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*[10 minute read]*

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UNION SECURITIES INTERNATIONAL

## The Platinum Group Metals

**Catalysts for a cleaner planet.**

Platinum, Palladium, Rhodium, Ruthenium, Osmium and Iridium. These are the platinum metals - close your eyes and attempt to read that list back. If you remembered four out of six you did well. Readers who have used lockdown to start a collections of spark plugs, crucibles and pen nibs will have learned the limited practical applications of those last three. Tiny volumes and more at home in a science lab -: they're better suited to trivial pursuit questions than investment debate. To bypass all the chat around 33 companies, here are the answers.

### Conclusion :

amongst the listed company names, we underline three :

- 1) Sibanye Stillwater (\$16.07)    2) Generation Mining (c\$0.80)    3) Chalice Gold (A\$4.35)**

## SUMMARY – the basics.

**Iridium** (2<sup>nd</sup> densest) and **Osmium** (the densest) are found in high concentrations on asteroids but are both quite scarce on earth. They are by-products of nickel (or copper) mining and neither have many applications as a pure metal. Iridium may find itself bonding with platinum for a new proton exchange membrane (PEM) electrolyser, part of the EU's green hydrogen master plan. Osmium metal is available only after Herculean efforts to extract it from super-heated powders into beads. As the gift to that spoilt friend with everything, it could work well. If you're on a budget and still short of bitcoin, order the sintered variety. Avoid posting the tetroxide version by mistake.

**Ruthenium** is handy for hardening its platinum and palladium siblings. Also used to boost data storage capacity in hard disk drives. It sounds a bit like Rhenium which has similar PGM properties and is a superalloy essential to the production of jet engine turbine blades. It should be included in the list of 9 **noble** metals which consist of the six platinum names plus gold and silver. Since great materials science is at the heart of the green revolution, it's worth simply recognising the processing limitations that exist in order to meet some of the more ambitious targets for the new economy. Proven rhenium reserves are only around 2500 tonnes compared to say 2 billion tonnes of titanium. It's an excellent starting point for the economic blueprint which assumes scaled access to a whole group of refractory metals including molybdenum, tungsten, niobium and tantalum.

Translating all this processing and metallurgical expertise into commercially viable volumes turns out to be an investment headache. Lots of brilliant aerospace and automotive applications do seem to be at risk of supply chain bottlenecks. For the scarcer metals, a tripling of the price won't do much for supply as the cost of extraction and separation can involve ruinous capex bets. It occurs to us that much of the processing skill required in the industrial use of precious metals is at odds with the glamour of the underlying material. Johnson Matthey plc is a huge store of metallurgical capabilities but its recent growth profile highlights the challenge of servicing multiple specialist product lines. Similar dynamics are at work in the rare earths market where the hoopla and racy investment profile are largely an illusion. As with high cost low volume specialist metals, rare earth processors find they can't just cherry pick the in vogue heavy earths like praseodymium or neodymium. They have to work with the whole group. US efforts to rebalance the Chinese processing advantage is taking a curiously long time.

The investor focus has to be on platinum and palladium. With a just a few asides on rhodium.

**Rhodium** has been a 30 bagger in five years and was trading at \$21,300 per troy ounce last week : thanks *metals daily* for the pricing guide. A familiar story with the auto sector consuming 85% of the roughly 25 tonnes a year produced. It's on a roll at the moment in part thanks to a 16% supply hit triggered by the Amplats processing facility outage. It's a metal in a near permanent state of deficit and of course the pricing process is on a need to know basis. There was a 40,000 oz shortfall in 2019 and last year was slightly greater.

Trillionaires eyeing up rhodium might replay the Bunker Hunt manoeuvre although cornering it might take longer than two months without a futures market. The wholesale market value this year is strangely similar to silver. In theory at least. But whereas the planet will mine 850 million ounces of silver worth \$26 or so this year, it will produce only 850 thousand ounces of rhodium. By approximation and sleight of maths, that's a mere thousandth of the task. A good place to start the collection would be on Tuvalu. This South Sea paradise and its capital, Funafuti, is an Aussie dollarized economy within the British Commonwealth. Ignore the paper dollars and seek out the South Sea Dragons. These are quite rare but it shouldn't take long to corner most of the 1000 in existence. Each coin contains 1 oz of pure rhodium and of course, comes with Her Majesty QEII stamped on one side. You can take possession of a better quality type of QE and not lose sleep over any kind of South Sea bubble developing here. When travel restrictions ease, a single coin will cover the cost of four of you flying first class return with Fiji Airlines.



That 1 oz rhodium coin

	tonnes	mm troy ozs	\$price oz	\$million market
gold	3300	105	1900	<b>199,500</b>
silver	25000	850	26	<b>22,100</b>
palladium	311	10	2350	<b>23,500</b>
rhodium	25	0.80	21000	<b>16,879</b>
platinum	250	8	1070	<b>8,560</b>
ruthenium	36	1.15	250	<b>288</b>
iridium	3	0.10	2800	<b>272</b>
osmium	1	0.03	400	<b>13</b>



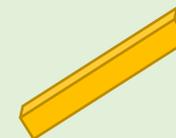
**Figure 1 :**

2020 metals production data :

Global 2020 production numbers by tonnes and ounces. Wholesale or implied trade values of metal transacted is only new supply.

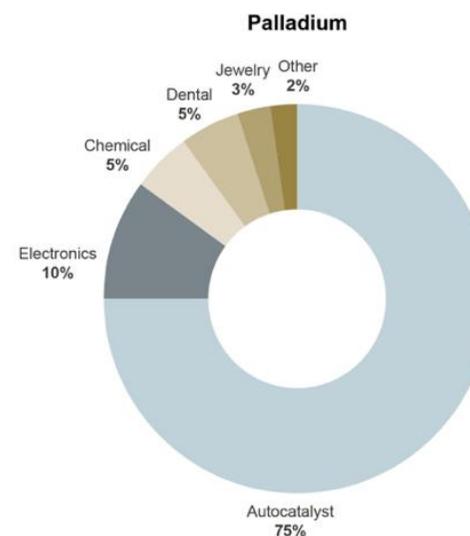
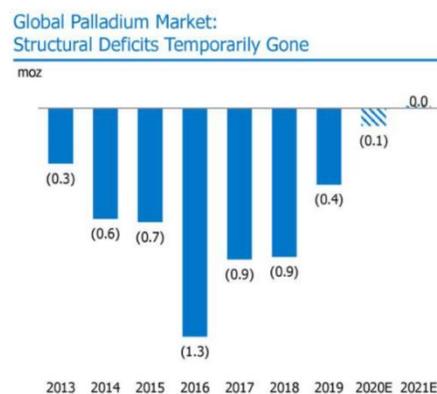
Economic values and investment assumptions should be viewed alongside above ground inventories, otc derivatives, ETF's, jewellery collections and Central Bank Reserve holdings.

## Palladium or Platinum ?



The vast majority of palladium, more than 80%, is used in catalytic converters that turn toxic gases like carbon monoxide and nitrogen dioxide, into less harmful nitrogen, carbon dioxide, and water vapour.

The tricky-to-calculate supply-demand economics of the two key metals creates an excellent framework for various *what if* scenarios. Structural deficits look to be easing for palladium, or so say a couple of prominent refiners. A 680,000 oz deficit in 2019 contrasted with only a 30,000 ounce deficit last year. Global auto sales units are unlikely to shift out of a 70 to 90mm annual unit rate any time soon but the hydrogen economy has a growing impact on perception. Pricy palladium may see its premium to platinum eroded but anything above \$2000 an ounce is very profitable for producers.

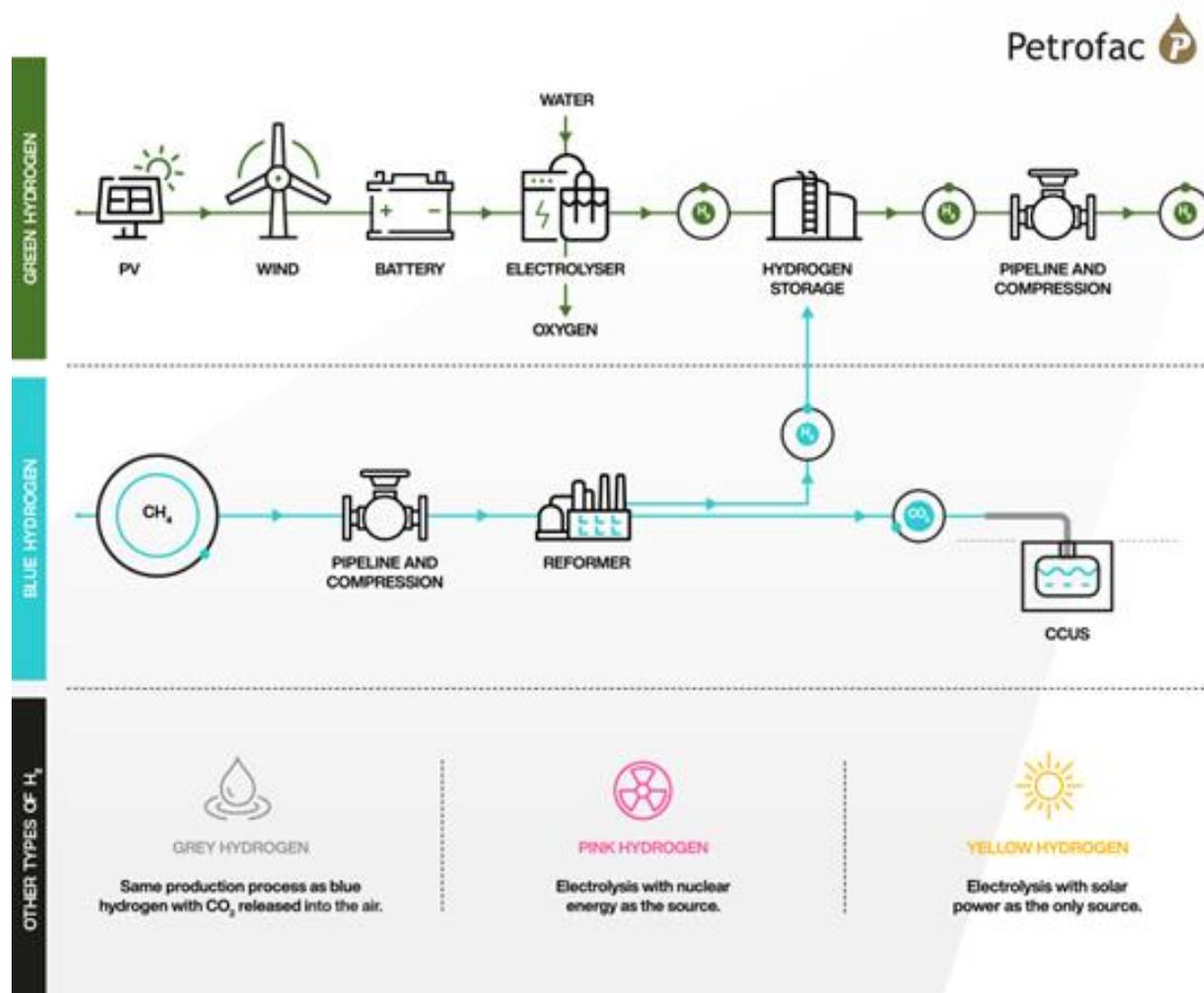


**Platinum** by contrast, finished with a 1.3mm ounce surplus in 2020 after a 1.285 million ounce surplus in 2019. Probably the largest excess since 2012. One of the ongoing challenges is how to source whose data and how to separate forecasts from hard fact. Heraeus Group and SFA Oxford both have valuable contributions to make. Jewellery and investment patterns can be tracked only approximately and readers are cautioned not to rely on a single supplier. As with so many numbers, there will be vested interests behind the headlines. The virus might have hammered demand but it clearly impacted supply too. Mid-march 2020 prices of \$560 for platinum do look like a low point - palladium last saw that price back in late 2015. The WPIC, the leading trade body for platinum, offers regular upbeat assessments on the outlook – along with other hydrogen fans they know that weakening diesel car sales won't stop a resurgent platinum. Hydrogen vehicles will use around 50 grams (31.1035 to an ounce) each, allegedly. We are still some ways from seeing commercial reality in the hydrogen trucks and freight market but long term investors should be paying attention now. The huge excess equity returns inspired by Tesla's performance is part of an unstoppable revolution spawning umpteen planet friendly vehicle platforms. Overkill becomes a distinct reality for the unwary. The real opportunity and investment rational for platinum and palladium upstream players is that they'll remain in an exclusive sort of club. The green investment story has equally powerful implications for copper and nickel demand and it is becoming easier to write about why the whole mining sector is likely to close the performance gap on some of its more fashionable rivals.

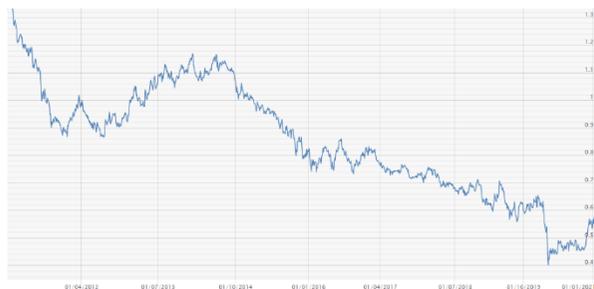


## Five shades of hydrogen and platinum

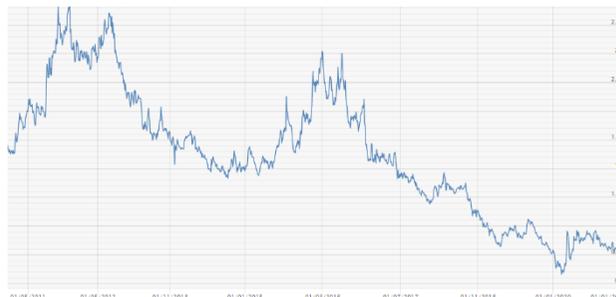
Although we are cautious about the actual speed of adoption, there is a new urgency around efforts to shift the energy mix. A good graphic saves hours of reading and fugacity coefficients are best visualised from the Petrofac graphic below. For detailed analytical data to support the most likely supply scenarios over the next decade, [SFA Oxford](#) is an excellent source.



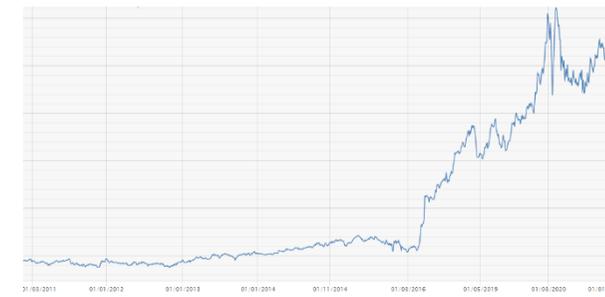
## The decade in charts .



Platinum's underperformance vs gold – 10 year chart



Gold's relative underperformance vs palladium – 10 year chart



Palladium's performance vs platinum – 10 year chart

The mean reversion trade would have platinum rebounding to parity with gold. The January 15<sup>th</sup> Bloomberg interview given by CEO [Neal Froneman](#) was a fortuitous piece of timing as we went to print. If we were in the forecasting business we'd go with parity on a 12month view. Only a small amount of the green hydrogen agenda has to look credible before speculation will close the gap. BASF has a new platinum based catalytic agent which may curb palladium's advantage – a joint venture with Impala for this tri-metal catalyst has few details yet but it will make headlines if it goes to full development.

The Euro6 emission standards and the RDE2 (Real Driving Emissions) standards are key drivers of the catalytic materials debate. No more than 80mg/km of NOx for a diesel car to be Euro 6 compliant. It's quite a full subject but we all get the gist.

## The listed companies

### First tier

shs outst		Operator	status	local price	local mkt cap mm	debt \$mm	mkt cap us\$mm	ev \$ mm	key persons	asset notes
mm										
159	MCX	PJSC Norilsk Nickel (Nornickel)	LSE listed	25,908	4,119,372	12661	55,442	68,103	Sergey Dyachenko	largest producer Pd : Talnakh mine near Norilsk. 0.57% nickel x 1.38billion tonnes
269	AMS	Amplats Anglo Am Platinum	JSE listed	1,510	406,190	1500	26,206	27,706	Natasha Viljoen CEO	38% of the worlds platinum production....Phase B unit repairs completed
669	SBSW	Sibanye Stillwater	NYSE/JSE listed	16.07	10,751	950	10,751	11,701	Neil Froneman, CEO	80,000 employees; Stillwater, a \$6.5bn top line, diminishing debt and v focussed.
799	IMP	Impala Platinum (Implats)	JSE listed	204	162,996	101	10,516	10,617	Nico Muller / Mark Munroe	Bot N.American Palladium Oct xix. 1.53mm ounces prod in 2020 Lac des Iles
510	NHM	Northam Platinum	JSE listed	207	105,570	165	6,811	6,976	Paul Dunne	PGM and chrome concentrate, Booysendaal, Zondereinde, 8000 fte
1204	IVN	Ivanhoe Mines	TSX listed	6.93	8,344	-376	6,418	6,042	Marna Cloete, Pres	feasibility : 600,000 oz 4E prod & 4.4mm tonnes by 2026? Add Kikula & Kipushi in DRC
225	ARI	African Rainbow Minerals	JSE listed	293.76	66,096	122	4,264	4,386	M Schmidt/T Mkatshana	Modikwa and Two Rivers mines. Anglo Am, Impala, Norilsk partners. Nkomati closing.
2788	EUA	Eurasian Mining	AIM listed	29	809	3	1,051	1,054	Christian Schaffaillitzky	Monchetundra, West Kytlim (68% .... (\$76mm npv) <i>UBS m&amp;a sale mandate ongoing</i>
259	RBP	Royal Bafokeng Platinum (RB Plats)	JSE listed	68	17,612	50	1,134	1,184	Steve Phiri / Neil Carr	1/3 BRPMjv with Anglo Amer Rustenb bot for \$135mm
108	ZIM	Zimplats Impala	AUS listed	14.01	1,513	40	1,089	1,129	Alexander Mhembere	Zim arm of Implats which own 87% ... generates \$53mm from rhodium

In the billion dollar plus category we have ranked the 10 names by enterprise value. Note that Ivanhoe has significant interests beyond its Platreef development and is still pre-revenue. Eurasia Mining, with no declared resource and nominal revenues only, is looking for a strategic partner. The entire group had a good 2020 with at least some of the electric hybrid and hydrogen revolution adding to any precious metals mystique. As we head for a virtual Indaba on February 2<sup>nd</sup>, there is a case for embracing the higher layer of sovereign risk for the in-country SA names. The currency has made a convincing 12 month rebound even if the pandemic has have done little to help structural deficits. 10 year rates have pulled back to 8.8% from 12.3% in April. And there is a cyclical case for improvement on a 15% fiscal deficit – that would help bring back many international bond investors. With respect to metals pricing assumptions more generally, stay tuned to financial models able capable of running NPV data using long term contract pricing.

The **Norilsk** machine looks pretty unstoppable and as asset quality goes, they may have the best. It will produce 110 tonnes of the three main PGM's this year and nearly 40% of its total sales are palladium. As with only a handful of operators they have a good view of the global customer base and can judge the platinum/palladium substitution effect. Platinum won't replace palladium without an overhaul of exhaust systems design but this debate is nuanced and

investors should not get distracted. Beyond Norilsk's measurable role to Russian GDP, The Global Palladium Fund and the Atomize platform (a jv with Traxys and Umicore) will help develop better provenance and traceability. Expect to see lots of mining presentations feature variations of their DLT (distributed ledger technology) as the global supply chain gets a digital revamp.

The emphasis on **Sibanye** (NYSE : \$16.07) being the must own choice for buy and hold investors is about several key conclusions. Its primary listing will remain JSE but as the only NYSE (ADR) listed name it has a head start. A return to dividend payments and calling the \$450mm 2023 convertible last September were amongst the more visible clues as to the way the board manages capital. The rand exchange rate will remain a factor but the £285mm acquisition of Lonmin does look better and better each quarter. The US operations at Stillwater and East Boulder (27mm ounces of 2E reserves) will be generating returns for at least another 20 years – new primary sources of supply are very unlikely to be found in the Americas. Also worth noting is the calibre and transparency of financial reporting.

## Second tier

*(Data may be difficult to view on the move, desk top viewing advised)*

302	CHN	Chalice Mining	ASX listed	4.26	1,287	-32	997	965	Tim Goyder/Alex Dorsch	WA : Julimar nickel-copper PGE, inc a 31metre 3.3gram intersection .... 6 rigs turning
270	THS	Tharisa	LSE/JSE listed	128.6	347	8	451	459	Phoevos Pourolis	Pourolis family, 74% owned Tharisa mine : K3 chrome ops; 2.27mm tonnes mined 1H
1630	WEZ	Wesizwe Platinum	JSE listed	0.54	880	400	49	449	Zhimin Li CEO	Bakubung, indebted, Chinese backed. Merensky/chromitite layer PGM orebodies.
2018	JLP	Jubilee Metals	AIM listed	13.3	268	13	349	362	Leon Coetzer, CEO	Inyoni/Windsor pgm plant, - bot Sable zinc refinery. 41/-oz pgm and 378/-oz chrome.
71	PLG	Platinum Group Metals	NYSE/TSX listed	4.33	307	45	307	352	R Michael Jones	Bushveld : DFS for Waterberg (50%) : Hosken HCl owns 31%. Net NPV \$333
273	SLP	Sylvania Platinum	AIM listed	111	303	-44	394	350	Jaco Prinsloo CEO	divvy; chrome tailings advantage. 7 operating plants. 18,000 ozs prod, good b/sheet
415	NOT	Noront	TSXv listed	0.25	104	44	80	124	Alan Coutts	Eagle's Nest, Voisey's Bay, Ring of Fire. Resource Cap 22%, Bao Steel 5.5% [+ Cr2O3]
161	GENM	Generation Mining	TSX listed	0.81	130	-7	100	93	Jamie Levy, Kerry Knoll	Marathon deposit Ontario & a PEA : ( shs : inc Sibanye/ Sprott/Lundin/Osisko)
189	AIR	Clean Air Metals	TSXv listed	0.37	70	-4	54	50	Jim Gallagher	ceo ex N.Am.Palladium. Thunder Bay North : 2011 PEA. Decent grade. Escape Lake
185	SIZE	Major Precious Metals	CSE listed	0.30	56	0	43	43	Joel Dumaresq	Skaergaard deposit in Greenland. See transaction with Platina Resources.
145	PGE	Group Ten Metals	TSXv listed	0.38	55	-5	42	37	Michael Rowley	Stillwater West PGE-Ni-Cu project Montana, USA. Kluane, Yukon. Black Lake-Drayton
125.5	PDM	Palladium One	TSXv listed	0.31	39	0	30	30	Derrick Weyrauch	LK Lantinen, Finland. Tyko, Marathon, Ontario
100.6	ELR	Eastern Platinum (Eastplats)	TSXv listed	0.37	37	0	29	29	Diana Hu	Mpumalanga , Mareesburg 4 Bushveld assets. Chrome. Sold CRM in 2016
103	VO	Valore Metals	TSXv listed	0.32	33	-1	25	24	Jim Paterson	(Formerly Kivalliq) Santa Amaro, Pedra Branca in Ceara,Brazil. \$35mm legacy spend
228	NAM	New Age Metals	TSXv listed	0.10	22	0	17	17	Harry Barr Ch	River Valley PGM project, new PEA imminent : Eric Sprott owns 18.5% Feb xx
91.7	GRDM	Grid Metals	TSXv listed	0.18	17	-1	13	12	Robin Dunbar	Makwa Mayville in Manitoba. 100% East Bull, Sudbury (WSA 8.6%) Early days.
100	BULL	Canadian Palladium Resources	CSE listed	0.14	14	0	11	11	Wayne Tisdale	East Bull, Massey, Ontario : 11.1mm tonnes at 1.46g/t, 523,000 ozs (c\$4mm Jan xx)
265	KAV	Kavango Resources	LSE listed	3.10	8	0	11	11	Michael Foster	KSZ Botswana ; South Ghanzi & Dita, early stage. Strategic jv with Power Metal Res.

**The second tier** of 18 names has seen an equally decent performance. Three of them, Tharisa, Jubilee and Sylvania are in production and offer a de-risked version of some of the names still wrestling with feasibility studies and permitting. Sylvania with its sound balance sheet and being a dividend payer deserves a second look. However in the slightly less liquid second tier category, we side with two other jurisdictions. Our primary influence is the development potential of the assets identified at Chalice Mining and Generation Mining.

It's been a good six months for **Generation Mining** (TSX : GENM : c\$0.80) shareholders and with a feasibility study imminent, there is still plenty of upside. Part of the risk oriented language being used here takes account of the dire conditions for so many projects since 2012. In Canada they own the Marathon deposit in Ontario. Generation visualises an open pit long life (14 years) mine with a c\$1541 NPV at current prices. The PEA has an upfront capital cost c\$431mm and a base case IRR of 30%. The property has had 200,000 metres of drilling and 1000 holes and the main portion has no outstanding royalties. It first came into Sibanye's control in 2017 when they acquired Stillwater mining. The major milestone for Generation occurred in November when they completed the last of the earn in requirements. Sibanye still owns 12% and can back to 51% once feasibility is completed.

There needs to be a case by case analysis of the names in the sector but it's our view that we're nine months into a 36 month rerating for many of the PGM names. Platinum Group Metals and New Age can also point to measured and indicated resources but investors need to judge how far away each company is from the dream. The pre-resource names can still expect a lot more positive attention if equity financing conditions continue to improve. That should shorten their timelines to a maiden resource.

**Chalice Mining** (ASX : CHN A\$4.35) is an unusual situation both because of location (only 22,000 ounces PGM produced in the whole country last year) and because it was a first hole discovery. Its centrepiece is the Julimar (Gonneville) project in Western Australia, discovered in March last year. Julimar has no mineral resource yet but plenty of drilling data. Interesting but of less impact on valuation is the gold target at the Karri gold prospect (Pyramid Hill) in Victoria.

What might have been a fluke early on is now a series of good assays to support the early intersections. Systematic drilling of 30 diamond drill holes and 120 RC holes has delivered a glimpse of what looks like a remarkable find. A bit early to be trumpeting 'unique' and 'world class' but 36.6metres at 2.7grams palladium certainly qualifies as high grade. 50m at 1.8g/t palladium followed in a growing list of quite widely distributed results. Disseminated sulphides at a depths of 460 metres added to the general sense of scale. This is not a stock for those who insist on a proper measured and indicated JORC score as market caps push into producer valuation territory. We'd prefer that comfort in most of the mining names we review but these are grades that really stand out. Fight the instinct to assume this is in bubble territory and buy into volatility.

## PRIVATELY HELD OPERATORS

Finally, the privately held names – we have to ask about to see what’s structured to accommodate private equity or pre-ipo financings. Enquiries and insights from readers welcome.

Element 46	private	Andrew Dacey	Penikat Central Finland, Porsanger in northern Norway.
Pallas Minerals	private	Anthony Balme	inferred resource in Bottenbacken Sweden, 10 to 15 million tonnes, copper and PGE
Sedibelo Platinum Mine (SPM)	private	Arne Frandsen/Erich Clarke	34mm ozs 4E, 17.4mm 4E reserves 2016. Pallinghurst affiliate
Suhanko Arctic Platinum	private	<a href="https://www.suhanko.com/when">https://www.suhanko.com/when</a>	CD Capital 100% owned, northern Finland. Quality asset, pre-feas, could start 2023
Vi Holding	private	Vitali Machitski	Great Dyke project in Zimbabwe, jv with Lindela Mining

We can say little about these deposits except that none of them are going to alter the global supply curve before 2025. Amongst programs on previously drilled sites that look promising given current conditions, we are tuned to progress in Sweden. Pallas has done well to get its confirmation drilling campaign underway. Hard data on grade and tonnage might be selectively available by the end of Q1.

[ENDS]

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