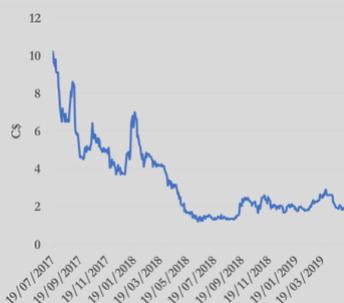


# Platinum Group Metals Ltd

## Palladium: The limited supply options.

### Platinum Group Metals Ltd

Ticker: PTM: TSX, PLG: NYSE  
 Share price: C\$1.78, US\$1.32.  
 Market cap: C\$58m, US\$43m.  
 Cash: US\$3.1m (28/02/19)  
 Debt: US\$43m (28/02/19)  
 Convertible Debt: US\$20m  
 Enterprise Value: US\$103m  
 Shares Out: 33.7m (07/05/19)  
 Warrants: 12.3m (Strike: US\$1.70)  
 Shares - Fully Diluted: 48.0m  
 CEO: R. Michael Jones



Prices as of the close of business  
 21<sup>st</sup> May 2019

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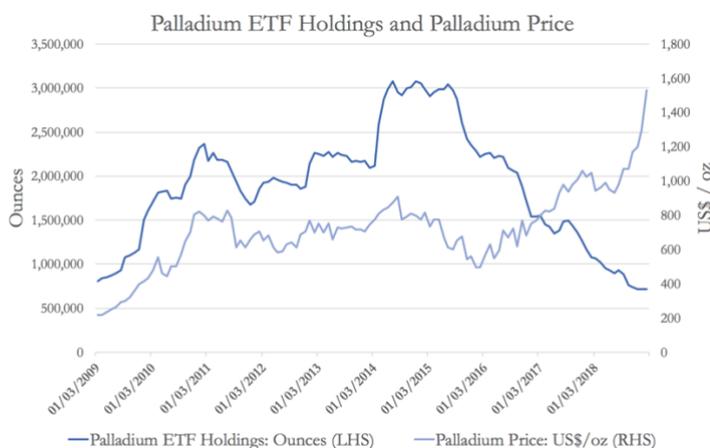
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**Waterberg JV:** The Waterberg project, located in South Africa, is one of the very few significant palladium development assets, globally. Impala Platinum, the world's second largest platinum producer, owns 15% of the project and has an option to increase their ownership to 50.01% following the publication of the Waterberg Definitive Feasibility Study (DFS), due later this year. Impala have been quoted recently as saying they intend to develop the mine.

**Metal Prices:** The palladium price has tripled since early 2016 and currently trades around US\$1,320 per ounce. Investors need to decide if this is a short-term bubble or a longer-term price rise driven by a structural shift in fundamentals. Over 85% of gross demand comes from its industrial use in auto-catalysts which has seen strong growth. Palladium has been in deficit since 2012 and despite outflows of physical palladium from Exchange Traded Funds (ETFs) over the last four years, prices continued to move higher.



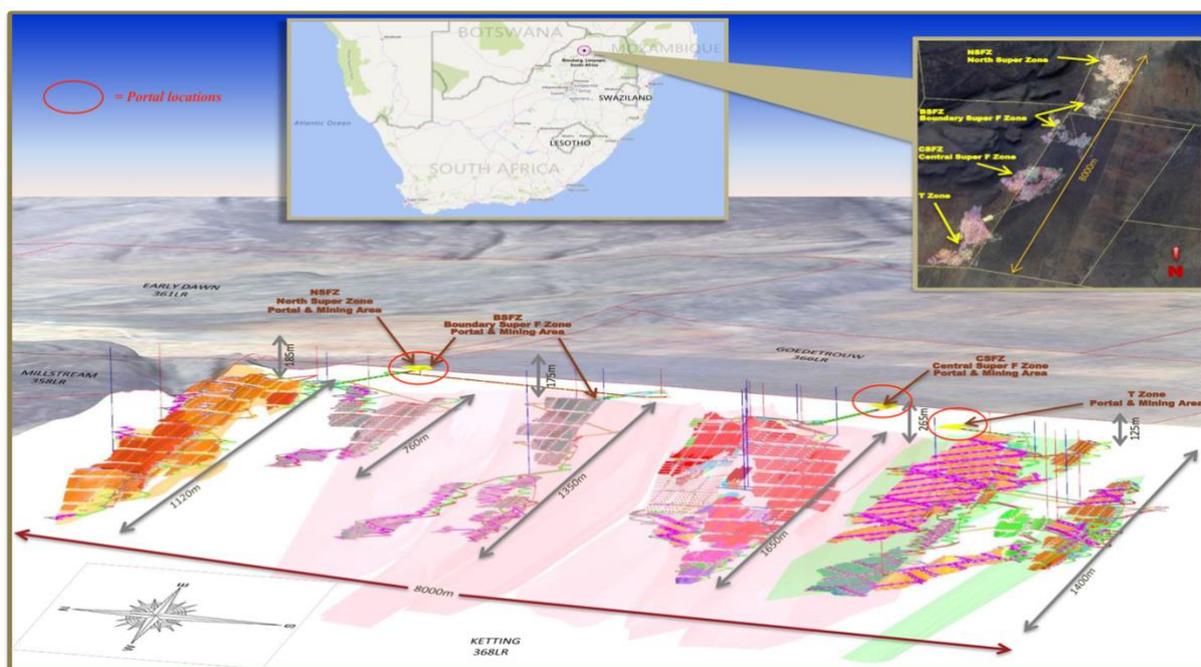
**China 6:** emissions legislation is being phased-in late 2019 and then in 2022. This legislation is arguably stricter than current European legislation. Since PGM loadings in Chinese vehicles are ~ 30% lower than in North America and Japan, in our opinion, the only way to meet the stricter regulation will be to increase PGM loadings per vehicle. Auto-catalyst manufacturer BASF forecast additional demand of 1 million ounces of palladium a year from the regulation, in a market with primary mine supply of only 7 million ounces per annum. The important question to consider – how will supply keep up with demand?

**Hybrids vs Electric Vehicles(EVs):** EVs receive most of the headlines and are estimated to take 8% of the global auto market by 2025, however **hybrids are expected to take a 23% share** - (JP Morgan). According to SFA Oxford, **hybrid vehicles contain 10-15% more palladium than conventional gasoline vehicles.** With major automaker production plans appearing to confirm a significant shift towards hybrids, we see palladium prices higher for longer.

## The Waterberg Project

**Waterberg's shallow depth allows for access by decline.**

Located at the top of the Northern Limb, Platinum Group Metals have discovered mineralisation at the Waterberg Project that extends over an **8km strike**. The shallowest edge of the known deposit occurs 140m below surface. By comparison, Impala's Rustenburg operations typically operate at 1km below surface. The Waterberg project considers three **declines** (as opposed to shafts) to access various sections of the ore body (proposed PFS portal locations circled in the figure below). The orebody strikes southwest to northeast with a dip of 34-38 degrees to the west.



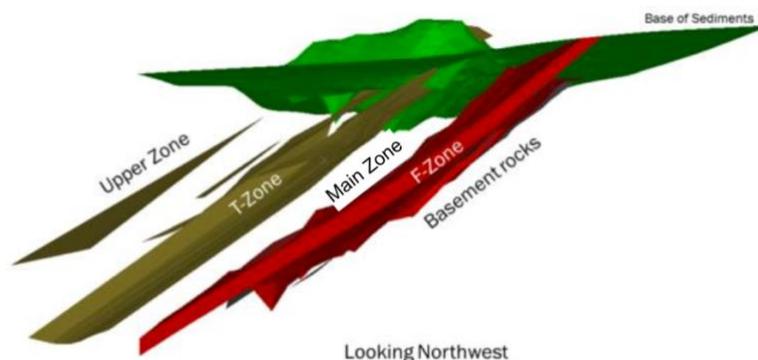
Source: PFS, October 2016.

**Two major mineralised zones.**

Mineralisation of economic interest is localised in two main zones. These are the T-Zone and the much more extensive F-Zone. The T-Zone overlies the F-Zone but only extends over a shorter distance towards the southwest of the orebody.

**Ore body geometry.**

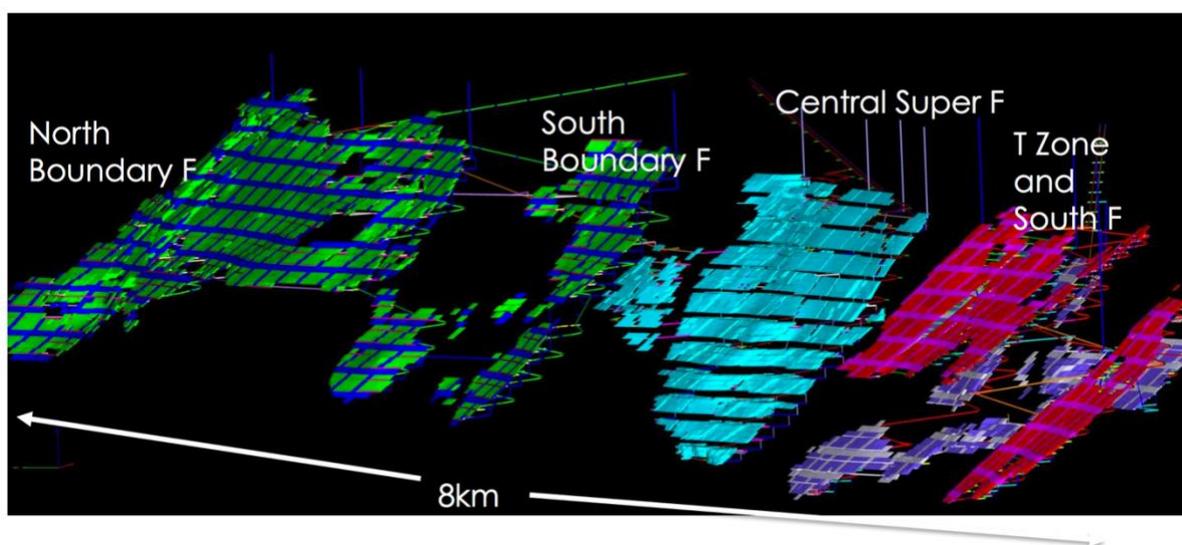
The figure on the next page is taken from the Pre-Feasibility Study (PFS) and shows a cross section of the orebody towards the southwest (looking northeast) and helps with understanding the geospatial relationship of the two zones.



**Figure 16-11: 3D View Showing Major Geological Units at the Waterberg Project**

Source: Waterberg PFS, October 2016.

The following figure, also from the PFS, shows the 8km strike and identifies the different mineralised zones.



Source: Platinum Group Metals Presentation March 2019.

**Mechanisation  
is the future.**

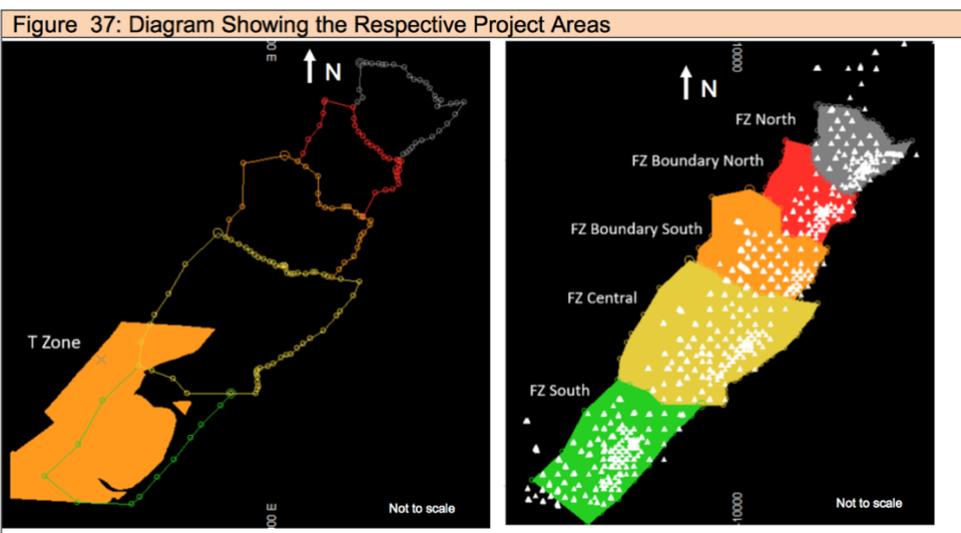
As mentioned previously, a key attraction of the project is the potential to access the ore body by decline rather than resorting to higher-capex shaft sinking, but the other major attraction is the potential to use **mechanised mining methods**.

Platinum Group Metals describe the ore body as ‘**40m wide**’, ‘**thick and amenable to bulk mechanized mining**’. The Waterberg Project Resource Update (October 22, 2018) provides further detail, as follows;

‘The F-Zone varies from thick (20-60m) well mineralised and continuous mineralisation (**Super F Zones**) to intermediate thickness (10m-20m) less

continuous to thin zones with scattered lower mineralisation. The T-Zone is generally thinner (5m-10m) with higher grades than the F-Zone.’

### Plan-view of the Waterberg ore body:



### **Super F Zones.**

‘Within the F Zone, basement topography may have played a role in the formation of higher grade and thicknesses where embankments or large-scale changes in magma flow direction facilitated the accumulation of magmatic sulphides. **These areas are referred to by PTM as the ‘Super F Zones’ where the sulphide mineralisation is over 40m thick and within the defined areas average 3 g/t to 4 g/t (2PGE+Au).’**

The white areas in the plan diagram below (Figure 42) indicate the locations of the ‘Super F Zones’ along the F-Zone strike length.



Source: Waterberg project Resource Update, dated October 22, 2018

**Proposed mining methods.**

The thicker nature of the ore body, than typically seen on the western and eastern limbs of the Bushveld, allows the following mechanised mining methods to be considered for the project; Blind Longitudinal Retreat (BLR) and SLOS Sub Level Open Stopping (SLOS). These are described as ‘**substantially feasible** as long as control is exercised diligently.’

**Reserves based on the October 2016 PFS.****Reserves:**

The Pre-Feasibility Study (PFS) completed in October 2016 presents a reserve statement containing **12.3mln ounces** of platinum group elements at a 4E grade of 3.73 g/t (4E – platinum, palladium, rhodium, gold).

Waterberg PGM Project - Reserves											
	Cut-off		Grade							Metal	
	4E g/t	Tonnage t	Pt g/t	Pd g/t	Rh g/t	Au g/t	4E g/t	Cu %	Ni %	4E kg	4E Moz
T-Zone	2.5	16,500,000	1.14	1.93	0.04	0.83	3.94	0.16	0.08	65,097	2.1
F-Zone	2.5	86,200,000	1.11	2.36	0.04	0.13	3.69	0.07	0.16	318,007	10.2
<b>Total</b>	<b>2.5</b>	<b>102,700,000</b>	<b>1.11</b>	<b>2.29</b>	<b>0.04</b>	<b>0.29</b>	<b>3.73</b>	<b>0.08</b>	<b>0.15</b>	<b>383,103</b>	<b>12.3</b>

**Waterberg's palladium bias**

Palladium dominates the Waterberg ore body and represents ~ 62% of the 4E metal grade versus ~ 30% for platinum, leading to a 1:2 Platinum to Palladium ratio. By comparison, Mogalakwena's ratio is closer to a 1:1 ratio.

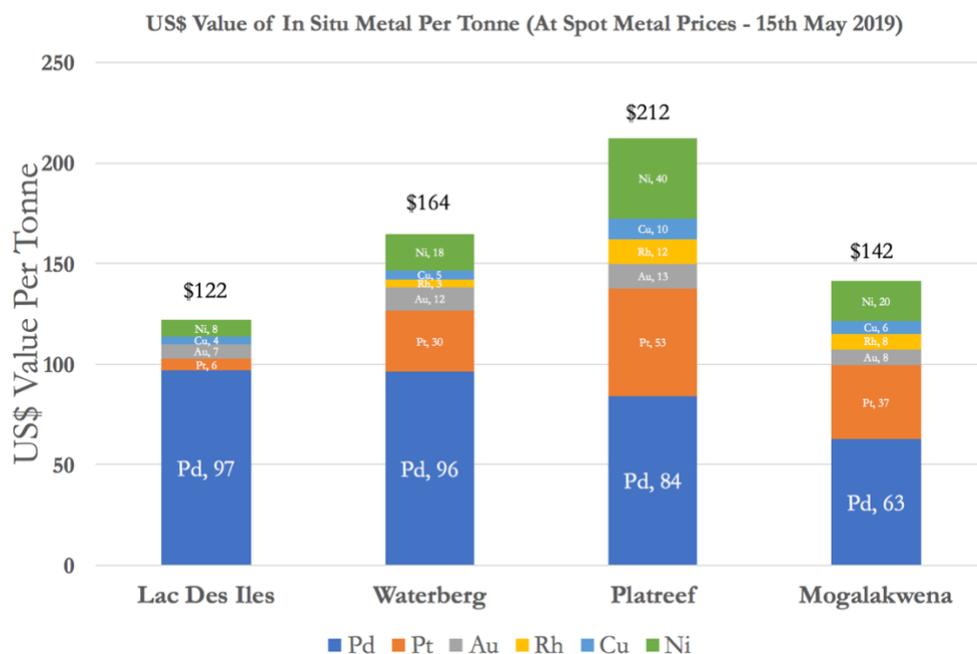
Prill Splits: Waterberg Reserves				
	Pt %	Pd %	Rh %	Au %
<b>Total</b>	<b>29.8</b>	<b>61.4</b>	<b>1.1</b>	<b>7.8</b>

An updated resource statement for Waterberg was released in October 2018 (See figure below) and declared a resource of approximately 33.4 million 4E ounces.

Waterberg PGM Project - Resources											
	Cut-off		Grade							Metal	
	4E g/t	Tonnage t	Pt g/t	Pd g/t	Rh g/t	Au g/t	4E g/t	Cu %	Ni %	4E kg	4E Moz
Measured	2.5	57,170,674	0.96	2.19	0.05	0.20	3.4	0.091	0.196	194,809	6.3
Indicated	2.5	185,314,816	0.99	2.11	0.05	0.22	3.37	0.100	0.177	624,498	20.1
<b>M+I</b>	<b>2.5</b>	<b>242,485,490</b>	<b>0.98</b>	<b>2.13</b>	<b>0.05</b>	<b>0.22</b>	<b>3.38</b>	<b>0.098</b>	<b>0.181</b>	<b>819,307</b>	<b>26.3</b>
Inferred	2.5	66,666,549	0.96	1.92	0.04	0.34	3.26	0.108	0.146	217,968	7.0
<b>Total</b>	<b>2.5</b>	<b>309,152,039</b>	<b>0.98</b>	<b>2.08</b>	<b>0.05</b>	<b>0.25</b>	<b>3.35</b>	<b>0.100</b>	<b>0.173</b>	<b>1,037,275</b>	<b>33.4</b>

### The value of metal in the rock.

Based on current metal prices (15<sup>th</sup> May, 2019) the US\$ value of contained metal per tonne of rock is approximately US\$164 per tonne. The figure below compares Waterberg to other significant palladium mines.



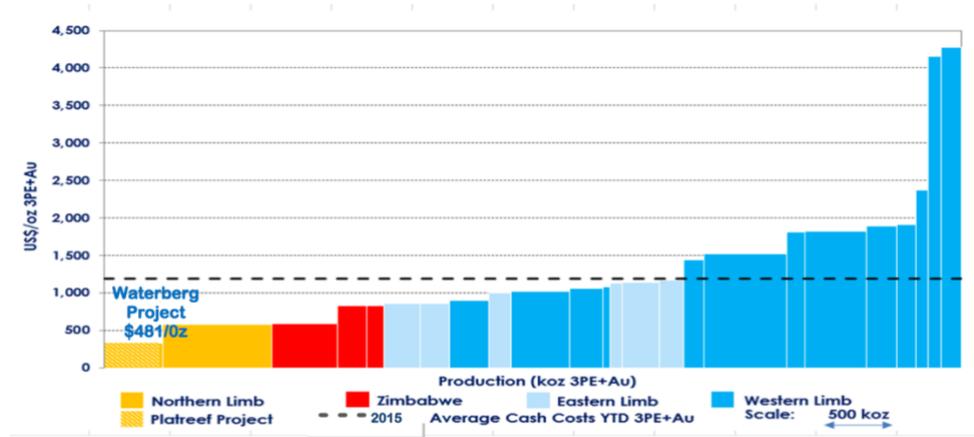
Turning our attention to what this means from a financial perspective, the PFS calculates life-of-mine total cash costs, after credits of US\$481 / OZ.

Item	Life-of-Mine Average	US\$/oz Payable 4E in concentrate	
		5-Year Average 2022-2026	10-Year Average 2022-2031
Mine Site Cash Costs	389	390	374
Nickel Credits	98	97	98
Copper Credits	42	40	40
Total Mine Cash Costs After Credits	248	253	236
Realisation Cost (Smelter 'cost', Transport)	232	224	231
<b>Total Cash Costs After Credits</b>	<b>481</b>	<b>477</b>	<b>467</b>

Source: Waterberg PFS, October 2016.

### Waterberg: PFS cash costs.

These cash cost estimates place the Waterberg Project within the **first quartile** of the cost curve alongside other Northern Limb peers, Mogalakwena (Anglo American Platinum) and Platreef (Ivanhoe Mines). The Mogalakwena mine is open-pit and currently in operation. The Platreef Project is a development stage project requiring the sinking of two shafts, the first to approximately 980m depth and the second to approximately 1,100m depth. The project also requires three ventilation raises of between 725m and 950m in length. Capex to first production for the Platreef project (including contingency) is estimated at US\$1.54bln.



Producer Cost Data Source: SFA (Oxford)

**Figure 22-4: Cash Cost Comparison Waterberg and 2015 Producers**

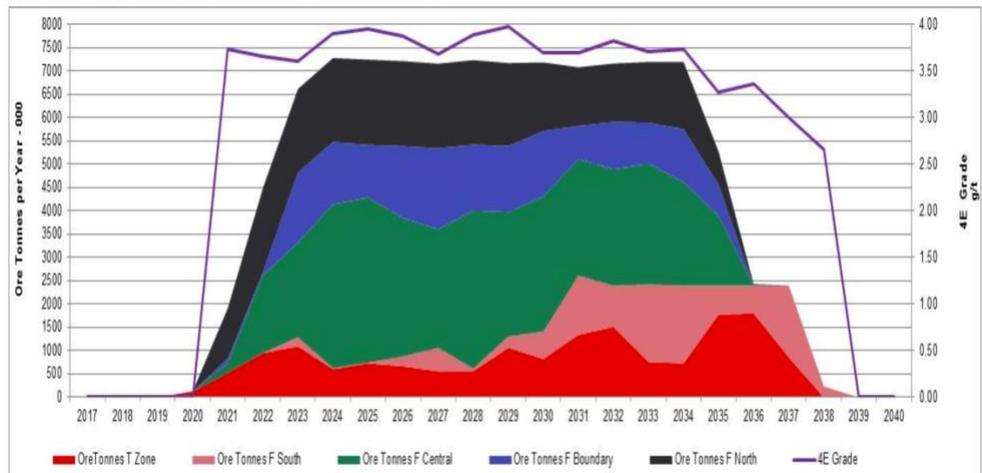
**Waterberg: the characteristics so far.**

**Other Characteristics of the Waterberg Project (October 2016 PFS):**

**Mine Life:** 18 years.

**Mine production:** ramps up to **7.2mln tonnes** over three years. Initially taking ore from the T-Zone, F Central and F North.

Total Mine production with the average grade is shown in Figure 1-8.



**Figure 1-8: Mining Method Total Mine Production**

Source: Waterberg PFS, October 2016.

**Milling:** Steady state capacity of 7.2mtpa will likely be achieved by the construction of the plant in two phases. Each phase consisting of a 3.6mtpa concentrator module, with the second concentrator module in operation 18 months after the first. Each of the modules comprises a three stage-crushing circuit, feeding crushed material to the primary milling circuit. Primary milling is achieved in a ball mill with closed circuit classification followed by a primary rougher floatation bank.

**Metallurgical Work:** Indicates that an ‘economically attractive concentrate can be produced from standard floatation methods’.

**Concentrate:** Annual production of 285k tpa of concentrate at a 4E grade of 81 g/t. (Platinum 24.2 g/t, Palladium 51.5 g/t, Gold 4.9 g/t, Rhodium 0.6 g/t) + Copper 1.9%, Nickel 1.8%. The report states: ‘Based on a comparison with the Merensky style of concentrate the Waterberg concentrate is considered attractive.’

**Chrome:** The concentrate does not contain any penalty elements such as chrome and is rich in Sulphur, thus making it ‘a desirable concentrate to blend with other high chrome concentrates.’

**Pay-ability:** Based upon industry data, it is ‘expected that the pay-ability for the concentrate sold to a local smelter operator will be up to 85% for the PGE’s, 73% for contained copper and 68% for contained nickel.’

**Royalty Rate:**  $\text{Royalty \%} = 0.5 + [\text{EBIT} / (\text{Gross Sales} * 9)] * 100$ , with a maximum of 7% and a minimum of 0.5%, for production of refined minerals. In the mine-model we have assumed a flat 5% royalty rate across the life of the project.

**Capex:** Requirement to full production (including contingency): ZAR15,906million (US\$1,097million).

**NPV:** The PFS study (October 2016) calculated an After Tax NPV (8%) of **US\$507million** based on 3 year trailing average metal prices of: Platinum US\$1,212, Palladium US\$710, Gold US\$1,229, Rhodium US\$984, Nickel US\$6.10/lb and Copper US\$2.56/lb.

**Arlington Group** considers an initial production rate of 4.8mln tonnes with a lower estimated initial capex of US\$600m, with a second stage of capex (an additional US\$497m) bringing production to 7.2mln tonnes in year 5. After Tax NPV comes to **US\$856m**. This uses an 8% discount rate and metal prices as follows: Platinum US\$900, Palladium US\$1,300, Gold US\$1,300, Rhodium US\$2,400, Copper US\$6,400/t, Nickel US\$13,000/t.

### NPV matrix of Waterberg Project on variable platinum and palladium prices.

		Palladium Price							
		US\$ 800	900	1,000	1,100	1,200	1,300	1,400	1,500
Platinum Price	800	13	167	321	475	629	783	937	1,091
	900	87	241	395	548	702	<b>856</b>	1,010	1,164
	1,000	160	314	468	622	776	930	1,084	1,238
	1,100	233	387	541	695	849	1,003	1,157	1,311
	1,200	307	461	615	768	922	1,076	1,230	1,384
	1,300	380	534	688	842	996	1,150	1,304	1,457
	1,400	453	607	761	915	1,069	1,223	1,377	1,531
	1,500	527	681	834	988	1,142	1,296	1,450	1,604

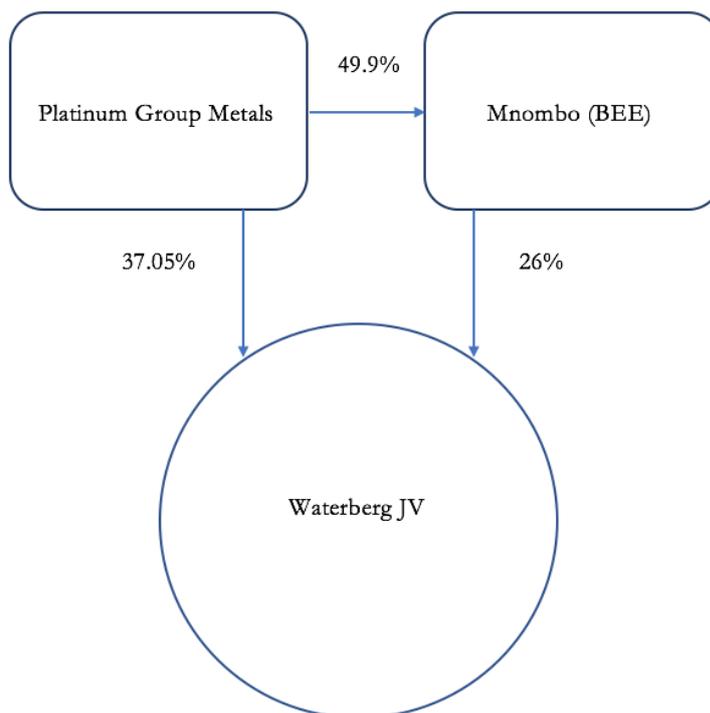
Source: Arlington Group.

**Arlington Group's Waterberg Mine Model:**

				2019	2020	2021	2022	2023	2024	2025
31.1034										
Platinum	US\$ / oz			900	900	900	900	900	900	900
Palladium	US\$ / oz			1300	1300	1300	1300	1300	1300	1300
Rhodium	US\$ / oz			2400	2400	2400	2400	2400	2400	2400
Gold	US\$ / oz			1300	1300	1300	1300	1300	1300	1300
Copper	US\$ / t			6400	6400	6400	6400	6400	6400	6400
Nickel	US\$ / t			13000	13000	13000	13000	13000	13000	13000
Period							1	2	3	4
USDZAR				14.5	14.5	14.5	14.5	14.5	14.5	14.5
				2019	2020	2021	2022	2023	2024	2025
<b>Assumptions:</b>	<b>4.8 mln tonnes per annum initially, rising to 7.2mln tonnes per annum after 4 years of initial production.</b>									
Ore Milled	Mt						3.4	4.8	4.8	4.8
<b>Assumptions:</b>	<b>Grades based on October 2016 PFS Reserves</b>									
Grade	Platinum	g/t					1.1	1.1	1.1	1.1
Grade	Palladium	g/t					2.29	2.29	2.29	2.29
Grade	Rhodium	g/t					0.04	0.04	0.04	0.04
Grade	Gold	g/t					0.29	0.29	0.29	0.29
Grade	4E	g/t					3.72	3.72	3.72	3.72
Grade	Copper	%/t					0.08%	0.08%	0.08%	0.08%
Grade	Nickel	%/t					0.15%	0.15%	0.15%	0.15%
<b>Assumptions:</b>	<b>Recoveries based on October 2016 PFS</b>									
Recoveries	Platinum	%					82.5%	82.5%	82.5%	82.5%
Recoveries	Palladium	%					83.2%	83.2%	83.2%	83.2%
Recoveries	Rhodium	%					59.4%	59.4%	59.4%	59.4%
Recoveries	Gold	%					75.3%	75.3%	75.3%	75.3%
Recoveries	4E	%					82.1%	82.1%	82.1%	82.1%
Recoveries	Copper	%					87.9%	87.9%	87.9%	87.9%
Recoveries	Nickel	%					48.8%	48.8%	48.8%	48.8%
Production	Platinum	koz					98	140	140	140
Production	Palladium	koz					206	294	294	294
Production	Rhodium	koz					3	4	4	4
Production	Gold	koz					24	34	34	34
Production	4E	koz					330	471	471	471
Production	Copper	t					2.4	3.4	3.4	3.4
Production	Nickel	t					2.5	3.5	3.5	3.5
<b>Assumption: Payability based on October 2016 PFS</b>										
Payability	PGM	%					85%	85%	85%	85%
Payability	Copper	%					73%	73%	73%	73%
Payability	Nickel	%					68%	68%	68%	68%
Payable Revenue	Platinum	\$ mln					75.0	107.1	107.1	107.1
Payable Revenue	Palladium	\$ mln					227.4	324.9	324.9	324.9
Payable Revenue	Rhodium	\$ mln					5.2	7.5	7.5	7.5
Payable Revenue	Gold	\$ mln					26.1	37.2	37.2	37.2
Payable Revenue	4E	\$ mln					333.7	476.8	476.8	476.8
Payable Revenue	Copper	\$ mln					11.0	15.8	15.8	15.8
Payable Revenue	Nickel	\$ mln					21.7	31.1	31.1	31.1
Concentrate	Total	ktpa	Target Con Grade 81g/t 4E				127	181	181	181
Revenue	Total	\$ mln					366.5	523.6	523.6	523.6
Revenue	Total	ZAR mln					5314.4	7592.0	7592.0	7592.0
TC / RC		\$ mln	Note: PFS report page 397 'A negotiated payability for each economic metal in the flotation concentrates which includes a provision for the tr							
Penalties		\$ mln	Note: PFS report page 398 'The concentrate from Waterberg will have negligible chromitite but the other elements could, cause penalties appli							
Transport	1.42	ZAR	Note: PFS report page 397 average distance 280km, R1.42 est. per wet concentra				55,408,886	79,155,551	79,155,551	79,155,551
Transport		\$ mln					3.8	5.5	5.5	5.5
<b>Assumption: Operating costs based on October 2016 PFS</b>										
Mining Costs		ZAR / t	LOM	272						
Engineering & Infrastructure		ZAR / t	LOM	107						
G&A		ZAR / t	LOM	41						
Processing		ZAR / t	LOM	155						
<b>Operating Costs (LOM)</b>		ZAR / t	LOM	575			575	575	575	575
<b>Operating Costs (LOM)</b>		US\$ / t	LOM	40			40	40	40	40
Royalty (Sliding Scale) ZAR/t		ZAR / t	5.0%	79			79	79	79	79
Royalty (Sliding Scale) USD/t		US\$ / t	5.0%	5			5	5	5	5
<b>Operating Costs (Inc. Royalty) ZAR/t</b>		ZAR / t		654			654	654	654	654
<b>Operating Costs (Inc. Royalty) USD/t</b>		\$ / t		45			45	45	45	45
<b>Operating Costs (Inc. Royalty)</b>		<b>US\$ mln</b>					<b>151</b>	<b>216</b>	<b>216</b>	<b>216</b>
Capex (Initial)	8,700	ZAR mln	Project Capex ZAR8,700mln	0	4,350	4,350				
Capex (Sustaining)	6,278	ZAR mln	Sustaining Capex est. ZAR6,278mln				603.6	603.6	603.6	603.6
Total Capex ZAR				0	4,350	4,350	603.6	603.6	603.6	603.6
<b>Capex (Initial to 4.2mln tonnes)</b>	<b>600</b>	<b>US\$ mln</b>	<b>Project Capex USD600mln</b>	<b>0</b>	<b>300</b>	<b>300</b>				
<b>Capex (Sustaining)</b>	<b>433</b>	<b>US\$ mln</b>	<b>Sustaining Capex est. USD433mln</b>				<b>42</b>	<b>42</b>	<b>42</b>	<b>42</b>
Capex for increase to 7.2mln after 2 years										
<b>Capex (Initial 4.2 to 7.2)</b>	<b>497</b>	<b>US\$ mln</b>							<b>249</b>	<b>249</b>
<b>Capex (Sustaining)</b>	<b>358</b>	<b>US\$ mln</b>								
<b>Total Capex (4.2m and 7.2m)</b>		<b>US\$ mln</b>		<b>0</b>	<b>300</b>	<b>300</b>	<b>42</b>	<b>42</b>	<b>290</b>	<b>290</b>
Opening Balance	US\$ mln			0	0	300	600	603	606	842
Additions to PP&E	US\$ mln			0	300	300	42	42	290	290
Total PP&E	US\$ mln			0	300	600	642	645	896	1133
Commercial production	0(No), 1(Yes)			0	0	0	1	1	1	1
<b>Depreciation</b>	US\$ mln	<b>6%</b>					<b>38</b>	<b>39</b>	<b>54</b>	<b>68</b>
Closing PP&E	US\$ mln			0	300	600	603	606	842	1065
<b>Unlevered Free Cash Flow</b>										
D&A	US\$ mln						38	39	54	68
EBITDA	US\$ mln						211	302	302	302
Capex	US\$ mln			0	300	300	42	42	290	290
Tax	28% US\$ mln						48	74	69	65
Cashflows	US\$ mln			0	-300	-300	121	186	-58	-54
<b>IRR</b>										<b>22%</b>
<b>NPV</b>	<b>8%</b>	US\$ mln								<b>856</b>

**The Waterberg JV - Ownership**

**PGM owns a 37.05% direct stake and a 12.97% indirect stake (49.9% \* 26%) in the Waterberg JV. This equates to a 50.02% effective interest.**

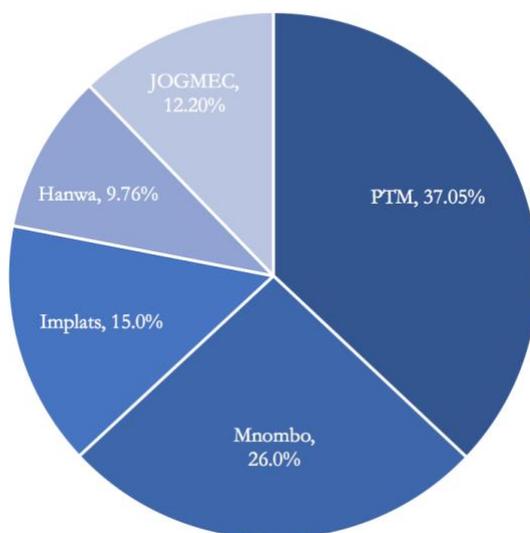


Platinum Group Metals (PTM) own a 37.05% direct stake in the Waterberg joint venture and also own a 12.97% indirect stake through their 49.9% stake in Black Economic Empowerment (BEE) group Mnombo. Mnombo themselves own a 26% direct stake in the Waterberg JV. In combination, Platinum Group Metals owns a **50.02% effective interest in the JV**.

While PTM is currently the operator of the Joint Venture (JV) there are five direct equity owners in total, as shown in the figure below.

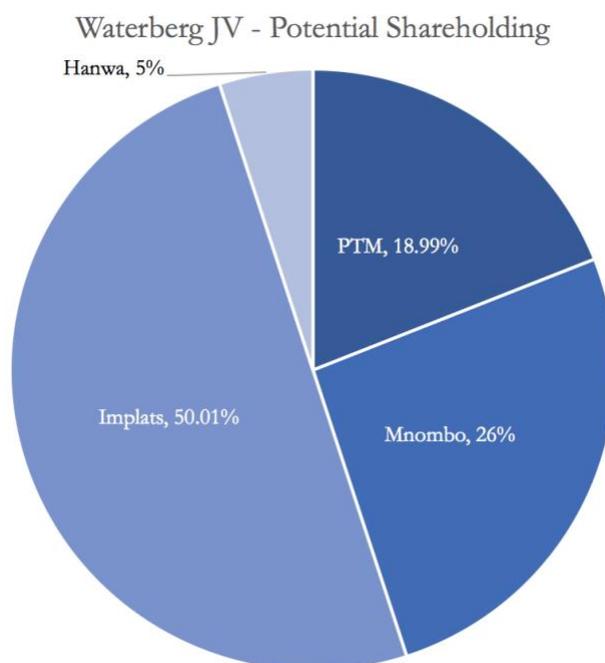
**How the Waterberg JV is owned currently.**

Waterberg JV - Current Shareholdings



When Impala Platinum acquired their 15% stake in the Waterberg JV back in November 2017 for US\$30million, it included an **option** over the project. This option is triggered by the publication of the **Waterberg DFS which is expected in Q2 2019**. Once this is published, Impala Platinum will have 90 days to exercise their option allowing them to increase their 15% holding to 50.01%. This would be achieved by paying JOGMEC US\$34.8million for their 12.2% share. Impala Platinum would acquire 4.755% from Hanwa and 18.06% from Platinum Group Metals in exchange for a **firm commitment to spend US\$130million on the Waterberg project**.

**If Impala exercise their option, PTM would have a 31.96% effective interest in the Waterberg JV. (18.99% direct ownership and 12.97% indirect ownership from PGM's 49.9% ownership of Mnombo)**



Following an election to go to 50.01% project interest, Impala Platinum will have another 90 days to confirm the 'salient terms of a Development and Mining financing for the Waterberg Project, including a signed financing term sheet, subject only to final credit approval and documentation.'

#### New Mining Charter:

**BEE to increase from current levels of 26% to 30% over 5 years, once mining rights for the project are granted.**

The new mining charter announced in South Africa in September 2018 revised the Black Economic Empowerment (BEE) ownership rules. The new rules increase BEE shareholding rights to a minimum 30% from 26%.

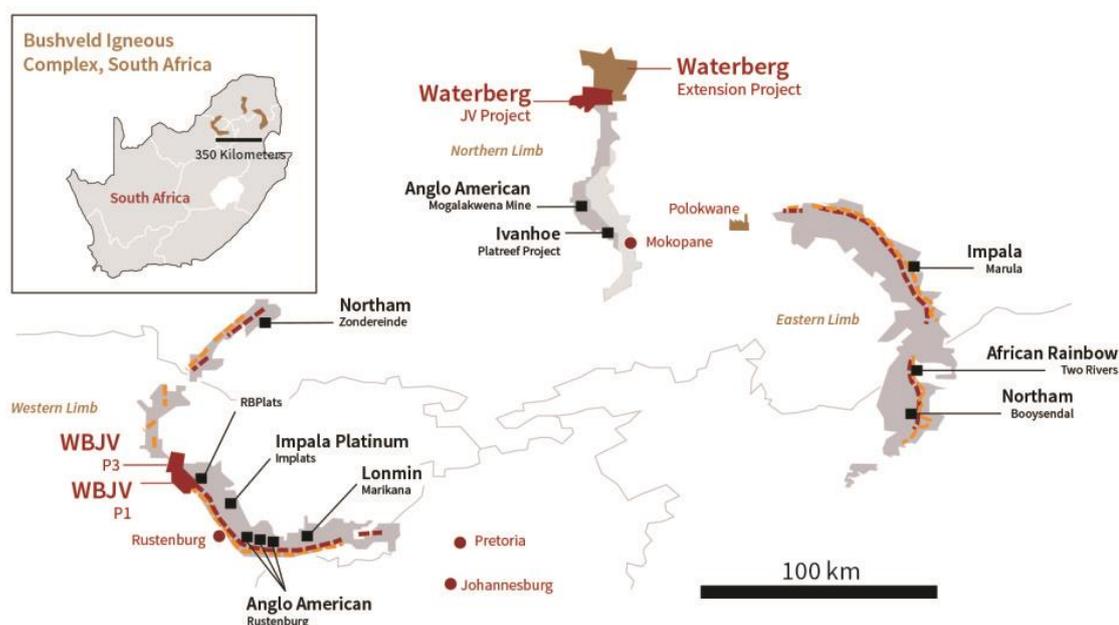
Impala Platinum's October 2017, Waterberg transaction includes provision for BEE rights and provides for the transfer of equity and

issuance of additional equity to one or more broad based black empowerment partners at fair value.

Once the Waterberg project mining right is granted, the JV will have a period of 5 years within which to increase the BEE shareholding to 30%. Although currently it remains unclear as to whether the shareholding will be required to be distributed amongst employees, communities and black entrepreneurs, and in what percentage.

### **The Bushveld Igneous Complex – A Brief History**

The Waterberg JV project is located on the Northern Limb of the Bushveld Igneous Complex (BIC) in South Africa. The BIC, discovered by Hans Merensky in 1924, contains the world's largest reserves of Platinum Group Elements (PGE) – platinum, palladium, rhodium, osmium, iridium and ruthenium. There are three distinct regions of the Bushveld Igneous Complex known as the Western Limb, Eastern Limb and Northern Limb, as shown in the figure below;

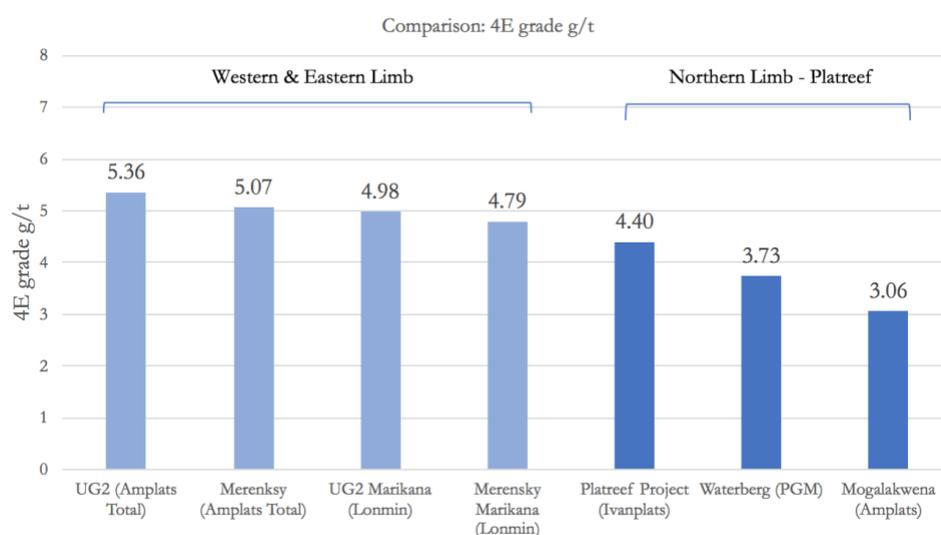


Source: Platinum Group Metals.

Within the three regions, there are also three distinct mineralised horizons, known as 'reefs' containing the ore. The three main reefs are; Merensky, UG2 (Upper Group 2) and Platreef. The Western and Eastern Limbs are typically richer in platinum than palladium and the Northern Limb typically displays an even distribution of platinum and palladium.

	Western Limb	Eastern Limb	Northern Limb
Dominant Reefs	Merensky, UG2	UG2	Platreef
Pt:Pd Ratio	1:0.5	1:0.8	1:1

From a grade perspective, both the Western and Eastern Limbs typically have higher 4E grades (4E: platinum, palladium, rhodium & gold) than the Northern Limb.



Source: company reports.

Historically, large scale mining first targeted the platinum-rich Merensky reef during the 1950s, as platinum's ability to act as a catalyst began to be understood and prices started to rise.

**Platinum smelters have difficulty processing concentrate with high chromite levels.**

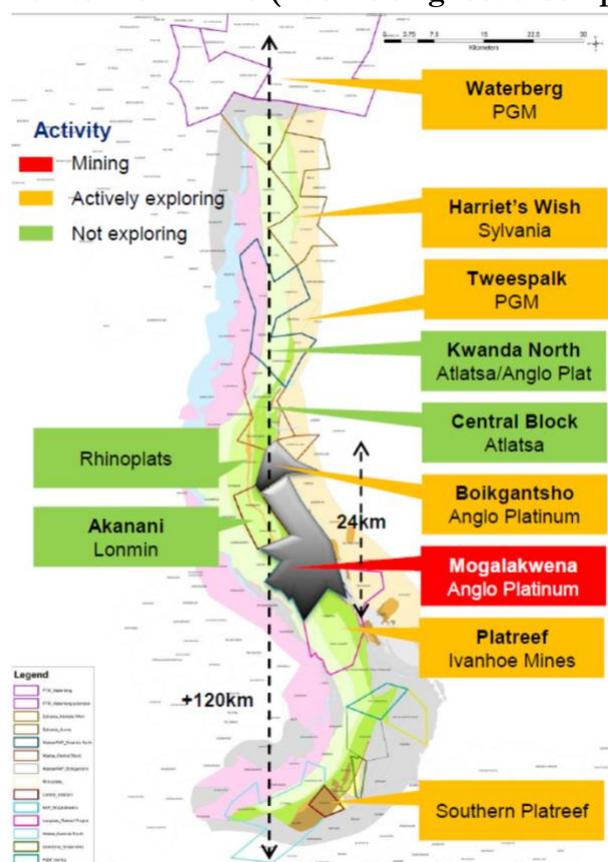
Initially, the UG2 reef posed a problem since it contains significant levels of chromite-containing ore that platinum smelters have difficulty handling at certain levels. The UG2 reef remained largely untouched until the 1970s / 1980s when flotation processes allowed chromite levels to be controlled. 'The first plant to treat UG2 ore on its own was commissioned at the Western Platinum Mine in 1984'. (Brugman 1985). Once methods to control the chromite levels were established, the UG2 reef steadily increased in importance and by 2011 accounted for 63% of ore processed in the Bushveld Complex.

**Mechanised mining of Merensky and UG2 is difficult due to the narrow width of the reefs.**

The Merensky and UG2 reefs are both **narrow** – typically less than one metre. As a consequence, they're mined using narrow-reef methods (pneumatics drills) which makes the endeavour **highly labour-intensive**.

The Platreef, found exclusively in the Northern Limb, varies in width from 5 to 90m and is low in chromite, lending itself to simpler metallurgical processing. The reef was mined briefly in the 1920s but was not exploited on a large scale until 1993, when Anglo Platinum's open-pit Mogalakwena mine started production.

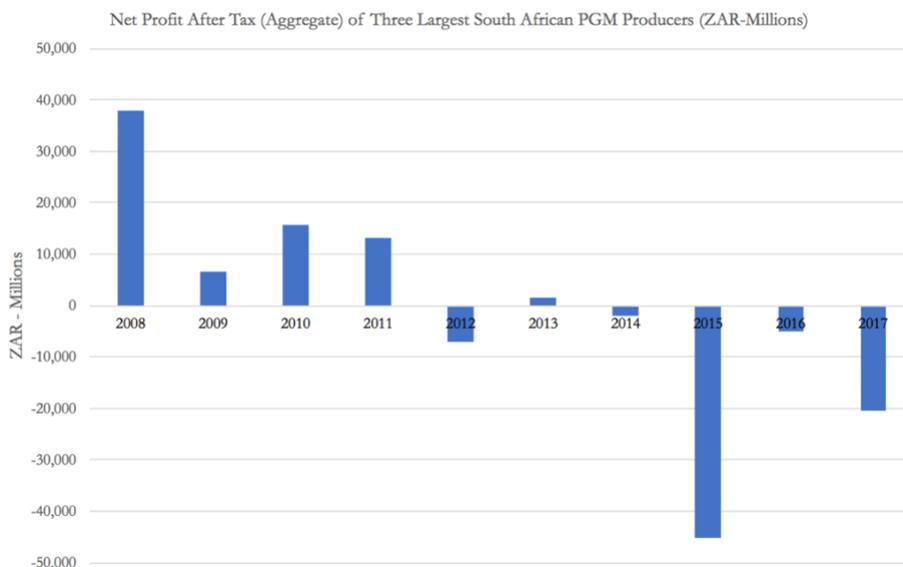
**Map of the Northern Limb (Bushveld Igneous Complex).**



Source: Anglo Platinum.

**The decline in profits over the decade.**

The importance of the Bushveld Igneous Complex (BIC) to global platinum supply is difficult to overstate. In 2018, global mine supply of platinum came to approximately 6.1mln ounces. South Africa accounted for 73% of this platinum production, with production coming almost exclusively from the BIC. However, the South African platinum producers have increasingly struggled with profitability.



Source: Amplats, Implats and Lonmin annual reports.

This decrease in profitability has led to some production loss across the Western Limb and Eastern Limbs as shown in the figure below.

Western Limb			Eastern Limb			Northern Limb	Great Dyke
		Pt koz estimate			Pt koz estimate	Pt koz estimate	Pt koz estimate
2009	Rustenburg (Anglo)	140	2009	Lonmin Limpopo	60		
2012	Marikana	90	2011	Blue Ridge	35		
2013	Crocodile River	65	2012	Everest	35		
2013	Union declines	60	2013	Smokey Hills	15		
2015	Eland - Kukama	30	2015	Bokoni -UM2 & Vertical	35		
2015	Impala - #8, #12 (mech.)	40	2016	Bokoni - Klipfontein O/C	5		
2017	Lonmin - 1B, O/C, Newman	50	2017	Bokoni - all remaining shafts	145		
2017	BRPM - South Shaft UG2	20					
2017	Maseve	10					
2017	Lonmin - E2	15					
<b>TOTAL CLOSED</b>		<b>520</b>	<b>TOTAL CLOSED</b>		<b>330</b>	<b>TOTAL CLOSED</b>	<b>0</b>

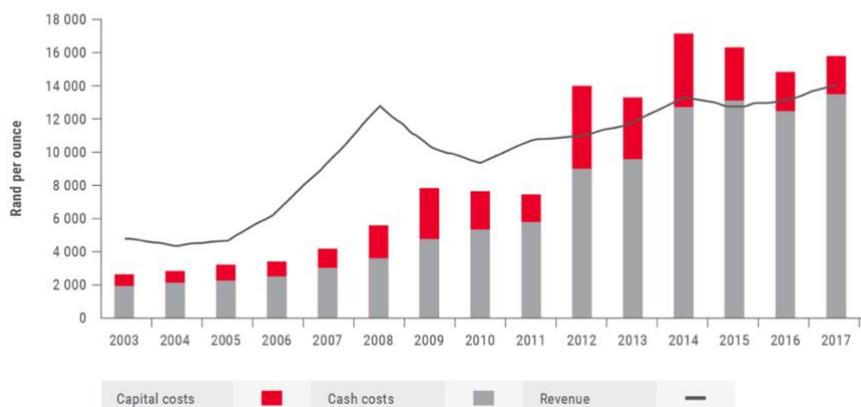
Source: Implats Strategic Review - August 2018

**The collapse in productivity.**

An excellent research note by Allan Gray, a long-term Impala Platinum shareholder, considers the key issues with the South African platinum industry in a report issued in June 2018. The report highlights the **collapse in productivity of the underground platinum miners and their inability to control costs**, citing a 16% annual unit cost increase at Implats’ Impala Lease Area compared to an annual consumer price increase of 6% over the same period. Allan Gray reject the idea that lower metal prices are the cause of the issue with profitability.

Impala Lease Area 1: Costs and revenue per 4E ounce.

Graph 1: Impala on mine costs and revenue

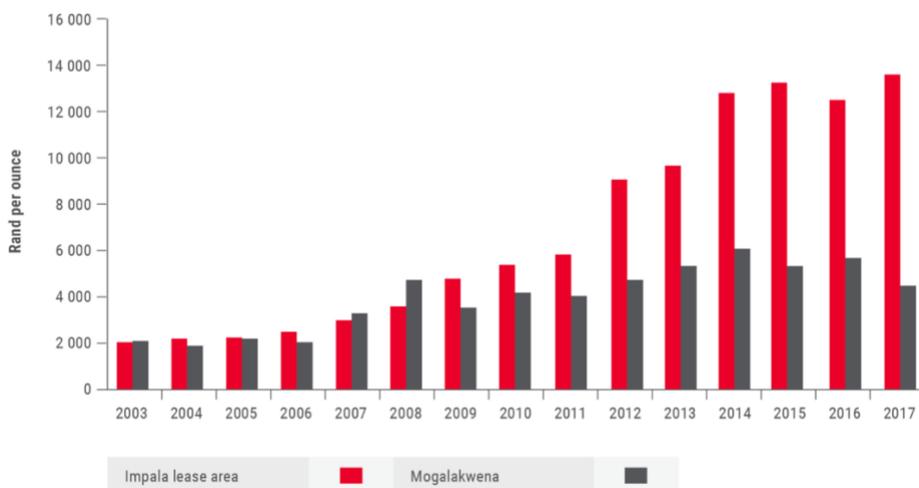


Source: Allan Gray report, June 2018.

**Mogalakwena's relative success.**

While considering the cost inflation difficulties of **underground mining** in South Africa, Allan Gray also consider the relative success that's been achieved with cost control at the Anglo Platinum's open-pit Mogalakwena mine on the Northern Limb, as shown below.

Graph 2: Cash on mine costs and unit costs



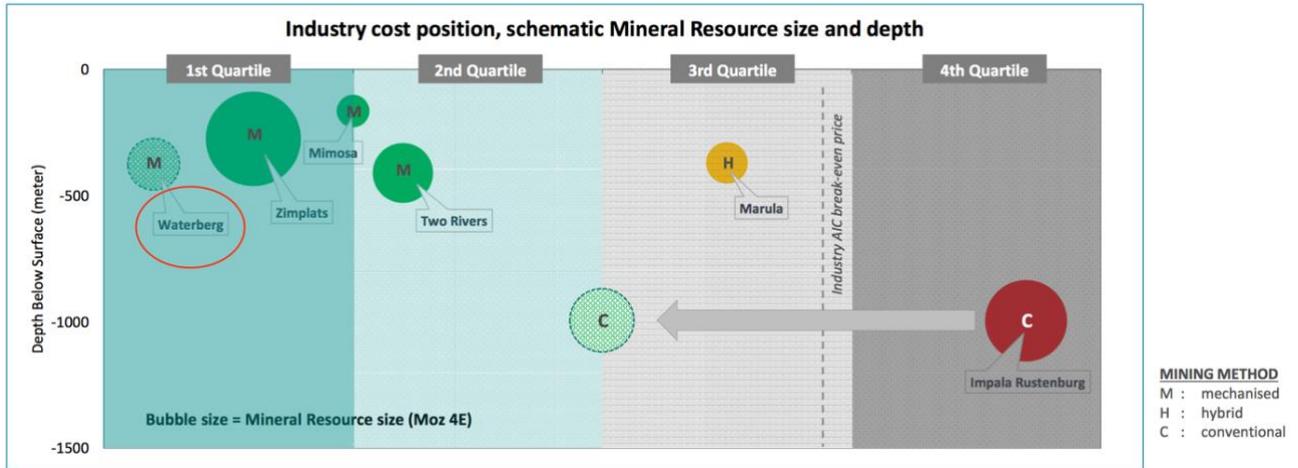
Source: Allan Gray report, June 2018.

The historic collapse in productivity for Impala Platinum sets the scene for the current strategic outlook of Impala Platinum and other South African PGM producers.

**Impala Platinum's strategy.**

Impala Platinum have been going to great lengths to signal their strategic plans which includes restructuring their Rustenburg operations by closing down the number of shafts in operation from 11 currently to 6 shafts by 2021. The intention is to close unprofitable mines and reduce the cost position of the remaining Rustenburg shafts. In the following figure, they

also highlight the position of the Waterberg project in which they currently own a 15% share.



Source: Impala Platinum, Impala Rustenburg Strategic Review.

**The end of shaft sinking?**

Speaking at the Indaba Mining Conference in 2018, Implats CEO Nico Muller suggested that the move to shallower, less labour intensive, safer and more cost-efficient mines means there is unlikely to be investment in new shafts going kilometres deep into the earth. Referring to the shallow mines owned by Anglo American Platinum and Northam Platinum in South Africa and by Impala Platinum in Zimbabwe, he argued that there is no way to justify the billions needed to sink another conventional deep-level mine in South Africa.

**Impala restructure – easier said than done?**

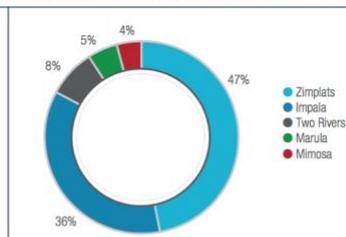
The case for restructuring seems strong but with the cost pressures faced by the South African mining industry, the case for the successful restructuring of the Rustenburg operations remains to be seen.

The following extract from Impala’s FY 2018 annual report illustrates the impact on platinum reserves from the review of Impala Rustenburg.

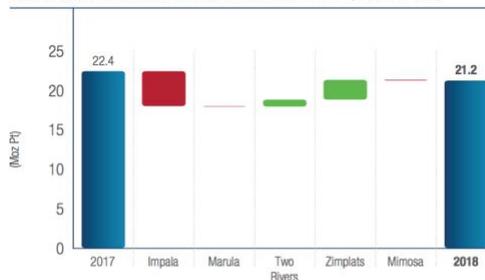
**Summary Mineral Reserves**  
(for more details see the separate Mineral Resource and Mineral Reserve Statement 2018)

Overall the attributable Group Mineral Reserve estimate decreased by 1.2Moz Pt to 21.2Moz Pt. The resultant estimate as at 30 June 2018 is based on a **material reduction at Impala** following the detailed review and also a material increase at Zimplats due to the conversion of some Upper Ores to Mineral Reserves. Furthermore the addition of the RE portion of Kalkfontein at Two Rivers had a positive impact on the combined Group Mineral Reserves. Some 47% of the attributable Group Mineral Reserves (Pt) is located at Zimplats and a further 36% at Impala.

**Attributable Mineral Reserves of 21.2Moz Pt** as at 30 June 2018



**Attributable Mineral Reserves** as at 30 June 2018 (variance Moz Pt)



Source: Impala Platinum’s FY 2018 annual report.

**16 Shaft: the deepest of the Impala mines.**

Interestingly, Impala Platinum also provide a breakdown of platinum reserves, illustrating the depth of reserves by mine. As highlighted by Impala Platinum, **‘the 16 and 20 shaft projects are critical to returning Impala Rustenburg to profitability.’** However, the 16-shaft reserve depth is at approximately 1.5km, where non-mechanised mining methods will continue to require considerable levels of labour, power and refrigeration.

The updated allocation of Implats’ Mineral Reserves per shaft infrastructure as at 30 June 2018 is depicted in the accompanying graphic illustration. The range below surface and quantum relating to the infrastructure is shown and depicts among others the advantage at Zimplats in this regard, both from a depth and a size perspective. This graph depicts the impact of the Rustenburg review where 1, 12 and 14 Shafts at Impala will cease mining in due course and also gives an indication of the potential impact of a possible further shaft closure in future should prices demand this.

**Platinum Mineral Reserve and depth range for individual Implats shafts** as at 30 June 2018



Source: Impala Platinum’s FY 2018 annual report.

On page 66 of the annual report Impala Platinum state;

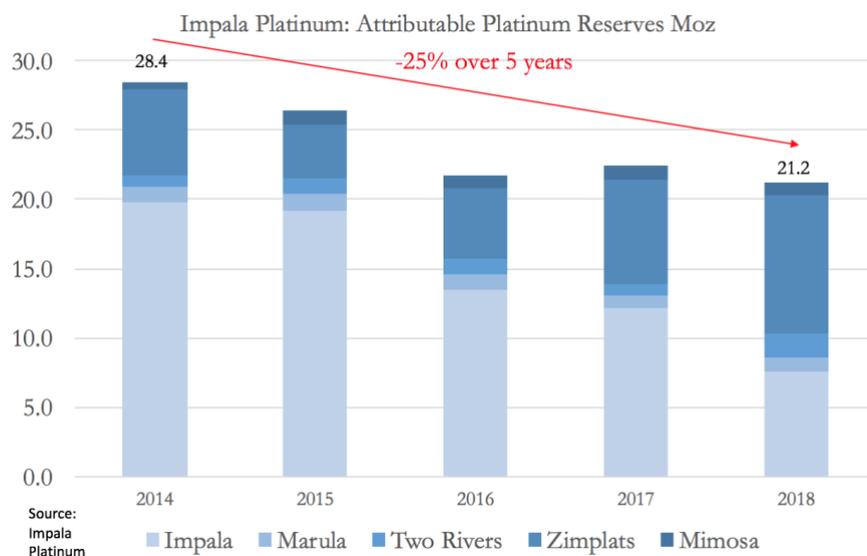
**Impala’s strategy defined.**

“Implats has previously highlighted several key strategic focus areas, including;

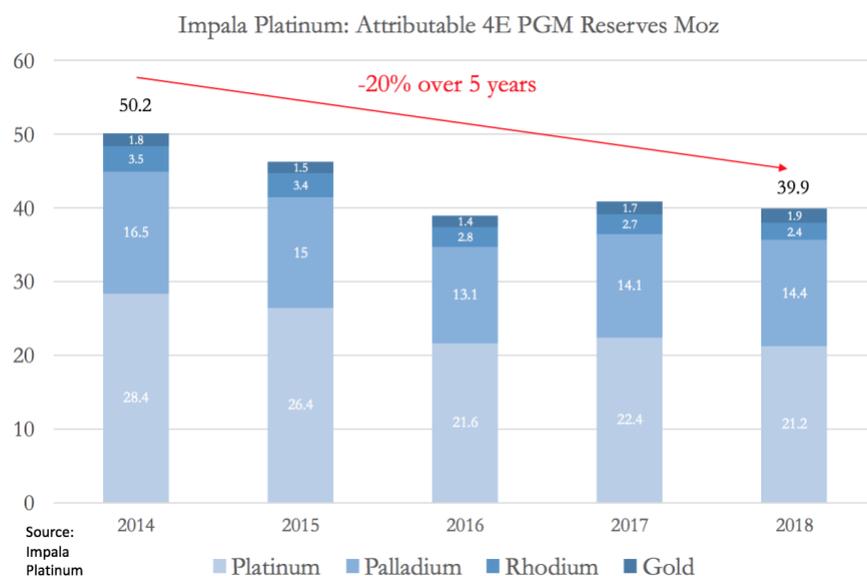
Enhancing the competitive position of the asset portfolio by;

- Eliminating loss-making production.
- Enhancing shareholder returns from Zimbabwean operations.
- **Growing exposure to low-cost mechanised and palladium focused operations.”**

With Waterberg representing a low-cost mechanised and palladium-biased project, just how important is Waterberg to Impala?



Implats’ platinum reserves have declined 25% over 5 years mainly due to declines at their Impala operations. This has been offset to some extent by reserve increases at Zimplats.



Total PGM 4E Reserves have also declined driven mainly by declines in platinum reserves. Palladium reserves have shown slower declines of -13% over the same period.

Impala Platinum’s reserve and resource statement makes the following comments regarding Waterberg;

“During the past year Implats secured a minority 15% interest in the Waterberg Joint Venture project (Waterberg JV Resources (Pty) Ltd) in the Limpopo province with the option to increase the Implats’ stake to 50.01%. **At year end the Mineral Resource estimate for the**

**Waterberg JV project was in progress and such attributable interest is not included in this report; the size of the attributable Mineral Resource is not material at the Implats Group level.”**

Impala Platinum’s 4E Resources amount to 243.9million ounces. The Waterberg Total 4E Resources amounts to 33.4million ounces. Impala Platinum’s 15% attributable share of the Waterberg project would be 5million 4E ounces and equates to 2% of their current resource. But Waterberg’s impact on Reserves could be quite different.

#### Attributable estimates

		2018	2017
Mineral Resources*	Moz Pt	133.8	191.6
	Moz 4E	243.9	360.4
	Mt	1 741	2 787
Mineral Reserves	Moz Pt	21.2	22.4
	Moz 4E	40.0	41.0
	Mt	365	358

\* Mineral Resource estimate is inclusive of Mineral Reserves.

In the October 2016 Pre-Feasibility Study (PFS), the technical report presents reserves of 12.3 million 4E ounces reported under South African Mineral Resource Committee (SAMREC) rules. (Note: Under SEC guidelines a final or feasibility study is required to report reserves.)

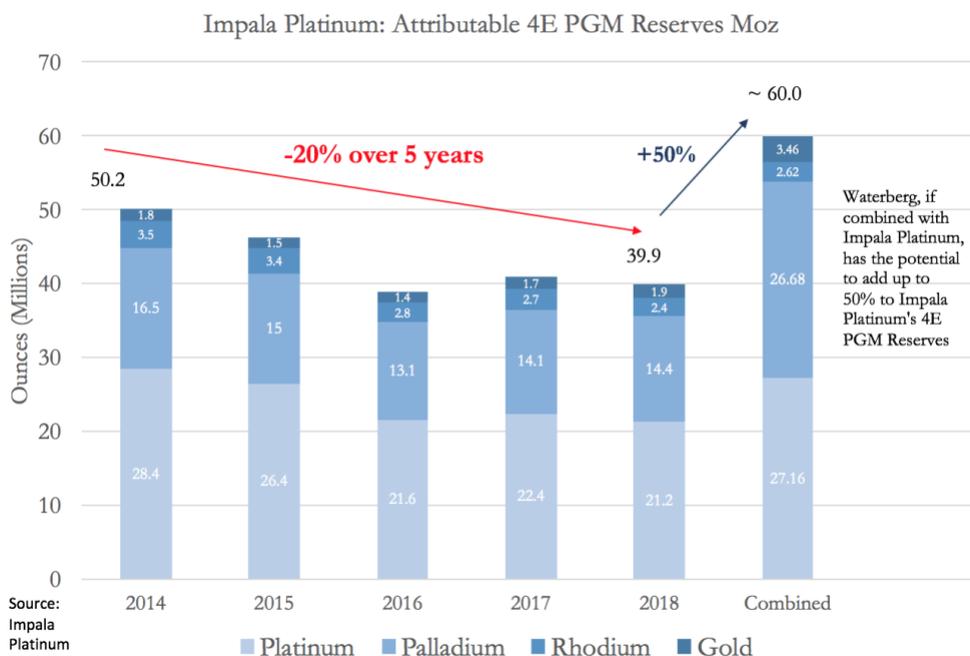
Waterberg PGM Project - Reserves											
	Cut-off		Grade							Metal	
	4E g/t	Tonnage t	Pt g/t	Pd g/t	Rh g/t	Au g/t	4E g/t	Cu %	Ni %	4E kg	4E Moz
T-Zone	2.5	16,500,000	1.14	1.93	0.04	0.83	3.94	0.16	0.08	65,097	2.1
F-Zone	2.5	86,200,000	1.11	2.36	0.04	0.13	3.69	0.07	0.16	318,007	10.2
<b>Total</b>	<b>2.5</b>	<b>102,700,000</b>	<b>1.11</b>	<b>2.29</b>	<b>0.04</b>	<b>0.29</b>	<b>3.73</b>	<b>0.08</b>	<b>0.15</b>	<b>383,103</b>	<b>12.3</b>

We think it’s likely that Platinum Group Metals, as part of the upcoming Definitive Feasibility Study (DFS), will be considering using **backfill operations** in conjunction with the potential mining methods described in the PFS. This has the potential to significantly increase the **resource to reserve conversion** seen in the PFS, as high-grade pillars become recoverable due to the backfill.

Waterberg PGM Project - Resources											
	Cut-off		Grade							Metal	
	4E g/t	Tonnage t	Pt g/t	Pd g/t	Rh g/t	Au g/t	4E g/t	Cu %	Ni %	4E kg	4E Moz
Measured	2.5	57,170,674	0.96	2.19	0.05	0.20	3.4	0.091	0.196	194,809	6.3
Indicated	2.5	185,314,816	0.99	2.11	0.05	0.22	3.37	0.100	0.177	624,498	20.1
<b>M+I</b>	<b>2.5</b>	<b>242,485,490</b>	<b>0.98</b>	<b>2.13</b>	<b>0.05</b>	<b>0.22</b>	<b>3.38</b>	<b>0.098</b>	<b>0.181</b>	<b>819,307</b>	<b>26.3</b>
Inferred	2.5	66,666,549	0.96	1.92	0.04	0.34	3.26	0.108	0.146	217,968	7.0
<b>Total</b>	<b>2.5</b>	<b>309,152,039</b>	<b>0.98</b>	<b>2.08</b>	<b>0.05</b>	<b>0.25</b>	<b>3.35</b>	<b>0.100</b>	<b>0.173</b>	<b>1,037,275</b>	<b>33.4</b>

If we assume that up to 75% of Waterberg’s 26.3million ounces of 4E (M&I) resources can be economically extracted using backfill then the reserve announced with the upcoming DFS could be of the order of 20mln ounces of 4E ounces.

If we consider the impact of 20million ounces of 4E reserve ounces to Impala Platinum’s current reserve statement then Waterberg could increase reserves by 50% if owned 100% by Impala Platinum.



Waterberg, if combined with Impala Platinum, has the potential to add up to 50% to Impala Platinum’s 4E PGM Reserves

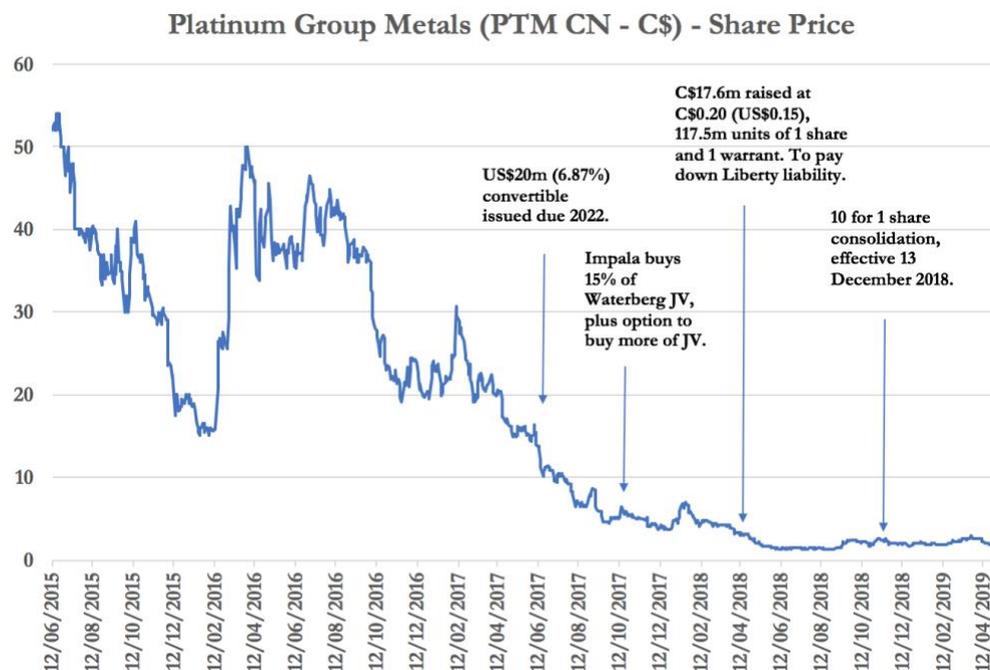
**Keeping the smelters full.**

Another consideration relates to Impala’s downstream infrastructure. Impala has smelter operating capacity in South Africa of 1,020,000 tonnes per annum. According to analysis by Investec Securities, by 2025 Implats will have spare smelter capacity of approximately 300k tonnes, sufficient to handle the 285k tonnes of concentrate produced each year by the Waterberg project.

**Table 15: Summary of excess capacity and steady state requirements by key projects in CY25E**

	Smelters	BMR	PMR-Pt	PMR-Pd
<b>Excess capacity</b>	<b>ktpa</b>	<b>Ni ktpa</b>	<b>koz pa</b>	<b>koz pa</b>
Amplats	381	6.2	1491	774
Implats	299	4.1	774	355
Lonmin	-21	1.1	151	130
Northam	46	-0.9		
<b>Total</b>	<b>705</b>	<b>10.6</b>	<b>2416</b>	<b>1259</b>
<b>Capacity requirement</b>	<b>ktpa</b>	<b>Ni ktpa</b>	<b>koz pa</b>	<b>koz pa</b>
Ivanplats	160	8.6	191	203
Waterberg	288	5.0	222	472
Wesizwe	90	2.4	261	117
Mogalakwena 600koz Pt	202	5.3	145	155
<b>Total</b>	<b>740</b>	<b>21.3</b>	<b>819</b>	<b>948</b>
<b>Surplus/(deficit)</b>	<b>-35</b>	<b>-10.7</b>	<b>1597</b>	<b>312</b>

Source: Company data, Investec Securities estimates

**Platinum Group Metals****As at May 7<sup>th</sup>, 2019;**

Shares currently outstanding: 33,741,961

Warrants: 12,285,716 (Strike US\$1.70). Expiry date: 15<sup>th</sup> November 2019.

Options/Restricted Stock Units (RSUs): 1,989,081

Fully diluted: 48,016,758

**Major shareholders:**

Hosken Consolidated Investments (HCI): 19.9%

Franklin Templeton: 17.0%

Liberty Mutual: 11.0%

**The largest shareholder.**

**Hosken Consolidated Investments (HCI: JSE)** raised their stake to 19.9% (6,525,389 shares) from 14.7% following the private placement announced 4<sup>th</sup> February 2019.

HCI is a South African black empowerment investment holding company with a US\$750 million market capitalization, listed on the JSE Securities Exchange. Its head office is located in Cape Town. HCI's major shareholder is the South African Clothing and Textile Workers Union. The group is involved in a range of investments including hotels and leisure, interactive gaming, media and broadcasting, transport, mining and properties.

**Balance Sheet:****PLATINUM GROUP METALS LTD.**Condensed Consolidated Interim Statements of Financial Position  
(in thousands of United States Dollars)

	February 28, 2019	August 31, 2018
<b>ASSETS</b>		
<b>Current</b>		
Cash	\$ 3,132	\$ 3,017
Restricted Cash – Waterberg	-	126
Marketable Securities (Note 3)	-	7,084
Amounts receivable	190	863
Prepaid expenses	200	226
<b>Total current assets</b>	<b>3,522</b>	<b>11,316</b>
Performance bonds	73	70
Exploration and evaluation assets (Note 4)	35,845	29,406
Property, plant and equipment	598	1,057
<b>Total assets</b>	<b>\$ 40,038</b>	<b>\$ 41,849</b>
<b>LIABILITIES</b>		
<b>Current</b>		
Accounts payable and other liabilities	\$ 3,720	\$ 3,572
Loan payable (Note 5)	43,780	-
<b>Total current liabilities</b>	<b>47,500</b>	<b>3,572</b>
Loans payable (Note 5)	-	42,291
Convertible notes (Note 6)	15,835	14,853
Warrant derivative (Note 8)	2,646	663
<b>Total liabilities</b>	<b>\$ 65,981</b>	<b>\$ 61,379</b>
<b>SHAREHOLDERS' EQUITY</b>		
Share capital (Note 7)	\$ 823,229	\$ 818,454
Contributed surplus (Note 7)	25,966	25,950
Accumulated other comprehensive loss	(158,881)	(159,742)
Deficit	(729,651)	(715,344)
<b>Total shareholders' deficit attributable to shareholders of Platinum Group Metals Ltd.</b>	<b>(39,337)</b>	<b>(30,682)</b>
Non-controlling interest	13,394	11,152
<b>Total shareholders' deficit</b>	<b>(25,943)</b>	<b>(19,530)</b>
<b>Total liabilities and shareholders' deficit</b>	<b>\$ 40,038</b>	<b>\$ 41,849</b>

Going Concern (Note 1)  
Contingencies and Commitments (Note 10)  
Subsequent Events (Note 13)

Approved by the Board of Directors and authorized for issue on April 12, 2019

/s/ Iain McLean  
Iain McLean, Director

/s/ Diana Walters  
Diana Walters, Director

The accompanying notes are an integral part of the condensed consolidated interim financial statements.

**Liberty's secured debt due October 31, 2019.**

**Debt:** As at February 28<sup>th</sup>, 2019, Approximately, US\$40mln was due to Liberty Metals & Mining (LMM) Holdings LLC (a subsidiary of Liberty Mutual Insurance) on October 31<sup>st</sup>, 2019. The actual interest rate is LIBOR plus 9.5%. The Current Loan Payable on the balance sheet shows US\$43.78m. This is because there are US\$2.8m of contingent brokerage fees that fall due on repayment of the debt.

The debt was initially drawn in November 2015. LMM have;

- 1) A first lien on the shares of PTM (RSA) held by the Company.
- 2) All current and future assets of the Company.

Interest will continue to accrue and be capitalized until the maturity date.

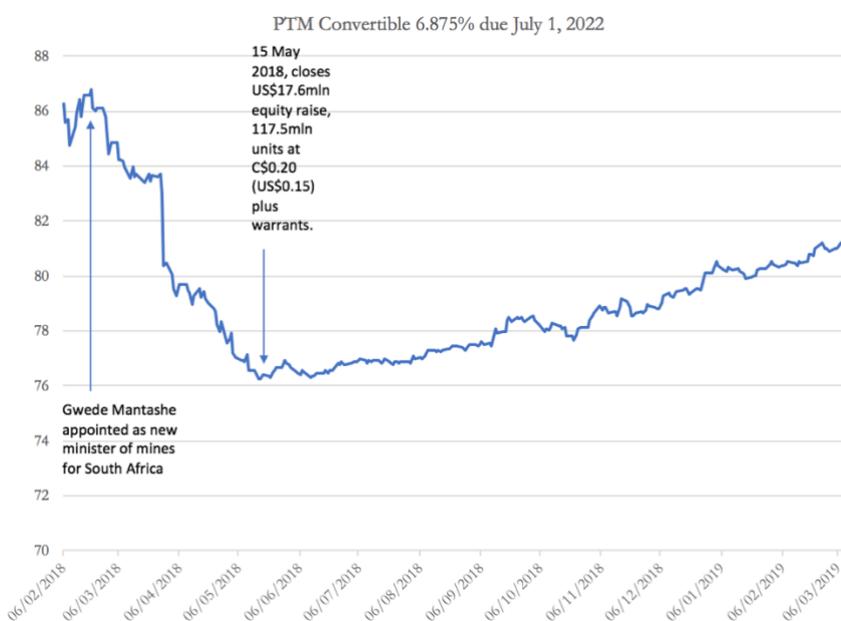
**Brokerage Fees**

There are certain brokerage fees that will become due when the Liberty loan is repaid in full. As these fees are contingent on the repayment of the debt they are grouped with the debt as follows:

LMM Facility	\$	40,978
Brokerage Fees		2,802
<b>Loan Payable</b>	<b>\$</b>	<b>43,780</b>

The Liberty loan is due October 31, 2019 with no payments owed until October 31, 2019. According to the financial statements released April 12<sup>th</sup>, 2019, 'the Company was not in default of any covenants on the LMM Facility at February 28, 2019.'

**Convertible Debt:**



Source: Bloomberg.

US\$20mln (**unsecured senior subordinated**) face value convertible debt issued on June 30, 2017, due on July 1, 2022. Interest rate payable 6.9% semi-annually (January 1<sup>st</sup> and July 1<sup>st</sup> each year). The notes will be

convertible at any time at the option of the holder, and may be settled, at the Company's election in shares.

Conversion terms: 1,001.1112 common shares per \$1,000 principal of convertible notes. (After share consolidation of 1 for 10 = 100.11112 common shares per \$1,000 principal of convertible notes.) Note: currently \$1,000 par value can convert into  $100.11112 * US\$1.98 = US\$198.22$  worth of shares, so currently out of the money.

The last three coupons paid in shares.

January 2, 2019 the Company issued 545,721 shares (post-consolidation) in settlement of US\$687,160 of bi-annual interest payable on \$19.99mln of outstanding Convertible Notes.

Warrants:



On May 15, 2018, 117.4mln units were issued as part of a capital raise of US\$17.6mln. Each unit included one warrant that entitles the holder to buy 1 common share at a price of US\$0.17 for a term of 18 months from the closing of the offering. The warrants are due to expire on November 15, 2019.

A share consolidation was announced November 20, 2018. One new share for ten old (1:10). Number of issued and outstanding shares reduced to 29.125mln from 291.259mln at the date of the consolidation. The number of common shares on a post-consolidation basis underlying the issued and outstanding warrants of the Company, including the warrants listed under the trading symbol "PTM.WT.U" and the exercise price thereof will be adjusted.

Therefore, warrant conversion price US\$1.70 and now 10 warrants needed to purchase one share. Warrants currently trading at

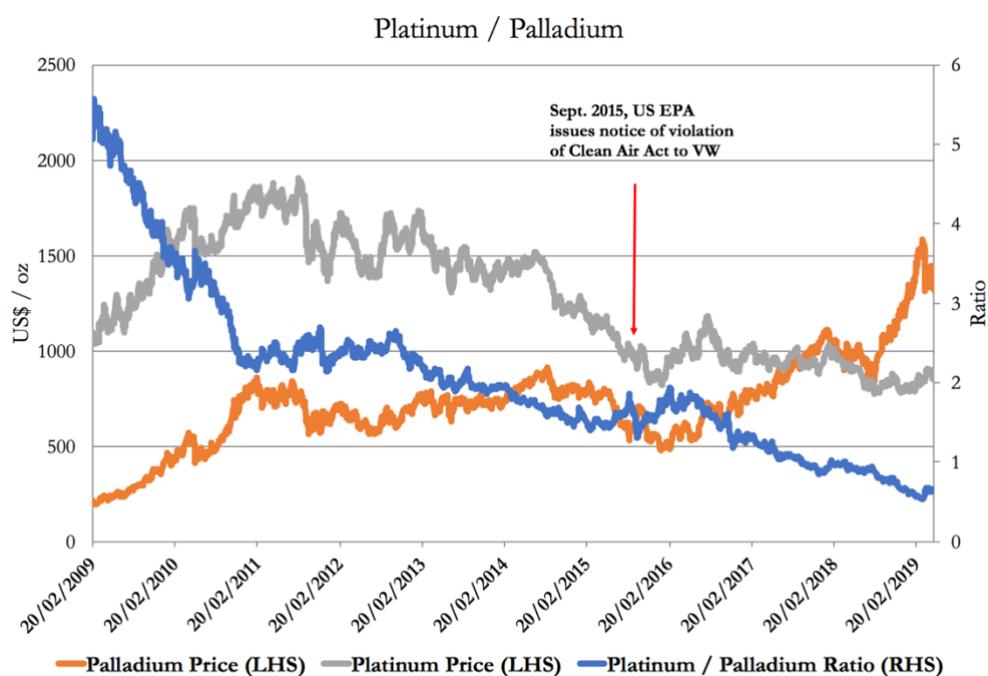
approximately US\$0.02. ( $10 * US\$0.02 = US\$0.20$ ). Platinum Group Metals (TSX) traded C\$2.63 (USDCAD: 1.33) = US\$1.98. Arbitrage available.

### Platinum and Palladium Prices

While the Waterberg project, in our opinion, makes robust economic sense at spot metal prices, investors still need to make assumptions about future metal prices.

#### **The platinum to palladium ratio.**

The following figure shows platinum and palladium prices (left axis) and the platinum/palladium ratio (right axis) that has moved from 5.5x in 2009 to under 0.7x currently.



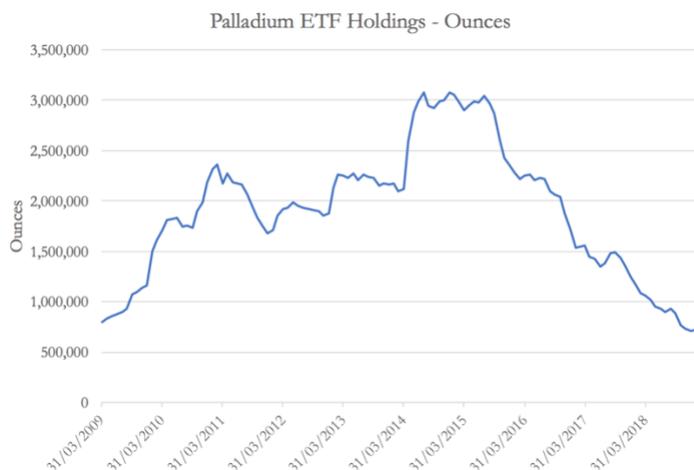
Source: Bloomberg

The car emissions announcement in September 2015 preceded a significant drop in the platinum/ palladium ratio as diesel vehicles using heavier platinum loadings have fallen out of favour.

#### **The palladium ETF outflows.**

When examining the physical holdings of palladium within Exchange Traded Futures (ETFs), the number of ounces held reached a peak in 2015 at approximately 3mln ounces. Since then, the holdings have steadily declined to approximately 720k ounces. The last time palladium holdings in ETF's were below 1million ounces was back in 2009. Interestingly this decline in ETF holdings coincided with a rise in palladium prices, possibly suggesting real demand.

### Palladium ETF Holdings



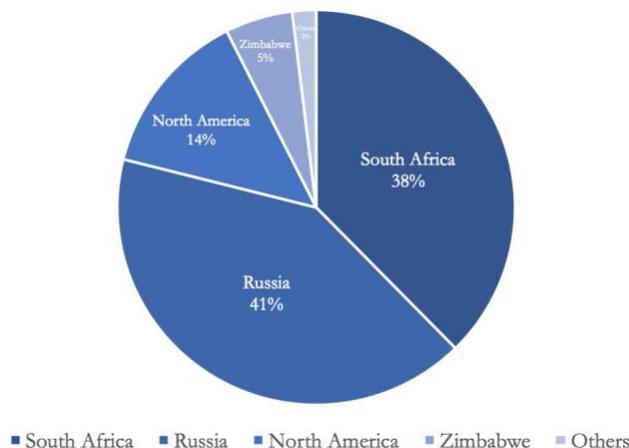
Source: Bloomberg

#### Russian and South African dominance.

Palladium supply and demand, as estimated by Johnson Matthey has remained stubbornly in deficit since 2013.

It's worth noting the significance of Russia in palladium mine supply which accounts for approximately 40% of global supply. This comes predominantly from Nornickel (formerly Norilsk Nickel).

Palladium Mine Supply by Country (2018)



Source: Johnson Matthey's PGM market report 2018.

#### Gokhran: The unknown element.

Gokhran is the Russian precious metals and gems repository. Founded in 1920, Gokhran is under the control of the Finance Ministry and frustratingly, its total reserves are a state secret. It is believed that Gokhran accumulated significant Palladium supplies during the Soviet era but is believed to have sold down holdings over recent times. Nothing is known for sure which makes analysis difficult.

In addition to the sentiment issue relating to diesel, it's worth considering the palladium requirements for hybrid vehicles, which require between 2-6g of PGM content with a 1:4 (Pt:Pd) ratio.

	Gasoline	Diesel	Hybrids
PGM Content (g/vehicle)	2-5 g	3-6 g	2-6g
Pt:Pd ratio	1:4	8:1	1:4

Source: Nornickel presentation

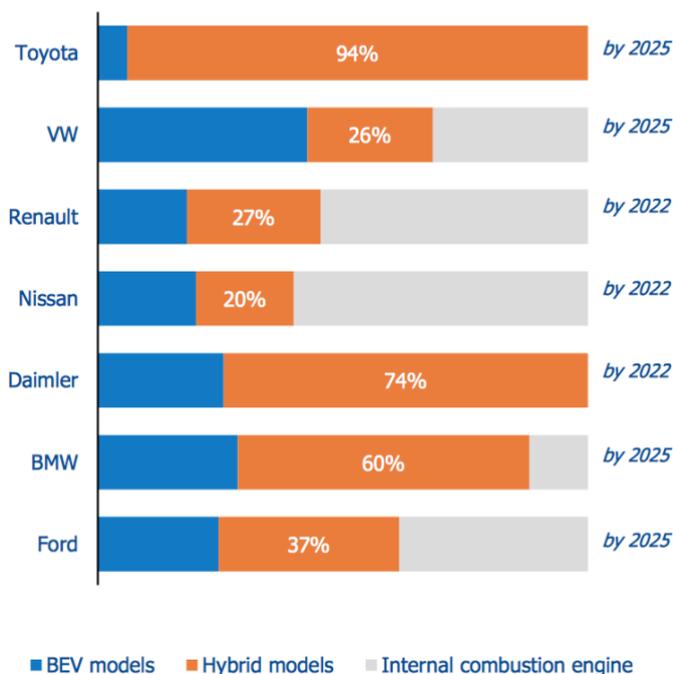
**Hybrids: a key demand driver for palladium.**

According to SFA Oxford, **hybrid vehicles contain 10-15% more palladium than conventional gasoline vehicles.**

Hybrids appear to dominate the production schedule of major automakers for the next five years.

### Automakers' Plans: Hybrids and Internal Combustion Engines to Dominate

*LV production*



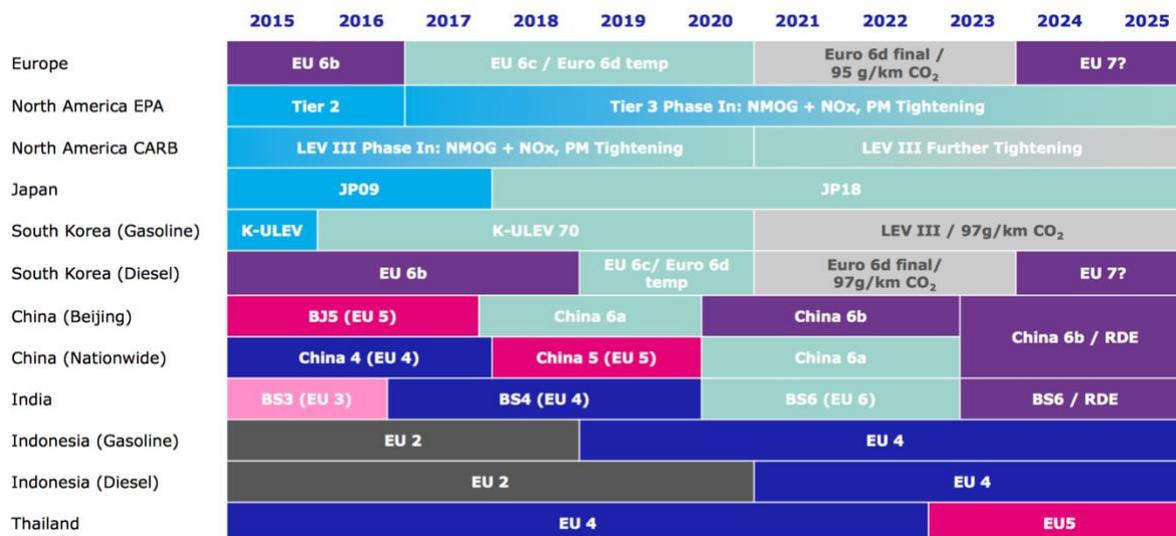
Source: Nornickel presentation.

**Increasing environmental regulation.**

**China 6** emissions regulation for light duty vehicles is being implemented in two stages. China 6a regulation comes into effect in July 2020 and China 6b in July 2023. The regulation sets fuel-neutral emissions limits for key pollutants; Carbon Monoxide (CO), Total Hydro Carbons (THC), Nitrogen Oxides (NOx), Particulate Matter (PM), Particulate Number (PN), and Nitrous Oxide (N2O).

The Chinese regulation also introduces Real-world Driving Emissions (RDE) testing based on the European RDE regulation that started in 2016. These Real-world Driving Emissions testing are seen as confirming the emissions compliance of vehicles that have previously been subjected to laboratory-testing conditions.

The following slide from Johnson Matthey summarises the roadmap of emissions regulation globally.

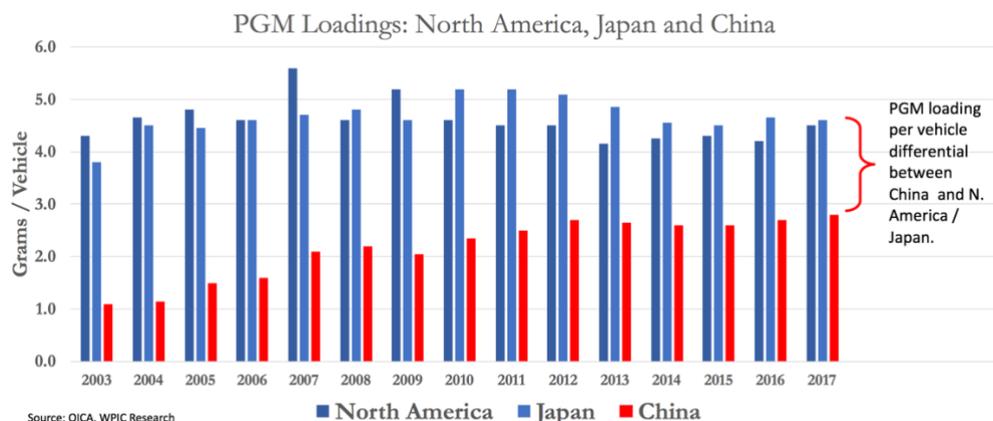


Source: Johnson Matthey clean air presentation, July 13,2018.

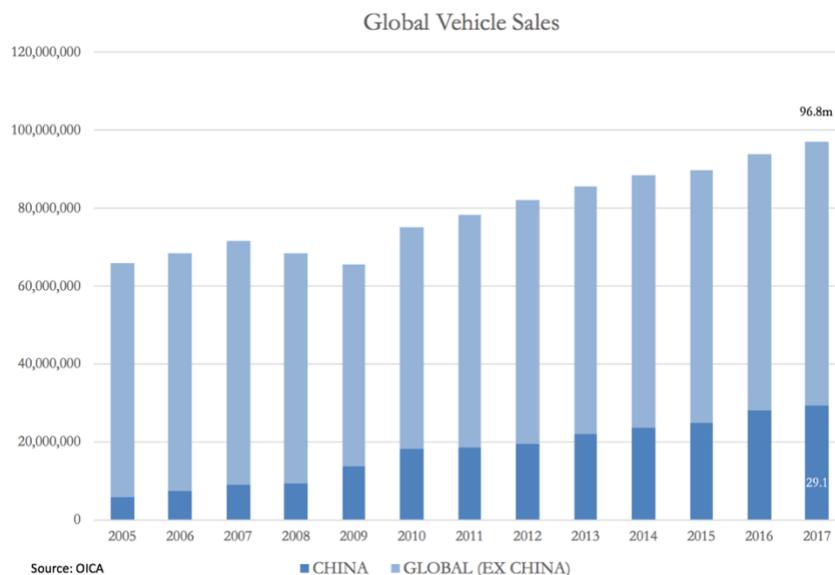
As can be seen, **China 6a** comes into effect **nationwide** in 2020. In Johnson Matthey’s February 2019 PGM report they point out;

‘The transition of **China 6** will result in a **step-change in palladium and rhodium loadings** compared to current China 5 systems; when RDE testing is rolled out, this is expected to result in further increases in the pgm content of catalyst systems. The exact requirements for RDE are not yet known, but it is likely to be extremely challenging to meet, **as China 6b emissions limits are even tighter than Euro 6 standards.**’

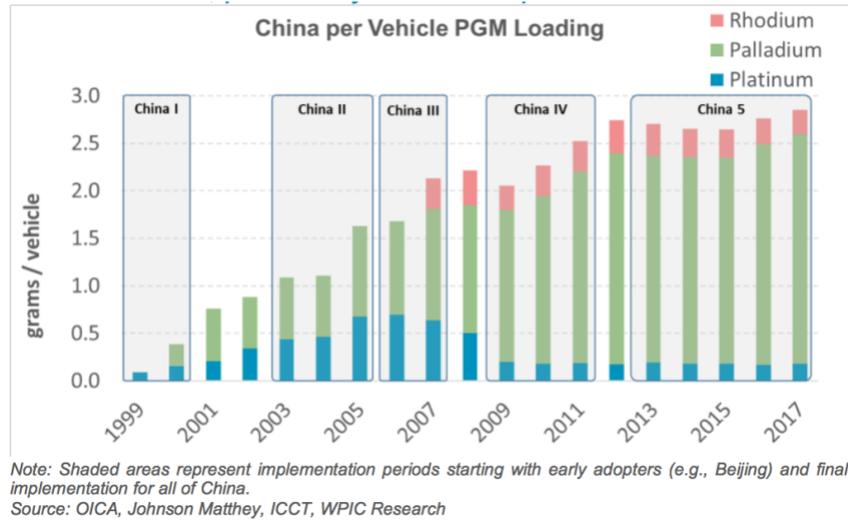
PGM loadings in vehicles in China are currently about a third lower than in North America and Japan as shown in the figure below.



The disparity between China and the Rest of The World is important due to China’s share of global vehicle sales. According to the data from the International Organisation of Vehicle Manufacturers (OICA), China accounted for 30% of global vehicle sales in 2017.



For Chinese automakers to achieve compliance with China 6 regulation, it appears likely that they will have to close the gap in PGM loadings. According to Johnson Matthey / OICA data, PGM loadings in China are already dominated by palladium (see figure below).



**The implications of China 6.**

So, what does China 6 mean in terms of potential palladium demand? First let’s assume that China 6 emissions regulation requires higher PGM loadings for Chinese vehicles and let’s assume that loadings per vehicle increase from approximately 3 grams per vehicle to 4 grams per vehicle. Then, using OICA vehicle data, let’s assume that all 29.1million vehicles require increased PGM loadings, based on the current PGM mix that is approximately 90% palladium. An increase in PGM loadings of 1g / vehicle multiplied by 29.1mln vehicles = 29,100,000 grams of PGM. Assuming 90% of this is palladium = 26,190,000 grams. Converting to ounces by dividing by 31.1 grams per ounce equals 842,122 ounces of palladium. German catalyst manufacturer BASF, also forecasts China light duty vehicles increasing consumption of PGMs significantly over the next few years. Specifically, they forecast palladium requirements increasing by 986,000 ounces of palladium **per annum** by 2021.



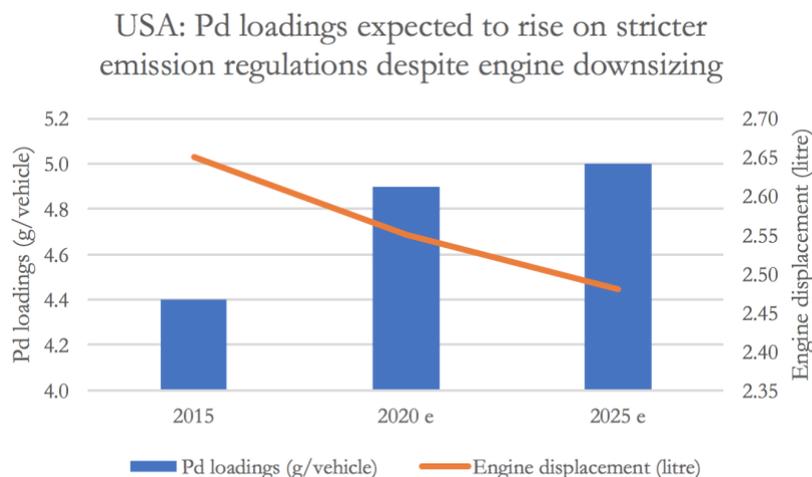
This additional demand is in a market already in deficit and with only 7mln ounces of annual mine supply.

## 02. China air quality focus brings legislation which doubles sales value per vehicle



Source: Johnson Matthey Capital Markets Day presentation.

Nornickel see increasing PGM loadings in North American gasoline light duty vehicles.

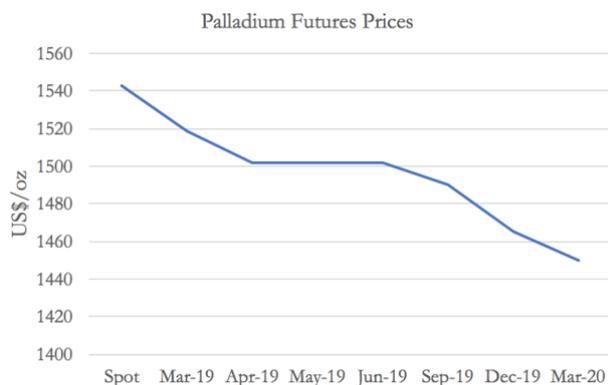


Source: Nornickel

The demand drivers for palladium appear to be present and supply, other than recycling seems to be constrained.

Palladium futures price has been exhibiting ‘normal backwardation’ since May 2017, potentially suggesting real demand since the futures trade often trades in ‘contango’ to account for the cost of storage. This is the shape of the forward curve currently.

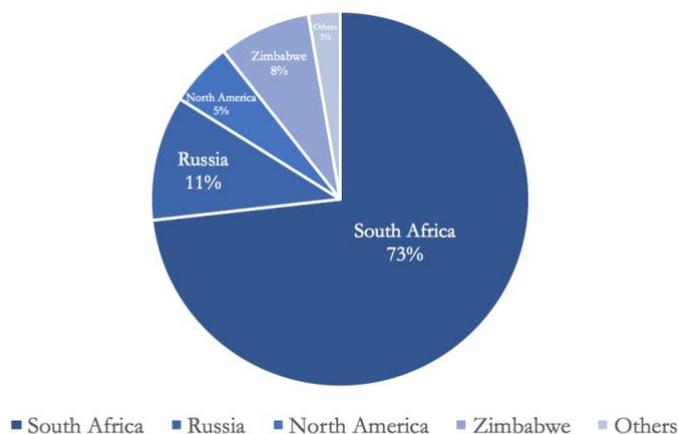
**Normal backwardation in the palladium futures market suggesting real**



Source: Bloomberg.

Platinum moves from a deficit in 2014 of 730,000 oz to a surplus of 498,000 oz (estimate) in 2018. Demand for platinum from auto-catalysts has shown a moderate decline from 3,244,000 oz in 2015, when the emissions scandal broke, to 3,052,000 in 2018 (estimate). Total mine supply saw a large jump in 2014 to 2015 but has remained steady since then. Jewellery demand has seen a significant decline since 2014, from 2,839,000 oz to 2,363,000 oz in 2018 (estimate). Recycling of auto-catalysts has increased from 2014 to 2018.

Platinum Mine Supply by Country (2018)



Source: Johnson Matthey's PGM market report 2018.

**North American Palladium**

**Palladium supply from North America.**

Analysing the options for palladium supply requires a look at the company North American Palladium, which operates the Lac des Iles palladium mine in Ontario, Canada.

In FY 2018, North American Palladium produced 237,000 oz of palladium, 16,000 oz of platinum, 15,800 oz of gold and 4.5mln lbs of copper. Approximately 84% of FY revenue was derived from palladium and the company reported a cash cost per ounce of palladium produced of US\$531/oz.

The company’s resource statement (see below) shows the significant grade bias towards palladium.

**Table 1-1: Summary of Mineral Resources Classified by Geological Association for the Lac des Iles Mine Property**

Resource Name	Category	Tonnes ('000s)	Pd (g/t)	Pt (g/t)	Au (g/t)	Cu (%)	Ni (%)	Contained Pd ('000 oz)
Offset Block	Mea&Ind	28,327	2.95	0.255	0.229	0.08	0.10	2,682
Roby Block	Mea&Ind	41,255	1.69	0.192	0.12	0.05	0.05	2,235
Stockpile	Mea&Ind	3,399	0.97	0.120	0.08	0.03	0.06	106
<b>Total</b>	<b>Mea&amp;Ind</b>	<b>72,982</b>	<b>2.14</b>	<b>0.213</b>	<b>0.16</b>	<b>0.06</b>	<b>0.07</b>	<b>5,024</b>
	Inferred	8,235	2.22	0.216	0.146	0.06	0.07	-

**Notes:**

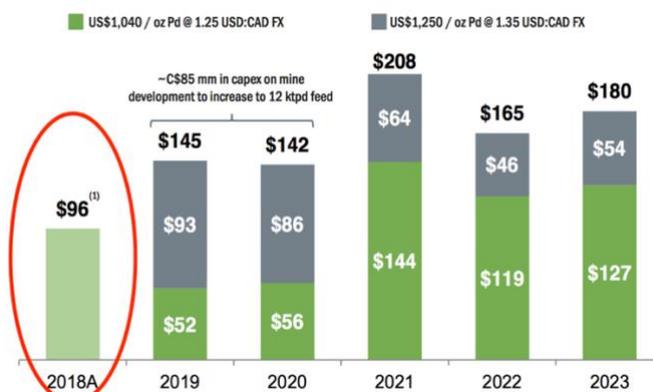
MEA = Measured Resource. IND = Indicated Resource. The effective date of Mineral Resources is July 4, 2018. Mineral Resources are inclusive of Mineral Reserve and reflect depletion from mining activities to July 1, 2018. The Mineral Resource estimates were made by Denis Decharte, P. Eng., Chris Roney, P.Geo., and Dave Peck, P.Geo., all of whom are Qualified Persons under NI 43-101.

For FY 2018, North American Palladium reported cash flows from operations of approximately C\$100m although after cash flows needed for investing and cash flows used in financing the net change in cash was minimal.

In Millions of CAD except Per Share	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Cash from Operating Activities	-73.8	31.6	55.2	6.5	-52.9	-14.1	-15.0	85.4	102.0
Cash from Investing Activities	-48.6	-146.4	-144.7	-108.3	-23.6	-31.6	-39.2	-60.5	-51.9
Cash from Financing Activities	99.2	90.6	59.2	91.4	70.8	52.8	58.0	-28.8	-48.9
Net Changes in Cash	-23.1	-24.3	-30.8	-10.4	-5.7	7.1	3.8	-3.9	1.2

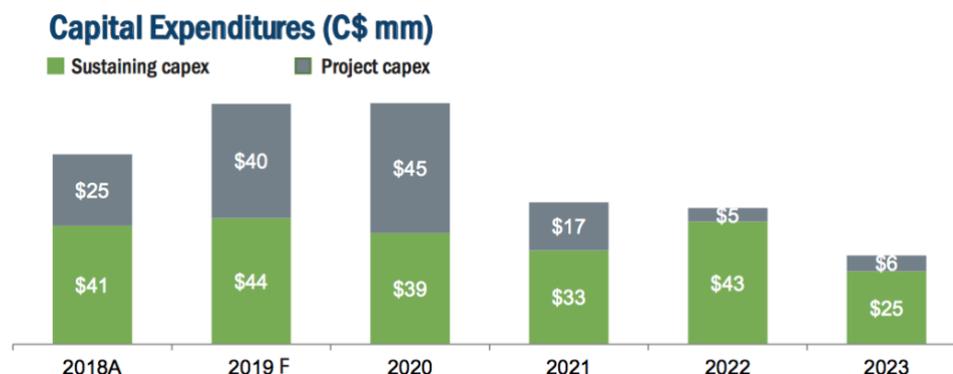
Source: Bloomberg

Going forward, the company forecasts significant levels of operating cash flow based on US\$1,250 / oz palladium prices. (See slide below).



Source: NAP Presentation, March 2019.

From the same presentation, the company also forecasts capital expenditure requirements as follows;



Source: North American Palladium Presentation, March 2019.

Based on these company estimates North American Palladium has the potential to yield approximately C\$200m in free cash flow in FY 2021.

Free Cash Flow Estimates	FY 2019	FY 2020	FY 2021
Cash Flow From Operations (CFO)	150	150	250
Capex (Total)	84	84	50
Free Cash Flow *	66	66	200
Free Cash Flow % Yield	10%	10%	30%

Free Cash Flow to Firm (FCFF) = CFO + Interest (1-t) - Capex  
Assuming no debt, formula used FCFF = CFO - Capex

A couple of things to also consider; By 2021, the mine life would be down to 5 years, based on the Lac Des Iles mine plan from the recent North American Palladium prospectus.

Lac Des Iles mine plan to 2026:

**Summary of Capital Costs – LDI Mine – Life of Mine:**

	2018 H2	2019	2020	2021	2022	2023	2024	2025	2026	Total
H2 2018 Forecast	22,164	-	-	-	-	-	-	-	-	22,164
Project Capital	-	40,456	45,455	16,782	4,830	5,533	14,956	10,325	3,410	142,578
Sustaining Capital	-	36,181	38,820	32,769	42,785	25,465	44,724	35,436	5,040	282,553
<b>Total</b>	<b>22,164</b>	<b>76,637</b>	<b>84,275</b>	<b>49,551</b>	<b>47,615</b>	<b>30,997</b>	<b>59,681</b>	<b>45,761</b>	<b>8,450</b>	<b>425,131</b>

Source: North American Palladium Prospectus, April 2019.

The other consideration, is that Brookfield have recently lowered their shareholding from 91% to 81%. Whether this might signal the beginning of an exit strategy for Brookfield, remains to be seen.

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**Conclusion:**

Analysis of Platinum Group Metals' Waterberg project indicates a **robust, economically-feasible** project. The **shallow ore body** and potential for **mechanisation** suggests that the project will be amongst the **lowest cash-cost producers** of PGMs globally, offering a strategically attractive mine, through all stages of the mining cycle.

The South African PGM industry, particularly the deep underground mines, have struggled to control costs over the last decade. The Western and Eastern limbs have seen production curtailments, with further supply likely to be lost as more unprofitable mines are closed.

Impala Platinum is addressing the cost issues at several poorly performing operations and is facing up to the politically difficult task of closing operations where necessary. With production and reserve losses from mine closures, Impala Platinum is understandably looking to the future and considering how to keep their smelters full. Their acquisition of a 15% stake, with an option to go to 50.01%, makes logical sense from a strategic perspective. **The upcoming publication of the Waterberg DFS will start a 90-day period in which Impala Platinum have the option to increase their stake by committing US\$130mln to the Waterberg JV and securing project financing.**

A key attraction of the Waterberg project is the significant palladium content – 61% by prill split. Our analysis suggests that the growth in **hybrid vehicles**, containing 10-15% more palladium than conventional gasoline vehicles, and the **increasing regulatory environment** (China 6) will sustain demand for the metal at a time where supply appears constrained. Real Driving Emissions (RDE) tests coming into force in Europe and included within China 6 regulation increases the burden on auto-catalyst performance. Automakers can ill-afford to fall foul of these tests.

Investors must make their own decision about future metal prices. The significant rise in palladium prices would intuitively warrant caution. However, the supply and demand fundamentals for palladium seem to suggest an ongoing deficit **exacerbated by the growing demand from hybrid vehicles**. The key challenge to prices appears to be the ability to substitute out palladium in favour of platinum within auto-catalysts. This remains to be seen, but while the Waterberg project is dominated by palladium, platinum still represents 30% by prill split, offering a level of protection from this type of substitution.

Based on NPV, Platinum Group Metals' share of the Waterberg project (currently 50.02% effective interest) appears significantly undervalued by the market.

REPORT END

**APPENDIX:**

# Palladium Supply & Demand

Troy ounces

		PALLADIUM '000 oz - Supply and Demand					
		2013	2014	2015	2016	2017	2018
		2018 numbers are a forecast					
<b>Supply<sup>1</sup></b>	South Africa	2,464	2,126	2,683	2,570	2,550	2,590
	Russia <sup>2</sup>	2,628	2,589	2,434	2,773	2,406	2,840
	North America	831	912	874	892	886	939
	Zimbabwe <sup>3</sup>	322	327	320	396	386	378
	Others <sup>3</sup>	152	160	144	129	133	133
	<b>Total Supply</b>	<b>6,397</b>	<b>6,114</b>	<b>6,455</b>	<b>6,760</b>	<b>6,361</b>	<b>6,880</b>
<b>Demand<sup>4</sup></b>	Autocatalyst <sup>4</sup>	7,069	7,517	7,649	7,951	8,428	8,655
	Chemical	378	315	452	418	462	493
	Dental	457	464	468	430	392	380
	Electrical <sup>4</sup>	1,017	970	903	872	842	828
	Investment	-8	943	-659	-646	-386	-555
	Jewellery <sup>4</sup>	354	272	222	191	173	166
	Other	109	111	134	155	136	154
	<b>Total Gross Demand</b>	<b>9,376</b>	<b>10,592</b>	<b>9,169</b>	<b>9,371</b>	<b>10,047</b>	<b>10,121</b>
<b>Recycling<sup>6</sup></b>	Autocatalyst	-1,899	-2,159	-1,882	-1,989	-2,399	-2,720
	Electrical	-463	-474	-475	-481	-479	-478
	Jewellery	-157	-89	-46	-21	-21	-14
	<b>Total Recycling</b>	<b>-2,519</b>	<b>-2,722</b>	<b>-2,403</b>	<b>-2,491</b>	<b>-2,899</b>	<b>-3,212</b>
<b>Total Net Demand<sup>7</sup></b>	<b>6,857</b>	<b>7,870</b>	<b>6,766</b>	<b>6,880</b>	<b>7,148</b>	<b>6,909</b>	
<b>Movement in Stocks<sup>8</sup></b>	<b>-460</b>	<b>-1,756</b>	<b>-311</b>	<b>-120</b>	<b>-787</b>	<b>-29</b>	

Source: Johnson Matthey, February 2019 PGM report.

# Platinum Supply & Demand

Troy ounces

		PLATINUM '000 oz - Supply and Demand						
		2018 numbers are a forecast						
		2013	2014	2015	2016	2017	2018	
<b>Supply<sup>1</sup></b>	South Africa	4,208	3,546	4,572	4,392	4,449	4,471	
	Russia <sup>2</sup>	736	700	670	717	703	657	
	North America	318	339	314	337	328	335	
	Zimbabwe <sup>3</sup>	410	401	400	489	466	480	
	Others <sup>3</sup>	174	167	151	162	159	165	
	<b>Total Supply</b>	<b>5,846</b>	<b>5,153</b>	<b>6,107</b>	<b>6,097</b>	<b>6,105</b>	<b>6,108</b>	
<b>Demand<sup>4</sup></b>	Autocatalyst <sup>4</sup>	2,937	3,064	3,244	3,342	3,218	3,052	
	Chemical	522	576	502	476	490	550	
	Electrical <sup>4</sup>	219	225	228	230	230	273	
	Glass	102	143	227	247	366	466	
	Investment	871	277	451	620	361	89	
	Jewellery <sup>4</sup>	2,984	2,839	2,746	2,412	2,400	2,363	
	Medical and Biomedical <sup>5</sup>	217	214	215	217	220	224	
	Petroleum	146	172	140	175	233	311	
	Other	419	434	443	461	483	497	
		<b>Total Gross Demand</b>	<b>8,417</b>	<b>7,944</b>	<b>8,196</b>	<b>8,180</b>	<b>8,001</b>	<b>7,825</b>
	<b>Recycling<sup>6</sup></b>	Autocatalyst	-1,199	-1,272	-1,110	-1,164	-1,292	-1,403
Electrical		-24	-27	-29	-32	-34	-36	
Jewellery		-790	-762	-574	-738	-746	-776	
	<b>Total Recycling</b>	<b>-2,013</b>	<b>-2,061</b>	<b>-1,713</b>	<b>-1,934</b>	<b>-2,072</b>	<b>-2,215</b>	
	<b>Total Net Demand<sup>7</sup></b>	<b>6,404</b>	<b>5,883</b>	<b>6,483</b>	<b>6,246</b>	<b>5,929</b>	<b>5,610</b>	
	<b>Movement in Stocks<sup>8</sup></b>	<b>-558</b>	<b>-730</b>	<b>-376</b>	<b>-149</b>	<b>176</b>	<b>498</b>	

Source: Johnson Matthey, February 2019 PGM report.

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