Chapter 2

A BRIEF HISTORY OF PLATINUM MINING WITH A FOCUS ON THE RUSTENBURG REGION

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ABSTRACT

A brief history of platinum mining traces the history of Rustenburg and its connection with platinum mining. Using secondary data from academic and media sources, it identifies the origin of many of the region's conflicts

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and complexities. It describes the relations between the mining companies, their employees and the surrounding communities, and the intricate institutional relations between government tiers in the region. It shows how interregional dependencies and economic value chains strongly influence Rustenburg and suggests how the future could be shaped by role players such as multinational companies and national organs of government.

Keywords: rustenburg, mining history, platinum

INTRODUCTION

The discovery of diamonds and gold, along with other metals, has played a prominent role in the history of South Africa. Gold mining, along with cheap energy fuelled by South Africa's huge coal deposits, drove the country's industrialisation and played an equally crucial role in the growth of its sizeable services sector (Harrison and Zack 2012). Although the proportional contribution to the economy has declined over the past five decades, government still views the mining industry as a critical sector, as it generates a huge segment of the country's foreign exchange income (i.e., in 2019, it constituted 38% of South Africa's exports in value) and directly employs over 465 000 people (i.e., in 2019, 5% of the total number of formally employed people in the country) (Minerals Council of South Africa [MCSA] 2021; Rogerson 2011; Vegter 2019). The 2030-National Development Plan also suggests that the mining industry, as long as it is viable, should increase exports and income, and provide valuable revenue for the state (South Africa, National Planning Commission 2012).

Besides its contribution to the economy, mining has influenced the spatial structure of the country. Towns and cities have sprung up around mines and people have flocked to them seeking employment and the hope of a better life. The Gauteng City Region was the primate of such areas. Over the past three decades, another region has emerged around the Platinum Group Metals (PGMs), in an area known as the Platinum Belt with its three limbs: Eastern, Northern and Western Limbs (see Figure 2.1).

Rustenburg lies at the economic heart of the Western Limb of the Platinum Belt. Its history parallels the development of many mining towns and regions and thus also exposes the psyche of those with power in relation to those without. While the extractive industries have enriched some, they have also exacted a huge toll from the thousands of people who have been impoverished, disempowered and dispossessed through the imposition of oppressive policies and actions to control mining and mine workers and to maximise profits.

In this chapter, we trace the intertwined history and context of PGMs mining and Rustenburg. We obtained our data through desktop research, drawing on a range of published and unpublished sources, including academic literature, research reports, conference papers and news media.

This chapter not only provides some background for other chapters in this book, and specifically **Chapter 4**, but identifies the origin of many of the conflicts and complexities in the region. Among these are the relations between the mining companies, their employees and the surrounding communities, and the intricate institutional relationships among the various layers of governance in the region. Our analysis reveals that interregional dependencies and economic value chains strongly influence Rustenburg. Just as much of its history, so could its future be shaped by role players, such as multinational companies and national organs of government, far away from the Rustenburg region.

The chapter follows the historical discovery of PGMs and then the discovery of the Merensky Reef, to the development of mining in the Western Limb of the Platinum Belt. Following a discussion of the issues and events that led up to and occurred after the Marikana massacre, we conclude this chapter with a discussion of the implication of the history and the prospects for the future of PGMs and Rustenburg.

DISCOVERING PLATINUM

It is well-documented that the mineral we call platinum was used for centuries by the ancient Egyptians and the pre-Colombian Native Americans

of present-day Ecuador and Colombia to make jewellery and ornaments (Baxter 2019; Hochreiter et al. 1985; Mining.com Editor 2013; Münze Österreich 2020; Scott 1992). Platinum-related metallurgical mining activity dates back to 700 BC and continued to at least 800 AD, but appears to have been unknown in Europe, North America or Asia until the eighteenth century (Baxter 2019; Scott 1992).

The name *platinum* stems from the era of Spanish conquest and exploitation of South America from the sixteenth century onwards (Haldar 2017; Mining.com Editor 2013). Spanish Conquistadors, while panning for gold in the Pinto River, found tiny beads of a silver-whitish metal intermingled with gold nuggets. They viewed this metal as a worthless impurity in the gold and inferior to silver, denigrating it as *platina* or "little silver" (Haldar 2017; Yanes 2016; Zientek and Loferski 2014).

The British Royal Society was introduced to *platina* by Antonio de Ulloa y Garcia de la Torre-Guiral, who was part of the Spanish–French expedition to measure the precise circumference of the earth around the equator in 1735. During this expedition they discovered a metal that could not (then) be separated from the gold with which it was mixed (Davenport 2013; Haldar 2017). On return to Europe, De Ulloa's ship was captured by the British; he was imprisoned and his scientific papers confiscated. However, The British Royal Society, recognising the value of his work, invited him to address them and thus *platina* was introduced to Britain. Later he and Don Jorge Juan y Santacilia, another member of the expedition, published an account of their expedition and again described *platina* as "a mining rock of such resistance that it is not easy to break or cut with the forces or blows on a steel anvil" (Yanes 2016).

In 1750, the Royal Society was again introduced to *platina*, this time by a British metallurgical scientist, William Brownrigg, who, along with William Watson and Charles Wood, had investigated it. Platinum was recognised as a separate metal, joining the other known metals. In the first half of the nineteenth century, the other metals in the platinum group – palladium, rhodium, osmium, iridium and ruthenium – were isolated and identified.

LOCATION AND RESERVES

The six metals in the PGMs group occur together in nature, often alongside nickel, copper, silver and gold (World Platinum Investment Council [WPIC] 2019a; Mining.com Editor 2013). Economically viable deposits of the metals are rare; mining is only viable with concentrations of PGMs of between 5 to 15 parts per million (ppm). It takes ten tons of ore to produce one troy ounce (31.1 g) of platinum with the standard purity of 95 (Business Coaching Journal Staff 2019; WPIC 2019a; Zientek et al. 2017).

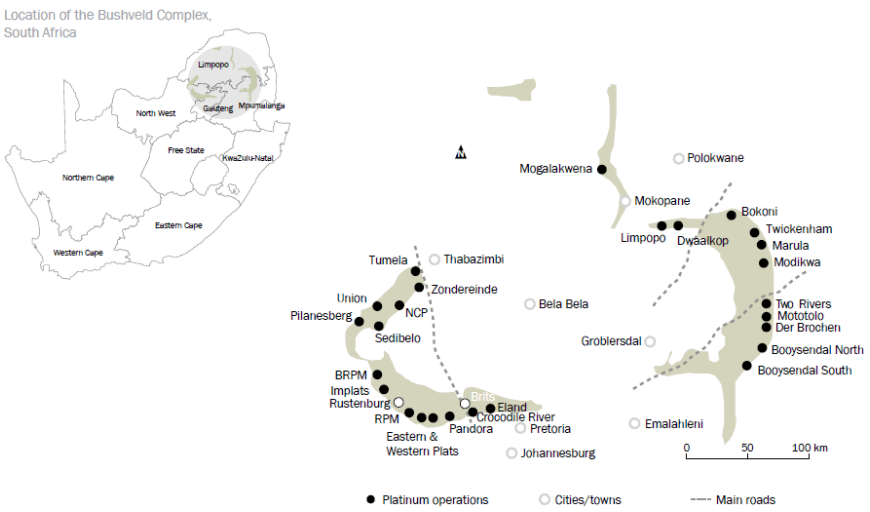
Countries that are known to have large reserves of PGMs are South Africa, Zimbabwe, Russia, the USA, Canada, Australia and Kazakhstan (Haldar 2017). Of the total global reserves of PGMs in 2018, over 90% are in South Africa and these are specifically found in the *Bushveld Igneous Complex* (Cawthorn 2010; Davenport 2013). Other large concentrations occur in the Norilsk-Talnakh area in Russia and the Great Dyke formation in Zimbabwe (Johnson Matthey n.d.-a, n.d.-b; Lapping 2018; Zientek et al. 2017).

PLATINUM MINING IN RUSTENBURG

The origin of PGMs mining in the Rustenburg area dates back to the mid-1920s, when the geologist Dr Hans Merensky found an exceptionally platinum-rich segment of what would later become known as the Western Limb of the Bushveld Igneous Complex (Figure 2.1) on a farm a few miles to the east of the town of Rustenburg (Baxter 2019; Johnson Matthey 1957). Initially, the metal was primarily used in jewellery production. Following this discovery, a number of small companies embarked on exploitation of the deposit, but due to a sharp decline in the price of platinum towards the end of the decade, some were closed down, or were absorbed by larger companies, which in turn merged in 1932 to form a single company, the Rustenburg Platinum Mines Limited (Hochreiter et al. 1985; Johnson Matthey 1957; Jones 1999; Vreken 2004). This company set up a blast furnace in the 1930s, with a second smelter that came into operation in 1953

(Davenport 2013). During the Second World War, mining grew rapidly to meet the demand for platinum as a crucial component in the production of ammunition. With the growing demand from the petroleum industry and other users, platinum mining expanded rapidly in the 1950s (Baxter 2019; Dumett 1985; Hochreiter et al. 1985; Johnson Matthey 1957).

In the late 1940s, Rustenburg Platinum Mines Limited began mining operations on the farm Swartklip, about 90 km north of Rustenburg and was the world's largest producer of platinum at the time (Johnson Matthey 1957). From the 1960s to the 1980s, the growing demand for PGMs in the manufacture of jewellery, platinum bars and coins and catalytic converters, saw a steady increase in mining in the Rustenburg area. South Africa became the producer of two thirds of the platinum mined outside the then Soviet Union (Jones 1999; Leiding 1975; Münze Österreich 2020; Provident Metals 2021).



Source: MCSA (2021)

Figure 2.1. South Africa's Platinum Belt and its three limbs.

During the 1990s, a meteoric increase in demand for platinum, driven largely by the demand in the automotive, aerospace and electronics sectors, fuelled a surge in the exploration of PGMs. This led to the opening of new

mines in both the Western and Eastern Limbs of the Bushveld Igneous Complex (Baxter 2019; Capps 2015; Wilburn 2005).

Huge increases in the price of platinum in the early 2000s saw a surge in interest from foreign investors and companies in PGMs mining in South Africa and spurred on the exploration for PGMs (Baxter 2019; Capps 2015; Vreken 2004; Wilburn 2005). This, in turn, also led to a change in the size of companies in the PGMs industry at the time, with several smaller companies emerging in the sector (Baxter 2019). PGMs mining also started moving at scale into the Eastern Limb of the Platinum Belt, with the town of Tubatse (formerly Burgersfort) becoming a new centre of PGMs activity, much like the town of Rustenburg on the Western Limb (see Anglo American 2001). Downstream processing of the PGMs, however, still took place in the Rustenburg area and in Polokwane (formerly Pietersburg) (Anglo American 2001).

By 2003, the supply emanating from the increased exploration in South Africa was coming to market and the enthusiasm for exploration started to wane despite the continuing high price of platinum (Wilburn 2005). At the same time, lower palladium prices tempered the search for new sources of the metal (Wilburn 2005). Towards the end of the decade, the boom in PGMs, together with the rest of the commodity boom at the time, would come to an abrupt end with the Global Financial Crisis in 2007/8, which led to the closure of many of the smaller PGMs operators that had sprung up over the course of the preceding decade (Baxter 2019).

INTERNAL FINANCIAL CRISIS AND MARIKANA MASSACRE

The global financial crisis has also further fuelled tensions in between workers and mining companies and between communities and mining companies, which had always been acrimonious, but had become increasingly strained since the significant expansion in PGMs mining in South Africa in the early 1990s (Bezuidenhout and Buhlungu 2015; Evans 2015; Frankel 2012; Legassick 2012; Stoddard and Lakmidas 2012). Consequently, platinum mining companies started shedding jobs in an effort

to cut costs and stay afloat and a number of mines went into "care and maintenance", while others were "shuttered" (Shabalala and Brown 2019; Stoddard and Lakmidas 2012). This rapid move from boom to bust in the course of a decade, coupled with the already dreadful living conditions of the majority of workers in the Platinum Belt, and the persistence of historical apartheid inequalities in income, society and space led to a substantial increase in protests and strike actions (Bench Marks Foundation 2017; Bezuidenhout and Buhlungu 2015; Chinguno 2015; Evans 2015; Frankel 2012; Legassick 2012; Ntema 2017; Rees 2012).

The deep anger and strikes, which became increasingly more violent, culminated in the Marikana massacre on 16 August 2012, when the South African Police Service opened fire with R5-automatic assault rifles and live ammunition on striking mine workers from Lonmin's Marikana Mine, killing 34 workers and wounding at least 78 others (Bench Marks Foundation 2017; Chinguno 2015; Frankel 2012; Legassick 2012; Rees 2012; Tolsi 2013). This, in turn, first led to a further six weeks of illegal strike actions throughout the Platinum Belt, which extended into gold mining operations, during which another 12 people lost their lives. It also led to the formation of the Association of Mineworkers and Construction Union (AMCU), a far more militant voice of workers, supplanting the National Union of Mineworkers, which had fallen out of favour with workers and communities in the area, as the majority union at mines in the Platinum Belt (Capps 2015; Chinguno 2015; De Lange 2012; Frankel 2012; Hlongwane 2013; Legassick 2012; Sacks 2012; Stoddard and Lakmidas 2012).

The horrific Marikana massacre and the damaging strike that followed, saw platinum production in South Africa plummet by 12%, or about 550 000 ounces (Noble Metals, n.d.). Due to South Africa's primacy in platinum production, the global output dropped by 8% during that year (Capps 2015; Noble Metals n.d.). This drop in output had devastating effects on workers, communities, mining companies and the economies of Rustenburg, as well as other smaller towns and villages in the region. It also led to affected municipalities, notably the Rustenburg Local Municipality, receiving far less income and struggling to provide basic services to their residents (Capps

2015; Frankel 2012; Legassick 2012; Tshwane 2018). The impacts on PGMs mining in South Africa affected other operations, with Amplats' chief executive, Mr Chris Griffith, stating in September 2012: "Our Rustenburg mining operations are under considerable economic pressure and their future is already under review" (Stoddard and Lakmidas 2012).

It furthermore changed the way the world looked at PGMs mining in South Africa. First, it became seen as a tainted, exploitative industry, with the then chief whip of the ANC in parliament, Mr Mathole Motshekga, stating that "the Lonmin tragedy must be seen in the context that the mainstay of the mines was and still is cheap labour, cheap black labour" (Parliamentary Monitoring Group 2012; see also Bezuidenhout and Buhlungu 2015); and second, a volatile PGMs supplier. While government's response to the Marikana crisis included large-scale investment in human settlement development by national sector departments (South Africa, The Presidency 2015), such developments did not necessarily consider local settlement dynamics, nor the financial viability of service delivery, nor the consequences of supporting the development of isolated settlements for highly vulnerable households at mines. Given that 72% of all the world's platinum mines were located in South Africa in 2012, it also hastened the search for alternatives for the PGMs and exploration for PGMs resources elsewhere, such as the United States of America (USA), Australia, Columbia and Russia where PGMs mining had occurred previously, or was still taking place (Colombia Gold 2018; Frankel 2012; Kay 2018a 2018b; Legassick 2012).

RECENT DEVELOPMENTS

In South Africa, these transitions resulted in a number of acquisitions and changes in ownership of mines, mining companies reducing their operations in high-cost production areas and moving into new, mostly opencast mines that offered higher ore yields, that could be operated with more mechanical means, had lower labour costs and were safer and hence less prone to injuries, fatalities and legally-required safety-related stoppages

and new companies entering the industry (Anglo American 2015; Baxter 2019; Capps 2015; Cornish 2019; De Wet 2014; Lonmin Plc 2019; Mtongana 2018).

Three years after the Marikana massacre, the platinum mining industry experienced a further blow, the so-called "Volkswagen-diesel-emissions scandal" or "Dieselgate" (see Gapper 2019; MCSA 2020) when it was discovered that the pollution emitted by diesel cars was considerably higher than what vehicle manufactures had officially certified (Business Coaching Journal Staff 2017; Hume and Sanderson 2019). This was followed by a global turn away from diesel. This unforeseen event further intensified research and development into electrical vehicles and hastened the need for new areas of demand for the PGMs – the most promising among these being the "hydrogen fuel cell" (Creamer 2019a 2019b; Harvey 2018).

As PGMs mines grew deeper, they required specialised hybrid mechanical equipment that could still be operated manually, they increasingly struggled with providing a safe working environment and became ever more expensive to operate, leading to a drop in profitability and further job losses (Mahopo 2018; Seccombe 2018b, 2019a, 2019b, 2019c). This already dire situation got even worse with a continuing upward trend in the price of electricity during this time, which, together with the ever-deeper mines and higher energy needs, dealt a major blow to mining companies (Seccombe 2019c). As PGMs mining companies cut costs and closed shafts, thousands of jobs were lost, followed by doom and gloom and more mine-related strikes and service protests, including in the Rustenburg region (James 2019; Mahopo 2018; Seccombe 2018a; Tshwane 2018).

In April 2018, the rapidly deteriorating situation of the PGMs sector, was captured in a hard-hitting review of the sector by JP Morgan Cazenove (cited by Ryan 2018), which compared the South African platinum mining sector to a "dysfunctional oligopoly – five South African companies control more than 65% of global primary mine supply and more than 80% of SA supply". The JP Morgan Report further lamented that "the outlook for the platinum price in 2018–19 is bleak. South Africa accounts for 70% of global mine supply and, at current prices, we estimated about 60% … of SA mines are cash negative" (cited by Ryan 2018). Lapping (2018:10) suggested that

the reason why there has not been a greater exodus of investors from this sector is that "the barriers to exit are high and people are unwilling to abandon hope, so supply leaves the industry very slowly despite years of subpar returns".

Over the past couple of years, mining companies in the PGMs sector have intensified their exploration for deposits that have better ore concentrations, and can be operated at lower depths, sought new cost-saving, more effective, hybrid mining techniques, including mining in more mechanised, less labour-intensive ways (Anglo American 2015; Cornish 2019; Global Africa Network 2018; Shabalala and Brown 2019; Souza 2017). The search also began for ores that included more than just PGMs, such as gold, nickel and copper, which could offset the impact of low platinum prices and provide PGMs mining companies with a far more diverse range of metals to take to market (Friedland 2019). At the same time, Amplats began selling off its older PGMs assets in the Western and Eastern Limbs of the Platinum Belt, to focus its energies on its flagship Mogalakwena mine in the Northern Limb of the Belt (Anglo American 2015; Anglo American Platinum 2014; Cornish 2019; Friedland 2019; Shabalala and Brown 2019). Other PGMs mining companies are also increasingly expressing a wish to move to this (Northern) Limb, including Implats, which has a long-term greenfields project in mind in this area (Cornish 2019; Friedland 2019; Mtongana 2018).

Midway through 2018, there was a huge surge in the price of palladium and rhodium – that have primarily been used to perform the catalytic conversion function in petrol – "as the automotive industry ready [sic] itself for the tighter controls and risk of penalties associated with further real driving emission regulations" (Gapper 2019; see also Njini 2019a). This pushed the price of palladium in March 2019 to above $1 600/oz, nearly triple the price it was selling at early in 2016, six times more than its price a decade ago, and above that of platinum and gold; and the price of rhodium to more than $3 000 per ounce, offering South African PGMs miners a very welcome respite (Gapper 2019; Lonmin Plc 2019; Macrotrends 2019; Njini 2019a; Rowling and Pakiam 2019). While such random rescues may provide some temporary relief, they are problematic from an inflationary

perspective, as inevitably a weak exchange rate leads to price hikes and an increase in costs, which has been one of the major challenges for PGMs mining companies over the last decade (MCSA 2020; Vreken 2004). The impact of the structural difficulties PGMs miners were facing, especially those that primarily produced platinum, was evident in Implats' indication that notwithstanding these silver linings, it would still shed 13 000 jobs at its Rustenburg operations, as first announced in mid-2018, where Lonmin was in the process of cutting 12 600 jobs (Njini 2019b; Seccombe 2018a).

Midway through 2019, despite large segments of the PGMs sector going through a turbulent period, the PGMs sector was still the largest employer in the mining sector in the country, directly employing around 168 000 people, and paying employees around R48 billion in earnings; produced around 270 tonnes of PGMs, amounting to R105 billion in sales and leading to around R96 billion in revenue; exported PGMs to the value of R94 billion, making it the biggest exporter of minerals in the country; and contributed R900 million in royalties to the national fiscus (Baxter 2019).

Reflecting on the *size of company and scale of operations*, the PGMs sector in South Africa was dominated by large corporations from the 1950s to the 2000s,[1] which in many cases did not disappear, but only really changed in terms of ownership and name, and by the late 1990s culminated in there being *four big integrated PGMs producers*, namely:

- *Amplats* (Anglo American Platinum Corporation Ltd, formerly Rustenburg Platinum Holdings Ltd, and prior to that Rustenburg Platinum Mines Ltd).
- *Implats* (formerly Impala Platinum).
- *Lonmin* Platinum (which includes Western Platinum).
- *Northam* Platinum (Baxter 2019; Hochreiter et al. 1985; Johnson Matthey 1957; Jones 1999).

Between the four of them, these companies produced as much as 80% of the world's PGMs supplies at the end of the 1990s (Baxter 2019; Jones

[1] Which was not dissimilar to the highly concentrated nature of corporate South Africa for most of the twentieth century and the first two decades of the twenty-first century (Capps 2015).

1999). What set these companies apart from most other PGMs producers in the world is that *their focus was (and still is) on PGMs mining, and not the production of PGMs as by-product or co-products from base-metal production*, such as nickel (Jones 1999).

TAKING STOCK AND LOOKING AHEAD

While "the big three" of the PGMs family – platinum, palladium and rhodium – have rare, unique and wonderful qualities, they are all very expensive, which has driven a search for substitutes (Baxter 2019; Lapping 2018). Within the PGMs family, car manufacturers readily make adjustments to their equipment and products to enable switching between platinum, palladium and rhodium as demand, supply and price dictates (Creamer 2019a; WPIC 2019b).[2]

As in the case of most commodities, there are cycles in supply and demand, and because of the unique qualities of the PGMs, new uses have constantly emerged. PGM producers have been able to sustain and expand and create new markets. To date, there has generally been an expansion in uses, with little loss of the major applications. This may, however, change in both the short and medium to longer term, with the following issues having potentially negative impacts on demand in the two largest market segments of the PGMs, namely catalytic converters and jewellery:

- The USA–China Trade Wars, which threaten global stability and economic growth,[3] and the purchase of commodities, including the

[2] According to Hume and Sanderson (2019), *"*a switch to platinum (from palladium) could take up to two years and involve the complete reconfiguration of an engine system, battery input and tailpipe".

[3] As postulated by Moody's in their Credit Outlook of 16 May 2019: "The export-oriented economies of Asia may be particularly exposed to the risk of global and regional trade downturns. And given the importance of both the US and China as sources of export demand and investment, export-oriented Asian economies may find it challenging to navigate between two increasingly hostile trading partners. In the longer term, the deterioration in the trade relationship between the US and China will lead to increased fragmentation of the global trading system and may weaken the rules-based system that has underpinned global growth

PGMs, which may lead to fewer sales of new vehicles that all require palladium, platinum and/or rhodium-containing catalytic converters, and in all lower purchases of jewellery globally, but especially so in China – the biggest market for platinum jewellery (Hsu 2018; Hume and Sanderson 2019; James 2019; Moody's 2019).[4]

- The hiking of import duties on metal products and cars, including German cars, imported to then-US President Donald Trump, raising the price of these cars, especially diesel cars, and reduce the sales of such cars in the USA.
- The growth in the electrical car market, which will very likely lead to a drop in the sales of petrol and diesel-powered cars that all have catalytic converters containing palladium, platinum and/or rhodium.
- The potential of cheaper opencast mining in other southern African countries (Reuters 2019).
- Of late, the global Coronavirus Disease 2019 (COVID-19) pandemic that has already seen shrinking economies and serious job losses in the USA and South Africa that may weaken the markets for PGMs, with reduced demand for both vehicles and jewellery.

Yet, it is definitely not a doom and gloom story for the PGMs sector, as in the case of its *medicinal and industrial uses or applications:*

- There are no indications that the medical uses of PGMs are set to change – in fact, the market can only grow with ageing populations growing in size throughout the world's richer countries creating a rapidly growing market for specialised micro-machines, equipment and implants to prolong life and improve quality of life, and a

for the past several decades. Greater inefficiency in production and supply chains will reduce global growth potential."

[4] This has already begun, with jewellery demand falling by 7% between the first quarters of 2018 and 2019, with an especially declining demand in China as driver (James 2019). Gapper (2019) pointed to the diamond market created and sustained by De Beers with its slogan of *"A Diamond is Forever"* as a model to follow in the PGMs sector, especially so in the case of palladium, which still has a very small footprint in this segment of the market.

pharmaceutical industry eager to develop such machines, equipment and implants.

- Robotics and space travel are sure to lead to new uses for metals with the qualities of the PGMs opening up.
- New computing technologies, super-fast processors, nanotechnologies, touchscreen-based applications and demands for ever faster and more secure cloud storage, will very likely offset the move away from storage on hard drives that use platinum, to solid-state drives, and cloud-based technologies that also run on solid-state drives.

In the area of *investment and finances*, platinum bars and coins could also be used as financial instruments of choice. This may already be happening, as cited by James (2019) in the most recent *Platinum Quarterly* report, with the WPIC noting that platinum demand increased by 32% year-on-year and proposing that this was attributable to "a surge in investment demand". James (2019) further indicated that "[i]nvestment demand was high enough to offset declines in the automotive, jewellery and industrial segments". South Africa was also a beneficiary from this increased demand, as a platinum coin producer, with the South African Mint, along with the UK-based Royal Mint, producing platinum coins. Higher palladium prices were also seen as fuelling a growth in demand for palladium jewellery, seemingly, as the more expensive it is, the more valuable it is in the eye of the beholder, whether as giver or receiver (Hsu 2018; James 2019).

The most promising and potentially game-changing application for PGMs, however, is the hydrogen fuel cell (Baxter 2019; Creamer 2019a, 2019c; East 2019; International Platinum Group Metals Association 2018; Sanderson 2019).[5] Hydrogen fuel cells are electrochemical devices in which platinum and ruthenium electrodes are used as catalysts to combine hydrogen and oxygen and, in the process of doing so, releasing vast amounts of clean, no-carbon emissions, electrical power in a highly efficient way,

[5] The first fuel cell was already constructed in 1842 using platinum electrodes (MCSA 2020). It is reported that in 2003, then US-President George W Bush said that he wanted more research into fuel-cell technology for cars (Wired 2003).

with water and heat as the only by-products (Baxter 2019; International Platinum Group Metals Association 2018; Mahaptra and Singh 2014; Ozin 2015; WPIC 2019c). In short, and of crucial importance to the PGMs industry, PGMs are used to turn chemical energy into clean electrical energy. In addition to offering far higher electrical efficiency than conventional forms of power generation, including the turbine generator, photovoltaic cells and wind turbines, they offer fuel flexibility, portability and off-grid, micro-grid and modular applications (Mahaptra and Singh 2014). Government has hinted at such collaboration and the establishment of formal public–private partnerships would be beneficial.

There is a potentially huge market opening up for these hydrogen fuel cells and one which the industry is actively promoting (Creamer 2019a, 2019b, 2019c; Fairley 2019; Sanderson 2019).[6] Japan and China are actively investing in this technology for vehicles as well as other forms of energy (East 2019; Mehta 2018). Canadian and Chinese researchers have developed technologies to extend the operating life, increase the efficiency and lower the costs of producing hydrogen fuel cells (Duarte 2019; Fairley 2019). While also emission-free, as electric vehicles are, hydrogen fuel cell-powered vehicles also address the current challenge of limited driving range and long charging times of electrical vehicles (East 2019). Hydrogen vehicles are also being trialled on road in parts of Australia, and there is strong support in the country, both inside government and from a number of political parties, for the hydrogen fuel cell (East 2019).

It is important for *South Africa to be a leader in the production of hydrogen fuel cells, and the vehicles that they will power.* Currently, Japan, South Korea, China, Australia and Canada have carved out significant niches for themselves in the hydrogen fuel cell market (East 2019; Sanderson 2019). China, in particular, is investing in the production of fuel cells to meet "Beijing's target of 1 million fuel cell vehicles on the road by

[6] The hydrogen fuel cell is watched with eagle eyes by the PGMs industry as it has been observed that "the platinum price will only pick up in response to a new source of demand" and "The industry is going to shrink in size until there is a new source of demand" (Business Coaching Journal Staff 2017).

2030" (Sanderson 2019).[7] Likewise, Australia envisages reusing its former vehicle manufacturing plants to enter into hydrogen fuel cell-driven vehicle production (East 2019).

South Africa and the Rustenburg region cannot simply be bystanders while PGMs are exported to other countries for use in this new technology and its many lucrative up- and downstream applications. It is crucial that both South Africa and Rustenburg do as much as possible to *become and remain part of the hydrogen fuel cell-story*, and both contribute to its success and reap the rewards from it. Of key importance in this regard is the joint initiative of the Gauteng Provincial Government and Implats for the development of a Special Economic Zone – comprising 16 ha of land donated by Implats close to its refinery nearby Springs in the Ekurhuleni Metropolitan Municipality – dedicated to hydrogen fuel cell development (Creamer 2019a).

Finally, there is the issue of *recycling*, which has been viewed with some concern. This will most likely, through efficiency enhancements, see the percentage of PGMs recycled from end-of-life vehicles, computers and medical equipment move close to 100%. Given that the current recycling rate is around 95%, moving it up to even 100%, it will have in all likelihood have a negligible impact on PGMs mining in the region.

These new technologies and assurances around recycling are providing a lifeline to the Rustenburg region, and extend the life of PGMs mining in the region – even in the face of ever-deeper and ever-more expensive mining. This, however, also continues the dependence of Rustenburg on mining as core economic activity, and as indicated in Chapter 4, may contribute to postponing the crucial need for planning for, and transitioning the region into a post-mining future.

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