

**Research on the Relationship between Capital
Expenditure and Refined Platinum Production in
the South African Platinum Mining Industry
Commissioned by the World Platinum Investment
Council**

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Reference No.:- VUK101

Effective Date:- 1 August 2015

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Synopsis

The World Platinum Investment Council (WPIC) commissioned Venmyn Deloitte (Proprietary) Limited (Venmyn Deloitte) to conduct research into the capital intensity of the platinum industry in South Africa.

The purpose of the research and analysis was to identify potential relationships between capital expenditure profiles and refined platinum production profiles. In particular, Venmyn Deloitte examined:-

- the annual capital expenditure levels and refined platinum production in South Africa, over 20 years (1994 to 2013). This refers to refined platinum only, and does not take into account other platinum group metals;
- expenditure of a capital nature associated with new platinum mines (Greenfields), expansions to existing mines (Brownfields) and operating mines with no announced programme to increase output (Steady State);
- observed changes in production following changes in the rate of capital expenditure;
- observed changes in production following changes in the ratio of Steady State capital expenditure in proportion to total spend; and
- changes in the capital intensity ratio of Greenfields, Brownfields and Steady State mining operations over time.

This report provides the details of Venmyn Deloitte's research, analysis and key findings as summarised below, in the context of defined limitations:-

- An observable relationship exists between the quantum of capital expenditure and the refined platinum output for the selected population over the 20 year period considered;
- both refined platinum output and capital expenditure have reduced from peaks in 2006 and 2008 respectively, and in spite of record capital expenditure between 2007 and 2009, output has continued to decline;
- the analysis indicates that capital intensity has increased over time with more capital now required to produce an ounce of refined platinum than historically, and the proportion of expansion capital relative to total capital expenditure has decreased;
- the time-lag for capital expenditure to take effect on output levels observed from the analysis is 2 to 4 years. If the reduced capital spend for the period 2010 to 2014 has a similar time-lag effect, production from 2015 to 2017 would be negatively impacted;
- Venmyn Deloitte calculated a projected platinum output for 2016 based on the capital intensity indicated from historical trends, in isolation of other critical factors. Given the observed time-lag effect, the capital intensity for 2010 and 2011 capital expenditure relative to 2012 and 2013 refined platinum output was applied to recorded and announced capital expenditure for 2014 and 2015. This methodology projects 2016 refined platinum output from South Africa to be 3.40 million ounces, which is a 16% decline from the forecast level published by the WPIC¹ for 2015 of 4.06 million ounces; and
- the time-lag effect means that there is limited opportunity for capital expenditure to lift 2016 output beyond the levels indicated by the research projections, although capital expenditure for the remainder of 2015 and 2016 could still impact 2017 output. In the event that 2016 capital expenditure is consistent with the level announced for 2015, the platinum output projected for 2017 could also be at least 16% below 2015 levels.

¹WPIC's Platinum Quarterly Q1 2015, published May 2015, which can be downloaded [here](#), is based upon independent research and analysis conducted by SFA (Oxford), a market specialist in mining and metals research.

Disclaimer

Venmyn Deloitte acknowledges the limitations of considering the capital expenditure impact on refined platinum production in isolation of other aspects related to platinum production in South Africa (such as platinum demand, platinum prices, operating margin, profitability, closure of shafts, labour conditions and other market factors). However, the primary focus of this research is to identify and investigate any observable relationship between capital expenditure and refined platinum production in isolation, and applying the principle of *ceteris paribus*.

In preparing this research report, Venmyn Deloitte utilised information from the public domain. Venmyn Deloitte has not verified this information.

Factors such as unforeseen political and industrial disruption, currency fluctuation and interest rates could have an impact on the South African platinum mining industry. The majority of these factors are, and will be, beyond the control of the South African platinum mining industry.

This report contains forward-looking statements. These forward-looking statements are based on the opinions of the Venmyn Deloitte research team at the date the statements were made. The statements are subject to a number of known and unknown risks, uncertainties and other factors that may cause actual results to differ materially from those forward-looking statements anticipated by the Venmyn Deloitte research team. Factors that could cause such differences include changes in world platinum markets, equity markets, costs and supply of materials, and regulatory changes, as well as the factors noted above. Although Venmyn Deloitte believes the expectations reflected in the forward-looking statements to be reasonable, Venmyn Deloitte does not guarantee future results, levels of activity, performance or achievements.

The facts, analysis and findings presented in this research report do not constitute investment advice. Venmyn Deloitte and its directors accept no liability for any losses arising from reliance upon the information presented in this research report, or in any excerpts from this report.

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1. Introduction

The World Platinum Investment Council (WPIC) commissioned Venmyn Deloitte (Proprietary) Limited (Venmyn Deloitte) to conduct research into the capital intensity of platinum mining in South Africa.

The purpose of the research and analysis was to identify relationships between capital expenditure profiles and refined platinum production profiles. In particular, Venmyn Deloitte examined:-

- the annual capital expenditure levels and refined platinum production in South Africa, over 20 years (1994 to 2013). This refers to refined platinum only, and does not take into account other platinum group metals;
- expenditure of a capital nature associated with new platinum mines (Greenfields), expansions to existing mines (Brownfields) and operating mines with no announced programme to increase output (Steady State);
- observed changes in production following changes in the rate of capital expenditure;
- observed changes in production following changes in the ratio of Steady State capital expenditure in proportion to total spend; and
- changes in the capital intensity ratio of Greenfields, Brownfields and Steady State mining operations over time.

The effective date of this report is 1 August 2015.

2. Data Collection and Research Population

Venmyn Deloitte collected publically available information on actual and planned capital expenditure for a representative selection of South African platinum companies, mines and projects covering a period of 20 years.

For the analysis on enterprise-level total absolute capital expenditure and refined platinum production, the population comprises producing platinum mining companies representing ~98% of total South African refined platinum production over the 20 year period.

For the analysis on project level capital intensity ratios and absolute capital expenditure, the population comprises Steady State mining operations representing ~58% of the refined platinum output, as well as 15 Greenfields projects and 14 Brownfields projects. The population includes the broad spectrum of mining methods and operational approaches in the South African platinum industry.

The selection of the population at enterprise and project level was undertaken based on the availability, reliability and relevance of publically available data. No proprietary data was used in the research.

Given the impact of the five month worker strike that affected the South African platinum industry in 2014, the production for this year was disregarded. Where 2014 figures are presented it is done for indicative purposes only. The 2014 capital expenditure was however used in projecting 2016 output levels.

Unless otherwise stated, all capital expenditure has been represented in 2015 money terms.

Venmyn Deloitte did not have any written or verbal discussion with the relevant mining companies, other than requests for publically available information.

3. Research Methodology and Key Assumptions

Analysing capital expenditure and refined platinum production from publically available information presents certain challenges. Venmyn Deloitte defined specific research methodologies and assumptions for researching and investigating the relationship between capital expenditure and refined platinum produced as set out below:-

- platinum companies implement different conventions and definitions when reporting capital expenditure. Venmyn Deloitte aimed to include any expenditure that could be described as “of a capital nature” and made certain interpretative assumptions, based on its in-depth knowledge of the South African platinum industry;

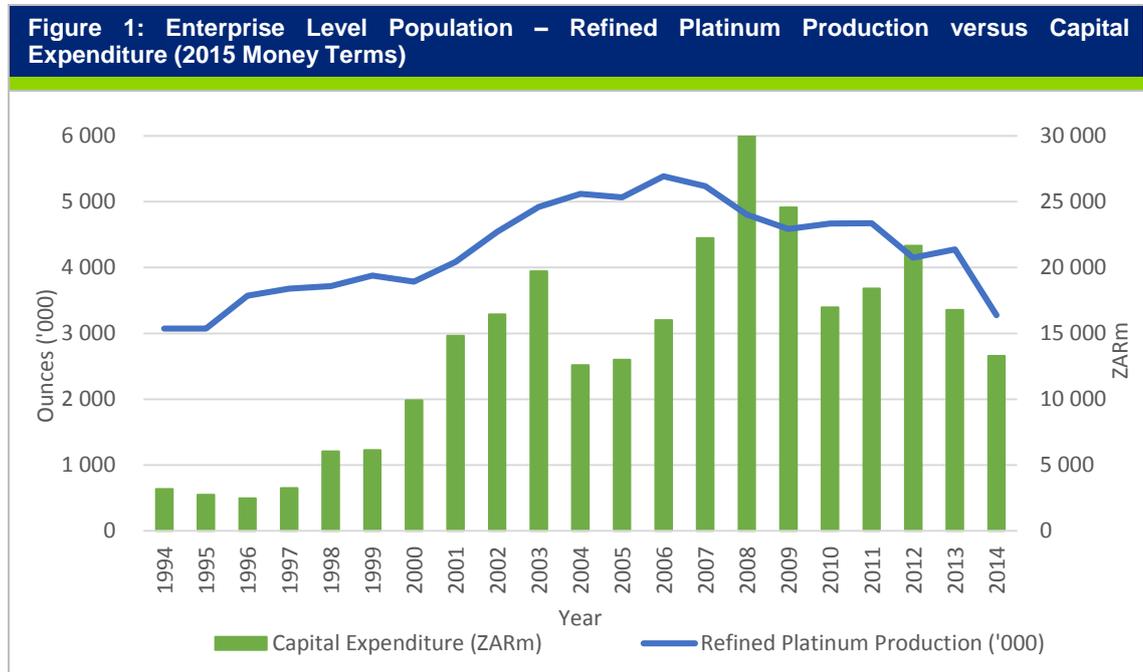
- disclosure in the earlier part of the 20 year period was in general less detailed than in the latter part and categorisation of expenditure and projects changed over time. In response, 20 year analysis was only conducted at an enterprise level, with project level analysis generally only available from 2008 onwards. Additionally, the population only includes enterprise and project level information that could be sourced on a consistent basis;
- Greenfields projects were defined as those that result in new platinum mines being created. For these projects, capital expenditure and refined platinum production is generally well documented and defined. Venmyn Deloitte generally used the targeted capital expenditure and annual production capacity as presented by the companies. For some projects where actual expenditure and/or production capacity was significantly different to the target levels, specific adjustments were made by adjusting the capital expenditure or refined production. The Greenfields population includes currently operating mines that were commissioned in the 20 year research period and projects that have yet to be developed. For Greenfields projects, Venmyn Deloitte analysed capital intensity on a total project basis irrespective of the period of construction;
- Brownfields projects were defined as those that result in expanded capacity at existing platinum mines. Information on such projects was found to be more challenging to obtain. Venmyn Deloitte only included Brownfields projects with clearly stated capital expenditure towards a defined production increase. For Brownfields projects, Venmyn Deloitte analysed capital intensity on a total project basis irrespective of the period of construction;
- Steady State operations were defined as ongoing operations with no announced programme to increase output. Operations were only included in the population if detailed capital expenditure matching refined platinum output over more than five years could be identified. The project population included mining operations representing over 32 shafts and average annual refined platinum output of more than 2.5 million ounces over the period 2008 to 2013;
- in some cases, capital expenditure of an expansion nature was incurred but projects were subsequently placed on hold. Such projects were not included in the project level analysis, but are included in the enterprise level analysis as information was insufficient to normalise for these;
- capital expenditure utilised in the research includes mining, processing and refining activities to capture the full cycle up to refined platinum product level;
- only refined platinum production attributable to a specific company was taken into account to avoid any double accounting of refined platinum production at an industry level;
- in no instance has the research population been increased or decreased with data that purposefully skews or otherwise distorts the representation of the South African platinum industry;
- capital cost inflation has played a major role in increasing the cost of Greenfields, Brownfields and Steady State capital expenditure over the 20 year research period. As the capital costs are generally incurred in South African Rand (ZAR), historical capital expenditure figures were converted to 2015 ZAR money terms. For amounts presented in ZAR, Venmyn Deloitte converted to 2015 ZAR money terms by applying South African consumer price index (CPI) compounded over the relevant period. For amounts originally presented in United States Dollar (USD), Venmyn Deloitte converted the amounts to ZAR at the average exchange rate for the relevant period, and then adjusted the ZAR amounts by applying South African CPI compounded over the relevant period. Where a 2015 ZAR amount is presented in USD, it has been converted to USD at an exchange rate of 12.69 ZAR:USD (exchange rate at effective date of report);
- capital intensity is defined as the ratio of capital expenditure to refined platinum produced; and
- the analysis does not take into account the effects of platinum demand, operating margin, profitability, closure of operations or the impact of labour productivity on output levels, which are acknowledged as several of many other factors that could impact production.

Venmyn Deloitte acknowledges the limitations of considering the capital expenditure impact on refined platinum production in isolation of other aspects related to platinum production in South Africa (such as platinum demand, platinum prices, operating margin, profitability, closure of shafts, labour conditions and other market factors). However, the primary focus of this research is to identify and investigate any observable relationship between capital expenditure and refined platinum production in isolation, and applying the principle of *ceteris paribus*.

4. Research Results – Enterprise Level Analysis

4.1. Analysis

The absolute capital expenditure for the selection of enterprises representing ~98% of South African refined platinum production is shown in Figure 1.



The graph shows an increasing trend in both capital expenditure and refined platinum output for the period 1995 to 2003. From 2004 to 2006 refined platinum production continued to increase, although capital expenditure reduced to below 2001 levels.

Since then, platinum output has reduced from the 2006 peak of ~5.4 million ounces to ~4.3 million ounces in 2013. Reduced 2014 production is a result of the protracted strike action of that year.

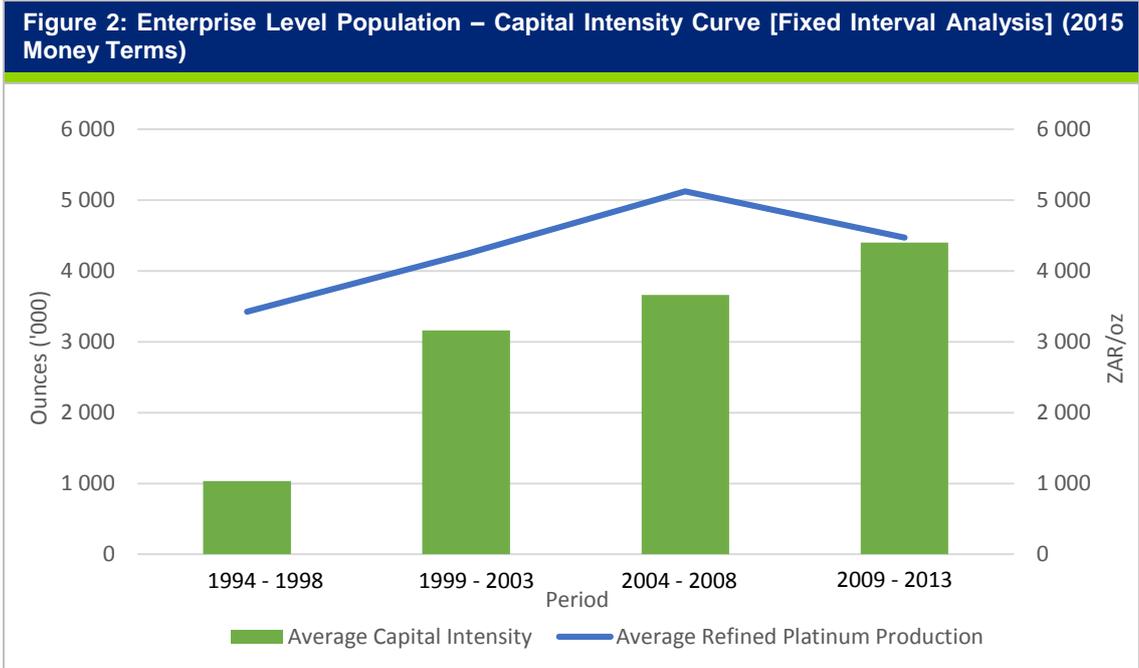
It appears that the reduced capital spend in 2004 to 2006 resulted in the drop-off from the 2006 production peak. Thereafter, record capital expenditure during 2007 to 2009 seemed to arrest the declining output, with production levels stabilising around 4.6 million ounces from 2009 to 2011.

Average annual capital expenditure reduced in the 2010 to 2012 period, with what appears to be a corresponding reduction in average annual output for 2012 and 2013 (from 2009 to 2011 levels). Refined platinum output for 2012 and 2013 was in line with production levels last seen in 2001.

In public announcements, the producers included in the enterprise level population estimated capital expenditure for 2015 to amount to ZAR11,127m (USD877m). This compares to ZAR16,780m (USD1,322m) and ZAR13,292m (USD1,047m) actual spend in 2013 and 2014 respectively.

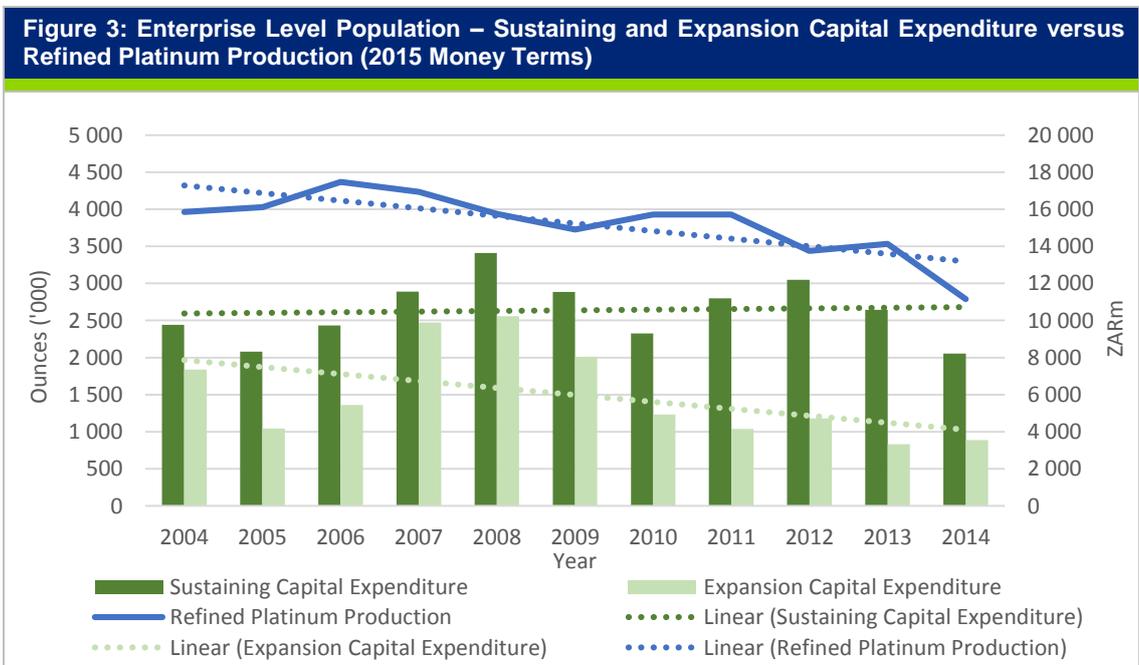
Illustrating the change in capital intensity at an enterprise level, Figure 2 on the following page highlights the average capital intensity broken down into 4 distinct 5 year periods.

For the period 1994-1998 average capital intensity stood at ZAR1,032/oz (USD81), with 1999-2003, 2004-2008 and 2009-2013 showing average capital intensities of ZAR3,159/oz (USD249), ZAR3,662/oz (USD289) and ZAR4,401 (USD347) respectively. It is evident that the capital intensity of the South African platinum mining industry has increased over the 20 year period analysed. From the period 1999–2003 to the period 2009-2013 the capital intensity has risen by 39%.



A ten year view of the refined platinum production versus capital expenditure split between expansion and sustaining capital is presented in Figure 3 below.

The ten year linear trendlines indicate declining expansion capital expenditure and declining production, but slightly increasing or stable sustaining capital expenditure. Expansion capital expenditure decreased from an average of 40% of total capital expenditure in the five year period 2004 to 2008, to 31% for 2009 to 2013.



Note: The Enterprise level population employed in collating Figure 3 differs from that of Figure 1 and 2 due to limitation of reported public data in the detail required. This reduced enterprise level population represents ~79% of South African refined platinum output in the period 2000 to 2013.

4.2. Conclusions

The analysis suggests that there is a relationship between the quantum of capital expenditure and the refined platinum output for the selected enterprise population.

Both platinum output and capital expenditure have reduced from peaks in 2006 and 2008 respectively, and in spite of record capital expenditure between 2007 and 2009, output has continued to decline. The inability to arrest the decline in output despite high levels of capital expenditure suggests that the capital intensity has increased over time (i.e. more capital is now required to produce an ounce of platinum than historically, with average capital intensity in the period 1999–2003 compared to the period 2009–2013 having risen by 39%).

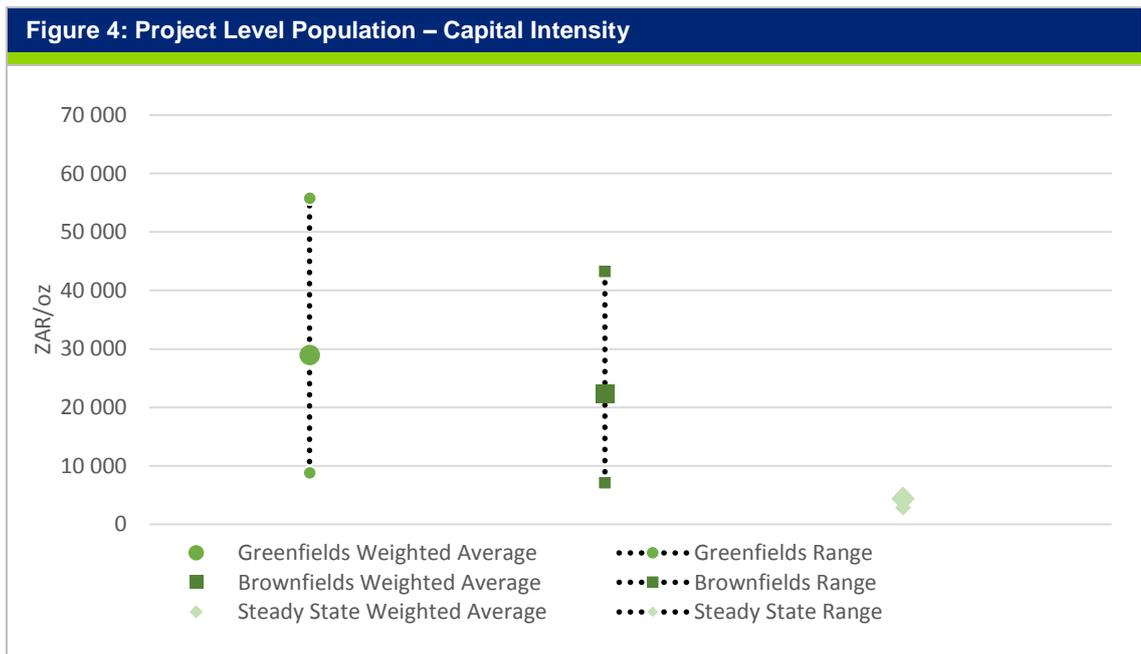
The declining proportion of expansion capital expenditure appears to have contributed to the decline in production as fewer new mines and/or shafts are commissioned.

The time-lag for capital expenditure to take effect on output levels observed from the analysis is 2 to 4 years. If the reduced capital spend from 2010 to 2013 has a similar time-lag effect, production from 2014 to 2017 would be negatively impacted. Additionally, the potential negative effect on future production may be exacerbated by increased capital intensity.

5. Research Results – Project Level Analysis

5.1. Analysis

Capital intensity calculated for Greenfields, Brownfields and Steady State for the population of projects and operations indicated in the methodology section above, is shown in Figure 4 below.

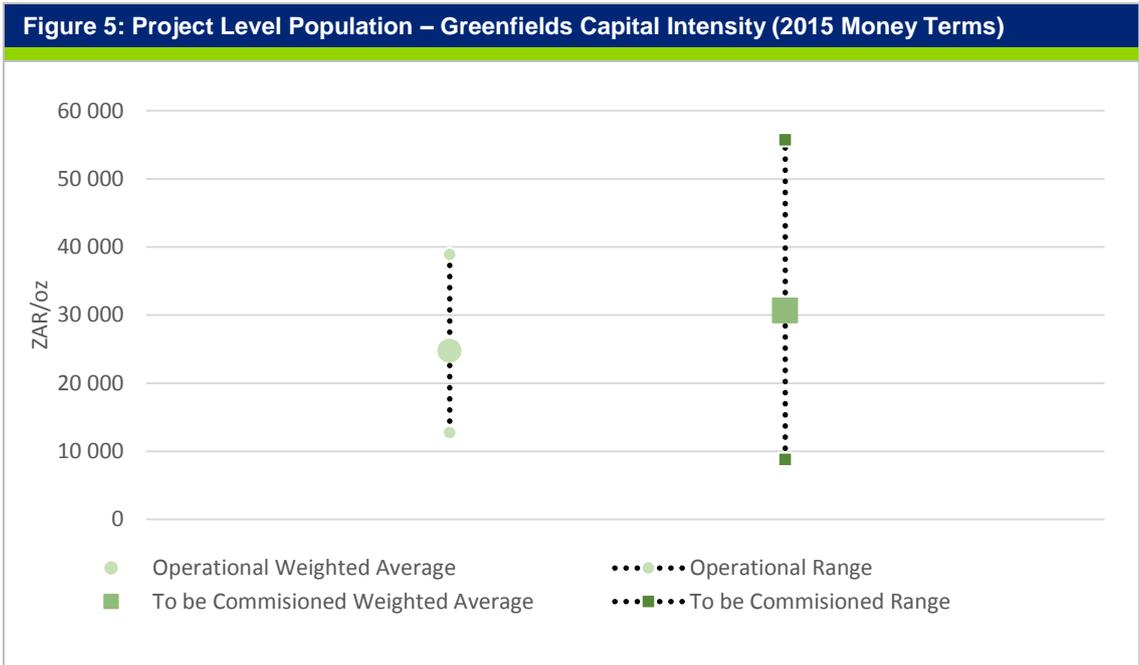


For analysis on project level capital intensity ratios (presented in Table 1) and absolute capital expenditure, the population comprises Steady State mining operations representing ~58% of the refined platinum output, as well as 15 Greenfields and 14 Brownfields projects. The population includes the broad spectrum of mining methods and operational approaches in the South African platinum industry.

Table 1: Project Level Population – Capital Intensity

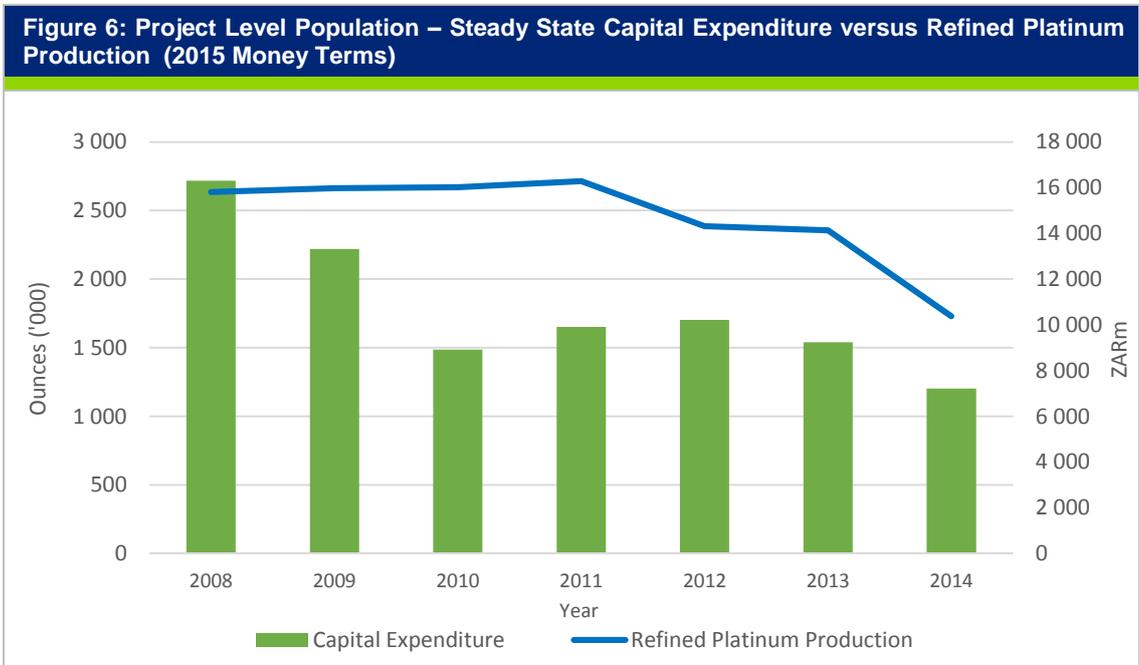
CAPITAL ALLOCATION	MIN		WEIGHTED AVERAGE		MAX	
	ZAR	USD	ZAR	USD	ZAR	USD
Greenfields	8,811	694	28,931	2,280	55,750	4,393
Brownfields	7,097	559	22,345	1,761	43,272	3,410
Steady State	2,834	223	4,403	347	5,067	399

The population of Greenfields projects was further split between those projects that are already operational versus those that have yet to be commissioned, as shown in Figure 5.



This graph reflects a weighted average capital intensity of ZAR24,774/oz (USD1,952) for 7 currently operational Greenfields projects, compared to a weighted average ZAR30,661/oz (USD2,416) for 8 yet to be commissioned Greenfields projects. The analysis suggests that bringing new Greenfields projects into production is more capital intensive than was the case historically, in 2015 money terms.

The absolute capital expenditure and refined platinum output for Steady State operations from 2008 to 2014 is presented in Figure 6.



Capital expenditure on the Steady State operations averaged ZAR14.8bn (USD1.17bn) in 2008 and 2009, but reduced to an average of ZAR9.4bn (USD0.74bn) for 2010 to 2012. There appears to be a 2 year time lag for the reduced capital spend to take effect on production, as indicated by the drop in platinum output in 2012. The reduced production in 2014 is related to the labour strike.

5.2. Conclusions

For the population of Steady State operations selected, reduced capital expenditure in the last 4 to 5 years appears to have had a negative impact on production and could continue to do so into 2015, 2016 and 2017.

The observed time-lag for capital expenditure to take effect on output levels observed from the analysis is 2 years.

Where companies are looking to replace Steady State operations to restore production levels, the project level analysis indicates that capital intensity is increasing for Greenfields projects. The increased capital intensity raises financial execution risk, potentially putting further downward pressure on output in the short to medium term.

6. Research Results – Output Projection

Given the conclusions from the capital intensity analysis, the following methodology was applied in formulating an indicative 2016 projection of refined platinum production from the South African platinum mining industry, based on observations of capital intensity in isolation of other contributing factors (applying the principle of *ceteris paribus*):-

- from the project level population, a capital intensity of ZAR3,971/oz (USD313/oz) was calculated from the average capital expenditure for 2010/11 and the average refined platinum production of 2012/13. In Venmyn Deloitte's view this is the most reliable historical indicator of capital intensity that can be applied to recent capital expenditure in order to calculate projected output. A more recent capital expenditure is not available as platinum production in 2014 cannot be used as a reliable indicator owing to the impact of the labour strikes;
- a 2 year average refined platinum output was derived for the 2015/16 and 2016/17 periods by:-
 - applying the capital intensity of ZAR3,971/oz to the average capital spend for 2013/14 to calculate an indicative refined platinum production for 2015/16; and
 - applying the capital intensity of ZAR3,971/oz to the average capital spend for 2014/15 to calculate an indicative refined platinum production for 2016/17 (2015 capital expenditure is based on the levels announced by platinum producers; actual 2015 capital expenditure may differ).
- the mid-point of the resulting 2015/16 and 2016/17 projected platinum output was taken as the 2016 projected output at project level. This indicates a decline of 16% from 2015 announced output at project level; and
- the 16% reduction observed at project level was then applied to the WPIC¹ forecast 2015 platinum output of 4.06 million ounces for the South African platinum industry, resulting in a projected output of 3.40 million ounces for 2016. In the event that 2016 capital expenditure is consistent with the level announced for 2015, the refined platinum output projected for 2017 could also be at least 16% below 2015 levels.

¹WPIC's Platinum Quarterly Q1 2015, published May 2015, which can be downloaded [here](#), is based upon independent research and analysis conducted by SFA (Oxford), a market specialist in mining and metals research.

7. Glossary

The following is a list of the terms, phrases and/or concepts employed in this report:-

Greenfields	South African platinum mine where no historical production has taken place. Some of the selected Greenfields mines are currently operational, but for Greenfields analysis their capital expenditure and annual refined platinum output was taken at the pre-commissioned stage.
Brownfields	South African platinum mine where it is planned to increase refined platinum production capacity.
Steady State	South African platinum mine that has no announced plans to increase refined platinum production capacity.
capital intensity	The ratio of capital expenditure to refined platinum production. In the case of Greenfields and Brownfields projects, capital intensity is calculated on the basis of the planned annual production capacity.
<i>ceteris paribus</i>	Latin for "all other things being equal or held constant". It is an assumption allowing one to examine the effect of a single variable by screening out other variables to permit illustration or elucidation of concepts thought relevant within a sphere of inquiry.
enterprise level population	A collection of South African platinum mines that contribute ~98% refined platinum production output of the South African platinum supply over the period of 1994 – 2013.
project level population	A collection of specific Steady State South African platinum mines that account for an average of ~58% of refined platinum production over the period of 2008 - 2013, as well as 15 Greenfields projects and 14 Brownfields projects.
sustaining capital	Expenditure of a capital nature intended to maintain the current refined platinum production capacity of a South African platinum mine.
expansion capital	Expenditure of a capital nature intended to increase the refined platinum production capacity of a South African platinum mine.
output (projected)	Refined platinum production that has been, through an analytically defined methodology detailed in this report, projected to be produced in a future period.
output (announced)	Refined platinum production that has been publically announced as a forecast or expectation.
oz	Refined platinum ounces.

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