Minxcon Group

NEWSLETTER

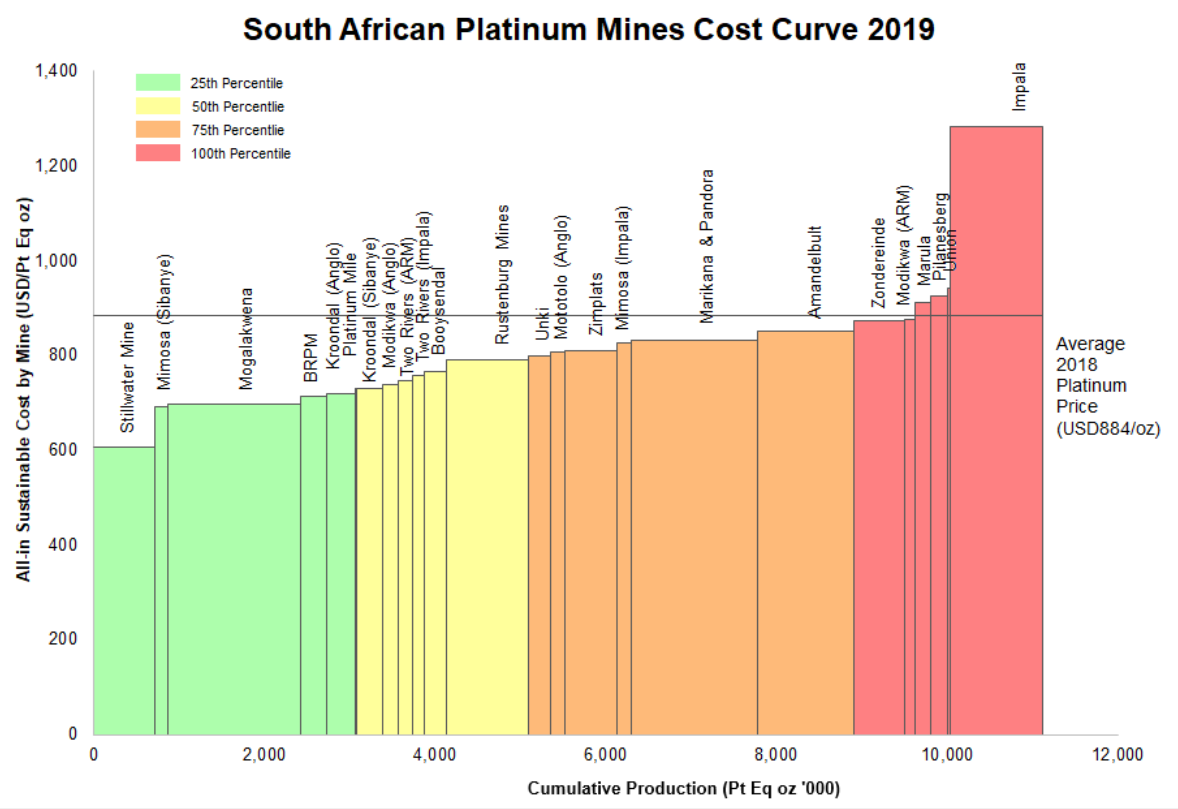
November 2019

EXPLORATION | CONSULTING | PROJECTS

Platinum Cost Curves

In 2018, the total all-in sustainable costs per Pt. eq. oz in ZAR terms, decreased by 11.2%. The total all-in sustaining costs per Pt. eq. oz in USD terms decreased by 10.8%, year-on-year, as the average Rand strength remained relatively unchanged year-on-year. The total all-in sustainable costs per milled tonne increased by 2.6% year-on-year.

2019 South African Industry Cost Curve by Mine (All-in Sustainable Costs USD/oz)



Disclaimer: Information displayed in graph is based on public information collected from the South African PGM mining company's annual reports. There is no guarantee that the interpreted information is 100% accurate.

NEWSLETTER SPOTLIGHT

◊ **South African platinum mines accounted for 73% of global platinum production during 2018.**

◊ **For 29% of South African platinum mines, all-in sustainable cost was higher than the average 2018 price.**

◊ **USD-denominated all-in sustainable costs per Pt eq. oz decreased by 10.8% year-on-year.**

◊ **ZAR-denominated all-in sustainable costs per milled tonne increased by 2.6% year-on-year.**

Industry cost curves are valuable tools to benchmark the operational cost performance of an existing operation or new proposed mine project against industry. The industry cost curve indicates the ability of the existing mines to endure cyclical commodity prices and ensure continuous mining operations over time. This measure of a mine's cash margin per ounce can also be a useful tool for the following:-

- Use as a Comparison tool;
- Use as an Analytical tool:-
  - Shareholders, Management, Industry analysts;
- Use as an Investment decision tool:-
  - Investors, Banks, Equity brokers;
  - Identification of high- and low-cost producing regions, informs company decisions on where to invest;
- Provide a trend in costs as the mine matures; and
- Determine commodity price in times of market oversupply.

The aim should be to remain within the lower 50th percentile of cost producers to ensure profitability even in market downturns. The principle of this logic is based on economic theory that states that the commodity price is a function of the supply-demand balance of the specific commodity. If demand decreases due to weak market conditions and commodity prices subsequently decline, it is likely that the highest cost producers will suspend production first, which reduces supply and ultimately supports higher commodity prices. This has been observed with Bokoni Mine which in the past appeared highest on our cost curve and was placed on care and maintenance in 2017 in response to the lower prices. Similarly, the Impala Rustenburg operation - which is currently the highest cost producer on our cost curve - is presently forced to restructure the operation to remain economically viable. The restructuring process includes reducing the mining footprint from 11 to six operating shafts, reducing production to 520k Pt ounces (581k in 2018 and 655k in 2017), and reducing the total workforce by 27,000 people.

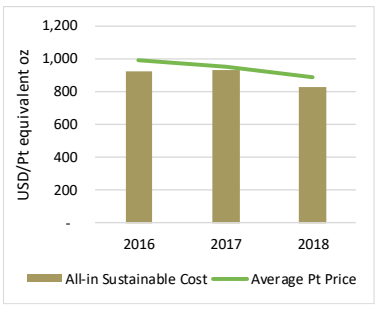
Cost curves can be constructed and analysed at a company or country level to facilitate comparison on a national, regional, or international level. South Africa produced 73% of global platinum during 2018 and is the main constituent of costed mine production.

Minxcon used the cost curves to compare the South African operating platinum mines' cost curves to the average platinum price for the year. The figure on the first page shows the South African platinum industry all-in sustainable cost curve for financial year 2018 at a mine level, while the figures below illustrate the historic performance of the industry.

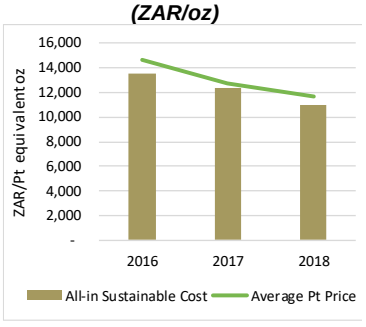
As a whole, platinum miners had a significantly improved year in 2018 from 2017 in USD-denominated terms with the all-in sustainable cost per Pt eq. oz decreasing by 11.8%. The average annual ZAR:USD exchange rate remained relatively constant year-on-year, strengthening slightly from 13.31 in 2017 to 13.24 in 2018. As a result, the ZAR-denominated all-in sustainable cost excluding capital and the all-in sustainable cost decreased by a slightly higher 11.2% and 12.2%, respectively.

The all-in sustainable cost per milled tonne has, however, increased by 2.6% year-on-year, indicating that the overall mine productivity has not improved. The 2018 marked improvement is less as a result of cost savings and more due to the significant increase in the prices of palladium and rhodium. The rising prices of palladium and rhodium have contributed to an increase in platinum equivalent ounces and therefore a reduced cost per platinum equivalent ounce.

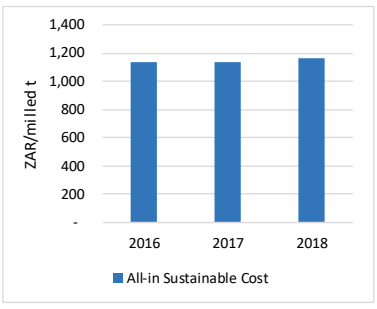
Historic Actual Unit Costs (USD/Pt eq. oz) vs Platinum Price (USD/oz)



Historic Actual Unit Costs (ZAR/Pt eq. oz) vs Platinum Price (ZAR/oz)



Historic Actual Unit Costs (ZAR/milled tonne)

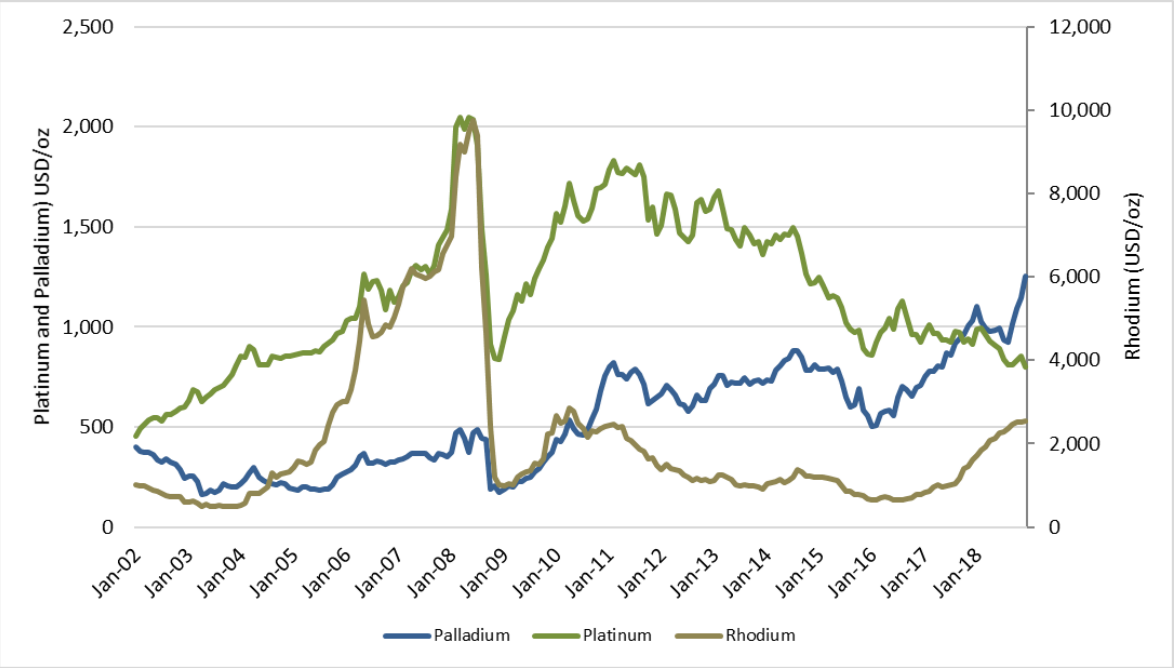


Notes: *All-in Sustainable Cost (AISC) includes cash cost incurred at each processing stage, from mining through to recoverable metal delivered to market inclusive of royalties and production taxes, sustaining and reserve development capital expenditure, corporate general and administrative costs, reclamation and remediation costs and sustaining exploration and study costs. Platinum producers report costs in a variety of ways. Where platinum producers report costs according to different definitions, Minxcon strives to adjust these costs to conform as close as possible to the above definitions. Pt equivalent ounces were calculated based on the mines' realised revenue divided by the annual average Pt price. By doing this, all companies -*

those with refineries or those selling concentrates - are directly comparable on a cost basis and against the spot platinum price.

The average annual palladium price increased by 18% to USD1,036/oz over 2018, from USD875/oz over the 2017 year, exceeding the platinum price for the first time in two decades. The average annual rhodium price increased by a further 100% to USD2,218/oz over 2018 from USD1,107 over 2017.

Historic PGM Prices



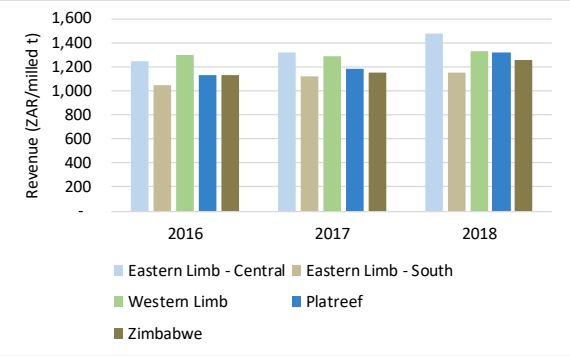
South African platinum mines have made significant strides in reducing operating costs with the average all-in sustainable cost exceeding USD1,200/oz as recently as 2014. This has come at the expense of closing several unprofitable mines and the loss of thousands of jobs. The industry has had to adapt to a falling price environment, with the platinum price having fallen for a seventh consecutive year to an average price of USD884/oz over 2018 from USD951/oz in 2017.

Despite the apparent improvement as a result of the overall increased price environment, many of South Africa's operations are still operating at costs exceeding the platinum price. Some of the major reasons for the high costs include the fact that a large percentage of the mines have been operating for decades, thus increasing maintenance costs on the shafts and machinery, as well as the fact that some of the platinum mines in South Africa are the deepest in the world. From the figure on the first page, it can be seen that at the average 2018 platinum price of USD884/oz, 29% of the platinum mines were not profitable on a platinum equivalent basis. These 29% mines accounted for 30% of southern Africa's platinum equivalent ounces produced during 2018.

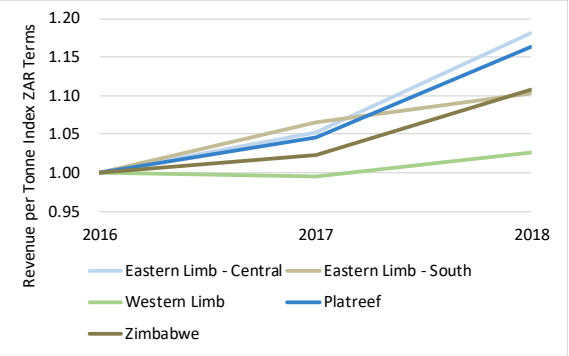
The average platinum price for 2019 thus far is USD846/oz, with a low of USD811/oz. Should platinum consolidate below the USD800/oz level, all other prices remaining the same, the costs of 29% of South African platinum mines will be above the price line on an operating cash cost basis, and 46% will be above the price line on an all-in sustainable cost basis. With South Africa producing in excess of 70% of global PGMs, these price levels are not sustainable for the industry in the medium to long term, unless costs can be further reduced; or prices increase. Fortunately, the PGM market has responded favourably in terms of the palladium and rhodium prices. If the upward trend continuous, the South African platinum mines will see much improved results in the short-term.

The graphs below illustrate the revenue achieved per milled tonne by operations according to location. Regionally, there appears to be a distinct price advantage in the Eastern Limb of the Bushveld Complex over the Western Limb. More specifically, the mines located in the central zone of the Eastern Limb have been able to take full advantage of the increased palladium and rhodium price environment. Mines on the Western Limb have, however, seen very minor improvement in revenue, which implies that unless the Western Limb mines reduce costs they will be the first to become unsustainable.

Historic Revenue per Tonne (ZAR/t) by Locality

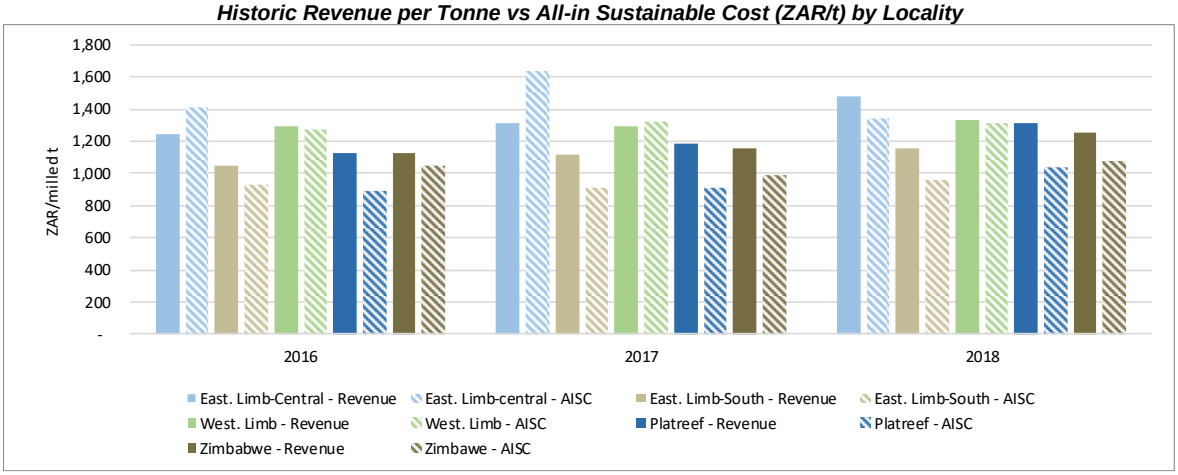


Historic Revenue per Tonne Index by Locality



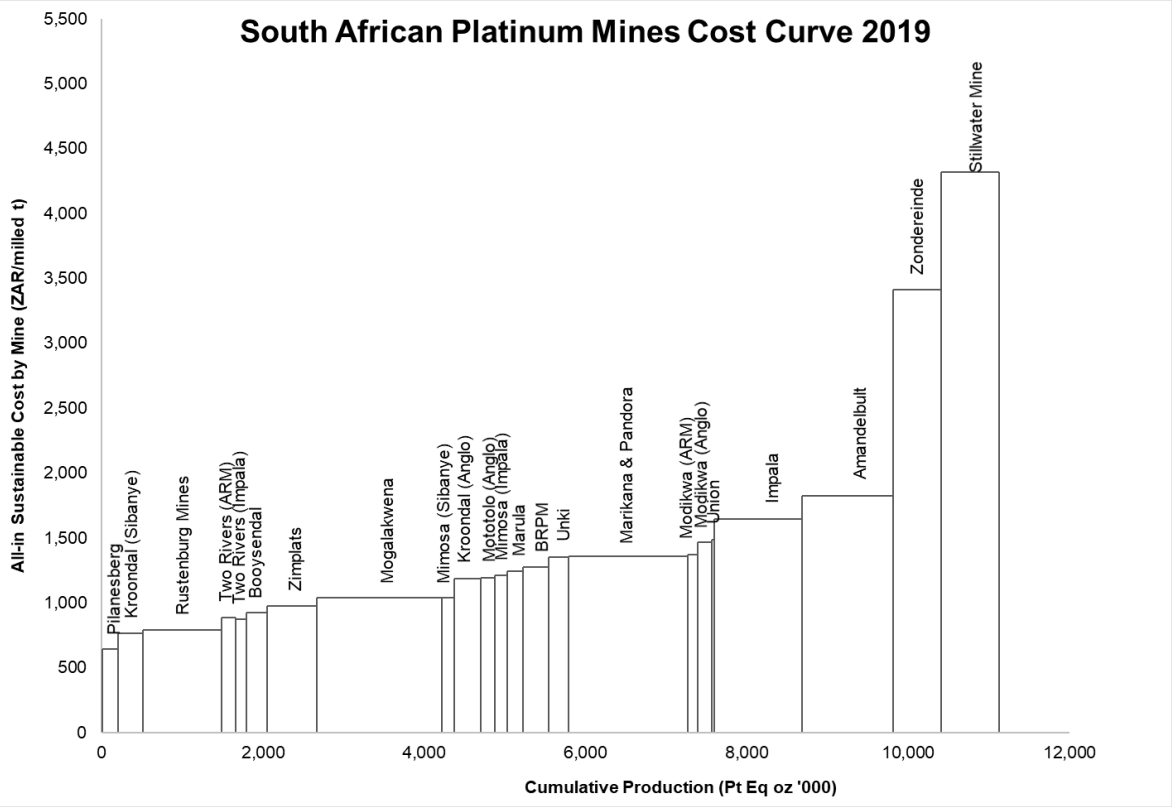
The figure below illustrates the revenue achieved per milled tonne against the all-in sustainable cost per milled tonne according to location. The figure clearly illustrates the effect of the lower realised revenue in the Western Limb, showing how marginal the region is. The marked turnaround seen in the cost from the Eastern Limb – Central is partly due to the closing of the high-cost Bokoni Mine.

Historic Revenue per Tonne vs All-in Sustainable Cost (ZAR/t) by Locality



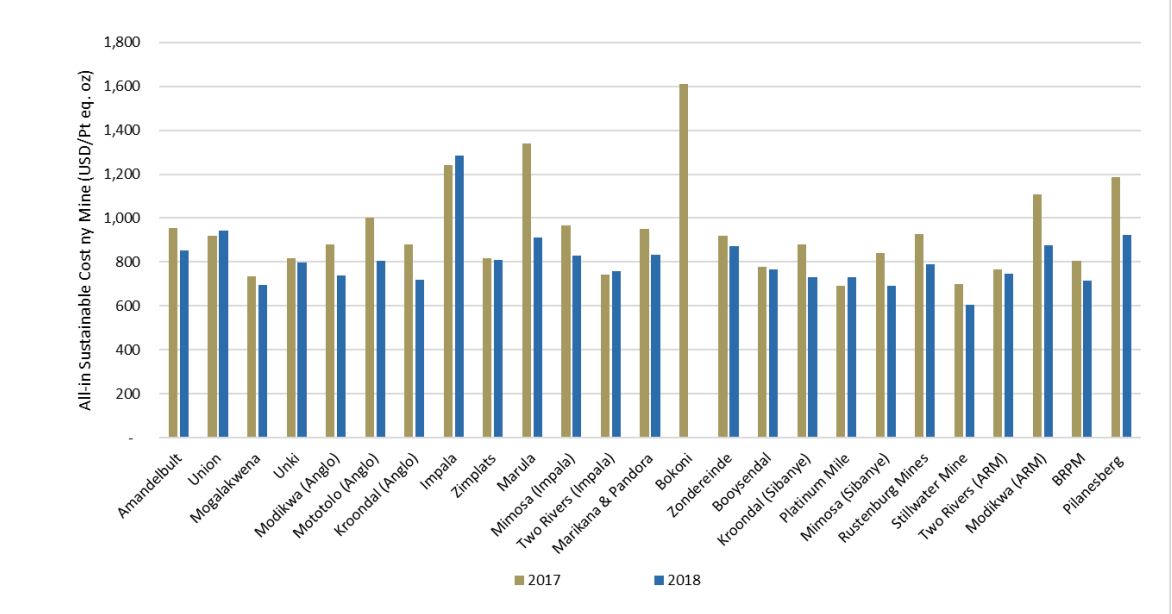
The figure below shows the South African platinum industry all-in sustainable cost curve per milled tonne for financial year 2018 at a mine level. Worryingly, the three highest South African cost producers per milled tonne are also amongst the highest cost producers per platinum equivalent ounce. The exception is the Sibanye-owned Stillwater Mine Complex from the United States, which is the highest cost producer per milled tonne, but the lowest cost producer per platinum equivalent ounce. Stillwater is predominantly a palladium producer.

2019 South African Platinum Industry Cost Curve by Mine (All-in Sustainable Costs per Milled t)



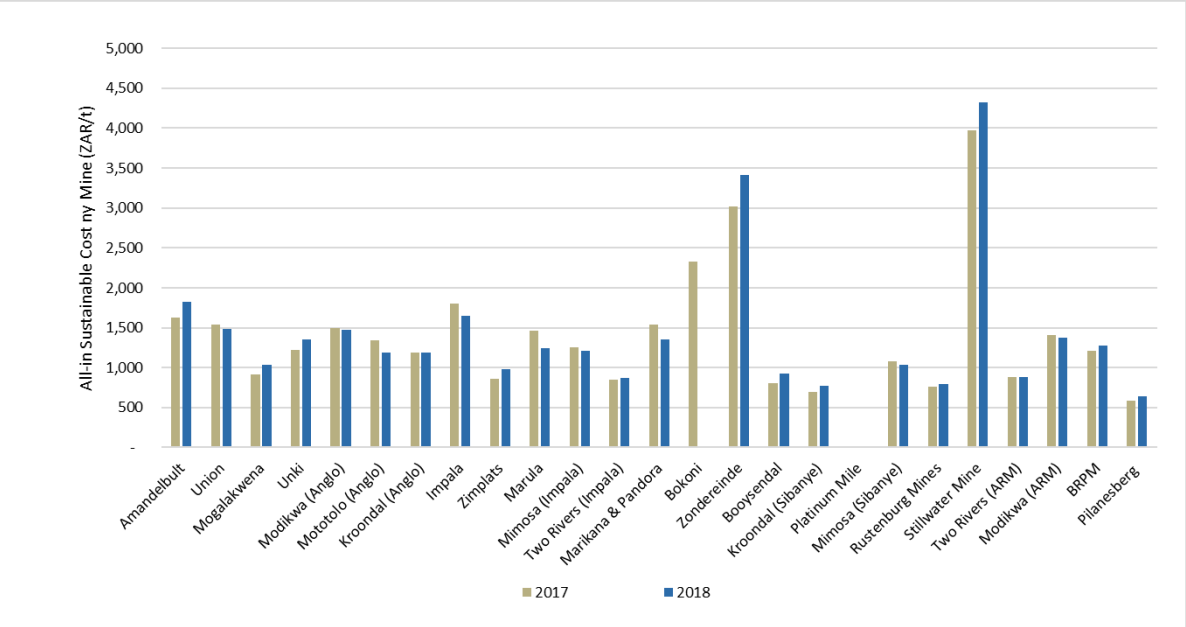
The figure below illustrates a year-on-year comparison of the South African platinum industry all-in sustainable cost per platinum equivalent ounce at a mine level in dollar terms. Most mines have had decreased apparent costs over the year; however, as discussed above, this is primarily due to increased prices of palladium and rhodium.

Year-on-Year Comparison of Cost by Mine (All-in Sustainable Costs USD/oz)



The figure below illustrates a year-on-year comparison of the South African platinum industry all-in sustainable cost per milled tonne at a mine level in ZAR terms. In contrast to the above figure, several mines that appear to have improved have in fact increased their cost per tonne. Interestingly, the inverse is also true for a few operations. Notably Impala has decreased their cost per tonne but did not realise the saving in cost per platinum equivalent ounce due to a major furnace rebuild leading to a stock build up and an 11% decrease in refined platinum production.

Year-on-Year Comparison of Cost by Mine (All-in Sustainable Costs ZAR/milled t)



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Minxcon Exploration

A project management company specialising in the management and optimisation of exploration projects within the mining industry.

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