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South Africa's beneficiation strategy and the proposed chrome ore export tax: the relevance towards economic development

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UNIVERSITY OF THE
WITWATERSRAND,
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SOUTH AFRICA'S BENEFICIATION STRATEGY AND THE PROPOSED CHROME ORE EXPORT TAX: THE RELEVANCE TOWARDS ECONOMIC DEVELOPMENT.

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A research thesis submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Engineering.

April, 2022

DECLARATION

I, Mahlangu MS declare that this thesis is my own, unaided work. It is being submitted for the Degree of Master of Science in Engineering at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



_____ 15 April 2022

Signature of Candidate Date

ABSTRACT

This study aimed to investigate the efficiency and relevance of the beneficiation approach as well as to examine the potential impact of the proposed chrome ore tax. A qualitative research approach was used in this study. Data was gathered from secondary sources and interviews with industry experts were undertaken to fulfil the purpose of the study. Purposive sampling was used to select the participating organisation. The study population comprised experts in the chrome ore and ferrochrome industries in the eastern bushveld complex and within the South African mining sector.

The assumption of the benefit of the chrome ore export tax is based on South Africa's chrome ore reserves, production, and export of chrome ore. The proposed chrome ore export tax is intended to help South Africa's ferrochrome industry. China is the primary importer of South African chrome ore, as well as the largest ferrochrome producer. South Africa is the leading ferrochrome exporter. The primary driver of South African ferrochrome' s lack of competitiveness has been rising electricity costs and supply. The responses of the experts from the interviews were also presented and organized into themes and sub-themes. The themes included: inputs of production and investment in infrastructure; FDI and investment in infrastructure; developing beneficiation abilities; cost and supply of electricity; close down of operations and displacement; cost and supply of electricity and lack of competitiveness; displaced by international competitors; displaced by international competitors and job losses; poor economic development; close down of operations and price manipulation; and investment in infrastructure and improved relationship with the mining community.

The findings show that the government's proposed export tax is not feasible in view of the country's challenges. It was revealed that the proposed export tax will raise the cost of production for the chrome ore producers, which will lead to displacement by foreign chrome ore producers and the loss of employment in the country. The government must establish an enabling climate for the industry to perform efficiently. As a result, the government must spend on infrastructure like roads, railways, and ports. The study recommended that the goal is to establish a favourable energy price strategy that would increase the international competitiveness of South Africa's downstream ferrochrome businesses. The study also suggested that, despite the

South African government's investments in renewable energy and gas resources, coal should not be abandoned, but rather modern technology should be employed to help minimize coal emissions, given that South Africa is rich in coal.

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ABBREVIATION

AMCOR – African Metals Corporation

AOD – Argon-Oxygen Decarburisation

BIC – Bushveld Igneous Complex

C – Carbon

ChCr – Charge Chrome

CMCV – Chromite Mineral Value Chain

Cr – Chromium

DME – Department of Minerals and Energy

DMR – Department of Mineral Resources

DMRE - Department of Mineral Resources and Energy

DTI – Department of Trade and Industry

FeCr – Ferrochrome

GDP – Gross Domestic Product

HC FeCr – High Carbon Ferrochrome

IDC – Industrial Development Corporation

IMF – International Monetary Fund

IPAP - Industrial Policy Action Plan

Iscor – South African Iron and Steel Industrial Corporation

ISSF – International Stainless Steel in Figures

MEC – Mineral Energy complex

MPRDA - Mineral and Petroleum Resources Development Act

MS&A – Middelburg Steel and Alloys

NDP – National Development Plan

NGP - New Growth Path

NIP – National Industrial Program

PAIRS – Pan-African Investment & Research Services

PGM – Platinum Group Metal

R&D – Research and Development

SAMI – South African Mining Industry

StatsSA – Statistics South Africa

UG2 – Upper Group 2

USD – U.S. Dollar

USGS – U.S. Geological Survey

USSR – Union of Soviet Socialist Republic

WEF – World Economic Forum

1 INTRODUCTION

1.1 Background of the Study

Since World War II, there has been a growing worry over South Africa's unsustainable reliance on a single commodity, Gold. Gold accounted for 72.7% of the overall value of South African mineral exports in 1987. Simultaneously, there has been growing realization of the great potential for beneficiation to enhance the value of other mineral commodity exports, thereby aiming to diminish the country's reliance on them to support economic advancement (Von Below, 1990). The country's dominant position in the supply of mineral raw materials to the international market, as well as popular sentiments among South Africans to encourage raw material beneficiation before export, prompted research and development to assess the feasibility of future mineral beneficiation projects (Von Below, 1990). The South African cabinet formally adopted the beneficiation plan in 2011 (Department of Mineral Resources (DMR, 2011). This strategy aimed to transform the comparative advantage of the country's rich mineral resource base into an economic competitive advantage. This was done by harmonising the National Industrialisation Program (NIP) with a greater emphasis on mineral beneficiation (DMR, 2011).

South Africa has vast chrome reserves, accounting for around 75% of world reserves (Department of Mineral Resources and Energy (DMRE), 2020). The South African chrome industry has a well-developed infrastructure and technology, making it the world's lowest-cost producer of chrome ore. Due to these advantages, South Africa produced 69% of the world's chrome in 2016 (KPMG, 2018). As a result, it makes sense for the country to beneficiate more of its resources, particularly chrome. South Africa already has a mineral beneficiation strategy in place that should benefit the economy in a number of ways, including policy interventions in supply chain industries, the development of additional semi-skilled and skilled employment, and a reduction in the raw material exports from the country (April, 2013).

In 2020, South Africa was the world's greatest producer of chrome ore, producing approximately 16 million Mt, somewhat less than in 2019 and has lost its lead in ferrochrome production (U.S. Geological Survey (USGS), 2021). In 2016, China produced 43% (4.3MT) of the world's ferrochrome output, while South Africa produced

33% (3.5MT). According to KPMG (2018), the decline in the production of ferrochrome in South Africa was mostly caused by unfavourable electricity and price factors (Figure 1 and 2). The rising cost of electricity, as shown in Figure 2, has increased the cost of doing business as ferrochrome smelters require high usage of electricity. As a result, South Africa is losing its dominance in ferrochrome production owing to competition, and some ferrochrome smelters have closed down due to the increased cost of doing business (Levin, 2020).To support the ferrochrome industry, the South African government has proposed an export tax on chrome ore, hoping to force chrome producers to beneficiate the ore into a ferrochrome product before exporting it (Levin, 2020). The focus of this study is to investigate the efficiency and relevance of the beneficiation strategy as well as to assess the possible impact of the proposed chrome ore tax.

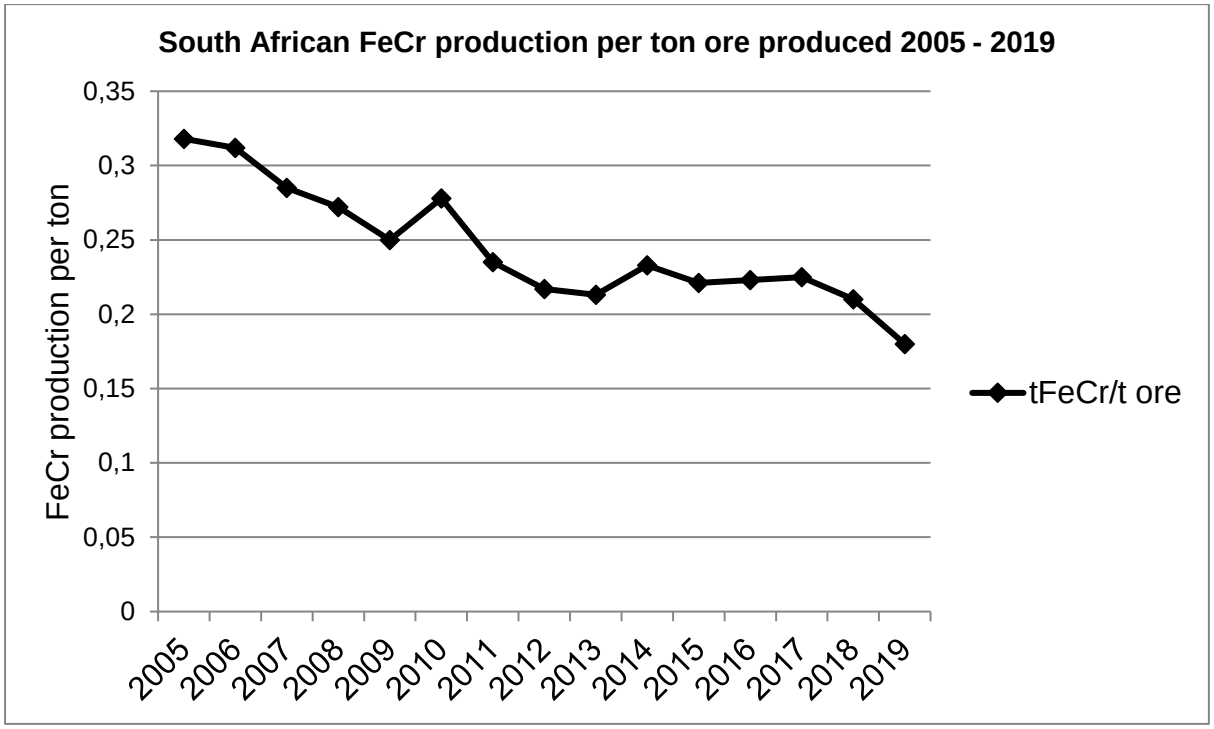


Figure 1. South African FeCr production per ton ore produced 2005 – 2019 (DMRE, 2020)

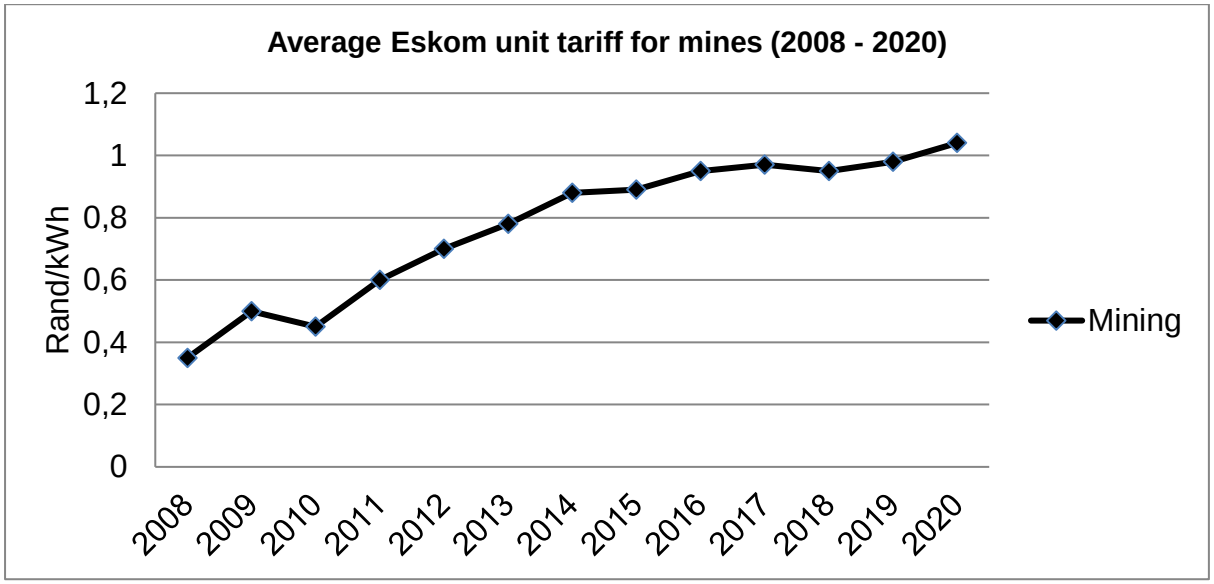


Figure 2. Average Eskom unit tariff for mines, 2008 to 2020 (year to March) in constant rand per kWh (Eskom, 2020)

1.1.1 Ferrochrome in South Africa

Chromium was first discovered and named by a French chemist, Louis Nicolas Vauqueline in 1797, during the years of the French revolution (Jones, 2020). The commercial mining of chromite in Southern Africa began in 1921 (Howat, 1986) with the first ferrochrome plant in Africa, founded in 1949 in Gwebo (now Gweru), Zimbabwe. This significant development was due to ores produced in South Africa not being considered for smelting to produce ferrochrome due to their low chromium to iron ratio (about 1.5). On the other hand, world ferrochrome producers chose to employ ores from Zimbabwe and the Union of Soviet Socialist Republic (USSR) with greater chromium to iron rations of around 2.5 to 3.0 (Howat, 1986). Despite South Africa's abundance of chrome ore, it was only through aggressive marketing efforts that South African ferrochrome alloys were accepted by stainless steel producers globally, contributing positively to the expansion of the South African ferrochrome industry. RMB Alloys of Rand Mines manufactured the first low-carbon ferrochrome from solely South African raw materials at Middelburg in 1964 (Pretorius and Opperman, 2006). Rand Mines developed RMB Alloys after researching the conversion of chromium ore to ferrochromium. In 1969, RMB Alloys merged with South Cross Stainless Steel Company and Palmiet Chrome to create Middelburg Steel and Alloys (MS&A) because the local market was too limited to maintain the business as a successful enterprise (Visser, 2006).

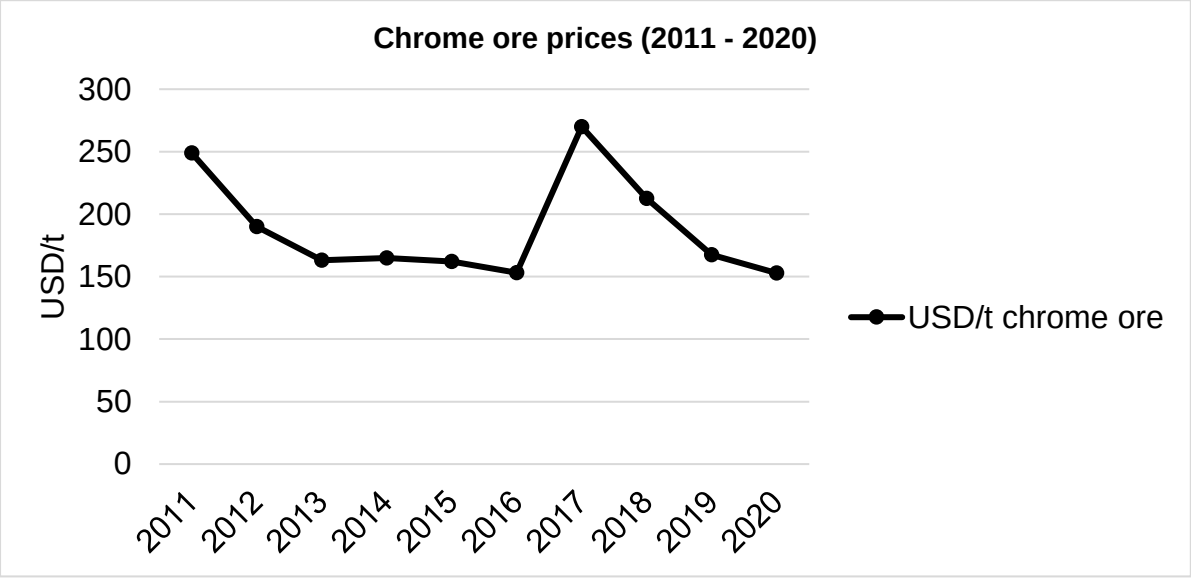


Figure 3. Chrome ore prices (2011 – 2020) (Minerals Council, 2020)

It is worth noting that chromite is an extremely valuable mineral that continues to play a key role in the global economy (Levin, 2020). As shown in Figure 3, year-on-year chrome prices were lower in 2020, averaging USD152.8/tonne, compared to USD167.4/tonne in 2019. In 2018, prices averaged USD 212.5/tonne (Minerals Council, 2020). The Chromite Mineral Value Chain (CMVC) is a significant contributor to the economic development of South Africa (Dlamini, 2020). The industrialisation program in South Africa cannot be isolated from the growth of the chromite and ferrochrome industry. Hence, South Africa's power generating capacity is also closely connected to the development of the Mineral Energy Complex (MEC) (Makgetla, 2021). Ferroalloy refineries in South Africa consumed a tenth of Eskom's electricity in 2018/2019. For example, electricity accounted for 31% of the unit cost of ferrochrome manufacturing in South Africa in 2018, which was higher than international estimates. (Makgetla, 2021). Historically, South Africa was a major exporter of chrome ores for a long period, until the 1960s and 1970s (Howat, 1986). The change occurred in 1973, when the world was affected by the quick and escalating rise in oil prices, as well as the stringent regulations enacted to reduce air pollution (Howat, 1986). Although South Africa had established ferrochrome smelting capacity in the 1960s, it was accelerated by changes in environmental policy in Europe, the United States, and Scandinavian countries, as well as rising oil prices (Jones, 2020). During the 1970s oil crisis, South Africa's ample and inexpensive coal-based thermal power led to the expansion of the ferrochrome sector, since anthracite coal supplied the major source for electricity generation, as well as reductants and feed for producing electrodes (Jones, 2020). As

a consequence of changes in oil prices and regulations to reduce air pollution, South Africa and Zimbabwe were able to mine and process chromite ores, exporting ferrochromium alloys to developed countries. Since the establishment of the ferrochrome industry in 1921, South Africa has dominated worldwide ferrochrome production until recent developments, when China surpassed South Africa in that regard (Backenber, 2020). For some time, South Africa has been a major exporter of chrome ore to China, which has contributed to the expansion of China's ferrochrome industry. Nevertheless, the strategy of being an exporter of raw chrome has had a detrimental influence on the value chain of ferrochrome manufacturing in South Africa.

1.2 Research Motivation

1.2.1 The context of South Africa's beneficiation strategy

South Africa is one of the major mining and mineral jurisdictions in the world (DMRE, 2020). South Africa operates in a global context and is influenced by the nature of global commerce. As a result, South Africa's beneficiation strategy cannot be isolated from global politics and commerce (Siddiqui, 1999). The beneficiation strategy adopted by the South African government is seen as a reform program aimed at boosting the economy. The Mineral and Petroleum Resources Development Act (MPRDA) 28 of 2002 contains provisions for boosting economic growth through improved mineral beneficiation, ensuring that mining contributes to rural development through job opportunities and the improvement of social and economic welfare, and ensuring that holders of rights contribute to socioeconomic programs through the implementation of proactive social and labour plans (Cawood, 2004). This decision is also backed by numerous government strategies, including the National Development Plan (NDP), New Growth Path (NGP), and the Department of Mineral Resources Strategy, which all state that the government acknowledges the country's mineral endowments provide it with a clear comparative advantage (DMR, 2011).

Even though the country has greatly improved its percentage of primary products obtained since the 1970s, South Africa's natural resources are mostly exported as raw ores or partially processed (DMR, 2011) (Figure 4). As a result of the accessibility and availability of its resources, it appears more natural for South Africa to encourage beneficiation. Through the Industrial Policy Action Plan (IPAP), the South African government calls for industrialisation to optimize long-term benefit initiatives, increase

export value, increase local content demand sources and build opportunities for sustainable employment (DTI, 2014). Beneficiation is one strategy to increase downstream value addition and ensuring that mineral resources contribute to the economy, but despite the developed infrastructure, and technological advancements, South Africa has been experiencing low growth rates for more than a decade (DMR, 2019). This is owing to poor infrastructural improvement and global dynamics, and research reveals that both these causal factors are responsible for the majority of our socio-economic challenges (Ngcaweni and Nkate, 2021). Under such economic conditions, it is natural for South Africa to consider measures to address the country's socio-economic challenges.

The population of South Africa is growing more rapidly than at any other time in history, and mineral consumption is increasing at a faster rate than the population as more domestic and international consumers enter the South African mineral market, increasing demand for the country's minerals (DMR, 2018/2019). Given the minerals that are available in South Africa, it is critical to efficiently use the minerals to maximize the economic growth, development, and employment potential that such national assets contain (DMR, 2018/2019). This extends throughout the value chain, from mining equipment and services through extraction, infrastructure development, beneficiation, skill development, and research and development (Valiani, 2018). South Africa's beneficiation plan has yielded a number of successes in many areas of the economy, including Platinum Group Metal (PGM) fuel cells and coal-to-liquid technology for the development of downstream activities and the addition of value to mined resources. The industry, along with other associated businesses like manufacturing, financial services, power, transportation, and so on, is still considered the cornerstone of the economy, with enormous growth potential (SAMI, 2020).

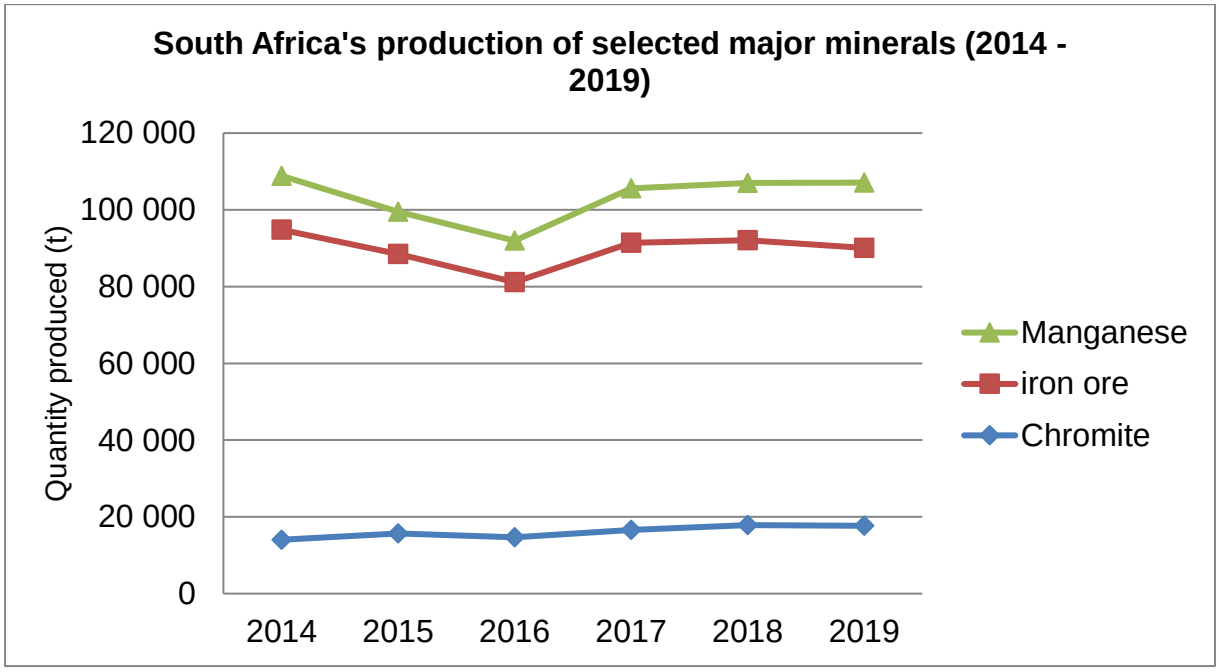


Figure 4. South Africa's production of selected major minerals, 2014 – 2019 (DMRE, 2020)

1.2.2 South Africa's proposed export tax on chrome ore

As shown in Figure 5, the contribution of South Africa to global chrome ore production is significant and cannot be downplayed (DMRE, 2020). South Africa possesses 75% of the world's Platinum Group Metals (PGM) deposits, large chromium and manganese reserves, and produces a significant amount of ferroalloys, and thus might be regarded as a threat to the liberty which the global free market enjoys in terms of strategic minerals (Burgess, 2010). Most of the chrome ores produced globally are consumed by the stainless steel industry, with a market share of about 77%. Hence; growth in the global steel industry drives demand for chromium as ferrochrome (Jones, 2020).

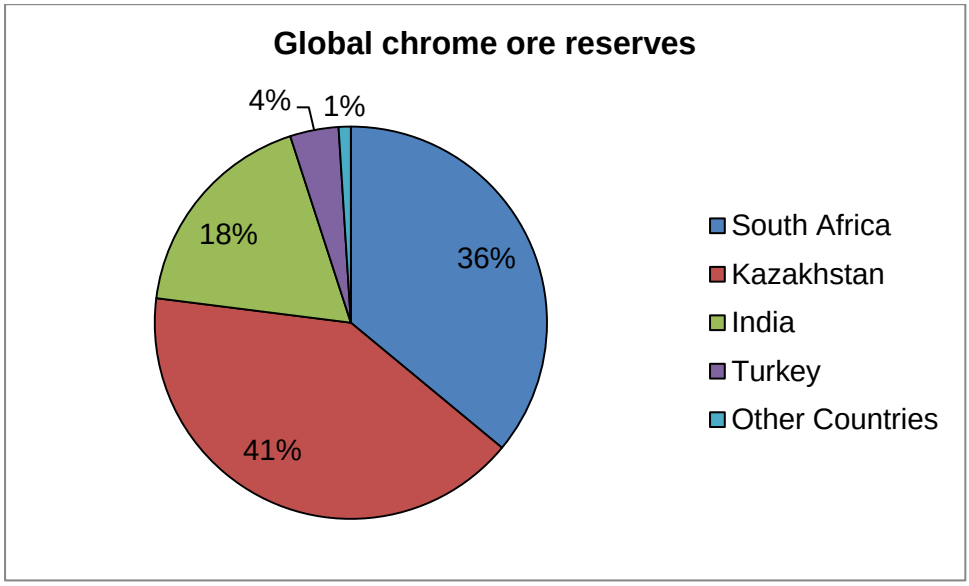


Figure 5. Global chrome ore reserves (U.S. Geological Survey (USGS, 2021)

Figure 5 shows that South Africa, while not the sole producer of chrome ore in the world, ought to have a significant comparative advantage with reserves of around 36% below Kazakhstan's 41%. The eastern limb of the Bushveld Igneous Complex (BIC) hosts a sizable amount of chrome reserves that are less expensive to mine, providing an opportunity to sustainably exploit the reserves and undertake new greenfield projects for economic development. South Africa's supply base requires government-supported expenditures on research and development (R&D), tertiary education institutions, and science councils to maintain a sustainable comparative advantage (Williams et al., 2014). These investments are required for South Africa to compete with growing Asian industrial competition as well as knowledge and innovation.

Table 1: World ferrochrome production and exports, 2019 (CRU, 2020b)

Country	Production			Exports		
	kt	%	Rank	kt	%	Rank
China	6 577	44.7	1	48	0.7	9
South Africa	3 273	22.2	2	2 561	39.2	1

Until recently, South Africa was the largest producer of ferrochrome. Due to South Africa's poor policy decisions, China has grown its global market share in ferrochrome production by using chromite ores imported from South Africa as shown in Table 1. Mineral-rich countries, such as South Africa, can apply higher export tariffs to increase financial income while also protecting domestic industries downstream in the value

chain. The arguments advanced to justify the proposed tax on chrome ore are accurate and can help save and stimulate the ferrochrome industry. However, it cannot be the only solution to the ferrochrome industry's resuscitation.

1.3 Background to Research Problem

China surpassed South Africa by obtaining a market share of ferrochrome produced easily and at a low cost from South Africa to increase its ferrochrome manufacturing capacity. The South African ferrochrome industry suffers due to unsustainable electricity costs and other operating costs. It is important to note that the Mineral Energy Complex (MEC), which is the backbone of South Africa's economy, is energy-intensive and the state-owned entity (Eskom) is currently unable to support the government's beneficiation strategy, hence South Africa is falling behind, particularly in ferrochrome production. The MEC is a conglomeration of well-developed industries and institutions centred on the South African economy's mining, energy, and financial sectors (Hlongwane, 2014).

Despite industrial expansion and a comparative advantage in resource endowment, South Africa has failed to produce more beneficiated products farther down the mineral value chain (Turok, 2013). Instead, the country has become a significant exporter of raw materials, alloys, and ores, as well as a big importer of finished products from India, Brazil, and China (Hlongwane, 2014). While the South African beneficiation strategy leaves much to be desired, the approach is impractical considering the country's current challenges. These challenges include inadequate power supply, skill shortages, transportation system, identification of markets for locally beneficiated products, and beneficiation infrastructure constraints. The country is continuing to lose its competitive advantage in the ferrochrome industry and the chrome ore market as the challenges have put an enormous burden on South Africa's smelting operations, and as a result, three smelter operations have shut down. The shutdown of smelting plants around South Africa is indicative of the present problems confronting most beneficiation businesses in the country, as well as an indication that the country's competitive edge is gradually eroding. With the current challenges that South Africa is facing, as well as the newly proposed chrome ore export tax, the government risks rendering the chrome ore sector uncompetitive, which may have serious implications for the country's economy. Therefore, the country's current economic trajectory needs

to fully utilise mining development, as it is well recognised that the mineral industry is unique, subject to price volatility, finite, and has limited sustainability. For this reason, it is crucial that South Africa builds a knowledge-based economy and strategically exploits its mineral wealth to achieve its aim.

1.3.1 Problem statement

An adequate theoretical and practical explanation of how the proposed chrome ore export tax is sensitive to the South African economy is lacking. The South African ferrochrome industry is losing its competitive edge as several ferrochrome smelters have mothballed due to the cost of doing business. The conceptualised theoretical and practical knowledge gaps were the focus of this thesis up to this point. That is to investigate the efficiency and relevance of the beneficiation approach as well as to examine the potential impact of the proposed chrome ore tax. The contribution of this study was to address these key issues of the beneficiation strategy and export tax that **are** sensitive to the South African mining context.

1.4 Purpose of the Study

This study investigates the efficiency and relevance of the beneficiation approach as well as to examine the potential impact of the proposed chrome ore tax.

1.4.1 Research Objectives

- To identify the challenges facing the South African ferrochrome industry.
- To analyse the advantages of South Africa’s chrome ore beneficiation strategy.
- To determine if South Africa’s rich endowment of chrome ore can deliver additional economic benefits through beneficiation above and beyond simple mining and exportation.
- To examine and analyse interventions or policies needed to create sustainable ferrochrome exports, with specific reference to the implications of the proposed chrome ore export tax.

1.4.2 Research questions

The major question in this study is how South Africa's resource advantage in chrome ore can be utilised under current, or a modified version of the beneficiation strategy, to increase the country's export earnings from ferrochrome?

Other important questions to be answered include:

a) Why is the beneficiation strategy on chrome ore not advantageous to South Africa?
b) What are the challenges facing the South African ferrochrome industry?

1.5 Assumptions of the Study

Several smelter plants have closed in South Africa over the last few decades as a result of general structural challenges such as electricity and cost; these closures further justify the uncompetitive nature of beneficiation plants in South Africa, primarily ferrochrome plants (Backenber, 2020). As a result, the country's strategy for exporting chrome ore and beneficiation must be reviewed. The South African government proposes the chrome ore export tax to save the ferrochrome industry, with the hope that it will also assist in economic development and employment creation. However, the export tax might create a conducive environment for other chrome producers around the world to wrestle South Africa for its market share, even though the country has the largest reserves in the world. The core of the problem is the input cost, which has a direct impact on competitiveness and is dependent on the cost of electricity, technological advancement, the cost and availability of freight, the cost of the wage bill, and the flexibility of government policy.

1.6 Scope of the Study

The scope of the study covers the following areas:

- An overview of the South Africa non-integrated chrome ore producers model and the ferrochrome industry
- Analyse the chrome beneficiation strategy and the possible impact of the proposed tax on chrome ore.

- Identification of challenges facing the chrome and ferrochrome industry in South Africa

The scope of this study is confined to the South African chrome mines and ferrochrome industry although some lessons may be derived from other local mineral industries and international experience where applicable.

1.7 Chapters Outline

The research will be carried out as outlined below.

Current Chapter (i.e., Chapter 1 – Introduction)

This chapter covers the background of the study and chrome and ferrochrome in South Africa. It also covers the context of the beneficiation strategy in South Africa and the proposed export tax on chrome ore. In this chapter, the problem statement was discussed as well as the purpose and objectives of the study

Chapter 2 - Literature review

The literature review of this study was covered in this chapter. It included the concept and current state of mineral beneficiation in South Africa. It covered the comparative advantages of chrome as well as the demerit of the beneficiation strategy in South Africa. The key debates of the proposed chrome ore export tax was covered in the chapter.

Chapter 3 – Research Methodology

In this chapter, the research methodology was covered. The research approach, research strategy, research design and ethical clearance were covered in this chapter

Chapter 4 – Data Analysis and Discussions

The analysis of data as well as its discussion was covered in this chapter. In this chapter, data was derived through questionnaires and review of literature.

Chapter 5 – Interpretation of the Findings

In this chapter, the responses from the respondents from the interviews were analysed and described in this section.

Chapter 6 - Conclusion and Recommendations

In this chapter, the conclusion of the study, the contribution of the study and recommendations of the study

2. LITERATURE REVIEW

2.1 Introduction

This chapter examines aspects of the beneficiation strategy of South Africa, based on literature to depict the unique setting of the country. The chapter delves into the mining industry, defines mineral beneficiation, including its stages, and explores the history and current state of beneficiation in South Africa. It also covers South Africa's comparative advantage in terms of reserves and resources (chrome ore), the constraints of the chrome ore beneficiation strategy, the ferrochrome industry and its challenges, and the proposed export tax on chrome ore. The following section addresses mineral beneficiation and its stages as well as its context related to chrome ore in South Africa.

2.2 The concept of Mineral Beneficiation

According to the South African Mineral Policy White Paper in 1998, beneficiation is described as the process of adding value to raw materials from their extraction through the sale of finished commodities to consumers, and it involves a wide variety of activities (Department of Minerals and Energy (DME), 1998). It involves transforming raw materials into finished products with a higher market value (DMR, 2011). Beneficiation entails a number of operations, including the following sequential stages of processing: smelting, which is characterized by large-scale and capital-intensive activities; refining, which is characterized by refinery facilities; and final processing, which is characterized by labour-intensive procedures such as craft jewellery, metal fabrication, and ceramic pottery (Tom, 2015). The processing stages adds value to the product, allowing it to be sold at a higher price than the prior intermediate product or raw material. There are three forms of beneficiation: upstream, side-stream, and downstream. The process of converting a mineral into a higher-value product that may be consumed locally or exported is referred to as "downstream" (Bhengu, 2016). Beneficiation is a vertical relationship in value chains known as linkages that has a significant impact on economic development in developing countries to promote structural change (Hausmann et al., 2008). According to Hausmann et al. (2008), "it is a logical and natural progression for countries exporting raw minerals to engage in the mineral processing industry, and policies that support its progression can help

accelerate economic growth." This viewpoint was held by Zoghby and Olivier (2013), who suggested that mineral beneficiation should be a top priority for resource-rich countries in order to maximize the potential for local job creation and economic growth.

The process of mineral beneficiation is classified into four stages (Baxter, 2005, Leeuw, 2012, Dzinomwa and Katiyo, 2014). The beneficiation is classified into four stages, with the commodity gaining value as it progresses from one stage to the next (DTI, 2014). The stages are:

- First stage: This is the most basic stage, which involves the mining and extraction of raw ore (minerals not beneficiated). This level requires a significant amount of capital and labour.
- Second stage: This involves the creation of intermediate products form minerals. The raw ore is cleaned and polished. This stage is capital and energy-intensive and involves limited beneficiation. Intermediate goods are made at capital and energy-intensive smelters and refineries.
- Third stage: This is the transformation stage, which requires crucial inputs such as skills and technology. This stage is characterized with high capital and highly extensive labour. Intermediate products are refined and semi-fabricated into finished products for use by small and sophisticated businesses. At this stage, heat-treating, cold forming, and/or finishing operations take place in foundries. At this stage, the levels of employment and the amount of added value are generally high.
- Last stage: This is the most time-consuming stage, but it adds the most value. It further transforms the processed metal into a wide range of finished products. End-users in various sectors of the economy, such as construction and infrastructure, machinery, plants, and equipment, can utilize finished products at this stage. At this stage, employment is substantially higher, and industries include both small and large manufacturers.

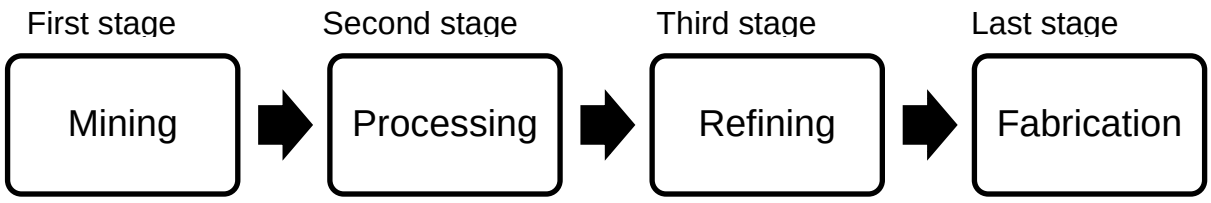


Figure 6. Stages of mineral beneficiation (Gautham et al., 2019)

According to Leeuw (2012), South Africa is involved in the primary stage of mineral beneficiation and argues that the secondary, tertiary, and final stages should be the focus of mineral beneficiation in the country. These are the stages where industrial competency has an upper hand in mining. To comprehend the South African beneficiation strategy, this section gave the backdrop to what beneficiation is and its stages. The next sub-sections address the beneficiation strategy and the current state of beneficiation in South Africa.

2.2.1 Mineral beneficiation in South Africa

The “Beneficiation Strategy for the Minerals Industry of South Africa” was adopted by the South African Cabinet in 2011 (DMR, 2011). The strategy serves as a framework for promoting and facilitating beneficiation. The South African government identifies the mining sector as a development instrument that may help the country achieve its socio-economic goals (Bhengu, 2016). According to DMR (2011), beneficiation is not a new concept in South Africa, and it is frequently initiated in response to the demands of the mining industry, such as power generation and coal conversion. The energy supply commission (ESKOM) was founded in 1923 to generate power from South African coal and distribute it to industrial, mining, commercial, agricultural, and residential consumers. The South African Iron and Steel Industrial Corporation (Iscor) was founded in 1943 to manufacture iron while also providing jobs. This was prompted by the wartime need for steel and the local production of a variety of requirements (ArcelorMittal, 2010). According to Eunomix (2012), the necessity for petroleum in South Africa prompted the creation of Sasol in 1950 to make petrochemicals from coal. Rand Mines, the world's largest holder of chromium ore deposits, investigated the

conversion of chromium ore to ferrochrome in 1964 and founded RMB Alloys to develop a production operation in Middelburg (Eunomix, 2012). The Southern Cross Stainless Steel Company was formed as a result of this, and a stainless steel facility was built in 1966. When the plant was enlarged in 1980, the local market was too limited to sustain the firm as a successful business (Dondofema et al., 2017). As a result, in 1969, RMB Alloys and Palmiet Chrome merged to become Middleburg Steel & Alloys (MS&A). MS&A actively promoted local fabricators to manufacture previously imported commodities, resulting in increased domestic demand (Dondofema et al., 2017).

South Africa's mineral resources were projected to be worth USD 6.3 trillion, and the government has adopted a mineral processing-based approach to maximise the value of those resources (DMR, 2011). The beneficiation strategy provides a framework that aims to translate the country's natural wealth into a competitive advantage. The beneficiation strategy identified ten essential mineral commodities, such as the chromium mineral value chain, which is a part of the iron and steel value chain (Bhengu, 2016). The chromium and steel value chains have been identified as key components of the government's mineral processing strategy (DMR, 2011). Historically, chromite (chromium ore) has been the sole commercially viable source of chromium (Neizel, 2010). The world's chromite reserves are 12 billion tonnes, with South Africa possessing between 72 percent (about 11700 Mt) and 80 percent (if Upper Group 2 (UG2) ores are considered) (Pan, 2013, USGS, 2018).

Despite South Africa's enormous mineral wealth, mineral beneficiation has been relatively modest. This is mostly due to concentration in the mining value chain's high-capital sectors. This demonstrates that having abundant natural resources does not guarantee downstream beneficiation. Following an overview of South Africa's beneficiation strategy and history, the potential and current state of South African beneficiation are examined.

2.3 Current state of Beneficiation Strategy in South Africa

Beneficiation is essential for enabling social and economic growth, as well as for creating local jobs and boosting the local skill base (Eunomix, 2012). The beneficiation strategy, which aims to add value to South Africa's gold, platinum, diamonds, iron ore, chromium, manganese, vanadium, nickel, titanium, energy coal, and uranium

endowments, was authorized by the country's cabinet (Creamer, 2020). According to the South African White Paper (1998), the beneficiation plan would maximize South Africa's natural resources for the benefit of the whole people (DMR, 2011). This was determined to be accomplished by enhanced development of secondary and tertiary mineral-based sectors aiming at adding value to raw materials. South Africa ranks first in the world in terms of mineral resources due to the fact that the majority of minerals produced are refined locally, with the remainder exported as raw ores to international markets (DMR, 2011, Leeuw, 2012). As a result of the physical proximity to raw minerals, local downstream processors should benefit greatly. Mineral supplies must be sufficient for industry and for the modern economy to continue to expand sustainably (Kitange, 2012). As seen in Figure 7, it is useful to assess the possibilities for value addition through beneficiation. Most minerals are exported as ores with little or no value-added, resulting in beneficiation occurring internationally and a lesser income stream for South Africa than would be expected if beneficiation occurred locally.

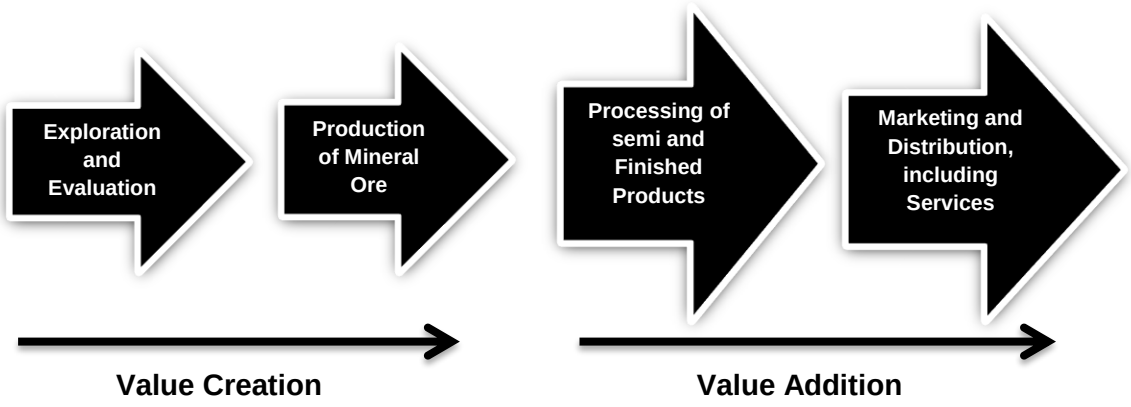


Figure 7. Mineral value chain creation and addition (Manhart et al., 2019)

The following sections discuss chrome ore in South Africa and its current state based on beneficiation.

2.3.1 Chrome ore in South Africa

Carl Mauch, an explorer and geologist, discovered chromium in South Africa in 1865 along the Hex River in the Rustenburg district. Mining began in 1924, after the railway from Lydenburg to Burgersfort and Steelpoort was expanded. The Bushveld Igneous Complex (BIC) stratiform deposits is the source of all chrome ore extracted in South

Africa (BIC) (Von Below, 1986). According to the U.S. Geological Survey (USGS) (2018), South Africa is home to 35.1 percent of the world's chrome deposits. Chromite reserves are deposits that have been discovered and are commercially viable to extract. In terms of production, exports, and employment, the South African chrome industry has expanded substantially during the last few decades. The sector's growth has been spurred by export-led output from non-integrated South African chrome ore producers (both primary ore miners and UG2 producers). The growth in export quantities has positioned South Africa as the world's leading player in terms of global chrome ore sales. South Africa produces the most chromite in the world (International Stainless Steel in Figures (ISSF), 2015). As shown below in Figure 8, South Africa produced 48% of the world's chrome ore in 2018, because of its comparative advantage. Approximately half of South Africa's chrome ore is exported for smelting into ferrochrome, which is subsequently processed into stainless steel (Letaba and Zulu, 2021).

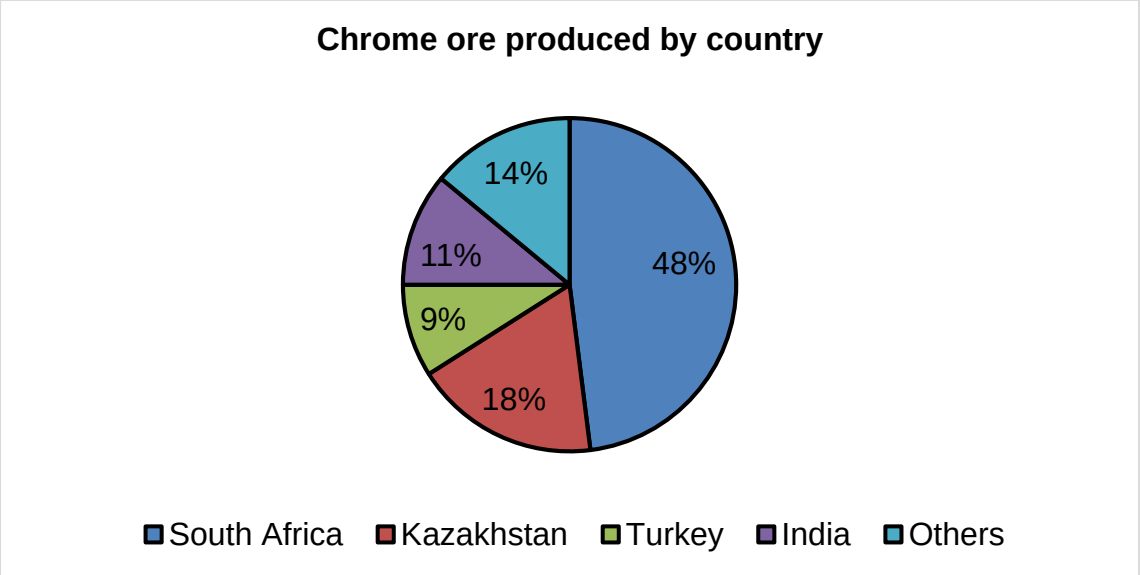


Figure 8. Chrome ore produced by country (USGS, 2018)

There are four primary applications for chrome ore, namely steel or alloy manufacturing (metallurgical grade ore), chemical, foundry sand, and refractory grade, as shown in Table 2. Steel or alloy making accounts for 94% of chrome ore use. South Africa produces about 61 percent of the world's chrome (Minerals Council, 2020). Metallurgical grade chrome ore is used to produce ferrochrome, with the main grades of the intermediate product being Charge Chrome (ChCr) and High Carbon Ferrochrome (HC FeCr) (together accounting for 93% of all ferrochrome production).

The majority of ferrochrome is used in the production of stainless steel (77% of all ferrochrome applications), with the remaining 23% feeding into other types of steel production (Pariser et al., 2018). As such, the main driver of demand for both chrome ore and ferrochrome is downstream global stainless steel production (Pariser et al., 2020). Since chrome ore, ferrochrome, and stainless steel are all closely related commodities, their pricing, demand, and consumption patterns are comparable (KPMG, 2018).

Table 2: Chrome ore specifications (DMR, 2006)

APPLICATION	GRADE (Cr Content)
Metallurgical	>46%
Chemical	40% - 46%
Foundry Sands	40% - 46%
Refractory	>60%

In 2019, South Africa produced 17.6 million tonnes of chrome ore, which accounted for 61% of global production. The number of employees has increased from 12,200 in 2008 to 20,901 in 2019. (Minerals Council, 2020). Domestic chrome ore production in recent years has increased on the back of increased demand for stainless steel globally. Chrome ore prices have been strongly linked to China's demand for and output of stainless steel (KPMG, 2018). The largest importer of South African chrome ore, accounting for around 93 percent of total exports.

Approximately 5 million tonnes of this total were exported, with the remainder consumed (or held in stock) locally (DMRE, 2020). Domestic sales of chrome ore have been volatile, but export demand has increased considerably, from 762,164 tonnes in 2008 to 5.2 million tonnes in 2019. In recent years, chrome ore prices have been strongly linked to China's demand for and output of stainless steel (KPMG, 2018). Chrome ore prices fell in 2015 due to a significant slowdown in the Chinese economy, which reduced demand for stainless steel. As a result, several South African chrome producers have reduced production and implemented mine maintenance programs.

South African production can be divided into those producers who mine chrome ore as their primary operation (primary chrome producers) and those who produce pre as a by-product of Platinum Group Metal (PGM) mining operations (UG2 producers).

South African chrome ore is generally of a lower grade relative to other international producers, with UG2 chrome ore falling below primary chrome ore. Primary chrome ore producers can further be split into non-integrated players and those who are integrated with downstream ferrochrome smelting. The integrated producers have significant reserves and sufficient captive mine capacity to supply their entire ferrochrome production and still export significant excess volumes. In contrast, non-integrated prime producers and UG2 producers export almost all their chrome ore production.

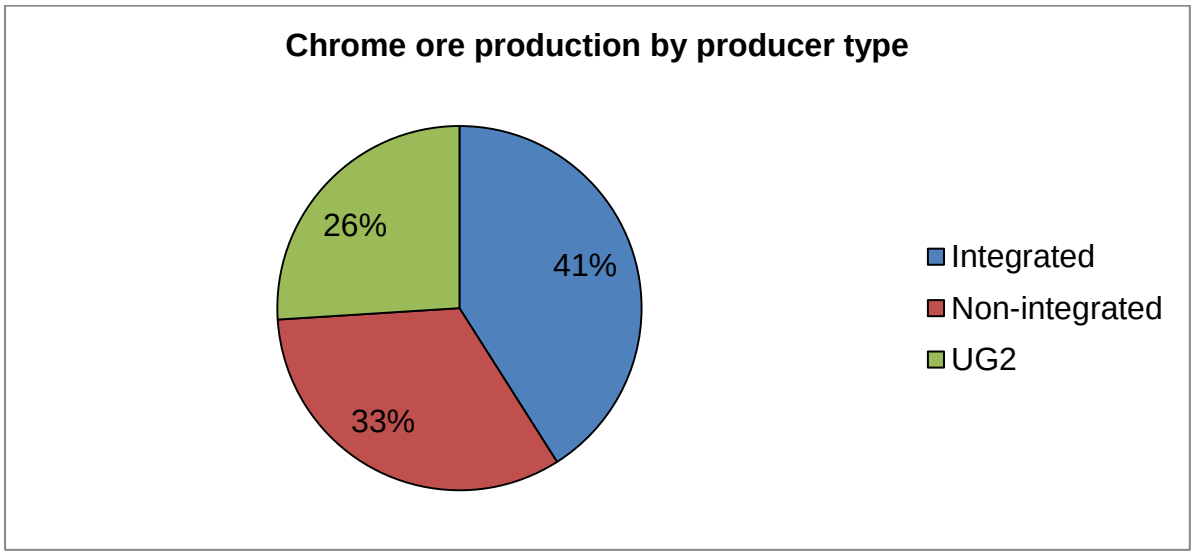


Figure 9. Chrome ore production by producer type, 2019 (kt) (CRU, 2020a)

2.3.2 Ferrochrome in South Africa

Ferrochrome (FeCr) is a chromium-iron alloy that contains between 50% and 70% chromium (DMR, 2013). It is made by electric arc melting chromite, which is an iron magnesium chromium oxide and the most significant chromium mineral (DMR, 2013). During World War II, the African Metals Corporation (AMCOR) established a factory in Vereeniging to create ferrochromium alloy for the construction of armaments (Von Below, 1986). South Africa contains very few of the high-grade lumpy ores that are used to make ferrochrome. These ores can be found in Turkey, the Philippines, and Zimbabwe, among other places. South Africa's chromite deposits, located in the Bushveld Complex, are mostly low quality and brittle. International steel and ferroalloy manufacturing institutions had traditionally avoided South Africa's chrome ore, which fueled the formation and quick expansion of a local ferrochrome sector (Von Below, 1986). South African industries had to find innovative processes to use the low-grade

chrome ore in the production of ferrochrome. The Argon-Oxygen Decarburisation (AOD) process operates on the premise that the lowered partial pressure created by an inert gas, such as argon, allows for selective carbon oxidation at lower melt temperatures. The AOD furnace for stainless steel production can withstand far higher carbon content in the alloy than the conventional direct-arc furnace, and the reduction in chromium losses implies that higher chromium content is no longer required. As a result, a low chromium (45 – 55% Cr) and high carbon (6 – 9% C) alloy might be employed. The low chromium and iron ratio (1.5:1) of Bushveld Igneous Complex ore was discovered to be suitable for this alloy. (Von Below, 1986).

Chrome ore is essential for ferrochrome production and is a valuable component for stainless steel production. Therefore, China has significantly increased its market share of stainless steel production. Due to easily accessible chrome ore imports, China reached a 53 percent market share in 2017, thus rising ferrochrome demand to meet its growing domestic stainless steel needs, driven by the construction industry. Increased ferrochrome output has been accomplished by constructing new furnaces and converting furnaces formerly used for other alloys to produce ferrochrome (KPMG, 2018). On the other hand, South Africa adopted a beneficiation strategy for its strategic minerals and is also proposing the implementation of a chrome ore export tax. This policy shift comes as a result of South Africa seeking to benefit more value from its host minerals, especially chrome ore. Ferrochrome producers are involved in both the upstream and downstream processes of mining and beneficiating chromite, as well as smelting chromite to make ferrochrome. Pricing and demand for ferrochrome are impacted by global economic circumstances, exchange rates, stainless steel demand, and chromite supply (KPMG, 2018). According to Von Below (1990), the fluctuation between South Africa and major producing countries has an impact on the pricing of these commodities. The minerals' long-term price elasticity is relatively high, causing genuine price changes to transfer to demand changes. Changes in real exchange rates will directly affect the cost competitiveness of South African factories in comparison to those in other producing countries(Von Below, 1990).

With the available chromium resources, South Africa will continue to dominate chrome ore production globally, with chromium being an important industrial element for producing steel and ferroalloys. Apart from the comparative advantage in chromite that South Africa enjoys, the economic prosperity of the sector is also affected by other

externalities, which have proven to outweigh the latter. The South African economy is linked to the world; therefore, the minerals sector as a whole is not immune to the cyclical nature of the industry, which is determined by price and market volatility. The ferrochrome ore industry has been seriously threatened in recent years, mostly owing to rises in power rates for heavy use sectors, which, along with South Africa's unstable supply of electricity, have devastated the industry to the point that reportedly 40% of the country's ferrochrome mines have been unable to continue production. China imports 84% of the South African ferrochrome (Tzarevski, 2021). South Africa is one of the world's top ferrochrome producers, and if its issues are properly addressed, the sector might play a critical role in the country's financial recovery.

2.4 Comparative Advantage of Chrome Ore Reserves to Economically Benefit

The capacity of an economy to produce a certain commodity or service at a lower opportunity cost than competitors is referred to as comparative advantage (Gupta, 2015). There are trade-related processes at work that are more paradoxical and possibly unique to South Africa, the most notable of which is the relatively limited export response to the dropping exchange rate (Draper et al., 2018). According to Von below (1990), it is required to first examine the trade theory of comparative advantage. The modern trade theory was developed in 1817 by David Ricardo, a British economist, and can be summarized as follows: If South Africa and Japan both produces ferrochrome, but South Africa’s production costs are lower, then South Africa has absolute advantage in ferrochrome production. If South Africa has an absolute advantage in pricing stainless steel, but the ferrochrome: stainless steel production cost ratio is 1:3 in South Africa and 1:2 in Japan, South Africa has a comparative advantage in producing ferrochrome and Japan has a comparative advantage in producing stainless steel. The trade theory dictates that trading between South Africa and Japan would commence, with each country specializing in the production of that good which it has a comparative advantage (Von Below, 1990).

The manufacturing sector of South Africa’s economy was historically built on the mining economy, and the collapse of the country's highly active minerals industry has significant ramifications for the numerous related upstream and downstream industries (Calì and Hollweg, 2017). The producers of chromium in South Africa have have continued to grow export quantities despite falling prices (Draper et al., 2018). In 2020,

the average price of chrome was USD152.8/tonne, down from USD167.4/tonne in 2019 and USD212.5/tonne in 2018 (Minerals Council, 2020). A recent International Monetary Fund (IMF) paper looked at this issue by using a unique database of export performance at the company level to evaluate the influence of structural variables on export performance (Anand et al., 2016). The authors found that electricity constraints, restricted product market competitiveness, and the frequency of strikes have reduced the responsiveness of firms' exports to the rand's depreciation. Consequently, despite the potential to grow exports provided by the rand's devaluation, these rigidities have limited businesses' ability to profit from this competitiveness gain.

Modern economic growth is a constant structural change process. This entails constant technical innovation in existing industries, the development of new, high-value-added industries, and improvements to physical infrastructure, such as electricity supply and road networks, as well as institutions (Lin et al., 2020). Infrastructure describe transaction costs that are endogenous to an economy's endowment structure (e.g., land, capital, and labour with the potential to provide comparative advantage), which exists at any one time and varies over time. High-performing countries have kept their growth going by leveraging and refining their core competencies and capitalizing on their comparative advantages to upgrade industrially, diversify, and increase the competitiveness and complexity of their goods and services (Lin et al., 2020).

The total budget and relative factor prices of the economy are determined by endowments and their structure at any given moment. These, in turn, decide which industries have a competitive edge in the economy. The economy will have an adequate industrial structure if all of the industries in the economy are consistent with the economy's comparative advantage (Lin et al., 2020). In both the local and foreign markets, such a structure allows the economy to function with the lowest factor costs for production. Traditionally, the goal of a firm is profit maximization, which is a function of the relative price of factor inputs when all other factors are equal. The relative cost of capital, labour, and natural resources is typically used to guide a firm's decision. A market system that generates price signals that represent the relative scarcity of the factors of production in the endowment structure is required for firms to follow the economy's comparative advantages in selecting whether to remain in or enter an industry. In developing countries, which often lack a competitive market, the

government must make efforts to enhance market institutions so that competition in product and factor markets may be created and protected. Firms require knowledge of manufacturing methods and the market for their goods as part of the industrial upgrading process. As a result, development is a dynamic process characterized by externalities that necessitate cooperation. Successful countries have pursued their comparative advantages, as defined by their factor endowments, and built their industries with government assistance in market economies (Tacchella et al., 2012).

2.5 Demerits of Beneficiation Strategy on Chrome Ore to South Africa

According to Pan-African Investment & Research Services (PAIRS) (2011), South Africa's industrial competitiveness has declined over the last decade as a result of various structural constraints such as growing input prices, inadequate infrastructure, energy shortages, and, most crucially, the sector's long-term competitiveness has not gotten appropriate attention. According to the World Economic Forum (WEF) (2013), greater emphasis should be devoted to the basic needs of competitiveness, with a particular focus on the macroeconomic environment, for South Africa to be competitive and successful in the beneficiation project. The government must invest in higher education and training, research and development, and technology to be effective. (WEF, 2013). Manufacturing competitiveness is critical for the beneficiation program's long-term viability.

According to Edwards and Lawrence (2012), there is little evidence that raw material production inherently offers a country a competitive edge in beneficiation operations. For example, in the beneficiation of iron ore, South Africa has significant disadvantages: it lacks sufficient local demand for scale; it is not close to major foreign demand centres; and profitability is harmed by high costs of significant factors (capital, labour, and energy), as well as the high cost of imported and coking coal (Anglo American Kumba Iron Ore, 2011). According to Edinger (2014), beneficiation is driven by concerns of competitive advantage (production, skills, craftsmanship, etc.) rather than the availability of raw resources. The World Economic Forum defines competitiveness as the set of institutions, regulations, and factors that influence a country's level of production (WEF, 2013). In a survey by the WEF, respondents were asked to select the five most difficult aspects of conducting business in South Africa (WEF, 2013). According to the study, the five biggest barriers to conducting business

in South Africa are a poorly educated workforce; stringent labour regulations; ineffective government bureaucracy; corruption; and a national workforce with a poor work ethic. This was also supported by Eunomix (2012), access to raw materials, infrastructure, adequate energy, labour cost inflation, quality education, and research and development are some of the key challenges faced by South Africa's mineral beneficiation sector.

Most beneficiation operations need a substantial and consistent supply of energy, and the recent exceptional levels of electricity consumption, along with a lack of investment in power generation, resulting in an energy supply shortfall beginning in the first quarter of 2008. South Africa has a well acknowledged skills deficit, owing to a mismatch between skills in demand and those in supply (Deloitte, 2014). The mining industry's present composition promotes raw material export, with most existing producers bound by long-term contracts with overseas clients. Constraints in research and development are restricting the opportunities for innovation and originality in the creation of goods for beneficiation. These considerations show that having a natural resource does not automatically translate to downstream beneficiation unless targeted interventions are made to overcome limitations and achieve competitive advantage for the mineral beneficiation industry.

2.6 The Proposed Export Tax on Chrome Ore in South Africa

The South African government has proposed the possibility of imposing a chrome ore export tax. Export taxes are a legal form of industrial development intervention that aims to increase downstream raw material beneficiation (Östensson, 2019). The proposed chrome ore export tax is aimed at supporting the ferrochrome sector in South Africa while also encouraging industrialisation and beneficiation. According to Levin (2020), the benefits given by the chrome ore export tax are critical for the long-term viability of the ferrochrome industry. The export tax is part of a wider strategy to enhance South Africa's industrial capacity and help the country fundamentally move away from its mining-dependent past and toward greater capability in value-added products. The continuous expansion of the stainless steel and downstream industries will have an influence on the economy (Levin, 2020). The next sub-section explains the context in which the export tax is being proposed.

2.6.1 Context of the proposed export tax on chrome ore in South Africa

South Africa was the world's largest and most cost-effective ferrochrome manufacturer until 2012. Its competitiveness was founded on the availability of chrome ore, world-class technology, low electricity rates, and a steady supply of electricity (Levin, 2020). The government has suggested some initiatives, one of which is the imposition of an export tax on chrome ore. The proposed chrome ore export tax is intended to boost domestic ferrochrome production and the chrome value chain in South Africa (Ghilotti, 2020). Thomashausen (2011) provided context, noting that South African ferrochrome manufacturers have been seeking export taxes on ferrochrome since 2009 to protect and improve the beneficiation of ferrochrome ore and ferrochrome exports. South African producers claim that a chrome export tax will raise chrome ore prices, reducing capacity in China's domestic ferrochrome sector and allowing South African producers to reclaim their ferrochrome manufacturing edge.

China is the world’s largest manufacturer of ferrochrome and is driving global ferrochrome demand. Chinese stainless steel consumption is likely to expand as domestic demand outpaces local supply. China's ferrochrome capacity was built with chrome ore from South Africa, and the country has risen from irrelevance to become the world's top producer (Levin, 2020). The industrial plan of China includes subsidizing and fostering ferrochrome production to expand stainless steel and downstream capacity, making them the world's top ferrochrome manufacturer (Levin, 2020). Almost all the ferrochrome produced in China is used to make domestic stainless steel, which is subsequently almost solely used to make white goods and other stainless steel items (Levin, 2020).

The basic rationale for the proposed export tax on chrome ore, as detailed in the TIPS report, is to boost the relative competitiveness of South African ferrochrome producers by raising the cost of Chinese ferrochrome producers (who use South African chrome ore) (Levin, 2020). It is believed that by reducing the competitiveness of the Chinese ferrochrome industry, domestic ferrochrome producers in South Africa will be able to attain a better effective export price for ferrochrome and/or increase ferrochrome export volumes, allowing them to become more sustainable. The premise of the export tax is also founded on the notion that, given South Africa's dominant position in the world chrome ore supply, the tax will be passed on to chrome ore exporters via the

export price without causing considerable harm. It's difficult to predict if an export tax would assist a country in the long run.

2.7 Key Debates on the Proposed Chrome Ore Export Tax

Export taxes, according to economic theory, can have a net positive effect on an economy. The protection of domestic raw material supplies and the promotion and/or protection of downstream industry growth are common policy objectives linked with the implementation of an export tax (Fung and Korinek, 2013). The overall goal of these policy objectives is to lower raw material input costs for local consumers and/or make the downstream industry more competitive globally by providing it with a relative price advantage (Fung and Korinek, 2013, Latina et al., 2011). Economic theory also recognizes that if a country is a large exporter with significant market power in terms of global raw material supply, the rationale and advantages of imposing an export tax might operate in a somewhat different way. In this scenario, imposing an export tax would likely raise the international world price, potentially improving a country's terms of trade (to the benefit of local industry) (Pothen et al., 2013). International competitors are charged a higher price in this case, lowering their competitiveness in the domestic downstream industry.

South Africa produces two-thirds of the world's ferrochrome and controls four-fifths of the world's seaborne markets. As a result, the government may maintain its stance on domestic chrome processing, putting pressure on the traditional global chrome leaders. International chrome ore producers have the capacity, allowing them to sufficiently substitute South African chrome ore, putting the South African chrome sector at risk. For example, China has vast purchasing power and could suppress any attempt to enact the tax (CastingsSA, 2021). Even though the tax would be applied equally to all chrome ore exports, China accounts for 93% of these exports. Of all of South Africa's major global ferrochrome competitors (Levin, 2020), only China is substantially reliant on South African chrome ore. Furthermore, considering China does not export ferrochrome, downstream competition between South African and Chinese ferrochrome is mostly restricted to sales within China's stainless steel industry. As a result, the rationale of the tax is largely targeted at boosting Chinese ferrochrome makers' costs to offer South African ferrochrome producers a comparative advantage in exporting ferrochrome to China. It is not intended to boost

absolute competitiveness. The proposed tax can only ever be aimed at enhancing the relative competitiveness of South African ferrochrome producers, not their absolute competitiveness, because there is no scarcity of chrome ore supply in South Africa. South African ferrochrome producers are vertically integrated, with access to their own chrome ore production and long-term off-take arrangements with some UG2 chrome ore producers (Merafe, 2010, Merafe, 2017). As a result, ferrochrome producers have a surplus of internal chrome ore supply that exceeds their own-use needs.

Rather than export taxes, Chrome SA proposes that the struggling ferrochrome industry should be given a special electricity arrangement. The Chrome SA argues that a low-cost energy price will help the ferrochrome sector restore the market share it has lost (Creamer, 2020). Ferrochrome producers advocate the implementation of a chrome ore export tax, claiming that only 60 to 65 percent of the existing ferrochrome furnace capacity is now operating due to smelters' lack of competitiveness due to high power prices (Creamer, 2020). Improvements in efficiency and competitiveness, such as self-generation of 750 MW of wind, solar, and cogenerated electricity, support for junior mining growth, and promotion of local coking coal production, should all be prioritized.

2.8 Summary of the Chapter

The mining industry, mineral beneficiation in South Africa, the chrome ore and ferrochrome industries in South Africa, and the planned export tax on chrome ore are all covered in this chapter. Beneficiation and its phases, as well as the history of beneficiation in South Africa, were explored in this chapter. The study found that South Africa's beneficiation plan is backed up by socioeconomic programmes and laws. Most minerals are exported as ores with little or no value-added, resulting in beneficiation taking place overseas and a lower income stream for South Africa than if beneficiation took place locally. Almost half of South Africa's chrome ore is exported to be smelted into ferrochrome, which is used in the manufacturing of stainless steel.

Several structural barriers, such as growing input costs, poor infrastructure, and energy shortages, have weakened South Africa's industrial competitiveness during the last decade. These factors illustrate that having a natural resource does not immediately translate to downstream beneficiation unless specific interventions are performed to overcome restrictions and provide the mineral beneficiation business

with a competitive edge. The proposed export tax on chrome ore by South Africa is necessary for the long-term viability of the ferrochrome industry and the growth of the downstream sector.

3. RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research design and methodology deployed in this study to address the efficiency and relevance of the beneficiation strategy as well as to assess the possible impact of the proposed chrome ore tax. Given the availability of chrome ore in South Africa, it's important to investigate the mining sector's beneficiation strategy and the possible impact of the proposed chrome ore export tax. This chapter presents the research questions, followed by a description and reasoning for the approach and methods selected for this study. The research approach, research strategy, research design, and data analysis are all covered in this chapter. The next section discussed the research approach used in this study.

3.2 Research Approach

According to Lincoln (2005), a research methodology and approach are defined by the core of the research question and the issue being investigated. The main topic addressed in this research is how South Africa’s resource advantage in chrome ore can be utilised under the current or a modified version of the beneficiation strategy to increase the export earnings from ferrochrome in the country.

3.2.1 Qualitative research approach

The qualitative research method explores people's knowledge and comprehension of a given program, their experiences, meanings, and connections, as well as the social processes and contextual circumstances that marginalise a group of individuals (Mohajan, 2018). This sort of study focuses on words rather than figures, and it examines the world in its natural environment, analyzing circumstances to comprehend the meaning that individuals derive from day-to-day living (Walia, 2015). The development of qualitative research involves informed judgements on consent and reactions to ethical concerns. The qualitative research method was used in this study to answer the research questions. The study used qualitative research methods to explore the views of scholars and policymakers debating how South Africa can sustain its beneficiation strategy. Based on the characteristics of the qualitative research approach, such as its all-inclusive nature, subjective approach, exploratory

research type, inductive reasoning, purposive sampling, verbal data, process-oriented inquiry, elements of analysis (words and pictures), and semi-structured interviews (Levitt et al., 2017), this study adopted the qualitative research approach. The next section discusses the qualitative research strategy used in this study.

3.3 Research Strategy

This section discusses the research strategy adopted in this study. As earlier stated in section 3.1.1, this study adopted a qualitative research approach. According to Leedy and Ormrod (2001), there are several methods of conducting qualitative research, for example, case study, grounded theory, ethnographic study, narrative, and phenomenology. In qualitative research, the case study method is one of the most widely used (Yazan, 2015). A case study can be a complete research project itself, such as the study of a particular organisation, community, or program. A case study investigates “a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between the phenomenon and the context are not evident” (Yin, 2017). The phenomena and its surroundings are intrinsically linked, yet the case study shows a limited system with a clearly defined case (Merriam and Tisdell, 2015). The limited system is the main requirement, any research circumstance in which the limited system plays a prominent role is a candidate for a case study.

There are different types of case studies, namely; exploratory, explanatory, comparative, intrinsic, instrumental, and collective case studies. An exploratory case study is utilized when there is no predetermined outcome. Case studies, according to Yin (2004), are useful for asking "how," "why," "what," and "who" inquiries. The exploratory case study answers the questions "how" and "what." Exploratory case studies are also useful when there is a need for a comprehensive and in-depth account of a social phenomena. An exploratory case study is designed to investigate hypothetical causal linkages that are too complicated for a survey or experiment (Yin, 2004). The next section discusses the research design adopted in this study, ranging from the unit of analysis, population, sampling technique, data sources, and the data collection method used.

3.4 Research Design

The research design, which comprises the unit of analysis, population, sampling technique, data sources, and data collection method, is discussed in this section. A research design is a strategy for carrying out the many activities associated with the research process. Research designs enable advanced planning of the methods to be utilized for gathering relevant data and the techniques to be employed in their analysis, while keeping the research purpose in mind. The research design has a significant impact on the reliability of the results obtained, and as such, it is the solid foundation upon which the entire research work is built (Sileyew, 2019). The next sub-sections discuss the unit of analysis, population, sampling technique, data sources, and the data collection method used.

3.4.1 Study area and population

The study is about the South African mining sector's beneficiation strategy and the potential impact of the proposed export tax on chrome ore. The location of the study is South Africa. According to the Chambers of Mines (2016), South Africa is the world's leading producer of chromium. According to Fraenkel (2002), the term population refers to the entire group of individuals (subjects or events) who have similar traits.Purposive sampling was used to determine the population for the study. The study population comprised experts in the chrome ore and ferrochrome industries in the eastern bushveld complex and within the South African mining sector.

3.4.2 Data sources

This study adopted a qualitative research method with a combination of primary and secondary data sources. The primary data was obtained from the source of information, i.e., industry experts. The primary data was trustworthy as it was gathered through semi-structured interviews from experts in the South African non-integrated chrome ore and ferrochrome industries. The data collected for this study were collected to achieve the result for the purpose and scope of this study. A desk review was conducted to collect data from various secondary sources. For the collection of secondary data, this study used both published data sources from the chrome ore and ferrochrome sectors. The published data are collected from: various publications of government bodies, international bodies, and their subsidiary organisations; research

reports by research scholars, universities, economists, etc.; books, theses, magazines, and newspapers; university libraries; technical and trade journals; and public records and statistics and other sources of published information. In general, the desk review has been completed, refined, and modified based on reports and documents obtained from the mining industry.

3.4.3 Data collection

This is a case study conducted on a South African non-integrated chrome ore producer. Purposive sampling was used to select the participating organisation. All participants interviewed were selected based on their position and roles in the organisation. In each position, a role is defined in terms of knowledge, skills, competencies, and experience within the chrome ore and ferrochrome sectors. To achieve the purpose of the study, data was collected from secondary sources and interviews were conducted with industry experts. Interviews are used to gain insights into a person's subjective experiences, opinions, and motivations – as opposed to facts or behaviours (Hak, 2007). Interviews can be distinguished by the degree to which they are structured (i.e. a questionnaire), open (free conversation or autobiographical interviews) or semi-structured (Hak, 2007, Punch, 2013). Semi-structured interviews are characterised by open-ended questions and the use of an interview guide or topic guide in which the broad areas of interest are listed (Hijmans, 2007). The topic in the interview guide can be derived from the literature, previous research, or a preliminary method of data collection. The semi-structured interview is usually conducted in a face-to-face setting, which permits the researcher to seek new insights, ask questions, and assess phenomena from different perspectives. It lets the researcher know in-depth the present working environment's influential factors and consequences (Sileyew, 2019).

The data collated for this study were collected to achieve the result for the purpose and scope of this study. Interviews were used to examine how South Africa can continue to advance its chrome beneficiation strategy. Different types of experts were sought based on their operational experience and knowledge of the chrome ore and ferrochrome industries. Interview requests were made through email, along with a brief overview of the study and a summary of the interviewees' contributions. Furthermore, the terms of the study on the use of the interview results and other ethical concerns

were outlined. The interviews were semi-structured to address significant aspects of the subject matter presented as shown in Appendix A. A brief overview of the report was presented to the interviewees. The interviewees were asked to sign a consent form outlining the parameters of the interview. Subsequently, the interviewees described their professional skills and experience in the chrome ore and ferrochrome industries. The interviews then proceeded with the interviewees sharing their insights in chrome ore and ferrochrome production. The interviews lasted between 20 and 30 minutes.

3.5 Ethical Clearance

Ethical clearance was obtained from the Faculty of Engineering and the Built Environment, University of Witwatersrand. This study complies with the ethics clearance procedures of the university, and where the study includes humans or animals, before publishing, the requisite permission will be requested to publish any company data. The interviews were conducted following the university's guidelines, which required approval of the ethics clearance committee. The participants in the interviews volunteered for the study, according to the consent form. The forms also indicated that the interviews would only be used for academic purposes.

3.6 Summary of the Chapter

The research design and methodology were covered in this chapter. The qualitative research approach was used to investigate the views of academics and policymakers on how South Africa might maintain its beneficiation plan. This is an exploratory case study of a non-integrated chrome ore producer. The population for the research was determined through purposeful sampling. Experts from the non-integrated chrome ore and ferrochrome industries in the eastern bushveld complex and the South African mining sector made up the study population. This research used a qualitative approach, combining primary and secondary data sources. In this study, data was gathered using a semi-structured interview. Thematic analysis was used to examine the interviews as well as the desk review and data trends.

4. DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

This section presents an overview of the findings of the study. This section used a desk review and responses from experts' interviews to analyse and evaluate the chrome ore industry's beneficiation strategy and the proposed export tax on chrome ore. Finally, the synthesis of the results is discussed in relation to the research questions.

4.2 Production Overview of Selected Major Minerals in South Africa

South Africa is one of the most important mining and resource jurisdictions in the world (DMRE, 2020). According to the USGS (2020), South Africa is the world's top producer of platinum, chromium, and manganese. Table 3 shows the reserves, production, and exports of minerals in South Africa and their rankings in the world. Platinum, chrome ore, and manganese have global reserve percentages of 91, 35.1, and 32.1 percent, respectively. In terms of chrome ore, it is ranked second, while in terms of production and exports, it is ranked number one (USGS, 2020).

Table 3: South Africa and world mineral reserves, production, and exports, 2019 (USGS, 2020)

Commodity	Reserves				Production				Exports			
	Unit	Mass	%	Rank	Unit	Mass	%	Rank	Unit	Mass	%	Rank
Chrome Ore	Mt	2 000	35.1	2	Kt	17 655	61	1	kt	5 245	76.1	1
Coal	Mt	66 699	6.2	6	Mt	265.1	3.3	7	Mt	77	5.4	5
Fluorspar	Mt	41	13.2	3	Kt	252	3.4	4	kt	170	*	*
Gold	t	3 200	6.4	3	T	105		11	t	42.4	*	*
Iron Ore	Mt	690	0.9	11	Mt	72.4	3	6	Mt	60.5	3.9	3
Manganese	Mt	260	32.1	1	Kt	17	28.9	1	kt	16.2	43.2	1
PGMs	t	63 000	91	1	T	268		1	t	227	*	*
Phosphate Rock	Mt	1 400	2	6	Kt	1 825	0.8	15	kt	569	*	*

Titanium Minerals	Mt	35	4.5	6	Kt	2 250	11.7	2	kt	233	*	*
Vanadium	Mt	14	*	3	Kt	158	36	2	kt	174	*	*
Zirconium	Mt	6.5	10.4	2	Kt	368	26.4	2	kt	413	*	*

*Information not available

The mining industry is evolving from a low-level, labour-intensive environment to a technologically advanced one (DMRE, 2020). Figure 10 below shows the production of PGMs, chrome ore, and manganese from South Africa, 2014 to 2019. These minerals were selected as South Africa has a comparative advantage in reserves, production, and exports in the world. The mining sector in South Africa has had a mixed performance over the past ten years, with PGMs and chrome declining by 0.9 and 1.12 percent, respectively (Figure 10). Manganese, on the other hand, did exceptionally well in the period under consideration, contributing 13.97 percent.

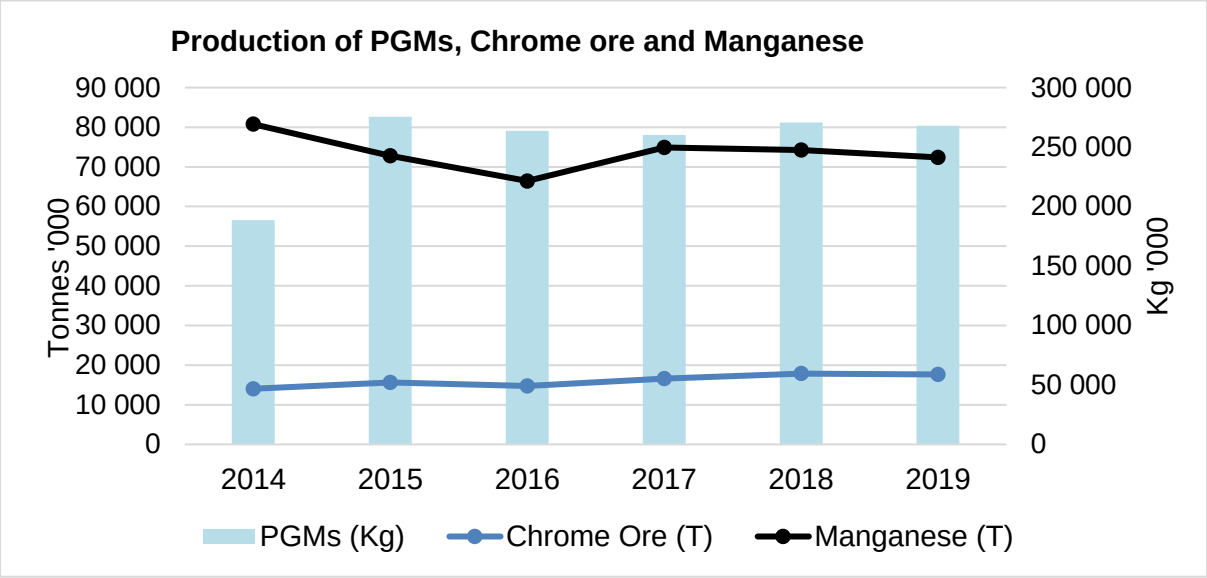


Figure 10. Production of PGMs, Chrome ore and Manganese in South Africa, 2014 – 2019 (DMRE, 2020).

4.2.1 Contribution of the mining industry to economic growth

The mining sector in South Africa continues to play an important role in the country's inclusive economic growth, foreign exchange earnings, transformation, employment, and skill development (DMR, 2017/18). The economy is based on the country's substantial natural resources, as shown in Table 3. The mining industry makes a significant direct contribution to GDP and has been producing growing sales revenue. There's no denying that 2020 was a difficult year for a lot of major industries, and the

mining industry in South Africa was no exception (Murray, 2020). The COVID-19 pandemic is one of the most serious difficulties the South African economy has faced since the global financial crisis (PwC, 2020).

Figure 11 shows the contribution of the mining industry to the GDP. As shown in the figure below, in 2020, mining contributed R200.8 billion or 7.5 percent, to GDP in real terms down from R226.1 billion or 7.9 percent, in 2019. This was a significant decrease of R25.3 billion or 11.2%. In nominal terms, as shown in Figures 11 and 12, mining contributed R371.9 billion or 8.4 percent, in 2020 compared to R376.3 billion or 8.3 percent, showing a significant decrease of R4.4 billion or 1.2% (Minerals Council, 2020).

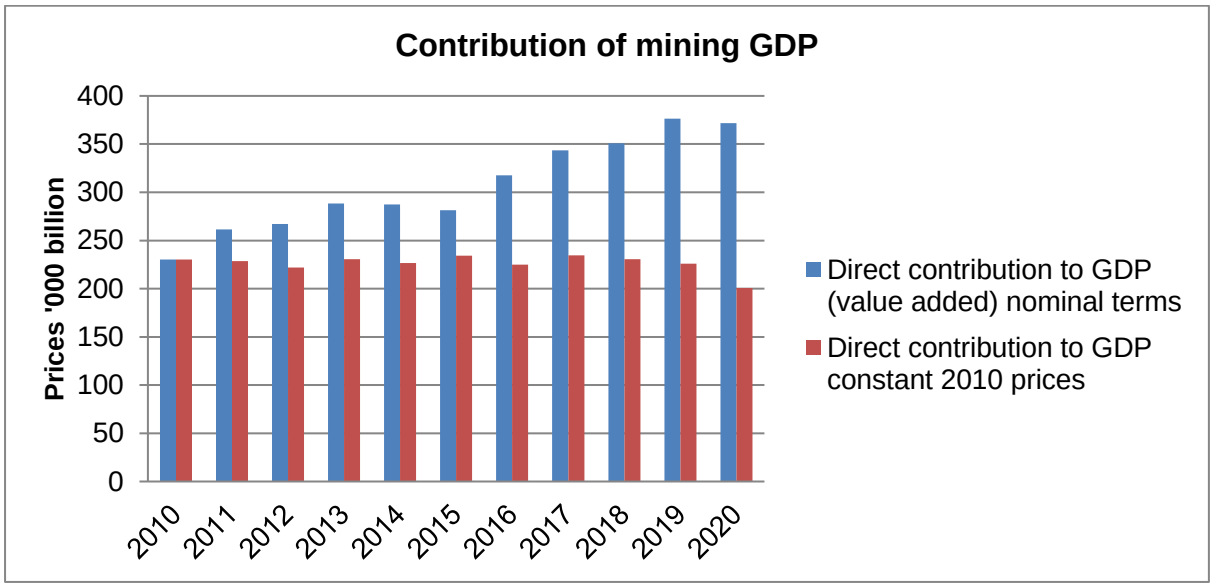


Figure 11. Contribution of mining to GDP in nominal and real terms (Minerals Council, 2020)

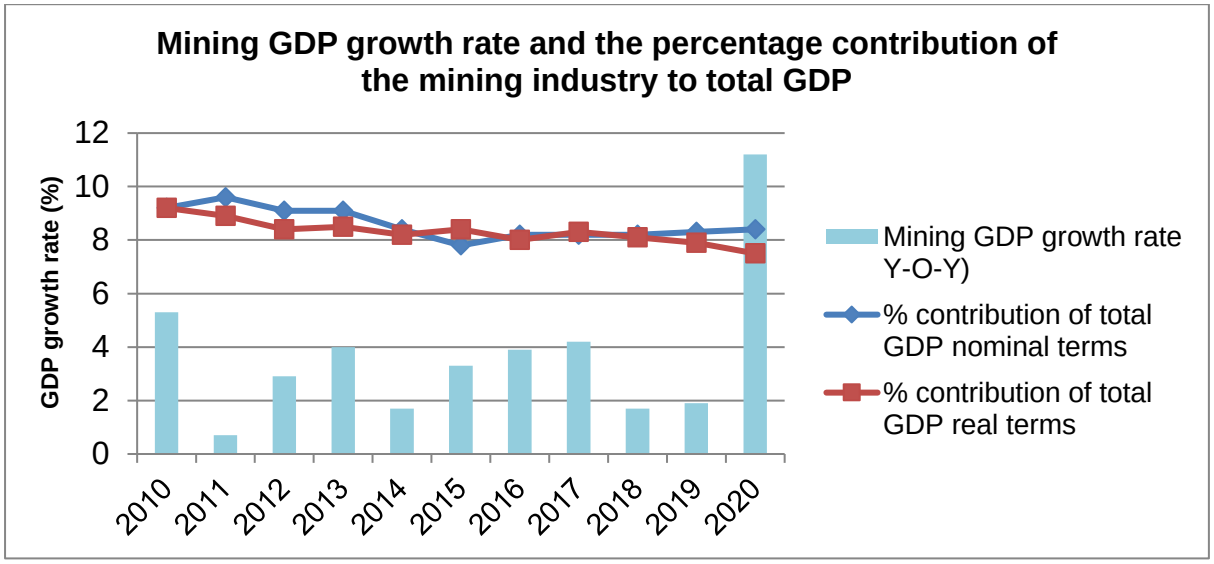


Figure 12. Mining GDP growth rate and the percentage contribution of the mining industry to total GDP (Minerals Council, 2020)

In the first quarter of 2020, the South African government implemented a lockdown, resulting in the temporary shutdown of the country's mines (Haider et al., 2020). Real GDP (measured by output) rose at an annualised rate of 4.6 percent in the first quarter of 2021, following a 5.8 percent gain in the fourth quarter of 2020. As shown in Figure 13, the impact of the COVID-19 lockdown restrictions since the end of March 2020 reduced real Gross Domestic Product (GDP) (measured by output) by a record 51.7% in the second quarter of 2020 (StatsSA, 2021a).

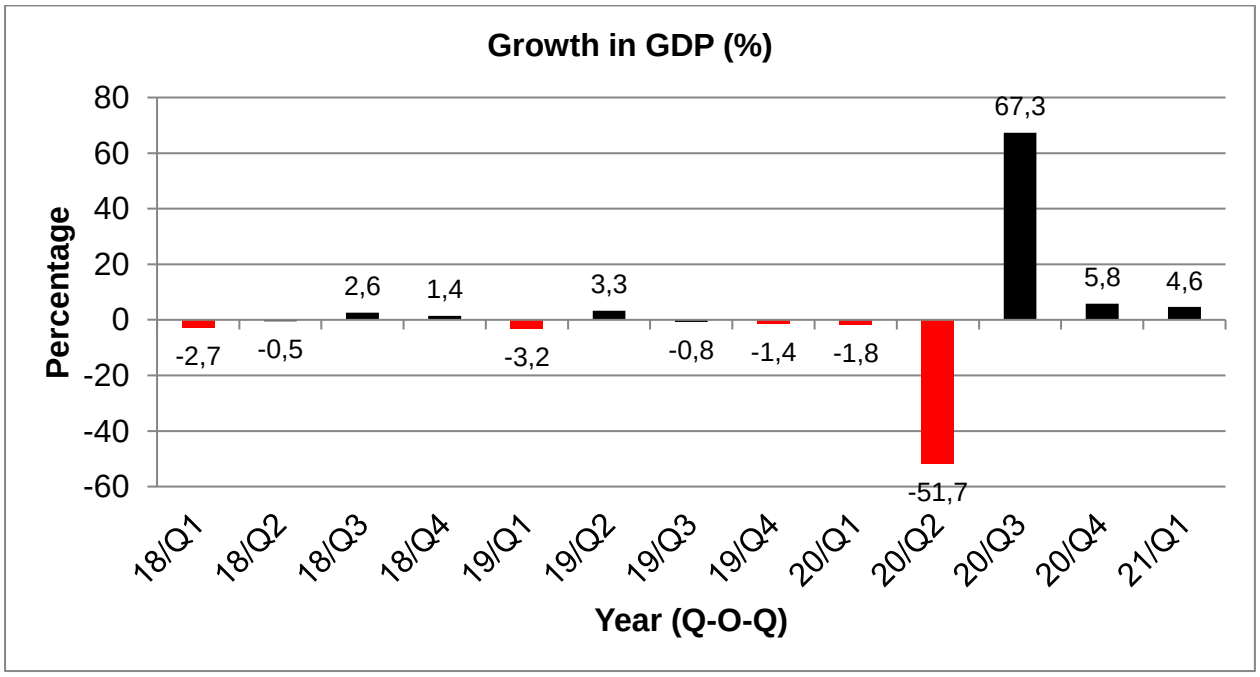


Figure 13. Growth in GDP (%) (Statistics South Africa (StatsSA, 2021a)

Figure 14 shows the eight industries that had increase during the fourth and first quarters of 2020 and 2021. According to Figure 14, the banking, mining, and trade industries were the most positive contributors to GDP growth in the first quarter. (StatsSA, 2021a). The mining industry profited from favourable commodities market trends, both in terms of volume demand and pricing. Figures 14 and 15 show that the mining industry rose by 18.1 percent (quarter-on-quarter, seasonally adjusted and annualized rate) and contributed 1.2 percent points to GDP growth. The surge was primarily driven by an unprecedented comeback in platinum group metals (PGMs) output (+118%), followed by iron ore (+87.3%) and chrome (+20.3%) (IDC, 2021).

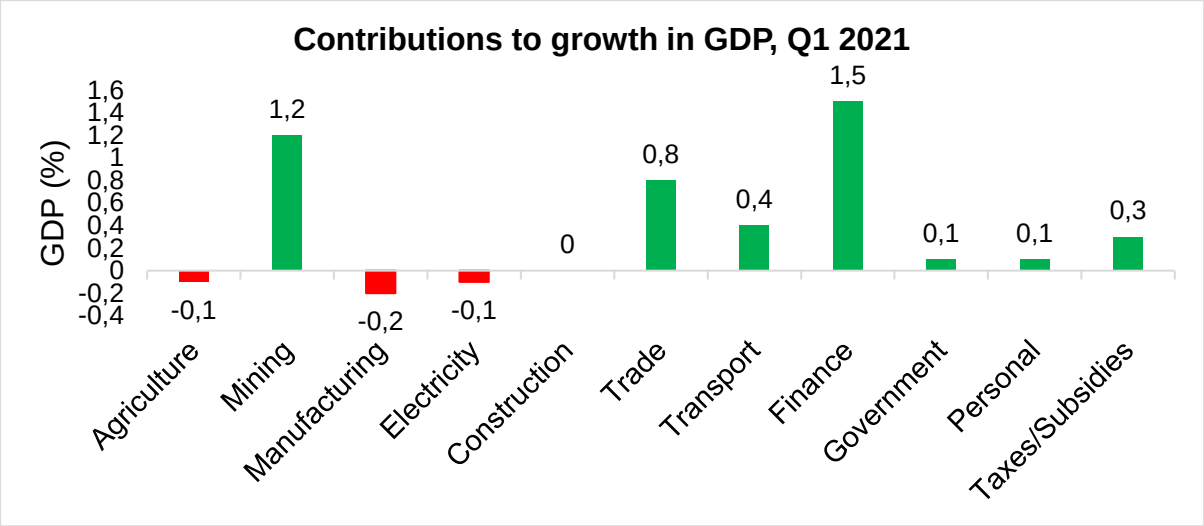


Figure 14. Contributions to growth in GDP, Q1 2021 (% points) (StatsSA, 2021a)

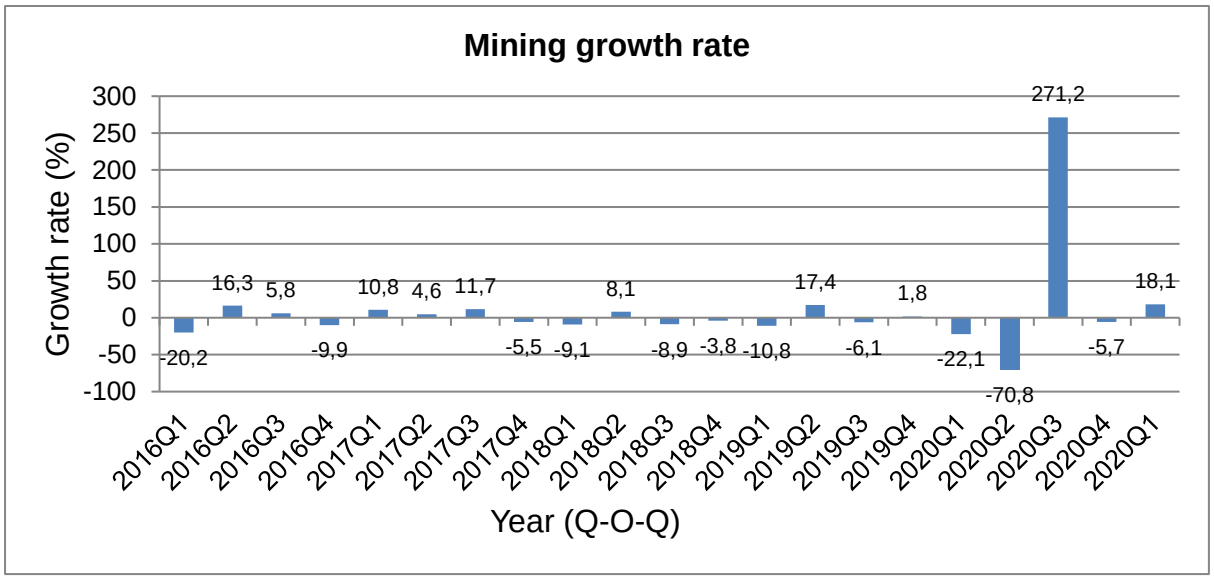


Figure 15. Mining growth rate (%) (StatsSA, 2021a)

4.2.2 Contribution of the mining industry to employment

Despite improvements in employment levels as production activity began to resume in the second half of 2020. As shown in Table 4, South Africa's unemployment rate hit an all-time high of 32.6 percent in the first quarter of 2021, illustrating the grim fact that 7.24 million people are presently unemployed (IDC, 2021). Overall employment was still 1.4 million lower in March 2021 than it was at the start of 2020 (prior to the lockdown).The mining sector employed about 40,500 fewer people compared to 12 months ago (it employed 395,000 in March 2021). An estimated 580,900 persons entered the labour force in the year leading up to March 2021. However, the economy's labour-absorption capability is now severely restricted. Many businesses have gone out of business since the onset of the economic downturn, while many others are still struggling financially due to low demand for their goods and/or services. As a consequence, an estimated 172,300 persons entered the ranks of the jobless on a year-over-year basis, resulting in a sharp increase in the unemployment rate (IDC, 2021).

Table 4: Mining and labour market indicators for the quarter to March 2021(IDC, 2012, StatsSA, 2021b)

Labour market indicators	Number ('000s)	Change in '000s (year-on-year)
Population (15 to 64 years)	39 455	580.9
Labour force	22 237	-1 214.9
Unemployed	7 242	172.3
Unemployment rate (%), change in percentage points	32.6%	2.5%
Employed	14 995	-1 387.2
Mining*	395	-40.5

*Employed

Figure 16 shows the employment and wage trend in the South African mining industry. It shows that employment decreased by 9 173 or (2%) year-on-year, from 462 039 in 2019 to 452 866 in 2020.

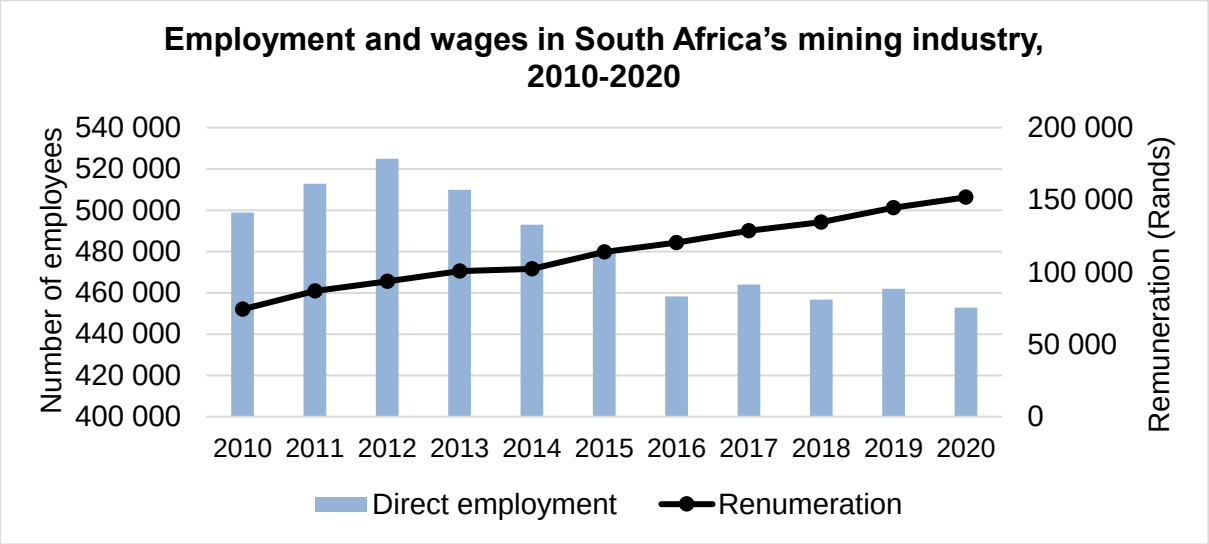


Figure 16. Employment and wages in South Africa's mining industry, 2010-2020 ((IDC, 2021); (StatsSA, 2021b))

South Africa has a comparative advantage and is highly ranked in the world in terms of reserves and production of chrome ore, manganese and PGMs. The South African government has made large investments in the mining industry, which is regarded as critical to the country's economic success. In many resource-rich countries, mining provides the economic basis, with developed and developing countries alike benefiting from its important role in poverty reduction, inclusive growth, and social development. The mining industry was one of the industries that recorded growth in the first quarter of 2021, after the government-imposed lockdown that affected the production capacity of the mines. As seen in Figure 16, the number of employees was highest in 2012 and has been on a downward trend till 2020, with the remuneration increasing every year from 2010 to 2020. The beneficiation strategy aims to increase the value of exports while also creating local manufacturing possibilities that will allow for more long-term employment creation. According to Von Below (1990), the chromium content increases 11 times during the first stage of beneficiation. The single highest gain in metal content value occurs during this capital-intensive stage of beneficiation. Stages 2 and 3 increase the value by 12 times, while the fourth stage increases the value by 2.5 times. A large increase in foreign revenues can be gained if domestic producers can capture the majority of stage 2 and 3 beneficiation of locally produced ferrous metals (Von Below, 1990).

Von Below further reiterates that the manufacturing sector employs more people than primary beneficiation sectors, implying that if job creation is a priority, the

manufacturing sector should be prioritized. Some may argue that the relative minor gain in value added at this stage of beneficiation (a factor of 2.5 times) does not justify the use of limited capital resources. However the country's persistent unemployment, on the other hand, necessitates the growth of labour-intensive industries such as metal fabrication (Von Below, 1990). Therefore, beneficiation of the mining industry will result in growth in the downstream sector, resulting in job creation in a wide range of industries, from manufacturing to supply chain.

4.3 Chrome Ore Industry in South Africa

4.3.1 Chrome ore production and sales

South Africa remains the leading producer and exporter of ferrous minerals. South Africa's total ferrous production was estimated at 107,062 tons (t) in 2019 and remained stagnant compared with 2018 (Table 5). A 14 percent increase in manganese production was offset by 1.1 percent and 2.5 percent decreases in chrome and iron ore production, respectively. Due to higher ferrous metal prices, ferrous total sales mass grew by 1.3 percent, while revenues grew by 17 percent. Steel is the most important demand driver for ferrous minerals and alloys, accounting for more than 85% of worldwide consumption. Average annual employment in South Africa's ferrous mineral sector was estimated at 51,813 in 2019, an increase of 10.3 percent compared with 2018 (Table 5).

Table 5 - South Africa's production and sales of ferrous minerals, 2018 and 2019 (DMRE, 2020)

Commodity	Year	Production	Local Sales		Export Sales	
		kt	kt	R '000	kt	R '000
Chrome ore	2019	17 655	10 301	11 845	5 245	10 453
	2018	17 850	9 955	11 755	4 065	10 045
Iron ore	2019	72 406	7 548	5 630	60 582	65 040
	2018	74 263	8 024	5 730	61 709	45 496
Manganese ore	2019	17 001	1 099	1 750	16 233	43 280
	2018	14 918	701	1 066	15 277	43 746
Total	2019	107 062	18 948	19 225	82 060	118 773

	2018	107 031	18 680	18 551	81 051	99 287

South Africa is host to 36 percent of the world's chromite reserves, which are estimated to be around 200 000 million tons (Mt). South Africa's chrome ore production amounted to 14 513 (kt) in 2020, an 18 percent decrease from 2019 (17 655 kt) (Table 5 and Figure 17). Domestic chrome ore production in recent years has increased on the back of increased demand for stainless steel globally (China specifically). China is the leading importer of South African chrome ore, accounting for 93% of the country's total exports.

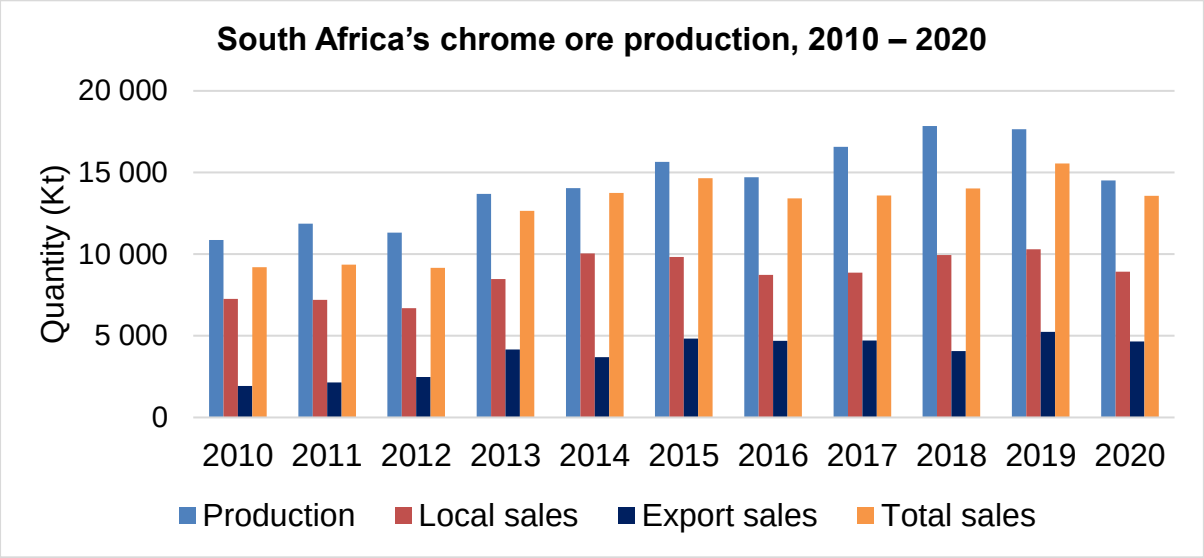


Figure 17. South Africa's chrome ore production, 2010 – 2020 (DMRE, 2020).

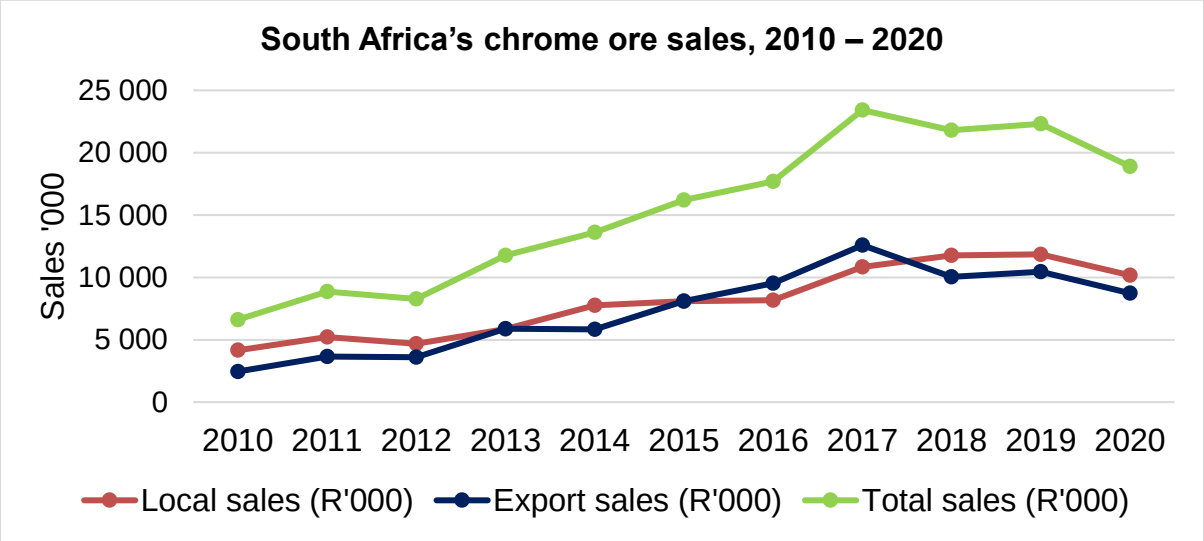


Figure 18. South Africa's chrome ore production and sales, 2010 – 2020 (DMRE, 2020).

Figure 19 shows the number of employees (direct and indirect) as well as earnings in the chrome ore industry. The number of employees decreased by 1,610 people (or 8%) in 2020 from 20 884 in 2019 to 19 274 people in 2020. The earnings of employees in the chrome ore sector decreased by R87 885 or (1.4%), from R6 399 648 in 2019 to R6 311 763 in 2020.

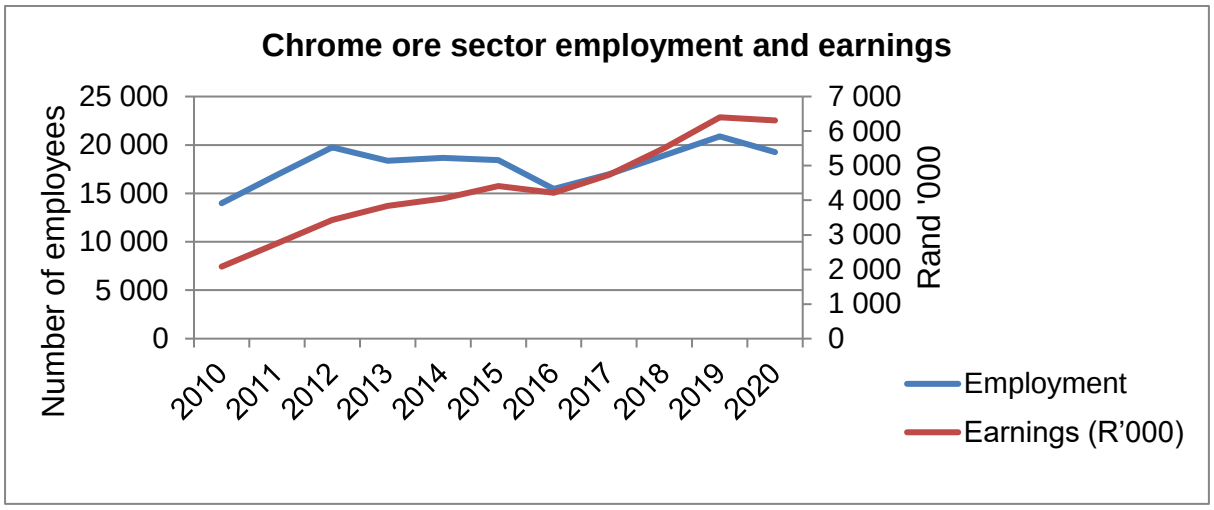


Figure 19. Chrome ore sector employment and earnings (DMRE, 2020)

Table 6 shows that the production of processed chromium alloys was 3.3 million tonnes, with 598 872 tonnes being sold locally and 2.6 million being exported. The total sales revenue of chromium alloys was R42.3 billion, with R6.5 billion and 30 billion realised from both local sales and export sales, respectively.

Table 6: South Africa's production, local and export sales of processed chrome ore, 2019 (DMRE, 2020)

Commodity	Production	Local sales		Export sales		Total sales	
	Mass (t)	Mass (t)	Value (FOR) (R'000)	Mass (t)	Value (FOB) (R'000)	Mass (t)	Value (FOB) (R'000)
Chromium alloys	3 272 712	598 872	6 547 716	2 560 740	30 048 709	3 529 810	42 767 057

The chrome ore sector is important in the mining industry for the economic development of South Africa as it generates revenue for the economy. In terms of production, local, and export sales, the chrome ore sector has done well in the past

10 years, but there was a decline in 2020. Employment in the chrome ore industry, much like the mining industry, has been declining in recent years.

4.3.2 Global supply of chrome ore

Chrome ore is mined in a few countries, with most of the reserves concentrated in South Africa, Kazakhstan, India, Turkey, and Zimbabwe. The latest global chrome ore reserves for 2020 are estimated at approximately 560 million tonnes, with South Africa and Kazakhstan having the largest estimated reserves of chrome ore, with 200 million and 230 million tonnes, respectively (USGS, 2020) (Figure 20). The two countries account for over 75% of the global reserves of chrome ore. There are other countries that have significant reserves of chrome ore. This includes countries such as India and Turkey, which have reserves of 100 million and 26 million tonnes, respectively.

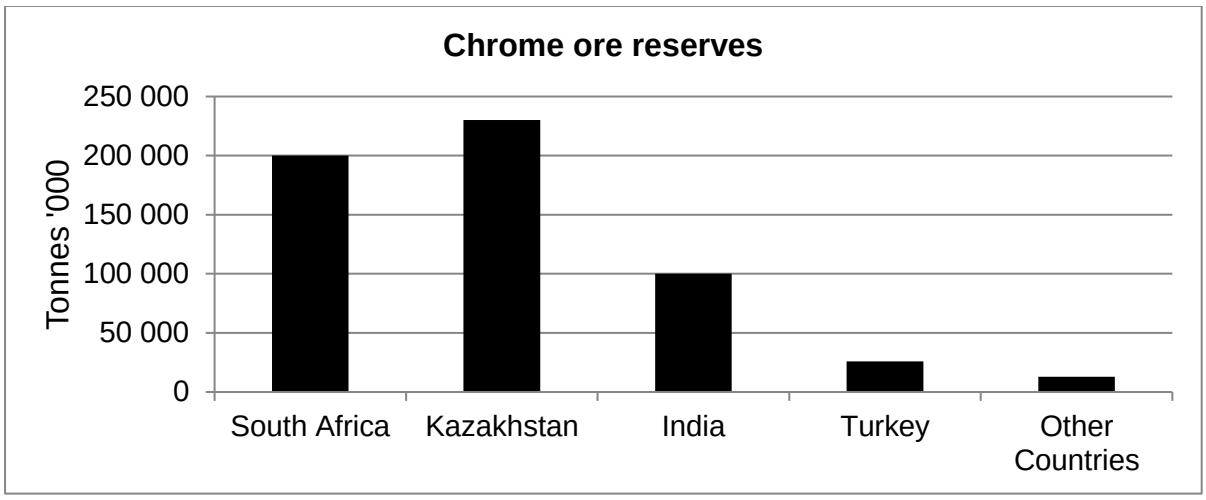


Figure 20. Chrome ore reserves, 2020 (million tonnes) (USGS, 2020)

Global production of chrome ore has grown over the last decade due to increased demand in the downstream ferrochrome and stainless steel industries. The increase in demand has closely followed developments in China, where the expansion of ferrochrome and stainless steel production has outpaced other countries (USGS, 2020). South Africa is currently the largest producer of chrome ore, accounting for 61% of global production. South Africa has grown production of chrome ore by 150% over the last decade due to increased demand from China and access to low-cost UG2 chrome. Kazakhstan is the second largest producer of chrome ore globally, at 12%.

4.3.3 Export of chrome ore

Chinese demand has shaped the trade dynamics of the chrome ore industry, with China accounting for 85% of global imports of chrome ore (Figure 21). South Africa is the largest exporter of chrome ore, accounting for 76% of global exports (and approximately 79% of China's chrome ore demand) (Figure 22). Some of the other producers, such as Kazakhstan and India, export significantly lower proportions of their production volumes due to the vertical integration between their domestic chrome and ferrochrome industries.

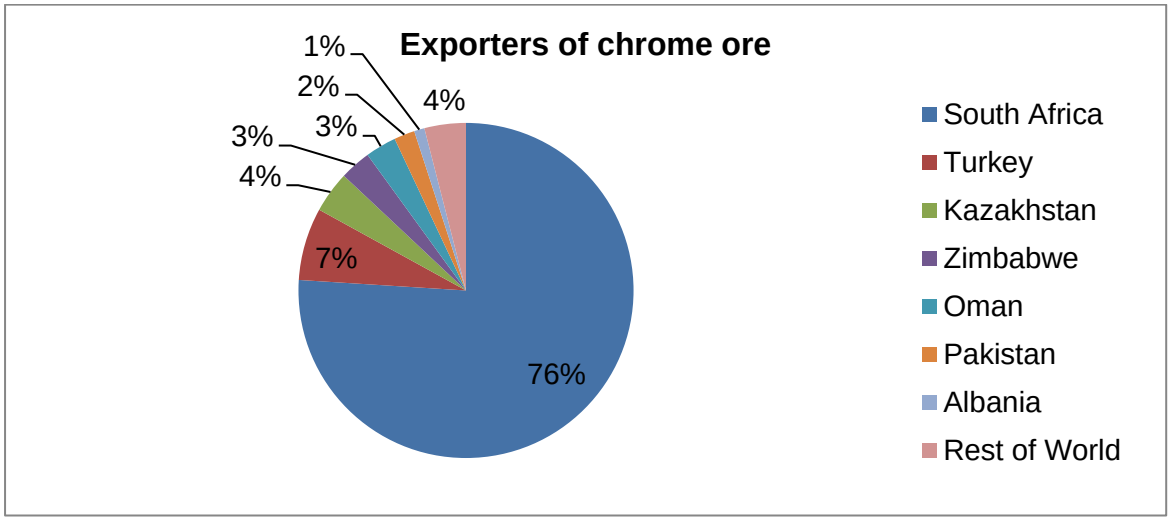


Figure 21. Exporters of chrome ore (International Chromium Development Association (International Chromium Development Association (ICDA, 2020)

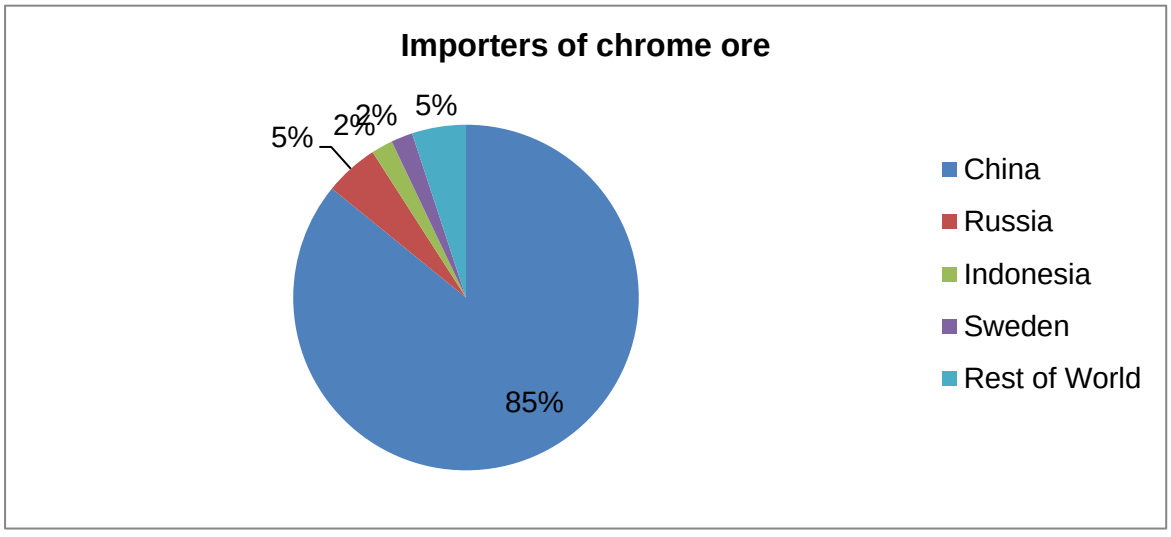


Figure 22. Importers of chrome ore (ICDA, 2020)

South Africa's role as the largest exporter of chrome ore has grown over the last decade, with total exports growing by 274% from 3.6 million tonnes of chrome ore in 2010 to 13.6 million tonnes in 2019 (Figure 23). This growth has seen South Africa's share of total international exports grow from 42% to 76%.

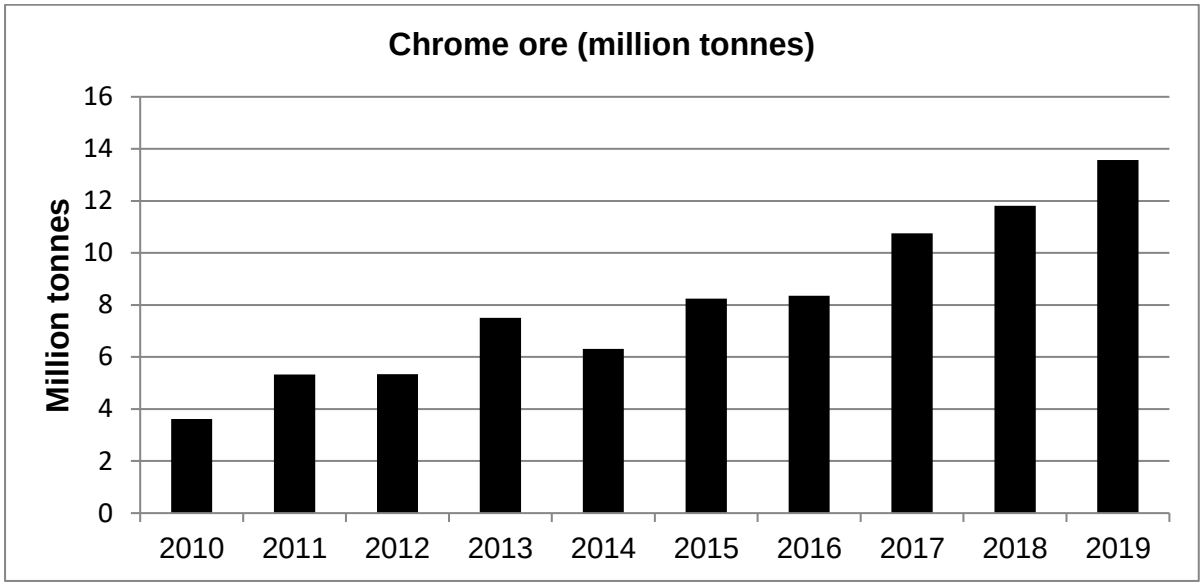


Figure 23. South Africa exports of chrome ore, million tonnes (DMRE, 2020)

This growth in South Africa's exports of chrome ore has been driven by growing demand in China. Much of the increasing volumes into China have been due to a growth in supply of low-cost UG2 chrome ore. In 2019, South Africa exported approximately 12.6 million tonnes of chrome ore to China (of which 4.2 million tonnes is UG2 and 8.3 million tonnes is primary chrome ore) – this accounted for 93% of South Africa's total chrome ore exports (Figure 24).

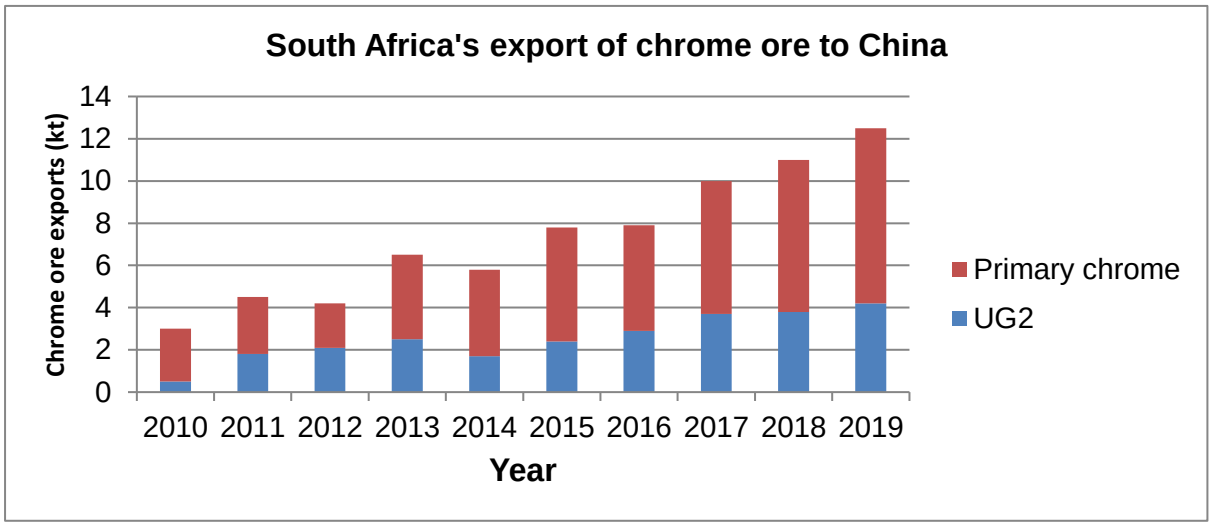


Figure 24. South Africa's export of chrome ore to China (kt), 2010-2019 (DMRE, 2020)

South Africa is the largest producer of chrome ore in the world. The production of chrome ore has grown due to the demand for chrome ore from China, as they are the major importers of chrome ore from South Africa. The export of raw ore and the ore sales industry has now escalated to the point that it has become the main business, with ferrochrome as a secondary. The South African ferrochrome industry is facing extinction after losing a sizable market share to China, which obtains most of its chrome from South Africa. While the introduction of an export tax on chrome ore is a good decision, it will not prevent China from purchasing South African chrome ore, but it will undoubtedly reduce the margins of ore exporters.

4.4 Ferrochrome Industry in South Africa

4.4.1 Ferrochrome production and sales

World ferrochrome production stood at 14.7 Mt in 2019, a 14 percent increase when compared with 2018 at 12.9 Mt (Table 7). China, whose output grew by 24 percent in 2019, was the largest contributor to this notable increase. In second place with a contracted output of 3.2 Mt from 3.5 Mt in 2018 is South Africa (DMRE, 2020).

Table 7: World ferrochrome production and sales, 2019 (DMRE, 2020)

Country	Production*		Exports*	
	Mt	%	Mt	%
2019	14 726	100	6 527	100
2018	12 914		6 087	

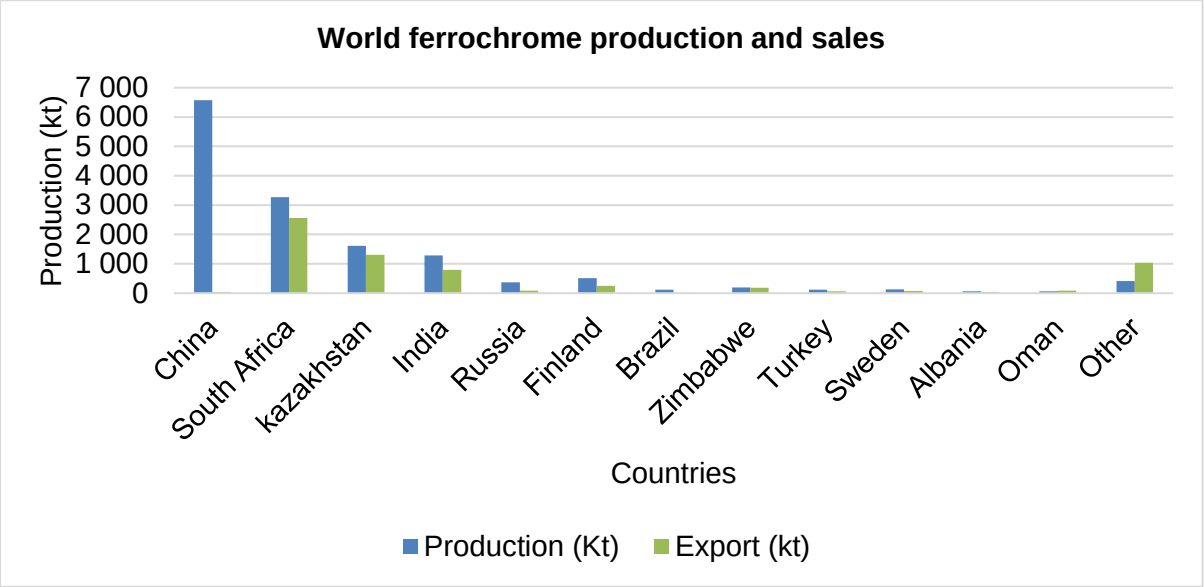


Figure 25. World ferrochrome production and export quantity (kt) (DMRE, 2020).

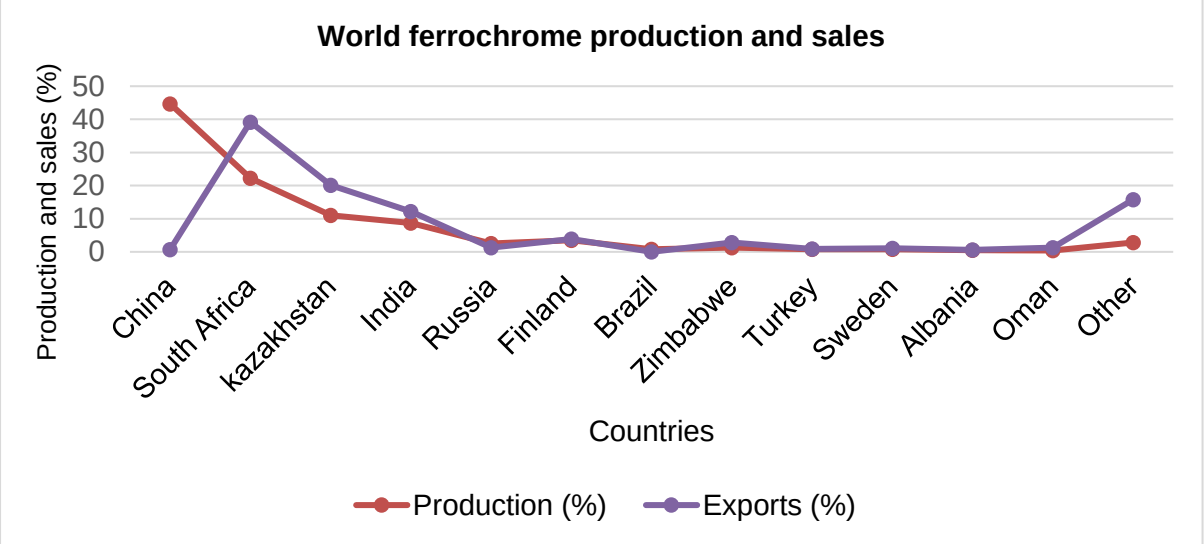


Figure 26. World ferrochrome production and export sales (DMRE, 2020).

It is by no coincidence that China is the world's largest consumer of chrome (with little to no chromite output) and the leading producer of ferrochrome (FeCr). An advanced transportation network, low capital investment costs and relatively low electricity tariffs all work seamlessly to place the country at an advantage of unsurpassed ferrochrome production, and the fact that South Africa is a glad and ready supplier of the main feedstock for their industry. In 2019, global ferrochrome production amounted to 14.7 Mt, with South Africa accounting for 22 percent.

South Africa's FeCr production decreased by 6.9 percent to 3.3 Mt in 2019 when compared with 2018 (Figure 27), owing to various challenges in the sector. At 71

United Stated Cents per pound (USc71/lb) China cost, insurance, and freight (CIF), many smelters were narrowly breaking even. Despite a 17 percent decrease in local stainless-steel production, local sales mass grew by 11.3 percent to 599 (Kt) in 2019, while export sales decreased by 5% over the same time. Approximately, 78 percent of South Africa's FeCr output was exported (mainly to China) for the advancement of stainless-steel industries abroad, while the local sector continues to shrink.

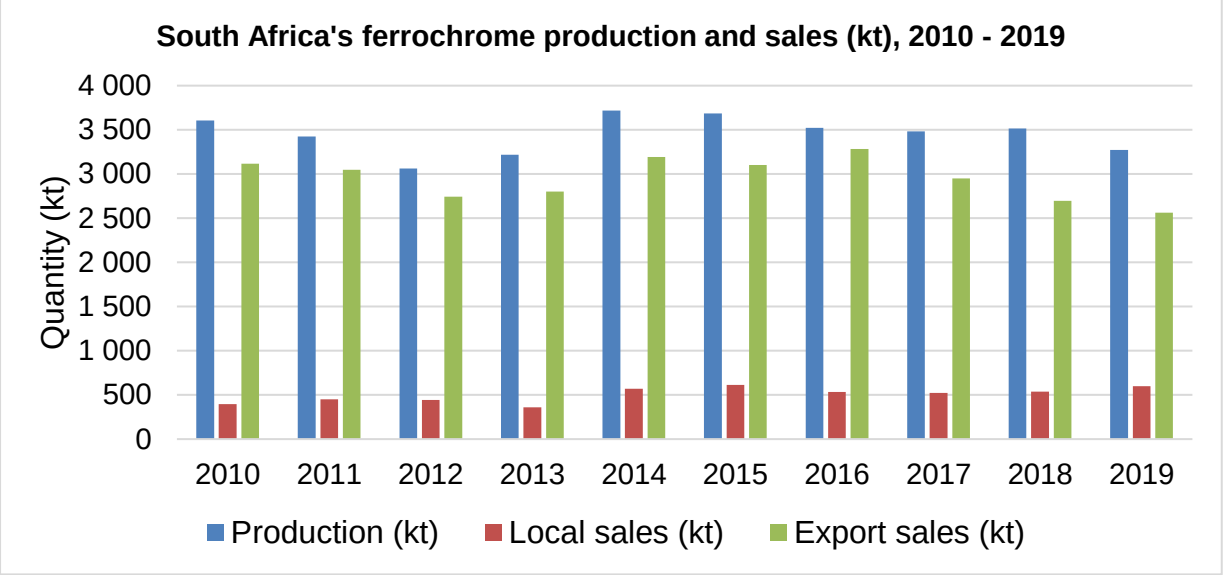


Figure 27. South Africa's ferrochrome production and sales (kt), 2010 – 2019 (DMRE, 2020)

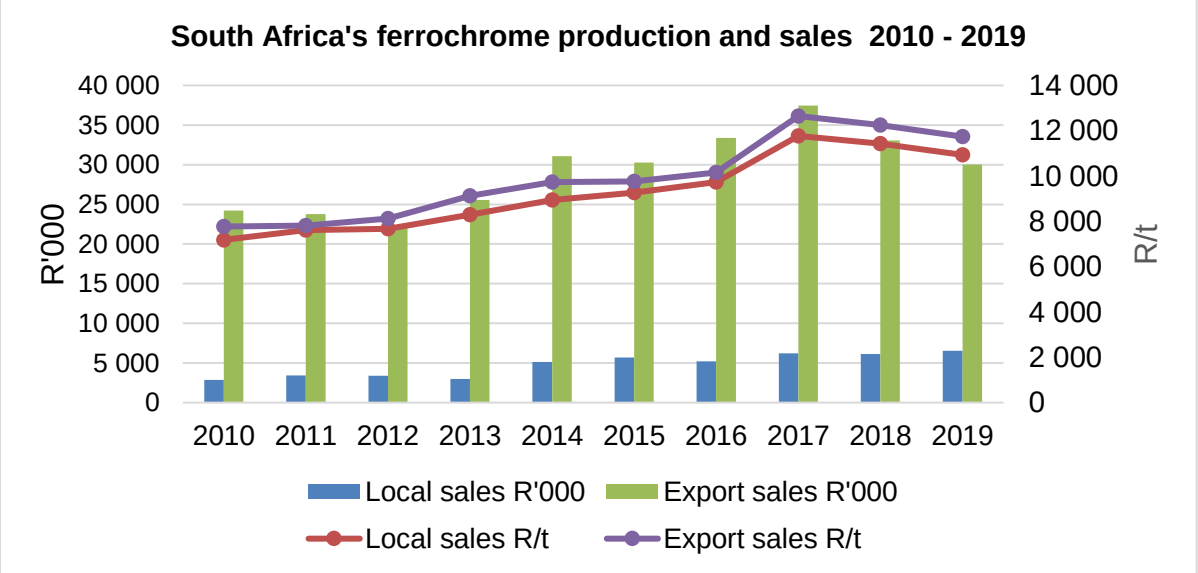


Figure 28. South Africa's ferrochrome production and sales (kt), 2010 – 2019 (DMRE, 2020)

In contrast to chrome mine production, ferrochrome smelting in South Africa has been stagnant in recent years (2014 to 2019) (Figure 29). Various ferrochrome producers suspended operations, entered business rescue and/or temporarily idled furnaces over the last few years. This contrasts with growth on chrome ore production, which increased by some 7.5 million tonnes (49%) over the same period.

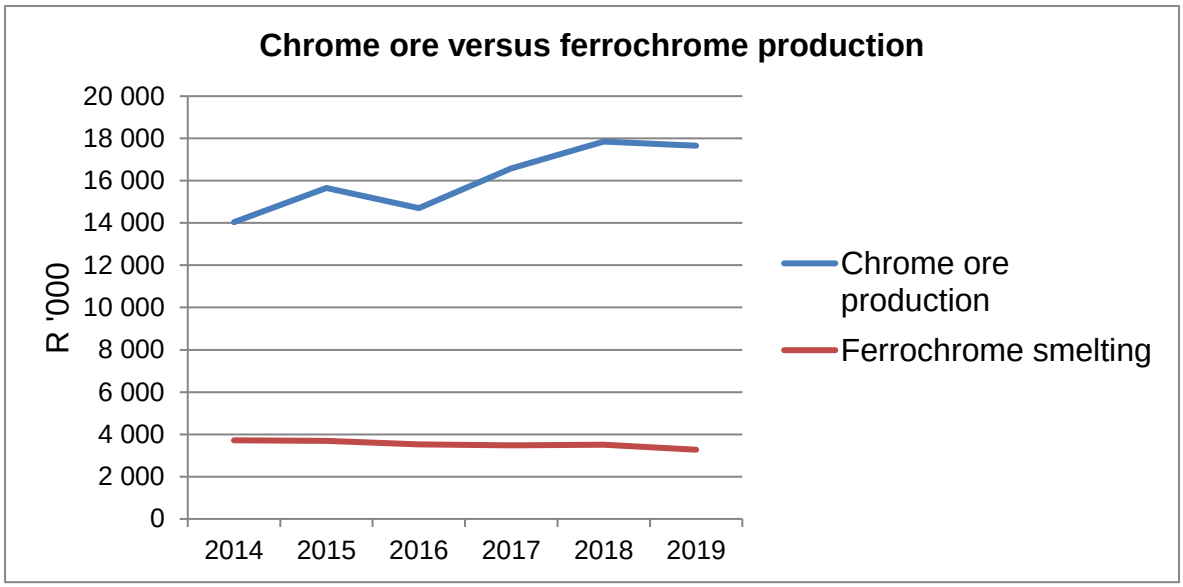


Figure 29. Chrome ore versus ferrochrome production (kt), 2014 to 2019 (DMRE, 2020)

4.4.2 Ferrochrome industry and employment

The stagnation and loss in competitiveness of the ferrochrome industry has led to reductions in employment over recent years. The decline is due to the suspension/partial suspension of operation at multiple furnaces (Levin, 2020). Direct smelter employees decreased by 20% (from 7 530 to 6 852) over the 2014 to 2019 period, with another 23% (1 608) of the remaining employees also subject to retrenchment given the Section 189 notices issued by integrated ferrochrome producers (Figure 30) (DMRE, 2020).

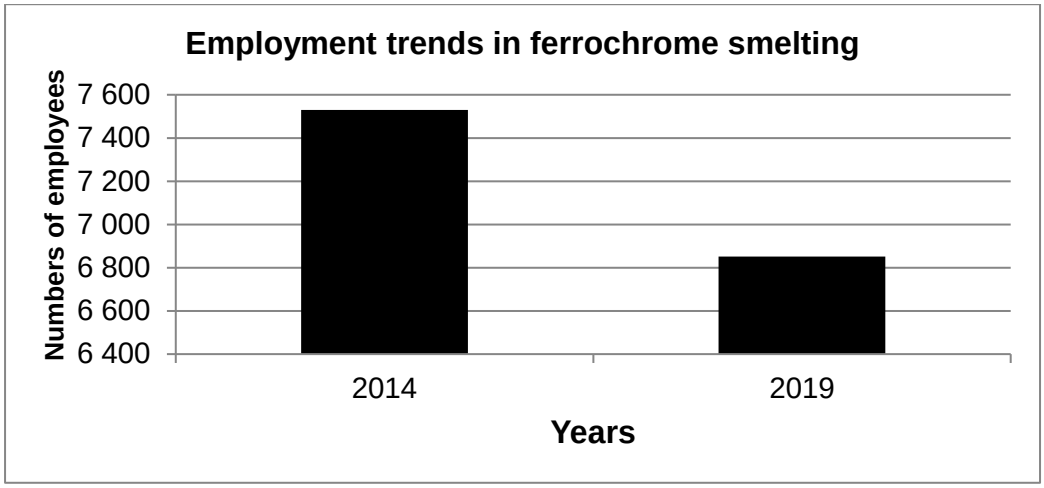


Figure 30. Employment trends in ferrochrome smelting, 2014 to 2019 (DMRE, 2020)

4.4.3 Challenges facing the Ferrochrome industry in South Africa

Most of the South African ferrochrome production is exported. There is only a single viable, but minor, source of domestic ferrochrome demand – the stainless steel producer Columbus Stainless. Domestic high-carbon ferrochrome consumption in recent years accounted for only 3-4% of production (CRU, 2020b). Despite growing demand for ferrochrome internationally, South Africa's total production and share in global production has continued to decrease in recent years. South African ferrochrome production has declined due to decreased competitiveness in the major stainless steel markets where it competes for market share internationally (Letaba and Zulu, 2021). From 2016 to 2019, South Africa has lost market share to other international ferrochrome exporters in all the major historical stainless steel markets where they compete (CRU, 2020b). In these markets, South African ferrochrome has generally been displaced by producers who have access to their own domestic chrome ore supplies and have displaced South African exports based on improvements in relative competitiveness on other cost dimensions (like Kazakhstan and India). Significant consolidation has occurred in the South African ferrochrome industry in recent years, with only three producers with captive mines remaining operational in 2019: Glencore, Samancor and Afarak (Jones, 2020). The major challenges facing the ferrochrome industry are discussed in the next section.

Electricity

While various other contributing factors have also been identified, the primary driver of the declining competitiveness of South African ferrochrome has been the steep real

increases in electricity prices (CRU, 2020b). According to the latest CRU industry analyses the key issue facing the domestic ferrochrome industry is the continued increase in electricity costs for South African ferrochrome producers which is likely to continue to undermine the production at these operations (Bucic, 2019, CRU, 2020b). The international chrome industry body, the ICDA, also documents the decline of the competitiveness of the South African ferrochrome industry. One of the key drivers of this decline in competitiveness over the 2012 to 2018 period was identified as being the continued energy supply shortages and price increases in South Africa (Letaba and Zulu, 2021). A 292% increase in industrial electricity tariffs over the 2007 to 2016 period was a major driver of increased input costs for domestic ferrochrome producers (Makgetla, 2021). Other cost drivers mentioned include an increase in labour costs of 8% to 10% annually, alongside cost increases stemming from metallurgical coke prices, high logistics costs and the cost of capital in South Africa (Levin, 2020).

Input cost of ferrochrome production

In 2020, CRU carried out industry analyses on comparison of costs between South African and the two other major international ferrochrome producers (China and Kazakhstan) over time (CRU, 2020b). Chrome ore input costs made up only 30% of South African delivered cost in 2015, decreasing further in both relative and absolute terms of 21% by 2019 (Figure 31). In contrast chrome ore costs accounted for some 46% of Chinese ferrochrome costs in 2019. In absolute terms, the cost of chrome ore was 51% cheaper for South African ferrochrome producers relative to competitors in China in 2019. Electricity costs have been the main cause for South Africa's loss in competitiveness. Whilst South African reductant costs increased by approximately 6 US cents/lb over the period, other international ferrochrome producers faced similar increased for reductant costs. By 2019, 30% of South African input costs went to electricity. This compared to only 22% of Chinese input cost and 14% in Kazakhstani costs. Of South Africa's total cost of production increase over the period, 53% was due to increases in electricity costs. This also only reflects the most recent impact of electricity cost increases and this provides a conservative estimate of electricity tariff impacts on South African competitiveness, since steep price increase in South African electricity tariffs started in 2009 (Bucic, 2019, CRU, 2020b). The increase in electricity costs for South African producers has thus more than offset the natural competitive advantage that the ferrochrome sector has in terms of access to low-cost chrome ore.

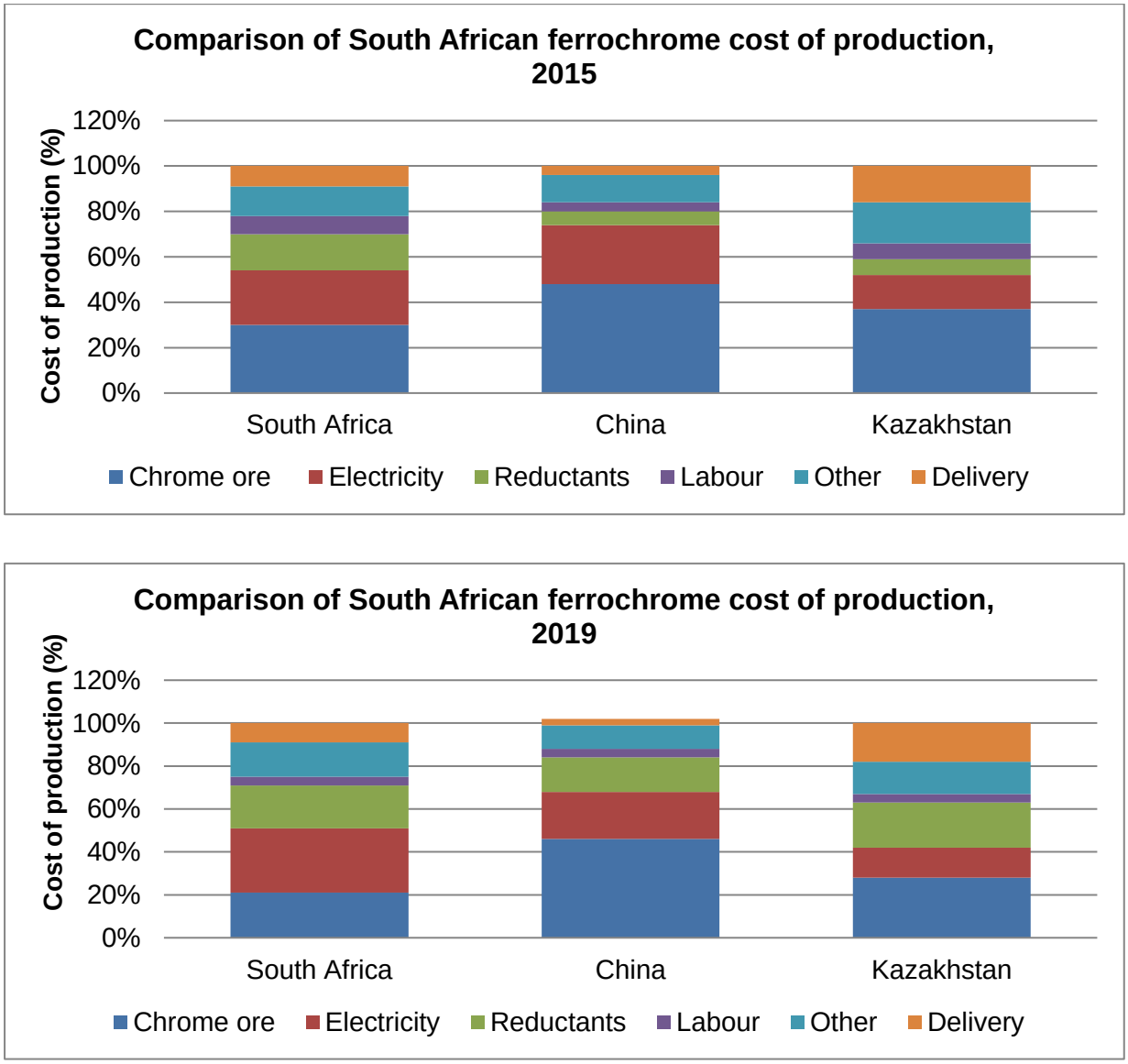


Figure 31. Comparison of South African ferrochrome cost of production, 2015 to 2019 (CRU, 2020b)

Therefore, it is apparent that the proposed export tax hopes to leverage the position of the South African chrome ore sector to compensate for a decline in competitiveness of the downstream ferrochrome industry. However, the decline in the downstream sector has been caused by factors other than the chrome ore cost – the primary among which is the rising energy costs. South African ferrochrome producers have sufficient chrome ore supply from integrated mining production and have access to some volumes of lower cost UG2 ore domestically. Despite Chinese ferrochrome producers obtaining chrome ore at a much higher cost than their South African counterparts, they have managed to become relatively more cost competitive based almost entirely on

differential pricing trends in the two countries in terms of domestic electricity input costs.

4.5 The Proposed Export Tax on Chrome Ore in South Africa

The South African government has proposed the possibility of imposing a chrome ore export tax. Export taxes are a legal kind of industrial development intervention that aims to increase downstream raw material beneficiation (Östensson, 2019). The proposed chrome ore export tax is aimed at supporting the ferrochrome sector in South Africa while also encouraging industrialisation and beneficiation. According to Levin (2020), the benefits given by the chrome ore export tax are critical for the long-term viability of the ferrochrome industry. The export tax is part of a wider strategy to enhance South Africa's industrial capacity and help the country fundamentally move away from its mining-dependent past and toward greater capability in value-added products. The continuous expansion of the stainless steel and downstream industries will have an influence on the economy (Levin, 2020). The next sub-section explains the context in which the export tax is being proposed.

4.5.1 Context of the proposed export tax on chrome ore in South Africa

South Africa was the world's largest and most cost-effective ferrochrome manufacturer until 2012. Its competitiveness was founded on the availability of chrome ore, world-class technology, low electricity rates, and a steady supply of electricity (Levin, 2020). The government has suggested some initiatives, one of which is the imposition of an export tax on chrome ore. The proposed chrome ore export tax is intended to boost domestic ferrochrome production and the chrome value chain in South Africa (Levin, 2020). Thomashausen (2011) provided context, noting that South African ferrochrome manufacturers have been seeking export taxes on ferrochrome since 2009 to protect and improve the beneficiation of ferrochrome ore and ferrochrome exports. South African producers claim that a chrome export tax will raise chrome ore prices, reducing capacity in China's domestic ferrochrome sector and allowing South African producers to reclaim their ferrochrome manufacturing edge.

China is the world’s largest manufacturer of ferrochrome and driving global ferrochrome demand. The Chinese stainless steel consumption is likely to expand as domestic demand outpaces local supply. China's ferrochrome capacity was built with

chrome ore from South Africa, and the country has risen from irrelevance to become the world's top producer (Levin, 2020). The industrial plan of China includes subsidizing and fostering ferrochrome production to expand stainless steel and downstream capacity made them the world's top ferrochrome manufacturer (Levin, 2020). Almost all ferrochrome produced in China is used to make domestic stainless steel, which is subsequently almost solely used to make white goods and other stainless steel items (Levin, 2020).

The proposed export tax on chrome ore is designed to increase South African ferrochrome companies' relative competitiveness by boosting the cost of Chinese ferrochrome. Ferrochrome producers in South Africa are expected to be able to get a higher effective export price for ferrochrome and/or improve ferrochrome export volumes by lowering the competitiveness of the Chinese ferrochrome sector, allowing them to become more sustainable. The export tax is also based on the assumption that, given South Africa's dominating position in the global supply of chrome ore, the tax will be passed on to chrome ore exporters via the export price without inflicting significant harm (Levin, 2020). A comprehensive investigation must be carried out before implementation if an export tax will help a country in the long run.

4.5.2 Key debates on the proposed chrome ore export tax

Export taxes, according to economic theory, can have a net positive effect on an economy. The protection of domestic raw material supplies and the promotion and/or protection of downstream industry growth are common policy objectives linked with the implementation of an export tax (Fung and Korinek, 2013). The overall goal of these policy objectives is to lower raw material input costs for local consumers and/or make the downstream industry more competitive globally by providing it with a relative price advantage (Fung and Korinek, 2013, Latina et al., 2011). Economic theory also recognizes that if a country is a large exporter with significant market power in terms of global raw material supply, the rationale, and advantages of imposing an export tax might operate in a somewhat different way. In this scenario, imposing an export tax would likely raise the international world price, potentially improving a country's terms of trade (to the benefit of local industry) (Pothen et al., 2013). International competitors are charged a higher price in this case, lowering their competitiveness in the domestic downstream industry.

South Africa produces two-thirds of the world's ferrochrome and controls four-fifths of the world's seaborne markets; thus, the government may stand firm on chrome processing domestically, putting pressure on the traditional global chrome leaders. International chrome ore producers have the capacity, allowing them to sufficiently substitute South African chrome ore, putting the South African chrome sector at risk. China, for example, has vast purchasing power and could suppress any attempt to enact the tax (CastingsSA, 2021). Even though the tax would be applied equally to all chrome ore exports, China accounts for 93% of these exports. Only China are substantially reliant on South African chrome ore out of all of South Africa's major global ferrochrome competitors (Levin, 2020). Furthermore, considering China does not export ferrochrome, downstream competition between South African and Chinese ferrochrome is mostly restricted to sales within China's stainless steel industry. As a result, the rationale of the tax is largely targeted at boosting Chinese ferrochrome makers' costs to offer South African ferrochrome producers a comparative advantage in exporting ferrochrome to China (Levin, 2020). It is not intended to boost absolute competitiveness. The proposed tax can only ever be aimed at enhancing the relative competitiveness of South African ferrochrome producers, not their absolute competitiveness because there is no scarcity of chrome ore supply in South Africa. South African ferrochrome producers are vertically integrated, with access to their own chrome ore production and long-term off take arrangements with some UG2 chrome ore producers (Letaba and Zulu, 2021). As a result, ferrochrome producers have surplus internal chrome ore supply that exceeds their own use needs.

Rather than export taxes, Chrome SA proposes that the struggling ferrochrome industry should be given a special electricity arrangement. The Chrome SA argues that a low-cost energy price will help the ferrochrome sector restore the market share it has lost (Creamer, 2020). Ferrochrome producers advocate the implementation of a chrome ore export tax, claiming that only 60 to 65 percent of existing ferrochrome furnace capacity is now operating due to smelters' lack of competitiveness due to high power prices (Creamer, 2020). Improvements in efficiency and competitiveness, such as self-generation of 750 MW of wind, solar, and cogenerated electricity, support for junior mining growth, and promotion of local coking coal production, should all be prioritized.

4.5.3 Case studies of export taxes on chrome ore

The experiences of India and Zimbabwe with the export tax on chrome ore were studied in this section. In most instances, the primary raw material mining industry has suffered a setback, both in terms of export volumes and absolute production levels. This was mainly because other international producing countries have tended to displace the country imposing the tax concerning raw material supply to the international market. The downstream demand and capacity in Zimbabwe have been insufficient to absorb these lost export volumes, particularly from non-integrated companies (Pariser et al., 2018). Export taxes have had a mixed influence on the downstream processing industry. The downstream industry has evolved in certain circumstances, while it has not in others. In India, it is impossible to separate the influence of the tax from other variables impacting downstream growth. Before the application of the tax, the Indian chrome ore downstream sectors had already experienced significant development, with the goal of the tax being to ensure domestic supply rather than disadvantage international downstream competitors. The downstream industry in Zimbabwe has not developed due to the tax, and other economic and political factors may have also played a role. This emphasizes the possibility that an export tax will only assist the downstream sector under specific conditions, and that predicting this effect is difficult (Levin, 2020)

It has been proposed that the instance of India's tax on chrome ore exports provides evidence for introducing a similar tax in South Africa (Sandrey, 2014). The policy goal and context, on the other hand, were distinct. The Indian strategy did not intend to impact global chrome ore pricing or reduce Chinese ferrochrome producers' relative competitiveness. Instead, the Indian government intervened in the face of rising global chrome ore prices, to divert scarce domestic supply to the already well-developed and fast-developing downstream stainless steel and, by extension, ferrochrome sector at a lower domestic cost. The reasoning of the export tax applied by India differed greatly from that suggested in South Africa, and the justification for the Indian context would not apply in South Africa. India lost its export market share as a result of the export tax. For example, India accounted for 31% of Chinese chrome ore imports in 2006, but by 2015, they only accounted for 1% as China diverted purchases to other import source countries (most notably South Africa). Between 2006 and 2015, overall chrome ore production in India declined by 48 percent (from 3.6 million tonnes to 2.2 million

tonnes). By 2019, chrome ore production in India had improved to 3 million tonnes but it was still much below pre-tax levels (CRU, 2020b, USGS, 2016). The impact of the export tax on the ferrochrome industry is uncertain. The stainless steel and ferrochrome industries in India were growing before the implementation of the export tax. During this period, a variety of other policy measures were implemented to promote downstream beneficiation in the steel industry (CRU, 2020b).

4.6 Likely Reaction of Major Players

The rationale behind the proposed chrome ore export tax relies on how three important international players respond to its implementation. International producers of chrome ore; the Chinese ferrochrome and stainless steel industry; and international producers of ferrochrome are the major players.

4.6.1 International chrome ore producers

One fundamental concern raised is whether international chrome ore producers would be able to displace a significant portion of South Africa's exports in the case of a tax on chrome ore export. According to the South African domestic ferrochrome producers, the ability of other foreign producers of chrome ore to displace South African supply would be very limited, even with an export tax on South African chrome ore (Levin, 2020). Although South African producers will not be completely displaced, a major amount of their output is in jeopardy. If the tax is enacted, they may be forced to decrease export pricing to avoid losing large volumes. In terms of international chrome ore sales to China, South Africa is not immune to competition. Many other chrome-producing countries have substantial unused capacity for chrome ore production (Östensson, 2019). As a result, it appears that the premise that South Africa has adequate market power to raise chrome ore export prices without risking major volume loss is untenable.

4.6.2 The Chinese ferrochrome and stainless steel industry

The factors driving the behaviour of Chinese ferrochrome and stainless steel players are complicated. These behaviours are governed by policies, economic and strategic considerations, one of which is the price of chrome ore. As a result, it's impossible to say with any confidence how China's policymakers, as well as the ferrochrome and

stainless steel industry, would react to the tax. China's readiness to absorb any cost effect and retain support for the domestic ferrochrome sector has been demonstrated by policymakers and the stainless steel sector in the past. There is a lot of ambiguity about whether the planned tariff would hurt Chinese ferrochrome competitiveness to the point where the Chinese stainless steel industry decides to prefer South African ferrochrome over Chinese ferrochrome producers.

4.6.3 International ferrochrome producers (China and the rest of the world)

South Africa contributes 56 percent of ferrochrome imported into China and 72 percent of ferrochrome imported into Indonesia, respectively. Other ferrochrome exporters to these markets do not use South African chrome ore. As a result, the proposed export tax will neither increase nor lower the cost of these other ferrochrome producers in comparison to South African ferrochrome production. Any reduction in the competitiveness of Chinese and Indonesian ferrochrome manufacturers will benefit not only South Africa but also other ferrochrome producers exporting to these countries. China and Indonesia account for just 48 percent to 60 percent of South African ferrochrome exports (Pariser et al., 2020). The remaining South African ferrochrome is exported to other countries like the UAE, the USA, South Korea, Japan, and Europe. Therefore, any benefit from the tax in the form of increased terms of trade for South African ferrochrome exporters will likely be limited.

4.7 Analysis of Open-Ended Questions

This section includes data presentation and analysis of the questions of the study. The data were transcribed, and content analysis was performed to extract themes from the research. The qualitative data was gathered from the responses to the questions and submitted to a method known as data transformation, in which the qualitative sub-themes were transformed into themes.

4.7.1 Description and analysis of data

Table 7 shows the themes that were developed for the responses from the experts. All questions were answered by the respondents. The position and number of years of experience in the industry is shown in Table 8. The view of the experts for questions

B3; B4; B5; B6; B7; B8; B9; B10; B11; B12 and B13 were collated and analysed based on the following key sub-themes explained below the table below.

Table 7: Sub-themes and frequencies recorded in the responses to the interviews

	Responses	**Frequency**	**Themes**
B3	Cost of electricity and supply	4	Inputs of production and investment in infrastructure
	Investment in infrastructure	2	
	Labour and cost	1	
B4	Cost of electricity and supply	2	FDI and investment in infrastructure
	Investment in infrastructure	2	
	Foreign Direct Investment	3	
	Reductant	1	
B5	Develop beneficiation ability	2	Develop beneficiation ability
	Foreign Direct Investment	3	
	Investment in infrastructure	3	
	Import and export tariff	1	
B6	Cost of electricity and supply	5	Cost and supply of electricity
	Labour cost and labour union	2	
	Illegal miners	1	
	Cost of logistics	1	
	Investment in infrastructure	1	
B7	Displacement by international competitors	3	Close down of operations and displacement
	Cost of production	2	
	Close down of operation	2	
	Investment in infrastructure	1	
B8	Cost of electricity and supply	3	Cost and supply of electricity and lack of competitiveness
	Job losses	1	
	Cost of production	1	
	Lack of competitiveness	1	
	China’s reaction	1	
B9	Displacement by international competitors	3	Displaced by international competitors

	Competitors will enter the market	1	
B10	Displacement by international competitors	2	Displacement by international competitors and job losses
	Close down of operation	1	
	Job losses	1	
	Competitors will enter the market	1	
B11	Close down of operation	2	Poor economic development
	Job losses	2	
	Research and development	2	
	Corruption	2	
	Loss of income	1	
	Create employment	1	
B12	Cost of production	2	Close down of operations and price manipulation
	Price manipulation	2	
	Lack of competitiveness	1	
	UG2 producers will not be affected	2	
B13	Cost of electricity and supply	4	Investment in infrastructure and improved relationship with mining community
	Investment in infrastructure	3	
	Corruption	1	
	Need for more skill	1	
	Transformation in terms of the relationship between the mine and the communities	1	

Table 8: The demographic section of the interview questions

Responses	Current position	Years of experience (numbers)

Interview 1	Metallurgical Engineer and Logistics	15
Interview 2	Manager Strategic Execution and Finance	19
Interview 3	Engineering Manager	23
Interview 4	Plant manager (Beneficiation complex manager)	19
Interview 5	Financial manager	15

Question B3:

Discussed how the chrome ore sector in South Africa is still competitive enough to provide an enabling environment for ferrochrome production. The view derived from all experts was that the competitiveness of South Africa is limited due to high electricity costs and erratic supply of electricity. In addition, one of the experts indicated that high labour cost also reduces the competitiveness of the chrome ore sector. The need for investment in technology and the ageing infrastructure of Eskom was also indicated by one of the experts. The reliance on open-cast mines by the biggest producers of chrome ore was also mentioned. Some of the comments that were given included the following:

Question B3	Responses
	• *"Yes, it is competitive. It depends on the strategies adopted by South Africa. South Africa needs to invest in the ferrochrome industry and put in advanced technology to produce at a lower cost, to remain competitive."* • *"The smelting is sitting with two major issues in South Africa that are limiting their competitiveness, expensive and erratic electricity supply, coupled with expensive labour cost."* • *"One of the critical issues is that 95% of the South African electricity is generated through coal powered plants. This is exacerbated by an ageing infrastructure and increased requirement for electricity and lack of flexibility on alternative supply"*

	• *"I don't think so, because we are currently grabbling with the issue of power."* • *"Most of the biggest producers of chrome ore are diluting their cost with open cast."*
Comment: It is notable from the responses of the experts that the rising cost of electricity and poor supply; the need for investment in technology; alternative sources of energy are the main factors limiting South Africa's competitiveness.	
Emerged Themes: • Inputs of production and investment in infrastructure	

Question B4:

Asked how South Africa could foster its beneficiation strategy, particularly regarding chrome ore, to achieve economic development. All experts were of the opinion that there is a need for investment in infrastructure and technology. One of the experts was of the view that adequate skill is required as well as the price of the reductants. Two were of the view that Foreign Direct Investment (FDI) could be formed by creating an enabling environment for chrome ore beneficiation. They also viewed the beneficiation of raw products to produce finished products to foster the South African beneficiation strategy. Some of the comments that were given included the following:

Question B4	Responses
	• *"The cost of electricity, the availability and limitations put on alternative energy resources. South Africa also needs to embrace."* • *"South Africa needs to create an enabling environment for chrome beneficiation and smelting which will also boost FDI."* • *"The problem now is we take half beneficiated products to other countries and the countries then sell it back to us, they manipulate the prices."* • *"Smelting actually supplements that because if we do not smelt in South Africa, then it's going to create opportunities in China."*

Comment: The above comments of the experts agreed that for South Africa to foster its beneficiation strategy on chrome ore, South Africa needs to create an enabling environment to encourage investors in form of FDI, the cost of electricity, the availability and limitations put on alternative energy resources and adoption of technology.
Emerged Themes: • FDI and investment in infrastructure

Question B5:

Asked how South Africa could use and leverage its comparative advantage of chrome ore reserves to economically benefit. Two of the experts were of the view that creating FDI by creating an enabling environment would leverage its comparative advantage of chrome ore reserves to economically benefit. Three of the experts also viewed developing beneficiation abilities and fully exploitation of the reserves to leverage their comparative advantage. While one of the respondents viewed investment in technology, sustainable energy and growth in furnace capacity and use. Some of the comments that were given included the following:

Question B5	Responses
	• *"South Africa needs investment in technology and innovation. South Africa needs to trust itself more and be less dependent on foreign countries for assistance."* • *"South Africa needs to exploit its reserves while developing beneficiation abilities. There should be growth in both mining exploitation and furnace capacity and use."* • *"The only differentiator with other countries e.g. they just have the technology, they don't have the resources/ore to process."* • *The major factor in maybe achieving the ultimate in terms of benefiting I think is mainly efficiency.*
Comment:	

The responses from the experts indicated that for South Africa to use and leverage its comparative advantage of chrome ore reserves to benefit economically, South Africa needs to exploit its reserves while developing beneficiation abilities
Emerged Themes: • Developing beneficiation abilities

Question B6:

Asked about the challenges facing the South African ferrochrome industry are. All experts agreed that high electricity costs and poor supply are the major challenges of the South African ferrochrome industry. One of the experts viewed illegal miners, high cost of reductants, labour unions and labour costs as some of the challenges facing the South African ferrochrome industry. Some of the comments that were given included the following:

Question B6	Responses
	• *"The competition is high based on pricing. In the chrome ore industry, the small suppliers "illegal miners" (zama-zama) flood the market with supply"* • *"Electricity challenges (costs & availability), labour (costs and skills), embracing cutting edge technology and cost of ore."* • *"The logistic cost, since most mines are located in the heart of South Africa away from the ports, which contribute significantly on the cost."* • *"The major problem that we have is the shortage as well as the price of electricity."*
Comment: From the responses on what the challenges facing the South African ferrochrome industry are, the experts generally agreed that high electricity cost and poor supply of electricity, rising cost of labour, high cost of logistics and illegal miners were identified	
Emerged Theme: • Cost and supply of electricity	

Question B7:

Asked what the perceived effects of the proposed tax on chrome ore are. Two of the experts agreed that it will lead to a high cost of production and businesses may shut down leading to job losses (chrome ore producers). One of the experts suggests that South Africa might be displaced by international chrome producers (Zimbabwe or Kazakhstan). One of the experts also suggested the need for a balance for the smelters. Some of the comments that were given included the following:

Question B7	Responses
	• *"Are you going to sacrifice for those two companies rather than sacrifice for other companies for the mining?"* • *"This will minimise export of concentrate chromite product but may results in high input cost of production, subsequently some business shutting down."* • *"The biggest challenge with chrome tax, even though we are country with the biggest reserves. There is a chance that the Chinese will go to countries that are actually cheaper."* • *"Integrated ferrochrome producers they will welcome the chrome tax they see it as a benefit to them"*
Comment: From the responses on what the perceived effects of the proposed tax on chrome ore are, the experts agreed that it will lead to high cost of production, chrome producers could go out of business, unemployment and displacement of South Africa by China for cheaper chrome	
Emerged Theme: • Close down of operations and displacement	

Question B8:

Asked if South Africa is ready for the implementation of the proposed export tax on chrome ore and what will be the benefit to the industry. Four of the experts agreed that South Africa is not ready for the proposed chrome ore export tax, as it will lead to job losses and counter-reaction from China. An expert commented that the South African chrome ore industry will become less competitive. Another respondent agreed that

South Africa is ready for the export tax but could be better if the challenges of energy can be addressed. Some of the comments that were given included the following:

Question B8	Responses
	• *"The major question is "where" and "how". Where in the industry, there is no information of where they are going to pay the export tax. It is either as an exporter you pay the tax or the buyer pays the tax. What will be the Chinese reaction?"* • *"South Africa is not ready and it will only add to our costs and make us less competitive than we currently are."* • *"South Africa is not ready as it is still battling to provide electricity to its residence and increased load shedding continues."* • *"South Africa is more than ready and it is coming at the right time, it could have been better if we also have energy for our chrome."*
Comment: The following sub-themes were generated from the responses from question B8 on if South Africa is ready for the implementation of the proposed export tax on chrome ore and what will be the benefit to the industry	
Emerged Themes: • Cost and supply of electricity and lack of competitiveness.	

Question B9:

This question asked if there is a possibility that South African producers could be displaced by the foreign competitors. Four of the experts agreed that South Africa could be displaced by foreign competitors while one disagreed based on the chrome reserves in the country. One of the experts suggested that the government of South Africa be very strategic to look closely at the contracts signed with China. Some of the comments that were given included the following:

Question B9	Responses
	• *"Based on the trend, it is possible."* • *"With a levy and increase in price, more competitors will enter the market"* • *"If the tax pushes our South Africa ore producers to be more expensive than Kazakhstan and India and everyone else, definitely it's going to push us out of the market."* • *"Yes, there is a big chance. The leadership has to be very strategic in the government to really look closely at these contracts they are signing with the Chinese."*
Comment: From the responses on whether there is a possibility that the South African producers could be displaced by the foreign competitors, the theme that was generated for question B9	
Emerged Theme: • Displaced by international competitors	

Question B10:

Asked what the impact of the proposed chrome ore export tax on the ferrochrome producers in South Africa will be. Two of the experts stated that it will lead to job losses and closure of mines. One of the experts commented that South Africa might be displaced, and less trade will occur as customers will resist. Another viewed that electricity and labour costs of competitors will remain unchanged. It was also mentioned that the ferrochrome producers will welcome the export tax as they will not pay any of the tax. Some of the comments that were given included the following:

Question B10	Responses
	• *"This will lead to job losses and more closure of companies as there won't be much trade because the customers are going to resist."* • *"It will not assist them greatly; their ore prices will not necessarily drop, while their main foes (electricity and labour) will remain unchanged."* • *"This will be disastrous and can lead to the closure of some mines if implemented immediately without creating a suitable environment and conducting structural upgrades"* • *"The threat becomes being replaced. The only problem we can encounter is if the Chinese can find an alternative or substitute then we have lost the battle"*
Comment: It is notable from the experts that the proposed chrome ore export tax will lead to job losses and closure of companies	
Emerged Theme: • Displacement by international competitors and job losses	

Question B11

Asked what the possible adverse impacts of the proposed chrome ore export tax are on the ore value chain, including on employees and communities. Majority of the experts view the possible adverse impact to be job loss, closing down of operations, loss of income for development in mining areas, poor economic development and displacement. Some of the comments that were given included the following:

Question B11	Responses
	• *"It will be significant"* • *"Joblessness as communities and small businesses rely on the jobs, poor economic development, poverty, displacement, brain drain and high crime rate amongst all."* • *"If mine closes down, many other industries will be affected e.g. transport, ports etc. The entire value chain will be affected."* • *"In most mining areas, unemployment remains a constant problem and this will be exacerbated, while money spent for development through social and labour Plans will not be available anymore."*
Comment: It is notable from the experts that the possible adverse impacts of the proposed chrome ore export tax on the ore value chain, including on employees and communities are closing down of operations, job losses, and loss of income for development in mining areas	
Emerged Theme: • Poor economic development	

Question B12:

Asked what the consequences of a tax on primary and UG2 chrome ore producers, their employees and communities are. Two of the experts stated that the UG2 producers might benefit as China will purchase their low-quality ore, instead of the prime material. Two experts agreed that operations might close due to high cost of production and South Africa may become less competitive. Another expert stated that there might be price manipulation by the Chinese. Some of the comments that were given included the following:

Question B12	Responses
	• *"The UG2 producers will benefit as the Chinese are looking to use the UG2 because of its low-quality ore, instead of the prime material"* • *"Your unit cost increases and you become less competitive due to the additional tax burden."* • *"This will be disastrous as most operations might close due to high input cost of production."* • *"The Chinese might manipulate the pricing system where at the end of the day we think we are scoring on the export tax but dribbling you on the prices."*
Comment: It is notable from the experts that the consequences of a tax on primary and UG2 chrome ore producers, their employees and communities are high cost of production, close down of operations and price manipulation	
Emerged Theme: • Close down of operations and price manipulation	

Question B13:

Asked what measures other than the proposed chrome ore tax the government could adopt to improve the SA ferrochrome industry's sustainable long-term outlook. All experts agreed that other measures should include the inquiry of the cost and supply of electricity and investment in infrastructures while another expert insisted on the control of illicit financial flows as well as the need for skill and innovators. Some of the comments that were given included the following:

Question B13	Responses
	• "The cost and supply of electricity as well as investment in infrastructures such as roads, rails and advanced smelters technologies." • "The government must find a way to make electricity more accessible and affordable to the community by also improving their infrastructure. The biggest challenge is the ageing infrastructure in Eskom." • "If the government removes the red tape in terms of private electricity producers, I think that will create competition and then companies will have a choice of buying electricity from Eskom and private producers which will be a competitive price and maybe force to Eskom start being competitive."
Comment: It is notable from the experts what measures other than the proposed chrome ore tax the government could adopt in order to improve the South African ferrochrome industry's sustainable long-term outlook. The measures include the cost and supply of electricity and investment in infrastructure	
Emerged Theme: • Investment in infrastructure and relations with the mining community	

4.8 Summary of the Chapter

South Africa is one of the world's leading mining and mineral jurisdictions with large reserves. The mining sector in South Africa continues to play an essential role in the country's inclusive economic growth, foreign exchange earnings, transformation, employment, and skill development. 2020 was a difficult year due to the COVID-19 pandemic as production was shut down temporarily in the first quarter of 2020. After the lockdown by the government, demand for products was high and the mining sector's contribution to economic growth was significant. In the first quarter of 2021, the South African mining industry recorded growth. In terms of employment in the mining industry in 2021, there was a decrease in employment. The mining industry has been a major driver of the South African economy. The sector accounts for 6% of

the country’s GDP and employs more than half a million people. In addition, it contributes to approximately 9% of South Africa’s export earnings.

South Africa is a leading producer and exporter of ferrous minerals. In 2019, the total sales revenue of processed chrome ore decreased, while the number of employees decreased in 2020. In South Africa, China accounts for about 76% of exports to this market. China is the world’s largest producer of ferrochrome, followed by South Africa. Ferrochrome producers in China rely on South Africa for the ore used to produce it. Due to the export of South Africa's ore, which makes up the bulk of ferrochrome production worldwide, the local industry has been shrinking at an alarming rate. It is no longer competitive enough in its own country, and jobs have trickled away as a result. Other factors have also been identified as contributing to the lack of competitiveness of South African ferrochrome, but it has been electricity costs and supply that are considered the primary drivers. The production of ferrochrome requires a large amount of electricity, and the cost of production in South Africa has been rising.

The proposed export tax on chrome ore will support the ferrochrome sector in South Africa; this is based on South Africa's reserves, production levels, and exports of chrome ore. The proposed export tax on chrome ore is intended to make South African ferrochrome producers more competitive by raising the cost of Chinese ferrochrome, which they rely on for their supply chain. It is unclear how the major players—international producers of chrome ore, the Chinese ferrochrome and stainless steel industries, and international producers of ferrochrome—will react. Most of the international ferrochrome producers do not use South African chrome, so the proposed export tax will not change their costs in comparison to those of local producers. The Chinese ferrochrome and stainless steel industries—which rely on South Africa for most of their chrome ore—might look to Kazakhstan or India as cheaper sources, displacing South African exports. This study shows that the South African chrome ore can be made more profitable by processing it into finished goods rather than simply selling raw minerals. The information in this chapter shows that despite the decrease in production in ferrochrome, South Africa is still a major player. The comments of the experts from the interviews were also presented in this chapter. The responses were transcribed and organized into themes and sub-themes. In this chapter, the concepts of each question were examined.

5. INTERPRETATION OF FINDINGS

5.1 Theme B3: Inputs of Production and Investment in Infrastructure

Theme B3 finds that experts in the field agree that high electricity cost and erratic supply of electricity as well as lack of investment in technology makes the South African chrome ore sector less competitive. The major input of production in ferrochrome is a high amount of electricity. This suggests that for the chrome ore sector to be competitive enough to provide an enabling environment for ferrochrome production, the issue of the cost and supply of electricity, as well as investment in technology to produce at a lower cost, must be solved. The improvement of the supply of electricity can only be possible with the improvement of Eskom's aging infrastructure and the provision of an alternative source of energy.

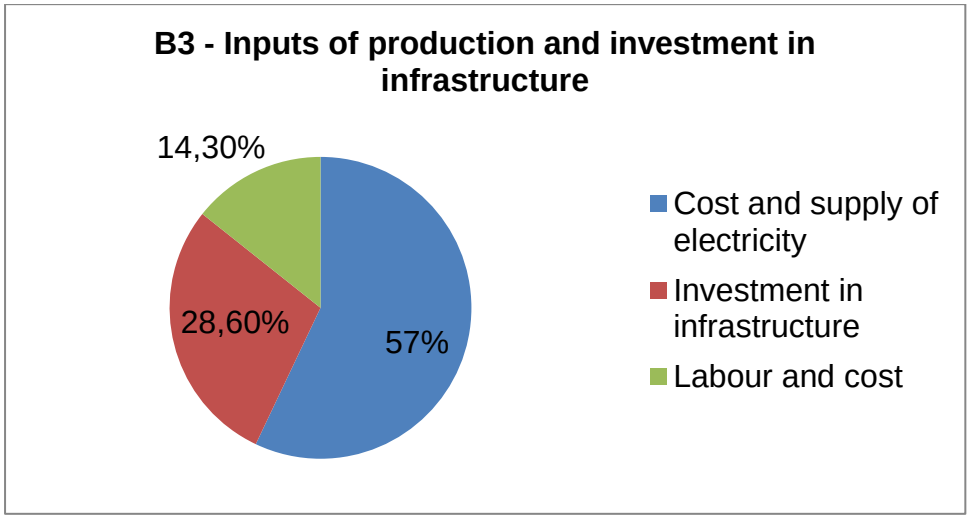


Figure 32. B3 - Inputs of production and investment in infrastructure

5.2 Theme B4: FDI and Investment in Infrastructure

Theme B4 shows how South African can foster its beneficiation strategy. Like in theme B3, cost and supply of electricity, as well as infrastructure, is important to foster beneficiation especially as electricity is important in chrome ore beneficiation. The experts agreed that to boost FDI, South Africa must create an enabling environment for chrome ore beneficiation. For South Africa to create an enabling environment, South Africa must embrace the use of modern and eco-friendly technology and face the electricity challenge head-on.

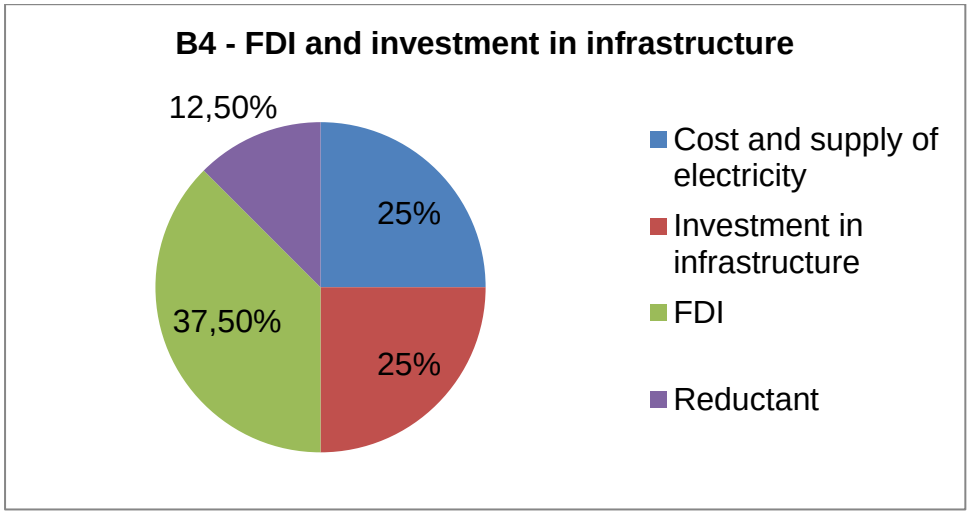


Figure 33. FDI and investment in infrastructure

5.3 Theme B5: Develop Beneficiation Abilities

Theme B5 shows how South Africa can use and leverage its competitive advantage of chrome ore reserves for its economic benefit. According to the experts, South Africa must exploit its reserves while developing beneficiation abilities. The country has large reserves of chrome but not fully exploiting it to its maximum benefits. There should be growth in both mining exploitation and furnace capacity and use. The growth of the chrome ore downstream industry will add to South Africa's already significant competitive advantage and economic gain. Therefore, South Africa needs a sustainability strategy on how to further invest, looking beyond the life of the mine.

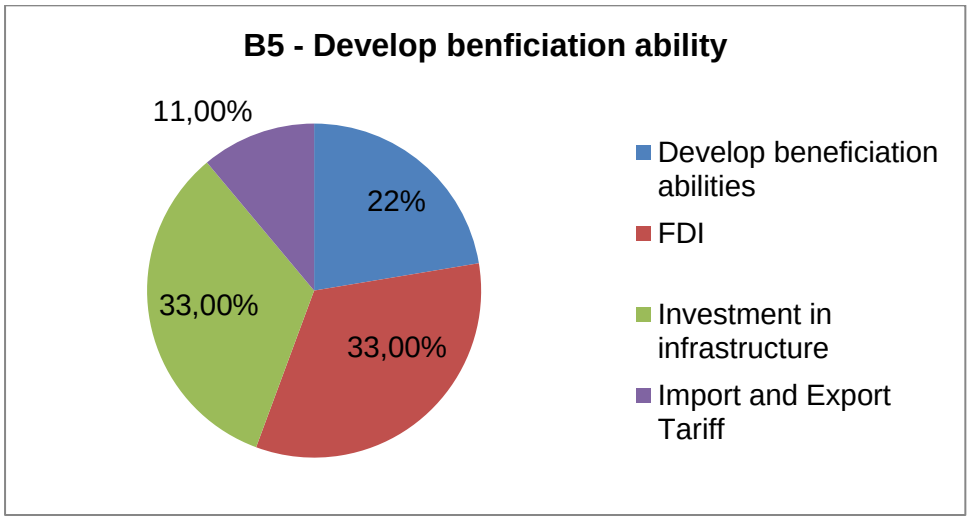


Figure 34. B5 - Develop beneficiation ability

5.4 Theme B6: Cost and Supply of Electricity

According to the experts, the challenges facing the South African ferrochrome industry are issues of electricity cost and supply, investment in technology, and cost of labour and labour unions. Of all the challenges, the cost and supply of electricity is the major one. Electricity is needed in smelting chrome ore to ferrochrome. In South Africa, there are labour unions while in China there are none. The cost of logistics was also identified which contribute significantly to the cost of production. Therefore, these challenges facing the South African ferrochrome industry leads to the close down of operations.

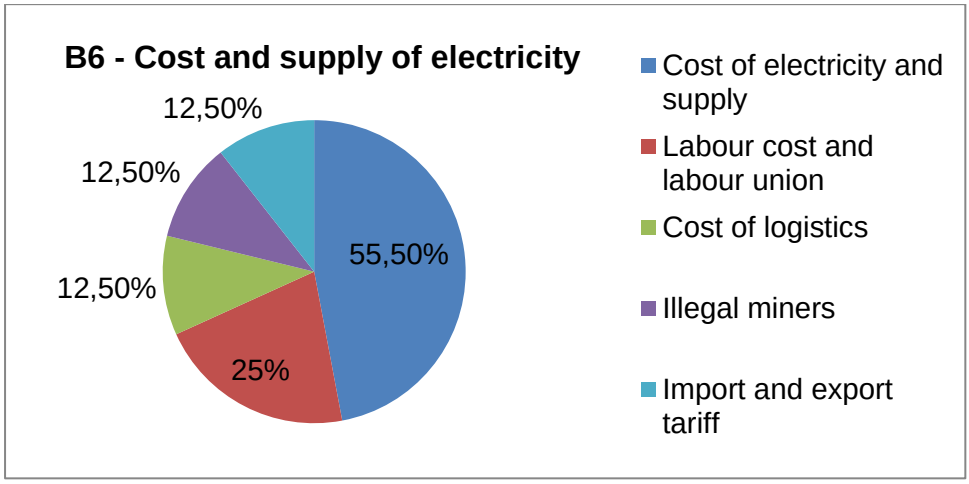


Figure 35. B6 - Cost and supply of electricity

5.5 Theme B7: Close down of Operations and Displacement

Theme B7 shows the perceived effects of the proposed tax on chrome ore. The perceived effects according to the experts are high cost of production, shutting down of operations due to the cost and the likely displacement of South Africa by other international competitors. Even though South Africa has large reserves, the reactions of the policymakers or chrome ore and ferrochrome industry in China will be difficult to predict. There is a chance that the Chinese will go to countries that are cheaper e.g., Kazakhstan and India.

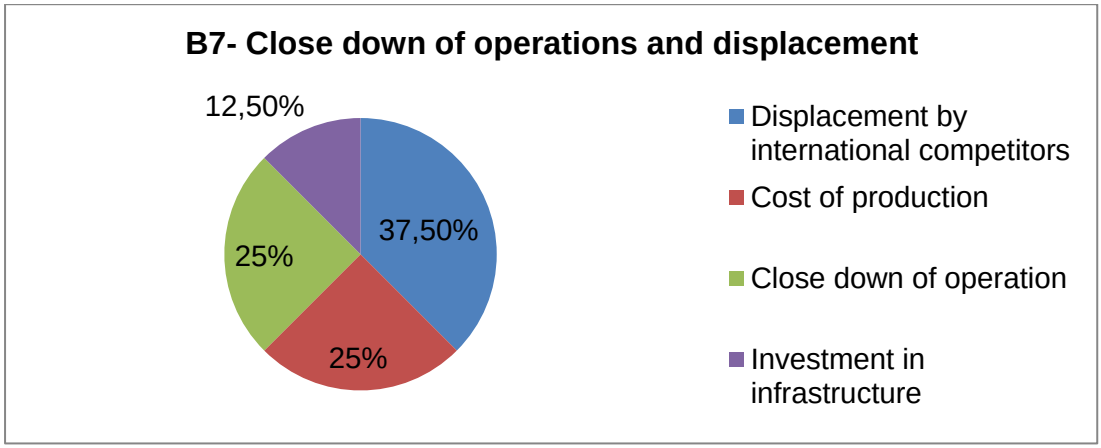


Figure 36. Close down of operations and displacement

5.6 Theme B8: Cost and Supply of Electricity and Lack of Competitiveness

Theme B8 shows the reasons why South Africa is not ready for the implementation of the proposed export tax on chrome ore. The experts agreed that the implementation of the export tax on chrome ore will lead to job losses and lack of competitiveness of the chrome ore industry in terms of job loss. Like in Theme B7, the reactions of the Chinese cannot be predicted. One of the experts asked if South Africa could afford not to export for 6 months as the Chinese may reduce their demand and strangle the market for a while because they have enough stockpile because South Africa had been flooding it. The issues of electricity in South Africa will also lead to lack of competitiveness in the chrome ore industry.

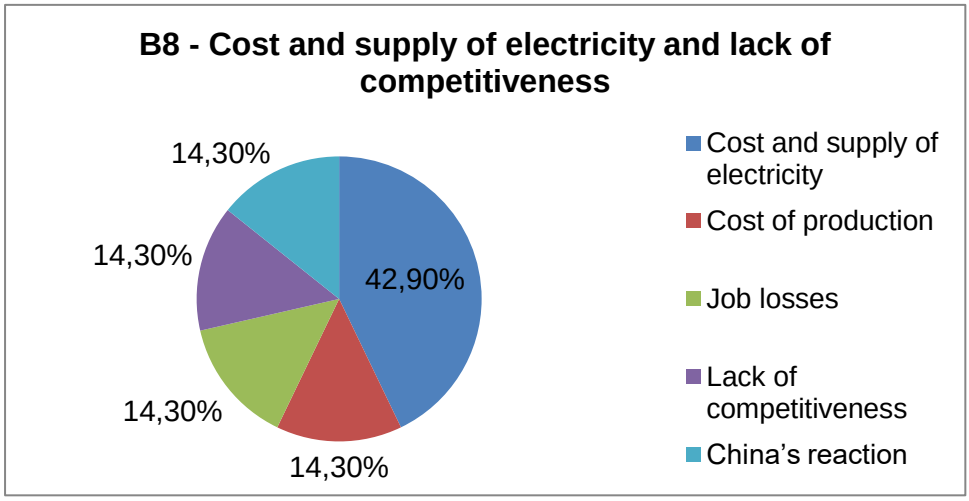


Figure 37. B8 - Cost and supply of electricity and lack of competitiveness

5.7 Theme B9: Displaced by International Competitors

Theme B9 shows the views of the experts on the possibility that the South African producers could be displaced by foreign competitors. Majority of the experts agreed except for one whose decision was based on the chrome reserves in the country. Despite the large reserves, South Africa is not leveraging on them. There is a big chance of being displaced by other international producers because the international chrome market is competitive, and it can be seen in the amount of chrome ore becoming available when the market hit certain pricing levels. With a tax and increase in price, more competitors will enter the market.

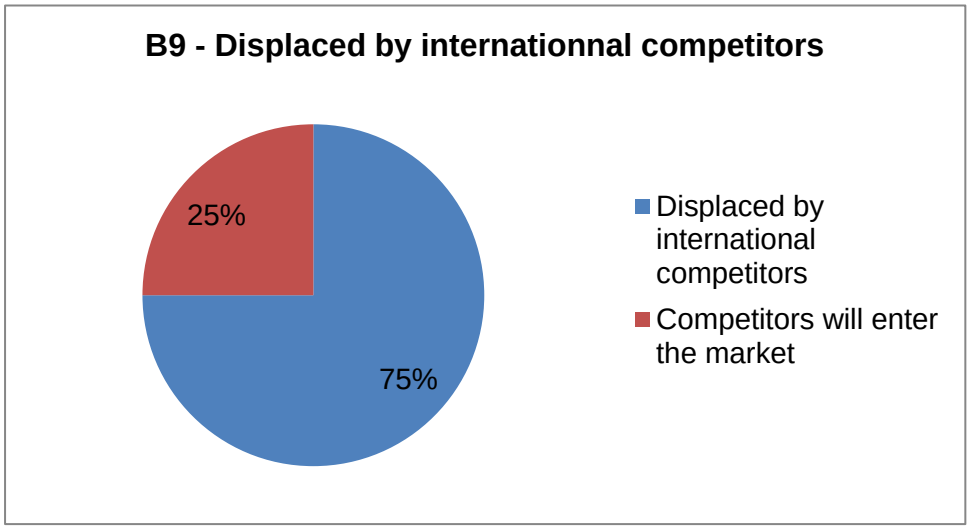


Figure 38. B9 - Displaced by international competitors

5.8 Theme B10: Displaced by International Competitors and Job Losses

Theme B10 shows the view of the experts on the impact of the proposed chrome ore export tax on the ferrochrome producers in South Africa. The experts agreed that it will lead to job losses, close down of operation and displacement of South Africa by foreign competitors. The issues of electricity and labour of their competitors will remain unchanged and lead to low competitiveness for the ferrochrome industry in South Africa. South Africa does not have an explicit steel industry as the country does not produce much steel. The major threat South Africa can encounter is if the Chinese can find an alternative source of chrome.

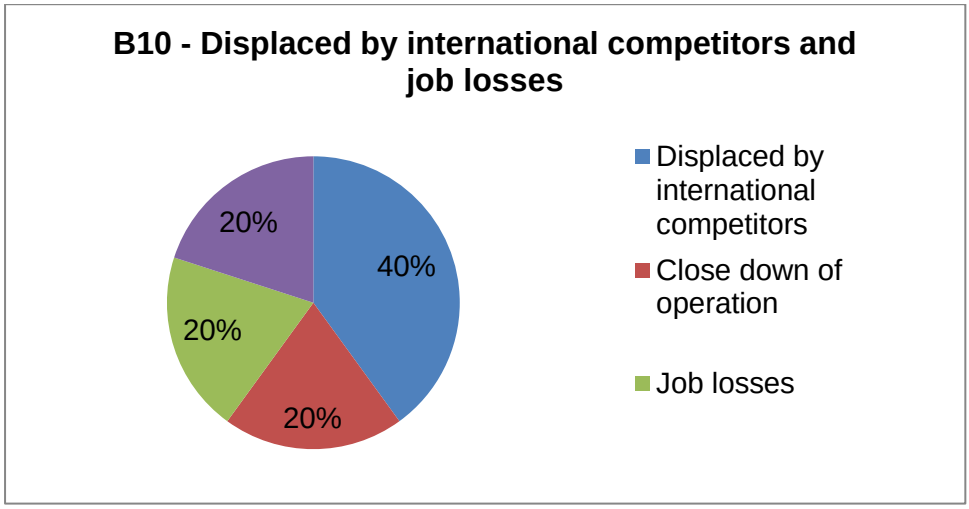


Figure 39. B10 - Displaced by international competitors and job losses

5.9 Theme B11: Poor Economic Development

Theme B11 shows the possible adverse impacts of the proposed chrome ore export tax on the ore value chain, including on employees and communities. The experts agreed that it will lead to job losses, lost contracts, loss of income for surrounding communities through social and labour plans. Other adverse impacts could include poor economic development as small businesses rely on jobs, poverty, displacement, brain drain and high crime rate. The close down of the operations from the proposed chrome ore export tax will the entire value chain e.g. transports, ports etc.

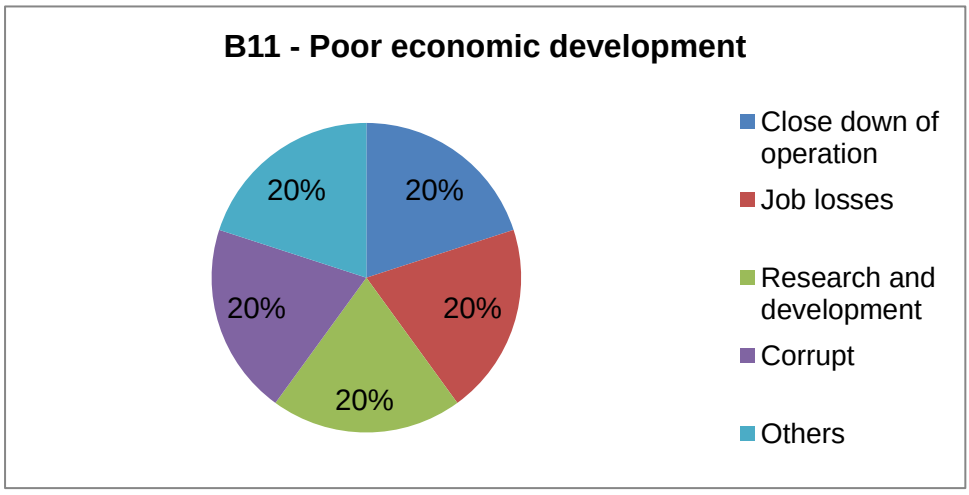


Figure 40. B11 - Poor economic development

5.10 Theme B12: Close Down of Operations and Price Manipulation

Theme B12 shows the views of the experts on the consequences of a tax on primary and UG2 chrome ore producers, their employees and communities. The consequences agreed to include high cost of production, close down of operations and price manipulation. An expert was of the view that due to additional tax burdens they are going to become less competitive. Miners are already paying companies tax, royalty tax and other mining charter requirements. Through salaries and services, a huge amount of indirect taxes are also generated (personal tax and VAT), which is already creating a big burden on miners, especially primary miners. The UG2 producers may benefit as the Chinese are looking to use the UG2 because of its low-quality ore, instead of the prime material. The UG2 producers still have PGMs and they will still survive. An expert viewed that based on the tax; the Chinese might manipulate the pricing system so as to compensate the deficit from the export tax.

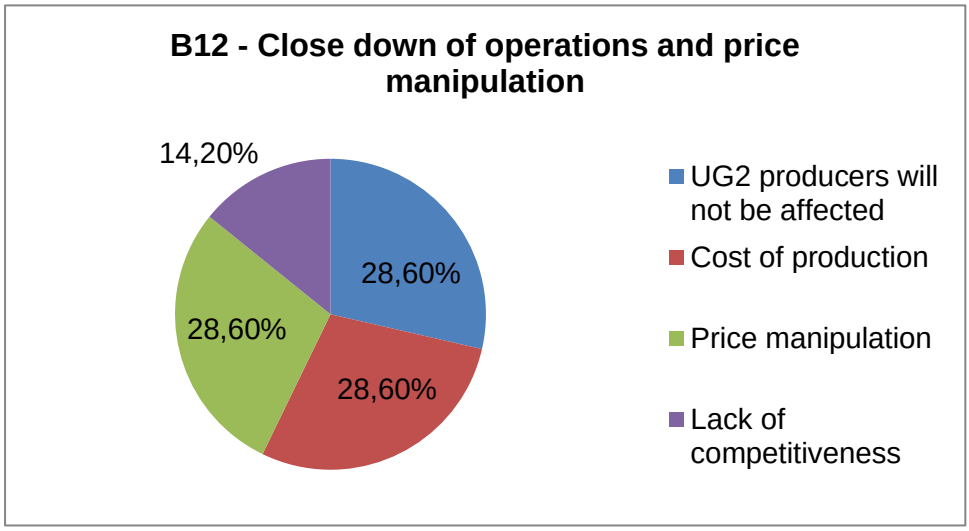


Figure 41. B12 - Close down of operations and price manipulation

5.11 Theme B13: Investment in Infrastructure and Improved Relationship with the Mining Community

Theme B13 shows the other measures proposed by the experts in place of the proposed chrome ore export tax. The experts highlighted cost and supply of electricity, investment in infrastructures such as roads, rails and advanced smelters technologies, skill and innovators and control of illicit financial flow in the mining sector. There is a need for electricity tariffs to be cheaper and improve the capacity of Eskom. The government must find a way to make electricity more accessible and affordable to the

community by also improving their infrastructure. An expert viewed that if the energy is available and stable and the FDI gets managed properly then the economy will grow and the chrome ore industry will become attractive and competitive again. The relationship between the mines and the hosting community has to improve as a stoppage by community members can cost the mines a lot of money. There needs to be change in terms of operations, managing operations and engaging with the communities.

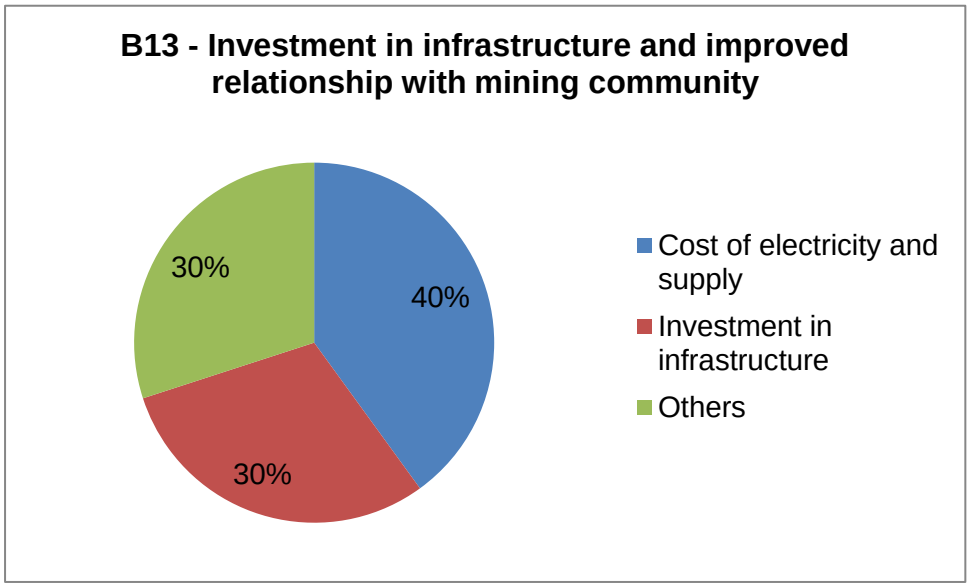


Figure 42. B13 - Investment in infrastructure and improved relationship with mining community.

Note - Others include: (Control of corruption; need for more skill; relationship between the mine and the communities)

5.14 Summary of the Findings

South Africa is one of the world's leading mining and mineral jurisdictions with large reserves. The mining sector in South Africa continues to play an essential role in the country's inclusive economic growth, foreign exchange earnings, transformation, employment, and skill development. 2020 was a difficult year due to the COVID-19 pandemic as production was shut down temporarily in the first quarter of 2020. After the lockdown by the government, demand for products was high and the mining sector's contribution to economic growth was significant. In the first quarter of 2021, the South African mining industry recorded growth. In terms of employment in the mining industry in 2021, there was a decrease in employment. The mining industry

has been a major driver of the South African economy. The sector accounts for 6% of the country's GDP and employs more than half a million people. In addition, it contributes to approximately 9% of South Africa's export earnings.

South Africa is a leading producer and exporter of ferrous minerals. In 2019, the total sales revenue of processed chrome ore decreased, while the number of employees decreased in 2020. In South Africa, China accounts for about 76% of exports to this market. China is the world's largest producer of ferrochrome, followed by South Africa. Ferrochrome producers in China rely on South Africa for the ore used to produce it. Due to the export of South Africa's ore, which makes up the bulk of ferrochrome production worldwide, the local industry has been shrinking at an alarming rate. It is no longer competitive enough in its own country, and jobs have trickled away as a result. Other factors have also been identified as contributing to the lack of competitiveness of South African ferrochrome, but it has been electricity costs and supply that are considered the primary drivers. The production of ferrochrome requires a large amount of electricity, and the cost of production in South Africa has been rising.

The proposed export tax on chrome ore will support the ferrochrome sector in South Africa; this is based on South Africa's reserves, production levels, and exports of chrome ore. The proposed export tax on chrome ore is intended to make South African ferrochrome producers more competitive by raising the cost of Chinese ferrochrome, which they rely on for their supply chain. It is unclear how the major players—international producers of chrome ore, the Chinese ferrochrome and stainless steel industries, and international producers of ferrochrome—will react. Most of the international ferrochrome producers do not use South African chrome, so the proposed export tax will not change their costs in comparison to those of local producers. The Chinese ferrochrome and stainless steel industries—which rely on South Africa for most of their chrome ore—might look to Kazakhstan or India as cheaper sources, displacing South African exports. This study shows that the South African chrome ore can be made more profitable by processing it into finished goods rather than simply selling raw minerals.

5.15 Summary of the Chapter

This chapter detailed the themes and the frequency of the sub-themes based on expert responses. The themes include: inputs of production and investment in infrastructure; FDI and investment in infrastructure; develop beneficiation abilities; cost and supply of electricity; close down of operations and displacement; cost and supply of electricity and lack of competitiveness; displaced by international competitors; displaced by international competitors and job losses; poor economic development; close down of operations and price manipulation; and investment in infrastructure and improved relationship with the mining community.

6. EVALUATION, CONCLUSION AND RECOMMENDATIONS

This chapter entails the recommendations and conclusion of the study by exploring and interpreting research findings considering the aim and objectives of the study and research question. The research objective posed is answered after which the conclusions to the findings follow. The limitations of the study are subsequently discussed, and some recommendations for future studies are made.

6.1 Evaluation of the Research Objective

Research objectives

Objective 1: To identify the challenges facing the South African ferrochrome industry.

The study identified key factors such as the rising cost and supply of electricity, importation of reductants, cost of labour and labour union, illegal miners that flood the market with supply, and high cost of logistics. Of all the challenges the major one is the rising cost and shortage of electricity. The main driver of the declining competitiveness of the South African ferrochrome industry is the rising cost and supply of electricity. The constant increase in industrial electricity tariffs has increased the input cost of production for domestic ferrochrome producers.

Objective 2: To analyse the advantages of South Africa's chrome ore beneficiation strategy.

The study collected data on raw and processed chrome ore productions and sales. The major advantage to the South African beneficiation of chrome ore is the abundance of chrome ore reserves. Until 2019, the production of chrome has been on an increase. The total production and sales of processed chromium alloys decreased in 2019. The mass of processed chromium alloys for local sale increased by a small margin in 2019 while it was sold cheaper in 2019. The South Africa chrome ore production and sale decreased in 2020 due to the government imposed lockdown due to COVID-19. The beneficiation of chrome ore should increase employment but from 2019 to 2020 jobs have been lost in the industry. The abundance of chrome ore should be an advantage in the beneficiation of chrome ore to the downstream sector, but South Africa has not been able to leverage it to beneficiate to the downstream.

Objective 3: To determine if South Africa's rich endowment of chrome ore can deliver additional economic benefits through beneficiation beyond simple mining and exportation

The study collated data on the mining industry especially the chrome ore and ferrochrome industry. The chrome ore sector also contributed to the GDP growth in the first quarter where mining contributed 18% quarter-on-quarter. The chrome ore sector employed between 18 000 to 20 000 people in 2020 while the ferrochrome smelters employed about 6 – 7 000 people in 2019. The chrome ore mine are obliged to make meaningful commitments to empower their host communities. The commitments are through the Social Responsibility Projects, building infrastructure, schools, clinics and creating employment for people of the community.

Objective 4: To examine and analyse interventions or policies needed to create sustainable ferrochrome exports.

The biggest problem of the ferrochrome industry is the cost and supply of electricity as identified in the study. The government has to invest in infrastructures such as roads, rails and advanced smelters technology. For the ferrochrome industry in South Africa to be competitive, the government needs to develop a strategy regarding electricity.

6.2 Contribution of the Study

The findings of this study will be of benefit to the chrome ore and ferrochrome industries, as well as the mining sector. South Africa's mining industry contributes to economic growth and employment. The beneficiation of chrome ore to ferrochrome and downstream is critical to the economic growth of the country. The beneficiation of chrome ore in South Africa is justified by the global need for ferrochrome in the manufacturing of stainless steel. The biggest difficulty facing the ferrochrome sector is the cost and shortage of electricity. The ferrochrome sector in South Africa is not as competitive as it should be which is why the government of South Africa is considering imposing an export tax on chrome ore.

The investigation of this study uncovers the impact of the export tax on chrome ore on the major players and their reactions. The investigation also proposes that before the export tax on chrome ore can benefit the chrome ore and ferrochrome industry, the

South African government needs to create an enabling environment for the industries to thrive.

6.3 Conclusion

This study focused on the beneficiation of the chrome ore and the lack of competitiveness of the South African ferrochrome industry. The study identified the major challenge of the ferrochrome industry to be the rising cost and shortage of electricity. The major advantage to the South African beneficiation of chrome ore is the abundance of chrome ore reserves. The abundance of chrome ore should be an advantage in the beneficiation of chrome ore to the downstream sector, but South Africa has not been able to leverage it. The South African chrome ore industry exports most of its products as raw or semi-processed ore. The chrome ore and ferrochrome industries are important for economic growth as the chrome ore industry contributes to GDP growth and employment. The proposed export tax by the government is not viable considering the challenges facing the country. The proposed export tax will increase the cost of production for the chrome ore producers which will lead to displacement by international chrome ore producers and loss of jobs in the country. For the sector to operate at its maximum the government needs to create an enabling environment. Therefore, the government has to invest in infrastructures such as roads, rails and Ports. For the ferrochrome industry in South Africa to be competitive, the government needs to develop a strategy regarding electricity.

6.4 Limitations of the Study

Several limitations are identified that could be addressed in future research. These limitations are:

Due to the magnitude and complexity of the South African mining industry, the study was confined to ferrous minerals, with emphasis on chrome ore and ferrochrome.

The study depended on the availability of a limited sample of people, which means the conclusions may only apply to that group. Future research might benefit from a large sample size to ensure that all stakeholders in the beneficiation process are represented.

6.5 Recommendation of the Study

Any initiative aimed at boosting the beneficiation strategy on chrome ore to ferrochrome and the downstream sector is foremost in addressing the key issues that are threatening the sector's sustainability. The cost and the supply of electricity is the most significant challenge that the South African ferrochrome industry is confronted with. In light of the proposed export tax, the gain accrued by the ferrochrome sector can be undermined by the cost of electricity. The goal would be to implement a favourable energy pricing plan that would boost South Africa's downstream ferrochrome industries' international competitiveness. The South African government is investing in renewable energy and gas resources, however, should not abandon coal. Some have suggested the use of modern technology to help reduce the emission from coal, as South Africa is rich in coal. While others have suggested that the government remove the red tape on the private producers to boost the competitiveness of Eskom as well as the introduction of the Industrial electricity Tariff Scheme.

6.6 Recommendation for Future Studies

The study depended on the availability of a limited sample of people, which means the conclusions may only apply to that group. Future research might benefit from a large sample size to ensure that all stakeholders in the beneficiation process are represented.

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APPENDIX A:

Questionnaires

Title - South Africa's Beneficiation strategy and the proposed chrome ore export tax: The Relevance towards economic development.

NOTE – If an answer to questions is yes/no, please explain why.

1. What is your current position?
2. How many years of experience do you have in the industry?
3. Do you think the chrome ore sector in South Africa is still competitive enough to provide an enabling environment for ferrochrome production?
4. How can South Africa foster its beneficiation strategy, particularly with regard to chrome ore, to achieve economic development?
5. How can South Africa use and leverage its comparative advantage of chrome ore reserves to economically benefit?
6. What are the challenges facing the South African Ferrochrome industry?
7. What are the perceived effects of the proposed tax on chrome ore?
8. Do you think South Africa is ready for the implementation of the proposed export tax on chrome ore and what will be the benefit to the industry?
9. Is there a possibility that the South African producers could be displaced by the foreign competitors?
10. What will be the impact of the proposed chrome ore export tax on the ferrochrome producers in South Africa?
11. What are the possible adverse impacts of the proposed chrome ore export tax on the ore value chain, including on employees and communities?
12. What are the consequences of a tax on primary and UG2 chrome ore producers, their employees and communities?
13. What measures other than the proposed chrome ore tax could the government adopt in order to improve the SA ferrochrome industry's sustainable long term outlook?