

Assessment of Technology Options for Low Emission Vehicles

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Low Emission vehicles are gaining widespread importance for its efficacy in emission reduction and thereby having a positive impact on the environment. With the advent of electric vehicles, more robust options are being presented to substitute the traditional vehicles; although there are some external factors which would delay the introduction of electric vehicles as an alternative. Thus, it is equally important to assess the technology options for Low Emission Vehicles.

Cobalt (Co) is a key components of batteries, also being the most expensive component in the battery. 60% of the Cobalt resources in the world are found in the Democratic Republic of Congo. From Figure 1, it can be inferred that a future geopolitical risk in the DRC could result in disruption to cobalt output, thereby causing a global cobalt supply squeeze. It can also be observed that changes to global copper and nickel production could be a major determinant of change in cobalt production, rather than the supply-demand dynamics and pricing of cobalt itself (GEMC, 2016).

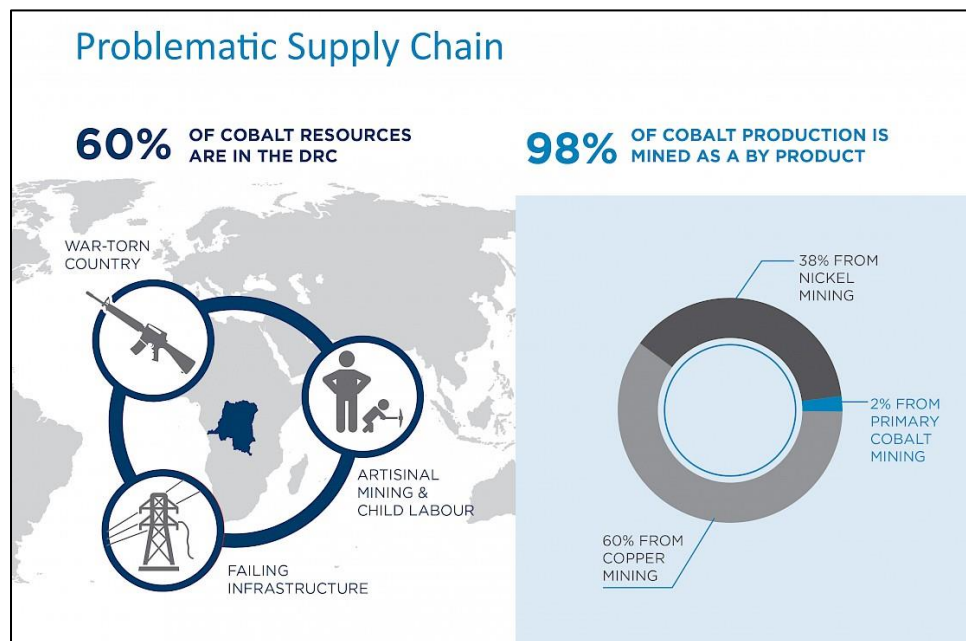


Figure 1: Supply statistics of Cobalt (GEMC, 2016)

Platinum (Pt) and Palladium (Pd) could turn out to be key materials in improving the existing devices or developing new applications for batteries in electric vehicles. A catalytic converter, which is typically used to reduce the toxicity of vehicle emissions by way of catalyzed or accelerated chemical reactions, have a primary catalyst component of Platinum (Pt) along with Palladium (Pd) (Dietz, 2014). The content of Pd and Pt used varies depending on the type of fuel utilized and the capacity of the engine. A combination of Pt and Pd is generally used for Carbon-Monoxide and HC oxidation (Claisse, 2015). For fuel cell self-driving vehicles, a chemical reaction between hydrogen fuel and oxygen generates electricity on a Pt or Pd catalyst. Presently, fraction of self-driving cars is negligible, although, as the world begins to embrace this idea of autonomous operated transportation, the demand for Pt/P could

potentially grow (Apmex, n.d.). Contrary to predictions that a substituted cheaper alternative might halt the rise in prices for Pt/Pd, the prices continue to rise. Prices are expected to climb by 8.4% for the year 2020, as per Mr. Staunovo (commodity analyst at UBS Wealth Management) (Ramkumar, 2019).

The transition from cobalt-nickel to Pt-Pd in possible battery technology applications is not that straightforward. The life cycle of the battery cell might be impacted for the worse if the cobalt content is reduced. By the current standards for electrical vehicles, the new battery should be able to replicate the behavior of retaining 80% of its original capacity, over a period of eight years. The cost of replacement of these batteries might prove to be more expensive than the cobalt savings (Chen, 2018). Reduction of cobalt content might also put forth potential safety risks. Cobalt has high energy density and thermal stability, which ensures that the battery cathodes don't overheat easily or catch fire. Apart from this, presence of cobalt also allows the battery to store and transfer more energy. Based on the estimation, cobalt constitutes of 10-33% of rechargeable cathodes, and thus, with the advent of electric vehicles, the cobalt demand is estimated to quadruple from 25000 tons to 100000 tons by 2025 (Roos, 2019).

As countries are planning to slow down the use of conventional cars to promote electric vehicles, Pd seems to benefit in investor interests, as car manufacturers look to additional ways to cut their overall emissions (Nelson, 2017). Stricter emission standards will further bolster the need for a catalytic converter, and thereby, bolster the demand for Pt/Pd. As per the report by Bloomberg New Energy Finance, until 2040, the ICE vehicles will not see a huge dip in the new car sales, thereby ensuring continuous demand for Pt/Pd (LePan, 2019).

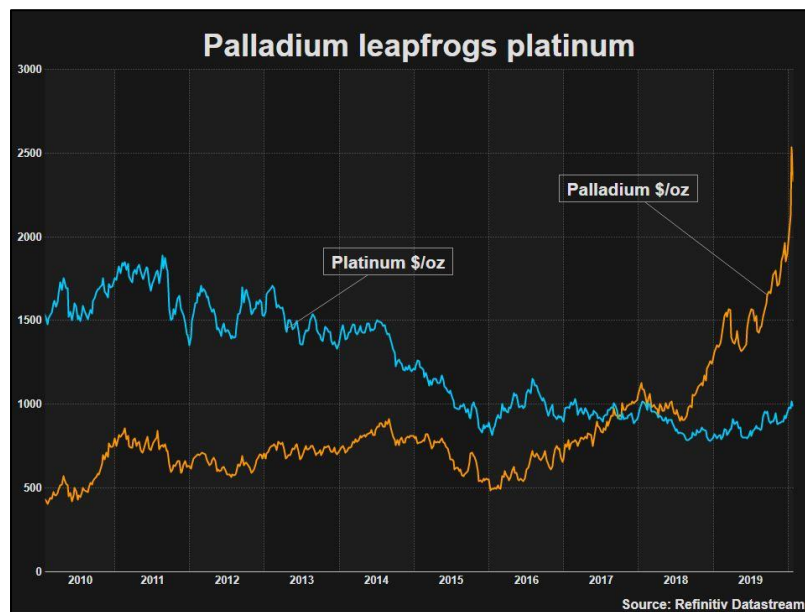


Figure 2: Pt/Pd Price over the years (Hobson & Soreng, 2020)

For Pt, industrial uses constitute around 60% of the demand, whereas that for Pd is much higher (around 94%). Because of the high demand for gasoline-powered automobiles, the cost of Palladium is on a rise, whereas the Volkswagen debacle has caused a decline in the Platinum demand (Fulp, 2018). The fluctuations in the relative price for Pt and Pd are largely driven by a number of external factors such as:

- Demand for gasoline and diesel production
- Effect of major geopolitical events on local and global economies
- Implementation of strict or relaxed emission standards

As per the Reuters poll, Pd will cost more than Pt (average), although, the gap will narrow down in 2021, with a slip in Pd prices, and a rise for Pt prices. As per analysts at Citi, many analysts expect some manufacturers to swap Pd for Pt to save money on their emission-cutting precious metals cost (Hobson & Soreng, 2020).

CAFE (Corporate Average Fuel Economy) Standards are considered important in order to reduce the use of gasoline, while making improvements in the fuel efficiency. Recently, by a rule issued by NHTSA and EPA, a new model has been put forth for the year 2021-2026, which increase the fuel economy and carbon-di-oxide standards by 1.5% every year (NHTSA, 2020). This seems to be an ambitious but achievable target, if the light duty vehicle producers put in additional effort to reduce carbon emissions. The Trump administration has deemed the efficiency goal set by the Obama administration as unattainable, and thus, have proposed relaxed standards such as 0.5-1% gains for the light duty vehicles (as opposed to the current 5%), which would help Americans buy 'Newer, safer vehicles that pollute less' (Hurley, 2019). Assuming that all these factors contribute to a rise in light duty vehicle demand, a rise in the Pt-Pd demand is expected, as manufacturers might look out to install catalytic converters to reduce the emissions, rather than switching to electric vehicles directly. As the standards for the CAFE could get relaxed, automobile manufacturers might delay their plan of switching to EVs, and focus on improving the efficiency of existing vehicles.

Based on the cited evidence, it seems viable for the Department of Energy to invest in Pt/Pd devices such as the catalytic converter or a fuel cell battery with Pt/Pd catalyst. The growing demand for Cobalt and Nickel all over the world, and also its over-dependence on a particular region makes it a less safe option. Moreover, as the current administration is planning to relax the standards, automobile companies are likely to extend their plan for introducing electric vehicles, installing a catalytic converter would be a good option to make their product more environment friendly. Also, significant improvements are required in the Pt/Pd based batteries to make them at par with the Co/Ni based battery.

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