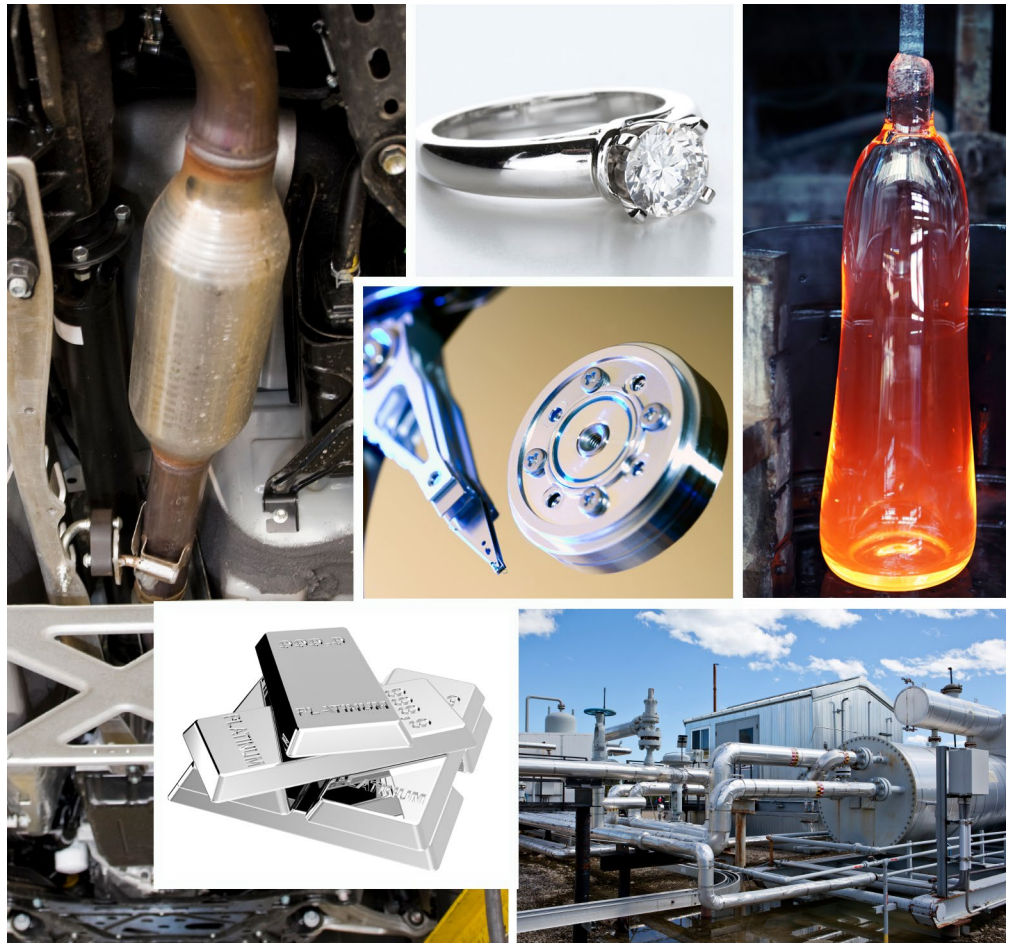


Thintri, Inc. announces the release of **Platinum Group Metals: Issues and Opportunities**, a new market study that surveys current market conditions in platinum group metals (PGMs), and analyzes emerging demand, supply constraints and price volatility. The report also explores opportunities generated by new techniques of PGM recovery from previously-unused resources, and opportunities created by development of new, much less costly substitutes.

The report separates hype from reality and assesses the dramatically changing landscape facing PGM users and suppliers. Forecasts are supplied for demand and prices under current conditions going out to 2022, as well as an analysis of the effects of new technologies for PGM replacement and recovery.



## Thintri Inc.

Thintri Inc. provides business and market intelligence for a wide range of technologies through custom consulting, technology assessments, and published market studies.

- Materials
- Electronics
- Telecommunications
- Photonics
- Manufacturing

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## Background on Platinum Group Metals

Platinum group metals (PGMs), namely platinum, palladium, rhodium, iridium, ruthenium and osmium, are rare, expensive and critical to today's economy. Up to now, there have been no other materials that can duplicate their performance in fundamental applications. Those applications include autocatalysts, the critical components in the catalytic converters found in most vehicles that reduce harmful emission; catalysts used in a broad range of industrial processes, including petroleum refining; high-temperature processing of abrasive materials such as glass; disc drives and electronic components; medical and dental implants and devices; and electrochemistry. Of course, selected PGMs are also highly prized in jewelry and investment.

Prices of PGMs are high and notoriously volatile. Rhodium, for example, went from slightly over \$6,000 per ounce in mid-2007, to \$10,000 per ounce in mid-2008 and then crashed to a little above \$1,000 before the end of that year. While this degree of fluctuation is exceptional, it's emblematic of the behavior of critical materials in limited supply, tied to broader economic forces like auto sales.

At this time of growing markets, the limits of supply are becoming clear. Like most natural resources, PGM supplies are inherently limited. Concerns about "peak metals," the idea that availability has peaked for limited resources and future production will be reduced and/or more costly (which has already occurred for a number of important minerals), will soon be an important influence with PGMs. Already, palladium has entered a period of supply uncertainty and political destabilization.

Tightening of supplies comes at a time of accelerating demand. Growth of auto sales and industrialization in the developing world, particularly Brazil, Russia, India and China (the BRIC countries), as well as interest in PGM jewelry and investment by newly-prosperous populations, will place significant stress on available supplies. In addition, tightening environmental restrictions worldwide are forcing the use of more PGMs per vehicle to meet emissions rules. Furthermore, building of new oil refineries and industrial growth in a recovering economy will put further stress on supplies. Other demand drivers like medicine and petroleum, which are functions of aging populations and global economic shifts, will place stress on PGM supplies as well.

Analyses indicate that presently-known platinum reserves are sufficient for another 360 years at present rates of production and consumption. However, that estimate drops to 15 years if growing demand, particularly from growing industrialization and automobile sales in the developing world, is taken into account.

With demand growth, inelasticity of supply will likely force up prices in this decade dramatically.

The response to scarcity will no doubt include reduction in PGM consumption through "thrifting," i.e. the devising of ways to use less PGMs in established applications (which has been underway for decades). Also, rising prices will mean that deposits with lower PGM content such as those in Australia, which had been too costly to exploit in the past, will now be profitably mined, to some degree mitigating that price increase.

Another consequence will be the development of high performance, low cost alternatives, and in improved recycling and recovery.

Alternatives are sometimes as simple as substituting a less expensive PGM, such as palladium, for a more expensive one, such as platinum, although, as seen in 2017, this can force the price of palladium past that of platinum. The more significant alternatives use nanotechnology with inexpensive materials such as nickel, to fine tune the properties of nanoparticles by controlling parameters such as diameter. Inexpensive nanomaterials can substitute for PGMs in some of the most important markets, such as catalysts in the automotive and industrial markets. PGM usage in some applications, such as jewelry and electronics, is relatively immune from substitution, but most applications are vulnerable.

Recycling will become more important as PGM prices rise. Newly available technologies are able to dramatically improve the amount of PGMs that can be captured from recycled products such as catalytic converters.

Other recently developed processes are able to extract significant quantities of PGMs from mine waste that contains much higher PGM concentrations than the best quality ores. Mountains of slag and mine waste in North America and worldwide contain enough PGMs to significantly impact the supply/demand/price picture for PGMs once exploited.

Alternatives that can capture markets directly from PGMs, and new technologies that can dramatically improve PGM recovery from recycled materials and mine waste, are already commercially available or very near commercialization and will exert a growing influence on

markets now owned by PGMs and PGM prices and availability.

The confluence of growing demand, limited and/or dwindling supplies, and growing availability of alternatives and new supplies will likely create a period of extraordinary volatility before things stabilize. Most of the time during the forecast period will witness the transition of established PGM markets as prices rise and users adjust to new conditions, while others take advantage of the new opportunities presented.

## Understand the Opportunities

Platinum group metals are at an extraordinary intersection of market forces. Their rarity and expense has largely confined them to a limited set of markets. Those markets, in turn, are largely dependent on PGMs simply because there have been no viable, and cheaper, alternatives. The inelasticity of supply has led to occasionally extreme volatility in the past. Today, growing demand, fueled by a range of factors that include accelerating motor vehicle sales around the world, a rising industrial sector in the developing world and a growing consumer preference for white metals in jewelry, while supplies are relatively fixed and in some cases declining, threatens to put PGMs in an even more volatile situation. As demand exceeds available supplies, prices can be expected to rise significantly.

The Thintri market study, *Platinum Group Metals: Issues and Opportunities*, relies on in-depth interviews with industry executives, market development managers and government and academic researchers. The report provides a survey of the current state of the PGM markets, an assessment of viable alternatives and recovery schemes, and discussion of the effects of growing demand on availability and prices, and the effects on those prices of PGM replacement technologies and improved recovery methods.



**Price: \$4,300**

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