



**Economic Analysis:
The Marathon Palladium Project**

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Executive Summary

The Marathon Palladium Project is a proposed low-grade, open-pit palladium-copper mine (0.69 g/t Pd, 0.21 g/t Pt, 0.22% Cu, 0.07 g/t Au and 1.52 g/t Ag) with a stripping ratio of waste-to-ore of 3.0:1. The project's anticipated mine life is 14 years. Generation PGM proposes constructing a processing plant designed to treat 22,000 tonnes per day of ore to produce approximately 78,000 wet metric tonnes of concentrate per year. Because of the low concentration of valuable minerals, the "mass pull" (that is, the amount of final concentrate produced) is small, equalling approximately 1.5% of the process feed. Generation PGM considers the production of concentrate for sale to a smelter to be the most realistic strategy for the Project and has identified Glencore's copper smelter located in Rouyn-Noranda (750 km west of the project site) as a potential buyer. Alternatives include unspecified "off-shore" smelters in Europe or Asia.

This report analyzes the Marathon Project with specific reference to the market prospects for palladium in the medium term. The analysis suggests that the Project entails far greater economic risk than Generation PGM's promotional material allows. In particular, the report draws attention to the following areas of concern:

- As a low-grade orebody, the Marathon Property may well be rendered uneconomic in the event of a decline in metals prices. Since the 1980s, the Property has been abandoned by several major mining companies in light of weak commodities markets. Most recently, in 2013, the former Property owner Stillwater Mining was subject to a proxy contest centring on management's "faulty due diligence" in purchasing the Property, ultimately resulting in the Project's suspension in 2014.
- Although palladium prices are currently well above their long-term averages, there are several risks that could undermine the metal's rally within the span of a few years, including:
 - The growing market penetration of electric vehicles at the expense of internal combustion engine vehicles;
 - The substitution of palladium by platinum in the production of automotive catalysts; and
 - An increase in the volume of palladium sales from either the Russian state stockpile or from new proposed mining projects in Russia.

The analysis begins with an overview of global palladium production, reserves, as well as its various end uses before highlighting in greater detail each of the areas of concern noted above.

Global Palladium Production, Reserves, and End Uses: An Overview

Palladium is one of six platinum group metals (PGMs/PGEs) and occurs naturally alongside nickel and copper. PGMs are resistant "to wear, tarnish, chemical attack and high temperature," and have catalytic and electrical properties.¹ Two countries, Russia and South Africa, dominate global palladium production. According to the U.S. Geological Survey, global palladium production in 2019 amounted to 210,000 kg, with combined Russian (86,000 kg) and South African (80,000 kg) output accounting for about 80

¹ Tania Bossi and Johannes Gediga, "The Environmental Profile of Platinum Group Metals," *Johnson Matthey Technol. Rev.*, 2017, 61(2): 112, doi:10.1595/205651317x694713.

percent of the world total. Other notable producers included Canada (20,000 kg), the United States (12,000 kg) and Zimbabwe (3,000 kg).²

The vast majority of the world's PGM reserves are located in South Africa. According to the U.S. Geological Survey, South Africa holds 63,000,000 of the total 69,000,000 kg in total PGM world reserves. That country's Bushveld Complex is the site of the world's largest reserves. A 2018 paper in the journal *Science of the Total Environment* found "strong evidence" — despite the "severely depressed market conditions for the PGEs" following the global financial crisis of 2007-08 — "that the potentially mineable quantity of PGEs globally continues to increase."³ Moreover, according to the International Platinum Institute, PGMs have a "high recyclability" rate, with as much as 95 percent of PGM content in automotive catalysts recoverable.⁴ Indeed, the same authors suggest, "The pgms are almost indefinitely recyclable. This high and repeatable recyclability reduces the environmental impact of pgm production with each recycling round, meaning that the investment in producing a primary ounce of pgms can in theory last in perpetuity."⁵ The U.S. Geological Survey reports that approximately 116,000 kg of palladium and platinum were recovered from scrap in 2018.⁶

Automotive catalytic converters, which accounted for more than 80 percent of total palladium consumption in 2015, account for the most important end use of palladium, with electrical applications a distant second. Mudd, Jowitt and Werner note that while "other technologies may emerge to drive new PGE demand, such as solid oxide fuel cells or another new technology, these technologies are not economic at present and it is simply not possible to predict their future trajectory with confidence." As such, the "rapid growth in [electric vehicles] ... is clearly of material interest for the PGEs sector."⁷

Marathon Project: Site History

The reported ore reserves at the Marathon Property are relatively low in grade, measuring 1.15 4E g/t (that is, 1.15 g of combined platinum, palladium, rhodium, and gold per ton). For comparative purposes, the two active dedicated PGM mines in North America measured 15.95 4E g/t (Stillwater East-Boulder) and 2.47 4E g/t (Lac des Iles) in 2015.⁸

As a low-grade deposit, the Marathon PGM Project is sensitive to fluctuations in market demand for metals. Although palladium prices are currently high (for reasons discussed below), there is good reason to believe a downturn in metals prices would render the Project uneconomic. Since the 1980s, several major mining companies have explored the property before shelving plans to advance to development as a result of low metals prices. Anaconda Copper acquired the property in 1963 before discontinuing exploration work in 1982 in a context of weak metals markets. Five years later, Teck Corporation conducted a Preliminary Economic Feasibility Report, concluding the project was uneconomic in light of market conditions. In 1989, BHP Engineering Pty Ltd. completed a Pre-Feasibility Study for Euralba Mining Ltd..⁹

² U.S. Geological Survey (USGS), *Mineral Commodity Summaries 2020*, 125, <https://doi.org/10.3133/mcs2020>.

³ Gavin M. Mudd, Simon M. Jowitt and Timothy T. Werner, "Global platinum group element resources, reserves and mining — A critical assessment," *Science of the Total Environment*, 2018, pp.622-624, <https://doi.org/10.1016/j.scitotenv.2017.11.350>.

⁴ Bossi and Gediga, "The Environmental Profile of Platinum Group Metals," p.112.

⁵ *Ibid*, p.120.

⁶ USGS, p.124.

⁷ Mudd, Jowitt and Werner, pp.623-24.

⁸ See Mudd, Jowitt and Werner, Online Supplementary Information, p.6.

⁹ NI 43-101 & 43-101F1 Technical Report for Generation Mining Limited, p.6.

Stillwater Proxy Contest: The Marathon Project and “Faulty Due Diligence”

More recently, in 2010 Colorado-based Stillwater Mining Company entered into an agreement with the Property’s then owner — Marathon PGM Corp. — to acquire all of Marathon’s outstanding shares. In 2011, a joint federal-provincial environmental impact assessment commenced, and in 2012 Stillwater submitted an environmental impact statement (EIS) to the Joint Review Panel (JRP). However, at Stillwater’s request in 2014 the JRP was put on hold.

Stillwater’s request to suspend the JRP process in 2014 took place shortly after the activist hedge fund Clinton Group, a shareholder in Stillwater, engaged in a successful proxy contest, unseating four of Stillwater’s corporate directors. Stillwater’s decision to purchase the Marathon Property figured prominently in this dispute. In challenging Stillwater’s board, Clinton Group criticized Stillwater’s “faulty due diligence” in its acquisition of Marathon PGM. As the Clinton Group’s 2013 Proxy Statement read, referencing Stillwater management’s discussion of the Project, “Because of the diligence mistake — which involved ‘palladium grades being overstated on a significant portion of the project area’ — there is ‘uncertainty as to the ultimate extent, quality, final grade, [and] mineability’ of Marathon.”¹⁰ Relatedly, in a 2013 conference call with investors, Stillwater management admitted, “the cost to develop the asset ‘has gone up quite dramatically from what we originally thought’ and that there is ‘deterioration in both the project economics and in the estimate of proven and probable reserves.’”¹¹ At Stillwater’s 2013 Annual General Meeting, the Clinton Group’s four nominees received the highest vote total of any nominees.¹²

In 2014, in the context of a broader strategic review of the company’s operations, Stillwater CEO Mick McMullen (a Clinton Group appointee) limited short-term expenditures on the Marathon Project and informed analysts that further capital would be earmarked only once the “project [had] demonstrate[d] suitable financial returns.” This decision was part of a wider strategy to limit “spending on assets that [did not] generate a strong payback to shareholders.” At the time, McMullen also noted that new information indicated that there had been a “material reduction in grade from what had been assumed.”¹³

In July 2019, Generation Mining purchased a 51 percent initial interest in the Marathon Property from Stillwater, and entered into a joint agreement with Stillwater (which had been acquired by Sibanye Gold for \$2.2 billion in 2017) with respect to the Property. Under the terms of the agreement, Generation Mining can increase its interest in the Property to 80 percent by making certain exploration commitments.¹⁴

Generation Mining’s renewed interest in the Property is best understood in light of recent trends in palladium markets, discussed in the following section.

¹⁰ Clinton Group Inc, PRRN14A - - Stillwater Mining Co. - March 19, 2013, <https://fintel.io/doc/sec-clinton-group-inc-prrn14a-2013-march-19-18590-573>.

¹¹ “Clinton Group Believes Stockholders Should Replace the Stillwater Mining Board of Directors,” *PR Newswire*, April 9, 2013, <https://www.prnewswire.com/news-releases/clinton-group-believes-stockholders-should-replace-the-stillwater-mining-board-of-directors-202120831.html>.

¹² Paul Quintaro, “Clinton Group Comments on Voting Results at Stillwater Mining Company,” *Benzinga*, May 8, 2013, <https://www.benzinga.com/news/13/05/3571542/clinton-group-comments-on-voting-results-at-stillwater-mining-company>.

¹³ Salma Tarikh, “Stillwater keeps its PGM costs down,” *The Northern Miner*, August, 20 2014, <https://www.northernminer.com/news/stillwater-is-back-in-the-black/1003213896/>.

¹⁴ NI 43-101 & 43-101F1 Technical Report for Generation Mining Limited, 8.

Recent Trends in Palladium Markets

During the last five years (January 2016 - January 2021) the market price for palladium has increased dramatically, rising more than four-fold from US\$500 per ounce in 2016 to more than US\$2,200 per ounce in early 2021. In contrast to long-standing historical patterns, palladium is now more expensive than other precious metals, including platinum and gold. Market analysts highlight three key factors in explaining palladium's recent strong performance: The introduction of stringent automobile emissions control laws in China and Europe, the relative shift from diesel- to gasoline-powered vehicles in Europe, and palladium shortages owing to a recent dearth of investment in new mining projects, particularly in Russia and South Africa.

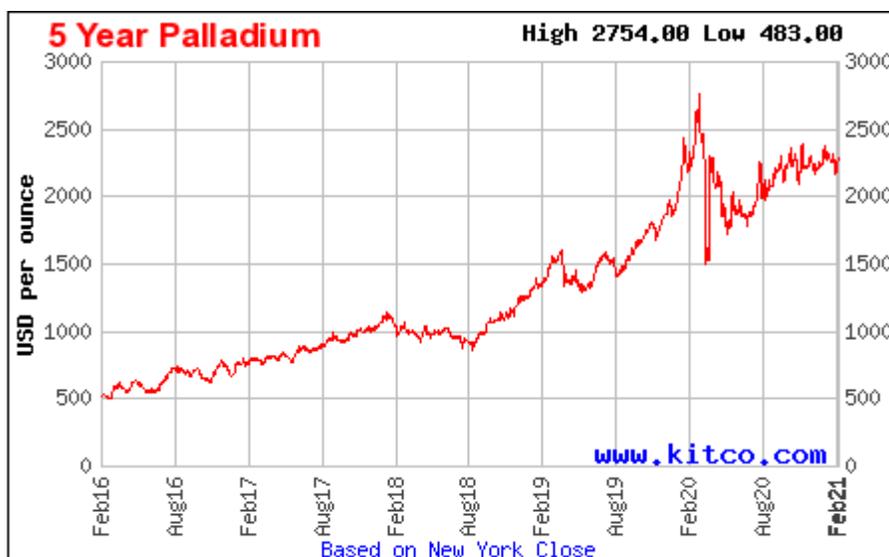
The majority of palladium, upwards of 80 percent is used in the manufacture of catalytic converters, which limit harmful emissions from gasoline-powered automobiles. Legislative changes aimed at curbing pollution in China (the world's largest automobile market) and the European Union (gaining steam following the Volkswagen diesel emissions scandal) have acted as the key drivers in pushing up demand for palladium over the past five years. Because most palladium is mined as a by-product of nickel and copper operations, in which there has recently been a general lack of new investment, palladium markets experienced supply deficits through much of the 2010s, pushing prices upwards.¹⁵ Recent labour strikes and technical challenges at mines in South Africa have aggravated these supply difficulties.

However, there are indications that the long-term palladium supply deficit is easing. According to a recent joint report by SFA (Oxford) and Haraeus Precious Metals (one of the world's largest PGM refiners), 2020 marked the first year in a decade in which the market deficit for palladium narrowed, falling from -670 koz in 2019 to -145 koz in 2020. This was the result of the slumps in the automotive and industrial sectors, themselves the product of the wider COVID-19 economic slowdown.¹⁶ Still, palladium prices remained far above their long-term averages throughout 2020. While the early pandemic saw prices fall from over US\$2,750 to less than US\$1,500/oz, prices gradually recovered after March and remained largely above \$2,000/oz throughout the year. COVID-19 related mine closures in South Africa, which limited production, offset to some extent the downturn in demand.¹⁷

¹⁵ Neil Hume and Henry Sanderson, "Palladium's new-found allure is catalyst for crime," *Financial Times*, January 25, 2019.

¹⁶ "Palladium market deficit to narrow significantly in 2020 - report," *Mining.com*, September 16, 2020, <https://www.mining.com/palladium-market-deficit-to-narrow-significantly-in-2020-report/>.

¹⁷ Georgia Williams, "Palladium Outlook 2021: Supply Constraints a Tailwind for Higher Value," *Investingnews.com*, January 12, 2021, <https://investingnews.com/daily/resource-investing/precious-metals-investing/palladium-investing/palladium-outlook/>.



Source: Kitco.com

The Future of Palladium Markets: Risks on the Horizon

Palladium's recent surge has been characterized by several analysts and industry executives as a bubble. The head of the Bank of America's Metals Research department, Michael Widmer, went so far as to say "It's the most dysfunctional market I've ever seen in my life."¹⁸ For many market analysts, it is simply a matter of time until a market correction occurs and prices fall. As a March 2019 report from ABN Amro put it, "We think palladium is the most overrated precious metal, and we expect lower prices."¹⁹

Analysts have identified three key risks to palladium markets that could undermine the metal's price: The increasing market penetration of electric vehicles at the expense of internal combustion engine vehicles in global passenger automobile sales, the substitution of palladium by platinum in autocatalysts, and renewed sales of palladium from Russia's state stockpile.

Internal Combustion Engine and Electric Vehicles

Because palladium is used almost exclusively in the production of automotive catalysts for internal combustion engine (ICE) vehicles, the widespread adoption of zero-emissions, battery electric vehicles (BEVs) represents the most important risk to the metal's long-term prospects. CRU senior analyst Kirill Kirilenko highlighted palladium's dependence on the autocatalyst market as follows: "In the long run, we are probably witnessing the zenith of the palladium market. It's at its peak now but unless there is a new application other than autocatalysts, it will eventually just die out."²⁰

¹⁸ Joe Wallace, "Palladium Prices Hit Record Despite Chinese Auto Disruption: Demand for the precious metal has surged as auto regulators tighten emissions regulations in China and Europe," *The Wall Street Journal*, February 18, 2020.

¹⁹ Neil Hume and Henry Sanderson, "Anglo American chief says palladium price surge creates 'bubble'," *Financial Times*, March 28, 2019.

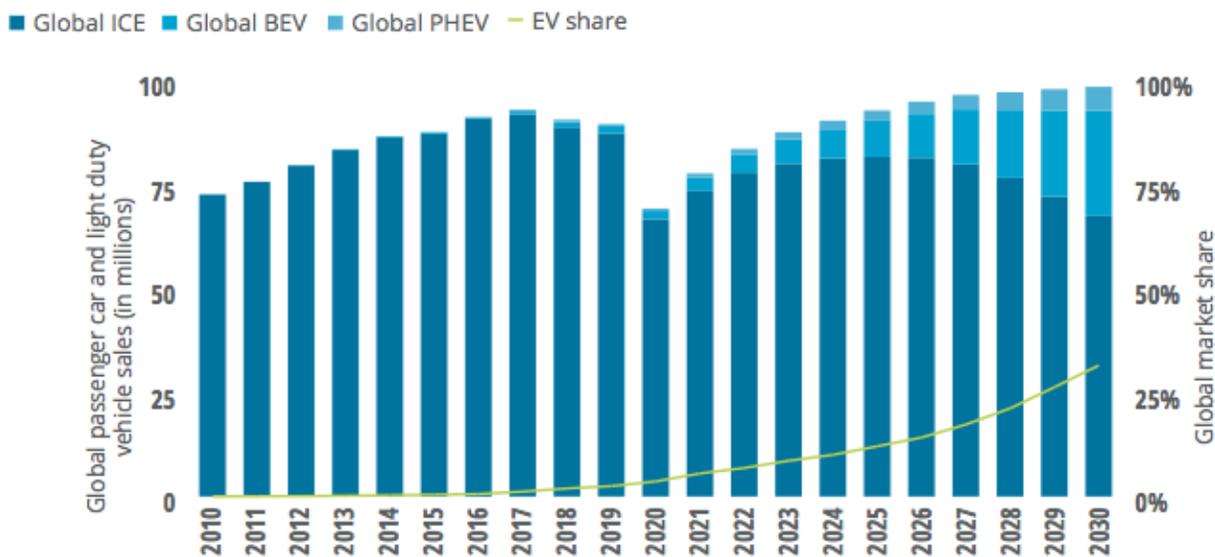
²⁰ Will Horner, "Platinum, Palladium Prices Diverge as Car Makers See Uneven Recovery," *The Wall Street Journal*, September 18, 2020.

The COVID-19 pandemic caused significant disruptions in the global automotive industry, and 2020 saw new-vehicle sales fall by 17.4 percent compared to 2019. As COVID restrictions ease, the Economist Intelligence Unit anticipates a slow recovery in vehicle sales, with most countries not returning to 2019-sales volumes until after 2021.²¹ Similarly, S&P Global anticipates that by 2022, new sales will remain six per cent below 2019 volumes.²² Lasting sluggishness in the automotive sector could further reduce the palladium market deficit in the near-term.

Longer term, Deloitte’s Global Automotive team anticipates significant structural changes in the global automotive industry entering the recovery period, with important implications for palladium markets. Looking ahead to 2030, Deloitte forecasts a compound annual growth rate in electric vehicles (EVs) of 29 percent, with EV sales reaching 31.1 million, or 32 percent of global passenger vehicle sales by 2030. Moreover, while Deloitte anticipates that global car sales will not reach pre-COVID-19 volumes until 2024, “the pace of recovery is forecasted to be *a result of a slowdown in ICE sales,*” [emphasis added]. In contrast, “EVs will continue to have a positive trajectory during the COVID-19 recovery period and may well end up capturing a disproportionate share of the market in the short term.”²³

Overall, Deloitte anticipates ICE vehicle sales to rise gradually until 2025, before experiencing a declining market penetration thereafter. At no point in the next decade does Deloitte anticipate ICE vehicle sales returning to their 2019-volumes, as EVs come to take a greater share of the passenger vehicle market.²⁴ The chart below depicts Deloitte’s outlook for global passenger vehicle sales until 2030, clearly demonstrating the anticipated growth in EV market share.

Outlook for annual global passenger-car and light-duty vehicle sales, to 2030



Source: Deloitte Insights, “Electric vehicles: Setting a course for 2030,” p.6.

²¹ The Economist Intelligence Unit, “Industries in 2021: a slow, painful recovery,” p.5.

²² S&P Global, “Global Auto Sales Forecasts: Hopes Pinned on China,” *SPglobal.com*, September 17, 2020, <https://www.spglobal.com/ratings/en/research/articles/200917-global-auto-sales-forecasts-hopes-pinned-on-china-11651519>.

²³ Deloitte Insights, “Electric vehicles: Setting a course for 2030,” p.6.

²⁴ *Ibid*, p.6.

In sum, it is anticipated that the next decade will be a sluggish one for ICE vehicles, the largest user of palladium in catalytic converters, while EV sales are expected to continue to grow. A slow recovery in ICE vehicle production and marketing could further erode the deficit in palladium supplies, with a negative implication for palladium prices. The recent inauguration of Joe Biden to the US Presidency, whose climate change policies include a plan to replace the US government fleet with American-produced EVs, build 550,000 EV charging stations, and invest in clean energy research, could further boost EV market prospects.²⁵ Meanwhile, in late January GM announced “one of the most ambitious [plans] in the auto industry,” pledging to sell only zero-emission EVs by 2035, providing further indication that carmakers see EVs as the future of the industry.²⁶

Substitution

The substitution of palladium by platinum in autocatalysts is another risk to the palladium market. According to a 2020 report from the US bank Citi, palladium shortages cost the global automotive industry US\$18 billion over the previous year. In addition, PGMs accounted for a total of 15 percent of automakers’ cash flow, up from four percent three years prior.²⁷

As palladium prices remain significantly higher than platinum prices, several analysts expect automakers to switch to platinum for catalysts. At present, platinum is used mostly in diesel-powered vehicles, but platinum-based converters in gasoline-powered vehicles are technically feasible. Indeed, as *The Wall Street Journal* reports, automakers initially switched to palladium-based converters in the 2010s because at the time palladium was cheaper than platinum.²⁸

There is debate among analysts as to the extent of the substitution risk. For some, because automakers are focused on expanding their EV production lines, there is little incentive in investing in the engineering and processing changes needed to make the switch, particularly in light of heightened regulatory sensitivity following the VW emissions scandal.

However, others suggest the switch is already under way and expect market effects to be felt starting next year. Among them are Bank of America Head of Metals Research Michael Widmer, who reported that big carmakers had already begun substituting palladium for platinum, expecting the palladium rally to come to an end within 12 to 18 months;²⁹ former Anglo American Platinum CEO Chris Griffith, who noted in early 2020 that there were signs that palladium demand had begun to weaken in response to high prices;³⁰ and Citi Head of EMEA Commodities Research Max Layton, who noted in early 2020, “By some accounts 25 per cent [of the palladium] ... can be substituted for platinum in gasoline vehicles in 18 to 24

²⁵ David Shepardson, “Biden vows to replace U.S. government fleet with electric vehicles,” *Reuters*, January 25, 2021, <https://www.reuters.com/article/us-usa-biden-autos-idUSKBN29U2LW>.

²⁶ Neal E. Boudette and Coral Davenport, “G.M. Will Sell Only Zero-Emission Vehicles by 2035,” *New York Times*, January 28, 2021, <https://www.nytimes.com/2021/01/28/business/gm-zero-emission-vehicles.html>.

²⁷ Neil Hume and Henry Sanderson, “The crazy price of palladium cost global carmakers \$18 billion last year — and it keeps going up,” *Financial Post*, January 22, 2020, <https://financialpost.com/financial-times/the-crazy-price-of-palladium-cost-global-carmakers-18-billion-last-year-and-it-keeps-going-up>.

²⁸ Will Horner, September 18, 2020.

²⁹ Henry Sanderson and Neil Hume, “Clean-car push puts palladium in the fast lane,” *Financial Times*, January 9, 2020.

³⁰ Joe Wallace, “Palladium Prices Hit Record Despite Chinese Auto Disruption: Demand for the precious metal has surged as auto regulators tighten emissions regulations in China and Europe,” *The Wall Street Journal*, February 18, 2020.

months and this may already be in the pipeline. ... In this case, this could gradually affect the market from 2021 and would likely substantially affect the market from 2022.”³¹

Renewed Sales from Russia’s State Stockpile

A third risk to palladium markets is renewed sales from Russia, the world’s largest producer of the metal. In 2016, Russian metals producer Norilsk established the Global Palladium Fund, which buys palladium from Russia’s central bank stockpile and sells it on the global market. Because the size of the stockpile is a state secret, it is unclear for how long the Fund will continue to receive the metal.³² However, the US bank Citi considers Russian stockpile sales a greater risk than a switch to platinum in autocatalysts, noting Norilsk may flood the market in an effort to prevent such a substitution.³³ Referring to palladium, Norilsk CEO Vladimir Potanin has stated: “We don’t want the price to be so high that people start replacing our material. We would prefer to find a balance in the market ... We are ready to invest important amounts of money to give this product to the market.”³⁴

In that vein, in December 2020 Norilsk announced a ten-year \$27-billion investment plan with an aim to boost metal production by 30 percent by 2030.³⁵ This expansion in palladium output could further reduce the supply deficit, bring markets closer to balance, and end palladium’s rally.

Conclusion

The Marathon Palladium Project is subject to considerable economic uncertainty. Owing to the low-grade of its ore reserves, the Project is especially sensitive to fluctuations in market prices for its products. The previous Property owner became subject of a proxy dispute centring on management’s “faulty due diligence” in acquiring the Property; new management shelved spending on the Project in light of its low potential return to shareholders.

Although palladium prices are now much higher than their long-term average, a host of developments threaten to end the metal’s rally, including the continued growth of EVs, the substitution of palladium for platinum in automotive catalysts, and renewed palladium stockpile sales from Russia.

³¹ Hume and Sanderson, January 22, 2020.

³² “Nornickel to sell less palladium, nickel than it produces in 2020 — head of sales,” *Mining.com*, December 1, 2020, <https://www.mining.com/web/nornickel-to-sell-less-palladium-nickel-than-it-produces-in-2020-head-of-sales/>.

³³ Neil Hume and Henry Sanderson, “Palladium bull market puts \$18bn dent in carmakers’ profits,” *Financial Times*, January 22, 2020, <https://www.ft.com/content/1634d184-3cfa-11ea-b232-000f4477fbca>.

³⁴ Neil Hume, “Norilsk flags lower dividends as it ramps up investment,” *Financial Times*, November 18, 2019.

³⁵ “Norilsk Nickel Announces Output Increase Plans while Committing to Ease Environmental Impact,” *PR Newswire*, December 2, 2020, <https://www.prnewswire.com/news-releases/norilsk-nickel-announces-output-increase-plans-while-committing-to-ease-environmental-impact-301183932.html>.