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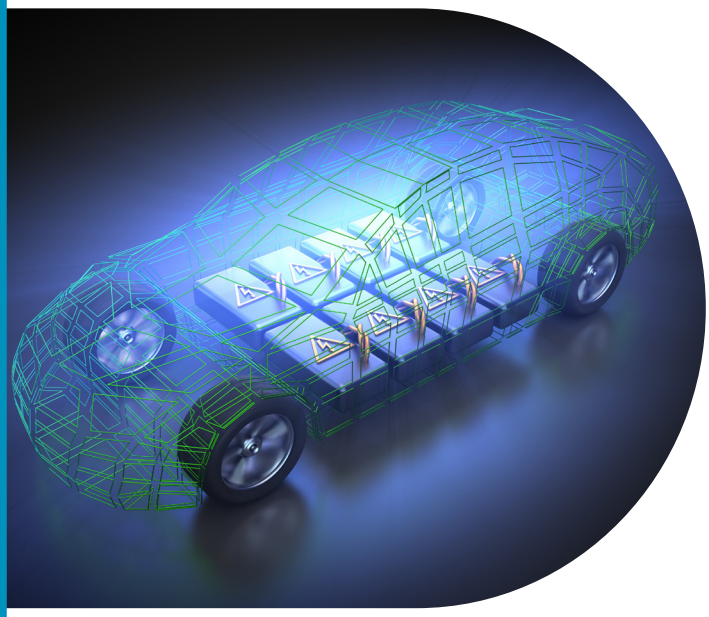

PLATINUM IN BATTERIES

The prospect of platinum use in battery electric vehicles is on the horizon

Automotive use of platinum is well established; platinum-based autocatalysts have been the single largest segment of platinum demand for decades. Platinum is also at the forefront of proton exchange membrane (PEM) technology used in hydrogen fuel cell electric vehicles (FCEVs), a market that is poised to grow significantly as automakers look to transition to the production of zero-emissions vehicles, initially in the heavy-duty sector.

Indeed, supportive hydrogen policies alone could result in FCEV demand for platinum equalling current automotive demand by 2039, while broad-based commercial adoption of FCEVs, as economies of scale and lower cost of hydrogen kick in, could bring this forward to 2033, adding over three million ounces to annual automotive platinum demand in just over ten years.

Conversely, no platinum or platinum group metals (PGMs) are currently deployed in the batteries used to power battery electric vehicle (BEV) models that are solely battery powered. However, next generation battery technology could see platinum used across the spectrum of BEVs from hybrid models which combine an internal combustion engine with some form of battery, to electric vehicles that run on rechargeable batteries alone.

PGMs improve battery performance

Lithium-air and lithium-sulphur battery technologies already offer the potential for energy densities three to ten times higher than the lithium-ion batteries currently in use, but electrochemical limitations have prevented their widespread use. However, current research and development into lithium-air and lithium-sulphur chemistry using platinum and its sister PGM palladium in cutting-edge lithium-ion batteries looks poised to address those limitations and unlock a step-change in battery performance, including improvements in 'cyclability' and 'discharge capacity'.

Cyclability is a measure of the number of times a battery can be recharged before it reaches its end-of-life.

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Discharge capacity is a measure of battery energy capacity and, when it comes to BEVs, it is a factor that impacts vehicle range as the vehicle ages. Alongside the significantly higher energy density offered by these new PGM-based battery technologies, improving both cyclability and discharge capacity could lead to longer-lasting, more efficient batteries with faster recharging times that enable a BEV to travel greater distances before it needs recharging.

Assuming commercial success for batteries containing platinum, the scale of market demand for such step changes in battery performance would be significant, given the increasing attractiveness of BEVs and hybrid vehicles where batteries greatly enhance fuel efficiency, further reducing CO2 emissions. Similarly, the use of higher energy density lithium batteries in other applications beyond mobility could create additional demand in the future for platinum and palladium from the wider battery sector.

Development of PGM use in batteries has also shown that platinum and palladium are able to improve the energy density of existing lithium-ion batteries. With early indications showing that PGM-based lithium-ion batteries could extend BEV range by as much as 30 per cent, this also means that, for the same battery range, batteries could be 30 per cent lighter - the weight of heavy batteries being a large drawback for BEVs, particularly in trucks.

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