PLATINUM PERSPECTIVES

"Electric" Vehicles (EVs) – Not all created equal

World Platinum Investment Council

We believe the market is overestimating the negative impact of powertrain electrification (moving to EVs) on platinum demand. We explain why **EVs represent only a limited risk to platinum demand** (even excluding potential demand upside from Fuel Cell Electric Vehicles, or FCEVs).

Market assumption: **EVs don't contain platinum**. Some market participants confuse EVs and Battery Electric Vehicles (BEVs). For example, Volvo's announcement that it would be producing only 'electric' cars post 2019 was significantly misinterpreted by many press sources.

Our view: In fact; Volvo committed to producing only cars that have an electric motor. This will include five new BEVs, the balance being hybrids, which can have gasoline or diesel internal combustion engines, and require platinum group metals (PGMs). Given mild hybrids are expected to gain significant market share, it is likely that most of Volvo's cars will contain PGMs, post 2019 and in the foreseeable years to come. **Different types of EVs have significantly different effects on platinum demand**.

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"Electric" Vehicles (EVs) – Some Definitions…….

Type of EV	Acronym	Description	Comment on PGM loadings
Battery Electric Vehicle	BEV	Contains a battery (minimum 30 minute recharge time) which stores electricity. Always runs on battery power alone	Generally BEVs contain no PGMs
Fuel Cell Electric Vehicle	FCEV	Contains a fuel cell which uses hydrogen to generate electricity which is the only powertrain for the vehicle (3 mins to refuel H_2)	High platinum loadings - we believe current models contain >30g of platinum and long term may reduce to 15-20g; compared to 3-10g for diesel
Plug-in Hybrid Electric Vehicle	PHEV	Like a HEV (can run on battery, combustion engine or both), can run solely on battery power for at least 10 miles, battery can be plugged in to be recharged	Likely contains similar PGM loadings to an equivalent internal combustion vehicle. Smaller combustion engine but runs intermittently (at lower average temperature, so higher PGMs relative to combustion engine size)
Hybrid Electric Vehicle	HEV	Contains both a combustion engine and a battery, can run on either battery or combustion engine or both in parallel, but smaller battery than a PHEV, so the battery-only range is shorter	Likely contains similar PGM loadings to an equivalent internal combustion vehicle. Smaller combustion engine but runs intermittently (at lower average temperature, so higher PGMs relative to combustion engine size)
Mild Hybrid / 48V	48V	Conventional car (gasoline or diesel) with a small 48 volt battery and electric motor to help with fuel efficiency. Cannot run on battery power alone	Likely to contain similar PGM loadings to an equivalent ICE vehicle - same combustion engine size

Source: WPIC research. Above excludes Extended Range Electric Vehicles (EREVs)

BEVs – greatest potential threat to PGM demand. However, the most ambitious targets for BEVs produced in 2025 are c25%. Therefore, it is unlikely that the passenger vehicle powertrain mix will be completely combustion engine-free over a reasonable investment horizon.

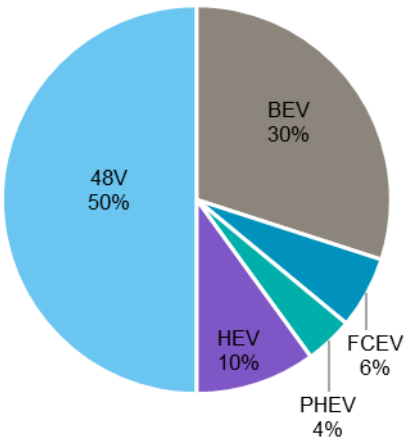
PHEVs – attractive due to the ability to run solely on battery power (especially in an urban environment) but suffer from the high combined cost of the battery plus the combustion engine.

HEVs – well established technology (e.g. Prius), can also run solely on battery power, but with a smaller battery, larger combustion engine, and shorter battery-only range than PHEVs.

48Vs – a conventional car with a small battery and electric motor to boost acceleration, helping performance and fuel consumption. The PGM loading in a 48V will be the same as the ICE car equivalent. Automakers have convinced the market that 48Vs represent "electrification" rather than incremental fuel efficiency. Fuel efficiency improvements are greater on diesel cars (for example Audi's SQ7 TDI).

Conclusion – most EVs contain PGMs. "Electrification" (e.g. as defined by Volvo) may not have a negative effect on platinum demand. Diesel share is more important; our June 2017 *Platinum Perspectives* explains why we believe diesel share may be higher for longer.

*Scenario for global **EV** market share split in 2025 – Would lead to a net increase in platinum demand, all else equal*



Source: WPIC Research. Note, in the scenario above, demand from FCEVs alone would represent 3.55moz (post significant thrifting to 17.5g/vehicle). Therefore, even if all other vehicles were BEVs (i.e. containing no platinum, which is highly unlikely); demand from autos would be higher in 2025 vs 2016 (3.4moz).

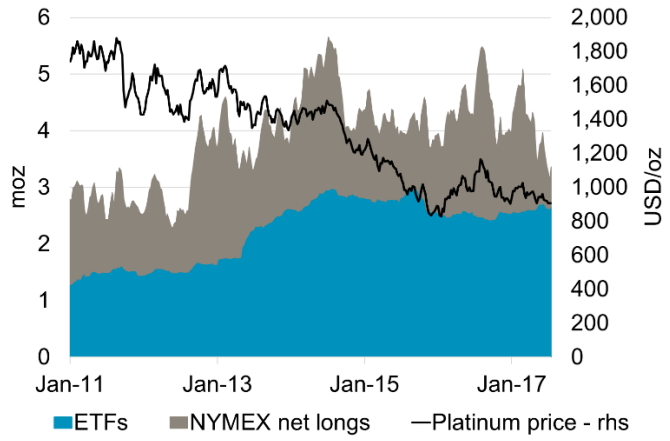
Platinum in six charts – July 2017

World Platinum Investment Council

We believe there are many reasons supporting consideration of platinum as an investment asset:

- Supply demand fundamentals are strong and ETF holdings are stable, despite price volatility
- Risks of supply declines are underestimated - cost pressure and falling mining investment continue
- Downside risks to platinum automotive demand are overestimated
- Futures positioning follows poor sentiment with high correlation to price
- Platinum is undervalued against its past, its production cost and against gold

Figure 1: ETF holdings stable despite price volatility; high correlation between futures and price

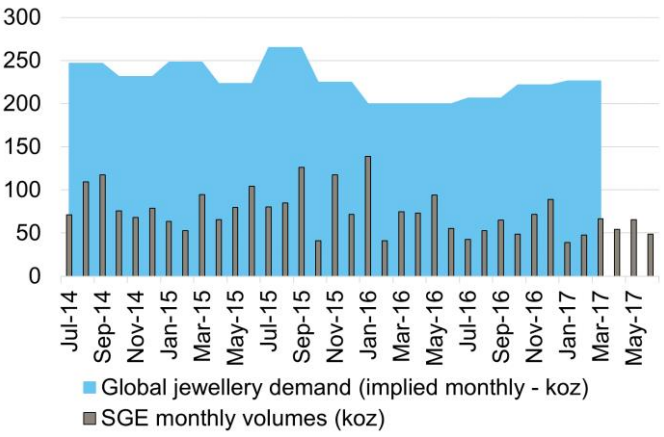


Source: Bloomberg, WPIC Research

Figure 2: Platinum discount to gold appears to have bottomed out at cUSD200-300/oz

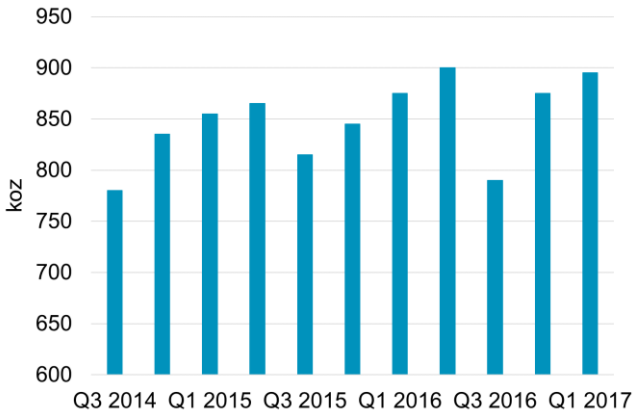
Source: Bloomberg, WPIC research

Figure 3: ROW platinum jewellery demand growth offsets dip in China demand



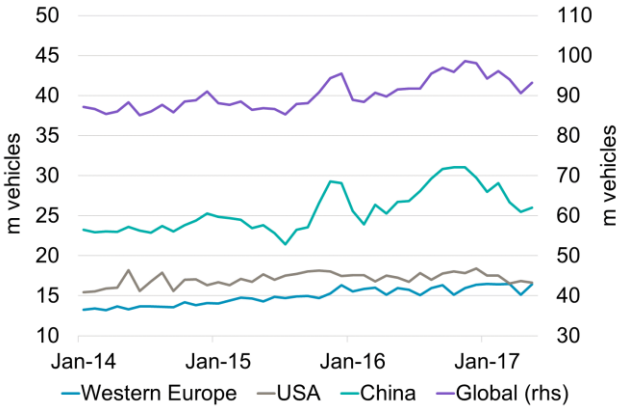
Source: Bloomberg, SFA (Oxford), WPIC research

Figure 4: Automotive platinum demand surprised to the upside in Q1-17 and revisions all positive to date



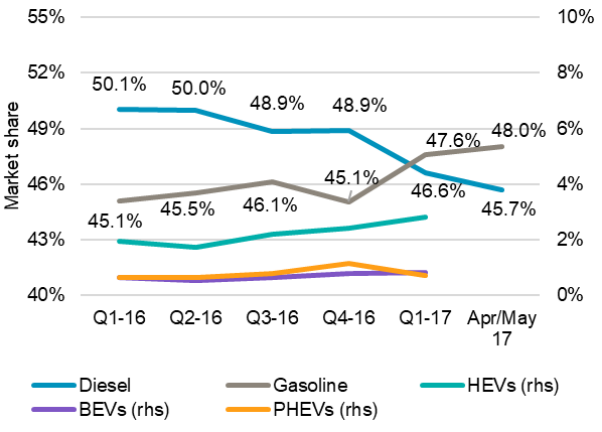
Source: WPIC Platinum Quarterly Q1 2017, SFA (Oxford)

Figure 5: Western Europe light vehicle car sales remain robust despite a softer global market



Source: LMC

Figure 6: European* passenger powertrain market share (%)



Source: LMC, ACEA, WPIC research

** Europe includes passenger vehicles in Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, UK, Norway and Switzerland (based on the availability of both diesel market share data and Alternative Fuel Vehicle data)..*