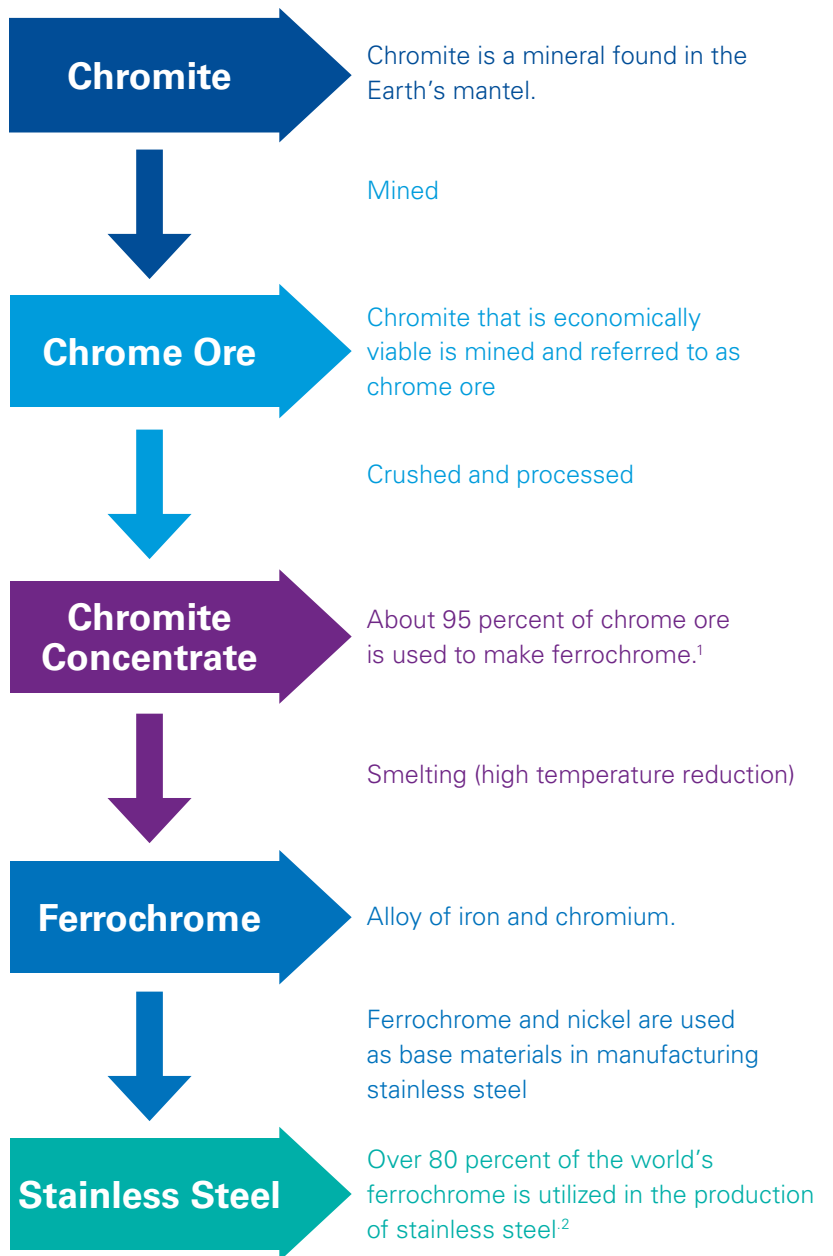
- Chromite is the commercial name of iron chromium oxide (FeCr_2O_4), a mineral comprised of chromium and iron oxide that is naturally found in the earth’s mantle. When extracted, it is referred to as chrome ore.
- Chromite is crucial for the production of ferrochrome, an alloying agent in manufacturing stainless steel. Chromite provides the corrosive resistance properties in stainless steel, making it an ideal material for use in a variety of industries.

When chromite, the mineral, is extracted from the earth's mantle, it is referred to as chrome ore. Chrome ore is crushed, screened, jigged into chrome concentrate and then smelted into ferrochrome. Ferrochrome, with nickel, is then processed into stainless steel. The processing of chromite is depicted in Figure 1. As chrome ore, ferrochrome and stainless steel commodities are closely linked, their pricing, demand, and consumption follow similar trends. These are described herein.

Chrome ore is essential for the production of ferrochrome. Ferrochrome, in addition to nickel, is vital for stainless steel production. Ferrochrome production accounts for more than 95 percent of global chrome ore consumption¹. Similarly, stainless steel production accounts for more than 80 percent and 70 percent of ferrochrome and nickel consumption, respectively². Hence, stainless steel is the major driver for demand and pricing of ferrochrome and chrome ore commodities³.

China has driven stainless steel production over the past decade. In 2017, China reached 53 percent market share, as shown in Figure 4⁴. China has tapped into easily accessible chrome ore imports to increase ferrochrome production in order to meet its increasing domestic needs of stainless steel, driven by the construction industry. Increased ferrochrome production has been achieved by building new furnaces and switching furnaces previously used for other alloys to ferrochrome. In the recent past, China overtook South Africa as the world's leading ferrochrome producer⁵.

Figure 1: Stainless steel production process



¹ 'Ore Processing', ICDA, 2011, Page 1, <http://www.icdacr.com/story-of-chrome/what-is-chromium/discover-chromium/ore-processing.pdf>

² 'Ore Processing', ICDA, 2011, Page 2, <http://www.icdacr.com/story-of-chrome/what-is-chromium/discover-chromium/ore-processing.pdf>

³ Commodities Comment, Macquarie Research, December 2017, Thomson One

⁴ Commodities Compendium, Macquarie Research, March 2018, Thomson One

⁵ 'South Africa crucial to global chrome supply, Chromium 2017 hears', Mining weekly, November 2017, <http://www.miningweekly.com/print-version/south-africa-crucial-to-global-chrome-supply-chromium-2017-hears-2017-11-10>

Chromite market overview by geography

Chromite reserves are proven deposits that are economically feasible for extraction. Chrome ore refers to mined chromite reserves. Similar to other commodities, the amount of reserves mined is dependent on a variety of factors including but not limited to; commodity pricing, government taxes and policies, available technology and labor expertise, and dependability of supply chain infrastructure.

Figure 2: Chromite reserves by country⁶

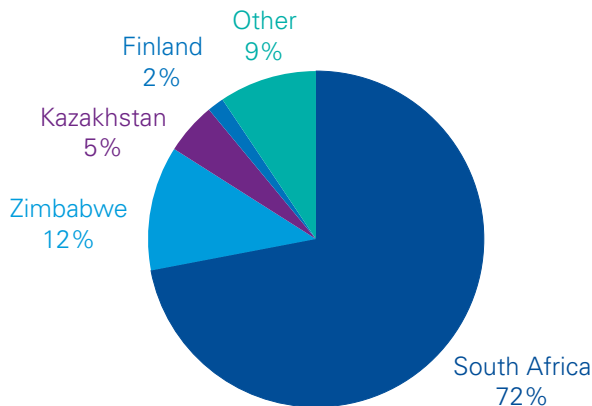
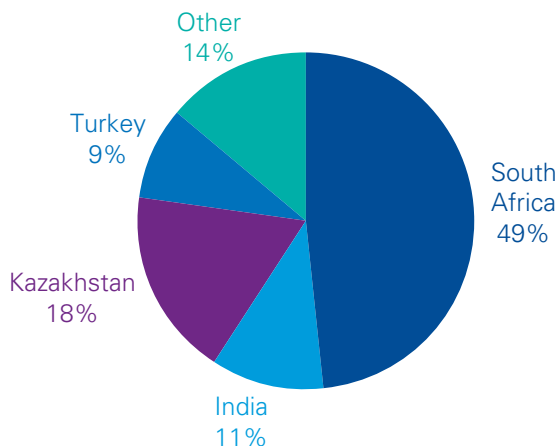


Figure 3: Chrome ore produced by country⁷



Note others includes: Turkey (0.9%), India (0.9%), Russia (0.5%), Brazil (0.2%), and others (6.9%)

South Africa

South Africa is the world's largest source of chromite. Historically it has accounted for approximately 72 percent of global reserves, as shown in Figure 2. As a result of South Africa's abundant chromite reserves, it has well developed infrastructure and technology allowing it to be one of the lowest-cost chrome ore producers in the world. In 2016, these advantages allowed South Africa to produce 49 percent of the world's chrome ore, as shown in Figure 3. Roughly half of chrome ore that is produced in South Africa is exported for smelting into ferrochrome which is then processed into stainless steel⁸.

Zimbabwe

Zimbabwe is historically the second largest location for chromite reserves, accounting for approximately 12 percent of the global chromite reserves. Zimbabwe chrome ore production has increased in recent years following domestic changes to economic and energy policy. In June 2015, the government lifted a ban on chrome exports that had been in place since 2011 and eliminated a 20 percent export tax to help the sector. The original intent of the prior ban was to increase the smelting of chrome ore into ferrochrome in Zimbabwe. Instead chrome stockpiles grew because of the lack of smelting capacity, high production costs and power shortages. The government has also increased its royalty from 2 percent to 5 percent on chrome but subsidizes electricity tariffs for chrome processing⁹. As a result, Zimbabwe's chrome exports have increased. Between January to September 2016 chrome concentrate exports were 100kt and in the same 2017 period exports increased to 385kt¹⁰.

Kazakhstan

Kazakhstan accounts for 5 percent of global reserves. In recent years, Kazakhstan has taken steps to attract mining investments in order to increase its supply of chrome ore, which now accounts of 18 percent of the global supply. For example, in December 2017, the government adopted legislation to replace regulations that had governed mining-related operations since 2010. The new code is expected to attract investments from foreign mining and exploration companies since the legislation, procedures and practices within the country have been simplified^{11, 12}.

⁶ Stainless Steel in Figures, ISSF, 2015, http://www.insg.org/docs/issf_stainless_steel_in_figures_2015_english.pdf

⁷ Mineral Commodity Summaries, U.S. Geological Survey, Published January 2018, Page 2, Mine Production Data from 2016, <https://minerals.usgs.gov/minerals/pubs/commodity/chromium/mcs-2018-chrom.pdf>

⁸ Annual Report, Tharisa PLC, 2017, Page 27, <http://www.tharisa.com/pdf/investors/annual-reports/2017/annual-report-2017.pdf>

⁹ 'Press Statement On The Lifting Of The Ban On Export Of Chrome Ore', Ministry of Mines and Mining Development, June 2015, <http://www.mines.gov.zw/?q=press-statement-lifting-ban-export-chrome-ore>

¹⁰ 'Chrome exports to drive mineral earnings', The Source, October 2017, <http://source.co.zw/2017/10/chrome-exports-to-drive-mineral-earnings-mmcz/>

¹¹ 'Kazakhstan Adopts New Subsoil Use Code', Lexology, January 2018, <https://www.lexology.com/library/detail.aspx?g=3b6ff123-528a-425e-9447-0fd3b8f86fed>

¹² 'Legal Reforms in the Kazakhstan Mining Sector', Michael Wilson & Partners, January 2018, <http://mwp.kz/presentation/legal-alerts/legal-reforms-in-the-kazakhstan-mining-sector/>

Global stainless steel market forecast

In 2015, there was a sharp decline in stainless steel prices due to the economic downturn in China, a main influencer on the stainless steel market. The Chinese economy and stainless steel prices rebounded in 2017 and analysts predict a stabilization of prices, demand and supply between 2018 and 2021.

Stainless steel demand is mainly driven by China, which accounted for nearly half of total demand in 2016, and then by Asia (except China) and Europe. Demand for stainless steel between 2016 and 2021 is expected to increase from 45.6 to 54.1 MT, resulting in a compound annual growth rate ('CAGR') of 3.5 percent. Future demand is expected to be driven by South America, China and the rest of Asia. This compares to the previous five years (2011-2016), where demand grew at a CAGR of 6.2 percent¹³.

Similarly, China has driven stainless steel production over the past decade. In 2017, China reached 53 percent market share, as shown in Figure 4. Global supply of stainless steel between 2017 and 2022 is expected to increase from 48.4MT to 57.7MT, resulting in a CAGR of 3.5 percent¹⁴.

As previously mentioned, ferrochrome with nickel are processed into stainless steel. Over the last decade stainless steel production increased its use of China's commercialized nickel pig iron (NPI)¹⁶, a cheaper substitute of pure nickel¹⁷, which in turn decreases the cost of stainless steel. It is expected that a portion of stainless steel demand will continue to be met by stainless steel produced using NPI rather than pure nickel. Using NPI rather than pure nickel, is not expected to influence the need of ferrochrome.

Figure 4: 2017 Stainless steel production by country¹⁵

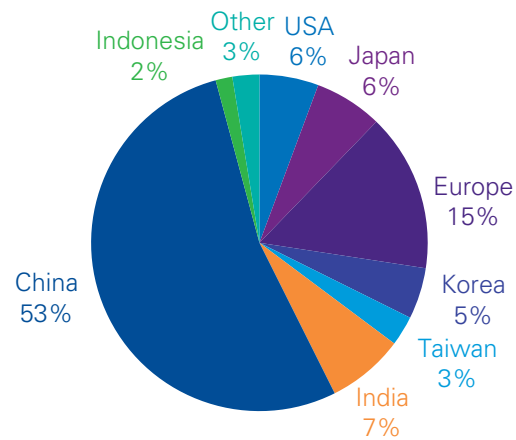
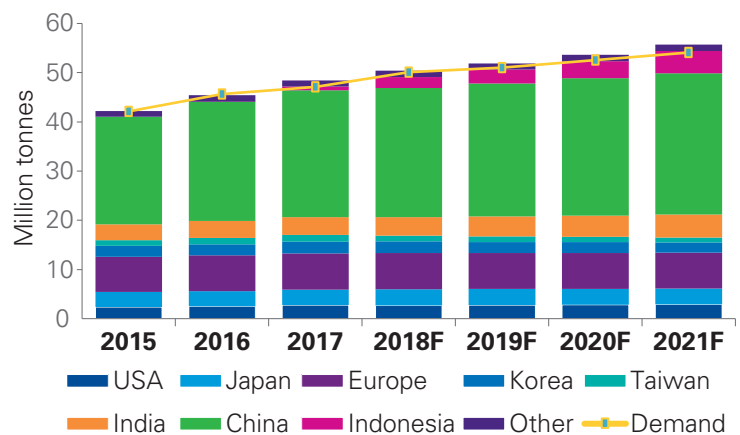


Figure 5: Stainless steel demand and supply



Source: Stainless Steel Market Update, UBS, August 2017, and Commodities Compendium, Macquarie Research, March 2018, Thomson One

¹³ 'Stainless Steel Market Update, Shining again on improving fundamentals', UBS, Global Research, 29 August 2017, Figure 7.

¹⁴ Commodities Compendium, Macquarie Research, March 2018, Thomson One

¹⁵ Commodities Compendium, Macquarie Research, March 2018, Thomson One. Data retrieved from 2017.

¹⁶ Nickel pig iron (NPI) is a low grade ferronickel invented in China as a cheaper alternative to pure nickel for the production of stainless steel. An integrated NPI utilizes nickel sulphide concentrate as part of the stainless steel production process. This innovation offers significant potential benefits to producers of suitable nickel sulphide concentrate feed including lower costs due to simpler processing, compared to traditional smelting and refining. http://www.wikiwand.com/en/Nickel_pig_iron, <https://www.newswire.ca/news-releases/royal-nickel-welcomes-construction-of-worlds-first-processing-plant-capable-of-producing-stainless-steel-directly-utilizing-nickel-sulphide-concentrate-513978301.html>

¹⁷ The future of nickel: A class act. November 2017. <https://www.mckinsey.com/~/media/McKinsey/Industries/Metals%20and%20Mining/Our%20Insights/The%20future%20of%20nickel%20A%20class%20act/The%20future%20of%20nickel%20A%20class%20act.ashx>

Commodity pricing

Stainless steel prices drive the pricing for ferrochrome, and in turn that of chrome ore. Historical and forecasted ferrochrome and chrome ore pricing are presented in the section below with the understanding that the end commodity, stainless steel, is the main price driver.

Ferrochrome's historical and forecasted pricing

Over the last few years, ferrochrome pricing has fluctuated due to market and economic factors. The consensus over the mid-term is that the positive outlook of stainless steel and stabilized markets factors will help smooth prices.

In the first half of 2016, low ferrochrome prices and the appreciation of the South African Rand negatively impacted the profitability of smelters, which are mainly owned by chrome extractors and processors. Consequently, 6 out of 14 South African smelters cut back operations by mid-2016, affecting the supply of ferrochrome and mining efforts of chrome ore¹⁸. The lack of ferrochrome supply then drove up prices in the second half of 2016.

In 2017, Chinese smelters and other marginal producers increased ferrochrome supply to take advantage of high alloy prices¹⁹. This additional supply of ferrochrome led to normalized prices in the first half of 2017. In June-July 2017, new winter electricity tariffs in South Africa led to decreased

ferrochrome production, resulting in a 50 percent year-on-year decrease of exports to China. Subsequently, the lack of ferrochrome supply combined with a strong stainless steel demand caused ferrochrome prices to increase again in Q3 2017.

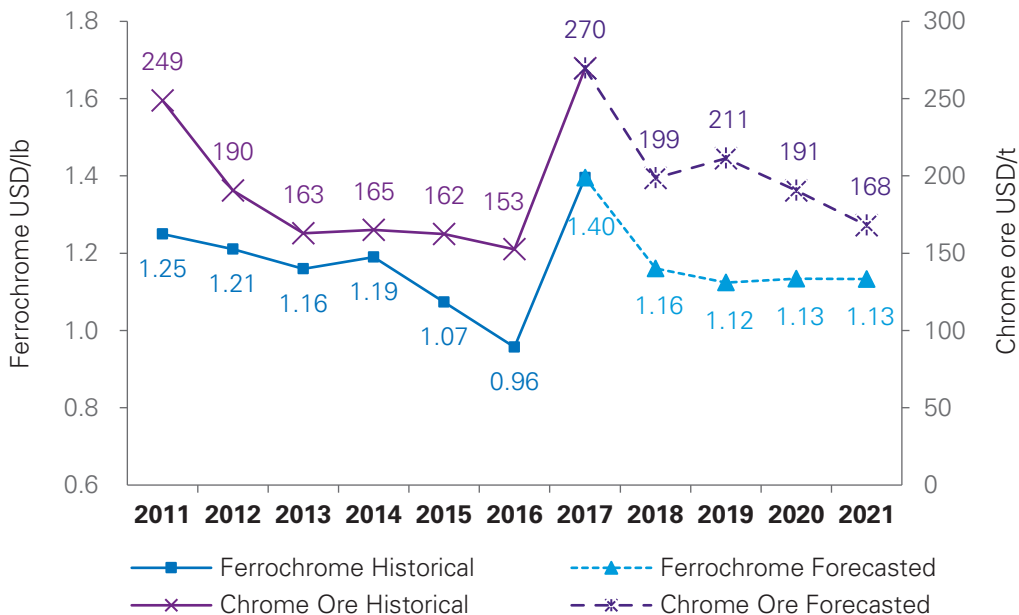
Ferrochrome prices are expected to hover around US\$1.13 per pound by 2020. In the short term, there is a possibility of seeing slightly bearish market movement as moderate demand growth will be fulfilled by ferrochrome volumes from South Africa and increases in Chinese stockpiles. This may put some pressure on prices²⁰ which are expected to drop to US\$1.16 per pound by 2018.

Chrome ore historical and forecast pricing

Similar to ferrochrome, chrome ore prices in recent years have been closely related to the demand and production of stainless steel in China.

In 2015, chrome ore prices collapsed because of a sharp downturn in the Chinese economy, contracting the demand for stainless steel. This prompted many South African chrome producers to cut production and undertake care and maintenance programs at their mines. The resulting decrease in chrome supply was substantial and created a shortage in Q4 2016 when stainless steel demand revived in China.

Figure 6: Historical and forecasted chrome ore and ferrochrome prices



Source: Bloomberg, KPMG analysis, (graph represents annual trends only)

¹⁸ Stainless Steel Market Update, UBS, August 2017, Thomson One

¹⁹ Metals Quarterly, HSBC, October 2017, Thomson One

²⁰ 'Eurasian Resources Group: base metals outlook', International Mining, November 2017, <https://im-mining.com/2017/11/01/eurasian-resources-group-base-metals-outlook/>

The shortage in chrome ore supply and revived demand initiated a recovery in prices in the second half of 2016. The price rise between 2016 and 2017 resulted in a supply surge from producers in South Africa and other countries such as India. The surge peaked in Q1 2017.

As producers restocked their chrome ore inventories in Q2 2017, there was a correction in Chinese demand and chrome prices. The demand collapse in Q2 was followed by a strong recovery in Q3 and another rush to buy, which pushed prices back up again.

Analyst reports describe these corrections as cyclical and temporary, and expect a balanced market in 2018, with the price of chrome ore expected to settle around US\$199 per ton. Over the next 2 to 3 years chrome ore supply is expected to plateau or increase marginally, potentially softening the price of chrome ore. It is expected that chrome ore prices will continue to be dependent on the production expectations of stainless steel²¹.

Key supply and demand drivers

As previously discussed, stainless steel demand is the major driver for demand of ferrochrome and chrome ore commodities. The demand of stainless steel was discussed earlier in section 5, but it should be noted that the supply of stainless steel is dependent on ferrochrome and chromite commodities as discussed below.

Ferrochrome

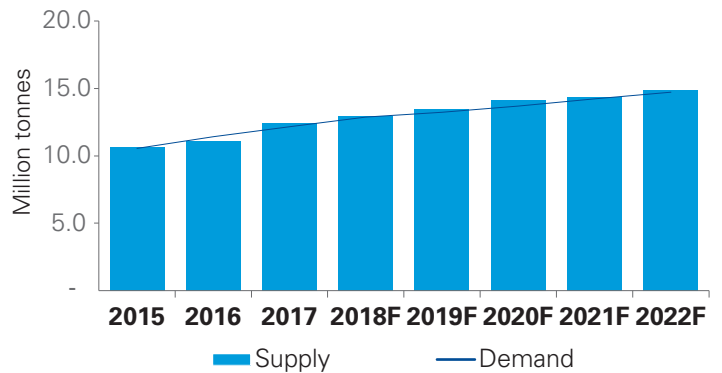
Chinese efforts to supply stainless steel remains the key driver of ferrochrome demand, whereas ferrochrome supply is heavily dependent on electricity supply and pricing.

Chinese stainless steel supply is anticipated to grow at a modest CAGR of 4.1 percent during 2017-21 because of stricter environmental regulations and the enactment of anti-dumping duties by importing nations²². Given the link between stainless steel supply and the demand for its input ferrochrome, it is expected ferrochrome demand will also have modest growth over the next 5 years.

The supply of ferrochrome diminished following the price collapse of 2015-16 leading to a massive shortage of the commodity in late 2016 when the Chinese demand for stainless steel strengthened²³. The increase in ferrochrome

supply between 2016 and 2017, can be attributed to the recovery in ferrochrome prices and the additional production from South African smelter restarts after maintenance and capacity ramp-ups. The increase in ferrochrome processing capacity in Asia (primarily Indonesia and India) are anticipated to drive ferrochrome supply for the next few years²⁴.

Figure 7: Ferrochrome supply and demand



Source: Commodities Compendium, Macquarie Research, March 2018, Thomson One

While South Africa continues to be the biggest producer of chrome ore, it has recently slipped from the top position in ferrochrome production. In 2016, China produced 43 percent (4.6 MT) of the world ferrochrome output and South Africa produced 33 percent (3.5 MT). The decline in South African production has occurred mainly on account of unfavorable electricity and price factors²⁵.

South African miners have traditionally faced constrained electricity supply and high electricity costs. Eskom, the state-owned utility generates approximately 95 percent of the electricity used in South Africa. Ferrochrome smelting is an energy-intensive process. In the face of high tariffs and power shortages over the past few years, producers have cut production of ferrochrome and increased production of other materials, reducing their dependence on expensive electricity.

As of 2017, Eskom is working towards augmenting power supply by rationing electricity tariff increases and commissioning power plants²⁶. However, there is still a massive requirement for additional electricity generation and ridding the utility of debt and corruption scandals to ensure adequacy of ferrochrome supply from South Africa^{27, 28}.

²¹ Commodities Compendium, Macquarie Research, October 2017, Thomson One

²² Metals Quarterly, HSBC, October 2017, Thomson One

²³ Commodities Compendium, Macquarie Research, October 2017, Thomson One

²⁴ Metals Quarterly, HSBC, October 2017, Thomson One

²⁵ 'South Africa crucial to global chrome supply, Chromium 2017 hears', Mining weekly, November 2017, <http://www.miningweekly.com/print-version/south-africa-crucial-to-global-chrome-supply-chromium-2017-hears-2017-11-10>

²⁶ 'Strong outlook for recovering ferrochrome industry', Polity South Africa, March 2017, <http://www.polity.org.za/article/strong-outlook-for-recovering-ferrochrome-industry-merafe-2017-03-08>

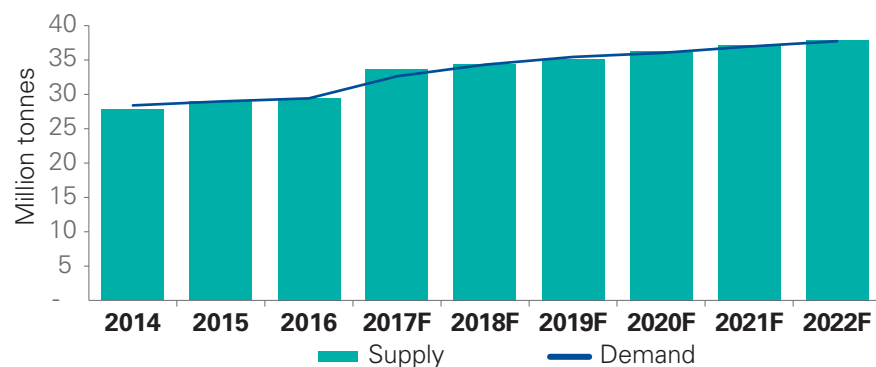
²⁷ 'Goldman Sees Eskom as Biggest Risk to South African Economy', Bloomberg, September 2017, <https://www.bloomberg.com/news/articles/2017-09-22/goldman-sachs-sees-eskom-as-biggest-risk-to-s-african-economy>

²⁸ 'South Africa - Electrical Power Systems', U.S. Department of Commerce, August 2017, <https://www.export.gov/article?id=South-Africa-electrical-power>

Chrome ore

The consensus five-year outlook for chrome ore is positive. As per the latest available data, supply of chrome ore is expected to increase at a CAGR of 2.4 percent over the 2018 to 2022 period. Demand is expected to increase at a CAGR of 2.9 percent. This compares to the previous five years, where supply grew at a CAGR of 2.8 percent and demand at 3.0 percent²⁹.

Figure 8: Chrome ore supply and demand



Source: Metals and Mining, HSBC, March 2018, Thomson One

²⁹ Metals and Mining, HSBC, March 2018, Thomson One

Appendix

Table 1: Recent M&A activity for chromite industry

Recent chrome M&A activity					
Announced date	Completion date	Deal status	Target company	Bidder company	Deal value (US\$ million)
31 July 2017	6 November 2017	Completed	Phoenix Platinum Mining Proprietary Limited	Sylvania Platinum Limited	7
19 May 2016	23 August 2016	Completed	International Ferro Metals (SA) (Pty) Limited African Rainbow Minerals	Samancor Chrome Limited	33
25 June 2015	30 June 2015	Completed	Limited (Dwarsrivier Chrome Mine) (50 percent Stake)	Assore Limited	37

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