

# Precious Metals Watch

**Group Economics**  
Macro & Financial Markets  
Research

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## Electric Vehicles to result in large platinum and palladium price declines

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### Introduction

The electrification of transport will have a big impact on specific industries and commodity markets during the next couple of decades. We will examine a number of aspects of the changes to come in a series of reports. As the future is uncertain, we have developed four automotive scenarios, which will be the basis for these reports. The four scenarios are presented in the tables below and in more detail in the appendix at the end of this document. In this report we will focus on the impact of our four scenarios on the platinum and palladium price outlook.

### Our scenarios of market share of light duty vehicle sales per category

% of total new annual global LDV sales, Petrol = Petrol & hybrid and includes LPG & Nat Gas

	Diesel	Petrol	Electric	Fuel cell	Total
Current*	20%	79%	1%	0%	100%
Base 2040	2%	33%	60%	5%	100%
Scenario 2	5%	60%	30%	5%	100%
Scenario 3	2%	13%	80%	5%	100%
Scenario 4	2%	48%	20%	30%	100%

Source: ABN AMRO Group Economics, \* Source share diesel current = Thomson Reuters

### Our scenarios and global light duty vehicle sales

LDV sales in millions

	Diesel	Petrol	Electric	Fuel cell	Total
Current	18.8	74.3	1.0	-	94.1
Base 2040	2.6	42.9	78.0	6.5	130.0
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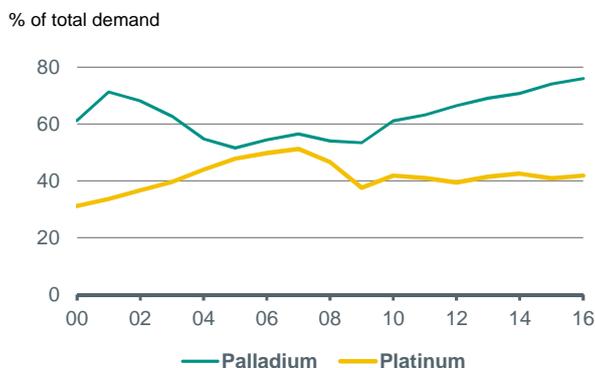
Source: ABN AMRO Group Economics

### Today's platinum group metal loadings for Light Duty Vehicles

Autocatalyst demand accounts for roughly 40% of total demand for platinum and 75% of total demand for palladium (see graph on the left below). Part of this autocatalyst demand comes back in supply in the future through recycling. The graph below on the right shows that autocatalyst scrap supply is increasing over time as the number of vehicles worldwide is increasing as well. Moreover, the attractive price (in the case of palladium) and the focus on sustainability play a role as well. It is likely that the upward trend will continue

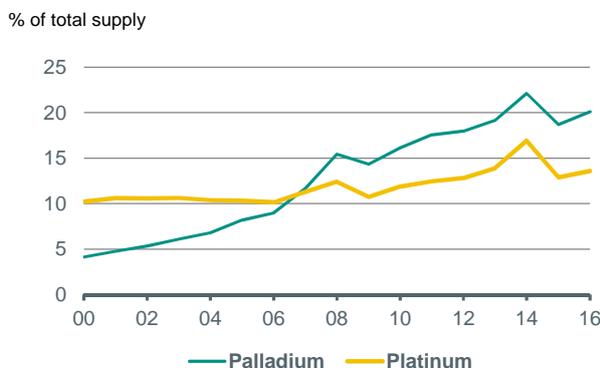
going forward. We expect that platinum and palladium supply will increase by 5 to 10% by 2040 because of higher recycling.

**Autocatalyst demand important for both**



Source: GFMS Thomson Reuters, ABN AMRO Group Economics

**Autocatalyst scrap supply is on the rise**



Source: GFMS Thomson Reuters, ABN AMRO Group Economics

According to Thomson Reuters, the average platinum group metals loadings (PGM i.e. mainly platinum, palladium and rhodium) for Light-Duty Vehicles (LDV) are slightly above 5 grammes for diesel cars and around 3.2 grammes for petrol cars. Autocatalysts for diesel cars largely contain platinum and to a lesser extent palladium and rhodium. Meanwhile, catalysts in petrol cars mainly contain palladium and some rhodium. Fuel Cell platinum cars currently contain platinum loadings that are around five times higher than those of diesel cars. In contrast, electric vehicles don't contain platinum or palladium.

We expect that the new emissions standards in various countries are likely to result in higher platinum group metals loadings in car catalysts. This will probably result in higher platinum and palladium demand in the near term supporting platinum and palladium prices. However, over time we expect that technology will result in lower loadings. By 2040 (our base scenario) we expect that the platinum loadings for fuel cell cars will converge to the current platinum loadings of diesel cars.

**Base scenario: 60% of new car sales to be electric by 2040**

**This base scenario is negative for platinum demand...**

In our base scenario we expect that the share of diesel cars in the total global annual light duty vehicle sales will drop from 20% today to around 2% in 2040. Meanwhile, we expect PGM loadings per car to decrease because of technology. This scenario will have a dramatic impact on platinum demand for autocatalysts. We expect platinum demand from car catalysts to drop by 65% by 2040 compared to today. If other demand (such as demand from jewellery, glass electronics, petroleum, other industrial and chemical) remains close to its long term average, it is possible that total demand for platinum will decrease by 30% by 2040.

Over this period we expect mine supply to decline because of lower ore grade and the difficulty of finding platinum. However, we expect scrap supply to increase because of a larger total vehicle float and this will more than offset the decline in mine production. All in

all, our base scenario will be negative for platinum prices because we expect excess supply to occur. Over time, platinum prices could drop to USD 500 per ounce in this scenario, which is close to -45%. In the near term, we expect platinum prices to recover as fundamentals are not as weak as investors now anticipate.

#### **... and negative for palladium demand**

In our base scenario, palladium demand will also be hit hard over time. The market share for petrol cars will drop substantially. We expect that the total number of petrol cars sold will decline to around 43 million cars from 70.5 million cars today. This will translate to roughly a 40% decline in global palladium demand by 2040.

We expect palladium mine supply to decrease considerably. However, scrap supply will increase as well and this should more than offset the decline in mine supply. All in all, in our base scenario we expect palladium prices to drop because of lower autocatalyst demand and higher scrap supply. In short, the supply-shortage will disappear in our view and turn into a, oversupply situation. Therefore, we expect prices to drop to USD 400 per ounce over time, which is around -60%.

#### **Scenario 2: 30% of new car sales to be electric by 2040**

##### **This scenario is less negative for platinum and palladium prices**

In scenario 2 we expect that electric cars will only be 30% of global LDV sales. That still represents a sharp increase in electric vehicle sales compared to today, while the number of petrol cars will rise modestly in contrast to our base scenario. This is because the global annual increase in LDV sales will more than offset the decrease in market share for petrol cars. This scenario is the least negative scenario (of the four) for palladium prices. In this scenario global palladium demand could decline by 3% mainly because of efficiency and lower palladium demand for diesel cars (diesel car catalysts also contain a small amount of palladium). As a result, the supply shortage will ease. Therefore, we expect prices to decline to USD 700 per ounce over time. This scenario is also negative for platinum prices. All else being equal, global platinum demand could drop by 20%. As a result prices could decline to around USD 600 per ounce.

#### **Scenario 3: 80% of new car sales to be electric by 2040**

##### **The most negative scenario for platinum and palladium prices**

This scenario 3 is by far the most negative for both platinum and palladium demand. Market share of petrol and diesel cars will drop sharply. This will translate into a sharp drop in autocatalyst demand for platinum and palladium as well. In the case of platinum, it is likely that global platinum demand will drop by 35% (all else being equal) and global palladium demand by 70%.

Palladium demand is impacted more because autocatalyst demand is a higher percentage of total demand. In the case of platinum there is still jewellery demand that could dampen the impact of a drop in autocatalyst demand. In this scenario we expect platinum prices to drop to USD 300 per ounce and palladium prices to drop to USD 100 per ounce over time. We expect the supply-demand balance for palladium to move to significant excess supply.

**Scenario 4: 30% of new car sales to have a fuel cell engine by 2040****A bull case for platinum prices but negative for palladium**

This scenario is the most positive scenario of the four for platinum demand and the platinum price outlook. Even though diesel cars will lose an enormous amount of market share, fuel cell cars' share of global Light-Duty Vehicle sales will rise to 30%. In this scenario we expect global platinum demand to increase by 30% and platinum prices to move towards their 2008 all-time high of some USD 2,300 per ounce. Today, fuel cell cars contain around five times more platinum than diesel cars. Over time, we expect that technology will result in sharply lower platinum loadings for fuel cell cars. For this scenario we expect that the platinum loadings for fuel cell cars will be around today's platinum loadings for diesel cars. It is possible that the loadings will be greater than this. If that is the case, platinum prices will go higher than we assume. However, we expect global palladium demand to decline by 25% because of a decline in autocatalyst demand. As a result, we expect palladium prices to decline to USD 500 over time.

**Summary**

In our base scenario we expect that the share of diesel cars in the total global annual light duty vehicle sales will drop from 20% today to around 2% in 2040. Meanwhile, we expect PGM loadings per car to decrease because of technology. This scenario will have a dramatic impact on platinum demand for autocatalysts. We expect **platinum** car catalyst demand to drop by 65% in 2040 compared to today. This results in a drop of total platinum demand close to 30%. Prices will also drop substantially to some **USD 500** per ounce in 2040. In the near-term we expect platinum prices to be supported though because of higher loading resulting from tighter emission standards.

**Palladium** demand will also be hit hard. We expect that the total sales of new petrol cars will decline to around 43 million cars from 70.5 million cars today. This will translate in roughly a 40% decline in global palladium demand by 2040. Prices will drop to some **USD 400** per ounce in 2040 because of sharp drops in demand and considerable increase in auto catalyst scrap supply.

Our scenario 2 (30% of new cars sales will be electric by 2040) is less negative for platinum and palladium prices compared to our base scenario while our scenario 3 (80% of new cars will be electric by 2040) is the most negative for the platinum and palladium price outlook. However, in our scenario of a dominant role for fuel cells in LDV (scenario 4), platinum prices could rise to 2008 all-time high of USD 2,300 per ounce. Meanwhile, we expect palladium prices to decline also in this scenario.

Our scenarios and price impact							
Platinum	Catalyst demand	Total Demand	Total Supply	Loadings	Price change \$	% Price impact	
Current						930	
Base 2040: 60% EV	-65%	-30%	5%	-20%	-430		-46%
Scenario 2: 30% EV	-50%	-20%	5%	-20%	-330		-35%
Scenario 3: 80% EV3	-75%	-35%	5%	-20%	-630		-68%
Scenario 4: 30% Fuel Cell	80%	30%	5%	-80%	1,370		147%
<b>Palladium</b>							
Current						990	
Base 2040: 60% EV	-40%	-40%	10%	-20%	-590		-60%
Scenario 2: 30% EV	-5%	-5%	10%	-20%	-290		-29%
Scenario 3: 80% EV3	-70%	-70%	10%	-20%	-890		-90%
Scenario 4: 30% Fuel Cell	-25%	-25%	10%	-20%	-490		-49%

Source: ABN AMRO Group Economics

# Appendix: Driving towards an emission free future for cars

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## Introduction

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## Our four automotive scenarios

In 2040, the worldwide vehicle fleet will be powered by a diverse range of engines, varying from conventional petrol engines and various types of hybrid engines to fully electric motors and fuel cell motors. Diesel will continue losing ground as a fuel for passenger cars in the next ten years. We are also pessimistic about the future of plug-in hybrid models. Once the driving range of fully electric cars is extended to about 500 kilometres, plug-in hybrids will lose their appeal.

In our projection for 2040, we expect the global number of Light-Duty Vehicles (or LDV) to be about 40% higher than in 2016. We have put average annual growth in new car sales until 2040 at 1.5%. The total vehicle fleet in 2016 ran to about 1.3 billion passengers and light-duty commercial vehicles. In our view, this number could increase to over 1.9 billion in 2040, which means growth of around 50%. The growth of the middle class in emerging countries will be the main driver behind the sales growth. Average annual growth of the fleet is estimated at 1.75% in our projection. Finally, we assume that 5% to 6% of the cars are written off each year.

## Base scenario: 60% new EV sales in 2040

In our baseline scenario, we assume that 60% of new cars sold around the world in 2040 will be electric. The affordability of the electric car is a crucial factor. Historical and also today's practice shows that financial stimulus is a key incentive for consumers. We expect that electric cars will achieve price parity with petrol cars around 2025. The tipping point will be triggered by the falling price of lithium and better production technologies.

Petrol cars will constitute a minority, albeit a sizeable one: assuming projected car sales of roughly 130 million in 2040, an electric-only share of 60% still leaves 46 million combustion-engine car sales in that year. It will be a challenge to achieve a higher electric-only percentage, not least because this requires major investment in infrastructure (charging stations) all over the world. Nevertheless, in countries like the Netherlands (early adopters) the electric-only share will be higher than 60% compared to less developed areas. Less developed countries in particular may struggle to put the necessary infrastructure in place. Slowly but surely, however, this infrastructure will be rolled out in the subsequent period. Paradoxically perhaps, this is where large oil companies can act as a key facilitator by equipping their petrol stations with electric charging points. What is

even more crucial is that the existing power network is upgraded to facilitate charging electric cars.

### Scenario 2: 30% new EV sales in 2040

This scenario assumes that electric transport will grow at a lower rate, with electric vehicles accounting for 30% of new sales in 2040. There are several reasons why this scenario may play out.

First the supply of lithium may not be able to keep up with demand. Thanks to intensive exploration activity, lithium reserves are growing annually. But whether extraction can keep pace with demand from car manufacturers is another matter. This mismatch could put a strong brake on the rise of the electric car. A second aspect in this regard is the ecological footprint that the extraction of lithium and other earths like cobalt, will leave. Sustainability, but also political stability will largely determine whether extraction of the commodities is feasible.

Another drag factor could occur in the form of less generous government support, such as from an automotive superpower such as in today's America. Governments in other countries may adopt a similar hands-off stance.

A final factor that may limit the share of electric cars is lacklustre adoption in large parts of the world. At present, no less than 95% of electric car sales are made in only ten countries. In this scenario, electric vehicles fail to take off in the rest of the world.

### Scenario 3: 80% new EV sales in 2040

In this scenario, we assume a much faster adoption of the electric car, so that no less than 80% of global new car sales are electric in 2040. This can happen, for instance, if incentives for electric cars are intensified by means of an aggressive government grant policy. This will also prompt car producers to focus entirely on electric vehicles. After an expected tipping point around 2025, we will see accelerating global adoption, with improved production and commodity exploration technologies also making electric cars more affordable in less developed countries. Government grants will cause a domino effect as more and more governments opt to sponsor the transition to electric transport. Ultimately, electric cars will have become so much cheaper that grants are no longer necessary.

Demand for petrol and diesel cars will fall faster as car-sharing becomes increasingly commonplace in large urban agglomerations. By that time, access to these city centres will be restricted to electric vehicles. In this scenario, Australia and Chile will be 'the new Saudi Arabia' in 2040, as lithium will have superseded oil as a key source of energy for the industry.

### Scenario 4: 30% fuel cell engines

An alternative scenario for the transformation to an emissions-free future for cars assumes a big breakthrough in hydrogen (fuel cell) technology. Car manufacturers are not yet betting big on this technology, but some are planning to launch small series of hydrogen-powered cars in the coming years. However, the infrastructure for hydrogen filling stations is still in its infancy.

In this fourth scenario, we assume that, by 2040, 30% of new cars sold will be powered by a platinum-based fuel cell. In our projection, this works out to about 40 million cars.

How this scenario unfolds depends strongly on the development of battery technology. At this stage, we cannot say which of the two will be the leading technology by 2040, but we do know that the pricing of the raw material (platinum for fuel cell technology, lithium for battery technology) is certain to play a key role. Whether the supply of lithium can keep pace with exponentially growing demand and at what price (ecological footprint) will partly determine the potential development of fuel cell technology.

### The data behind the scenario's

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	Diesel	Petrol	Electric	Fuel cell	Total
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Source: ABN AMRO Group Economics

#### Total fleet

In millions

	*ICE	Electric	Fuel cell	Total
Current	1,297	2	1	1,300
Base 2040	1,189	698	85	1,971
Scenario 2	1,536	351	85	1,971
Scenario 3	957	930	85	1,971
Scenario 4	1,144	235	591	1,971

Source: ABN AMRO Group Economics, \*Internal combustion engine

Find out more about Group Economics at: <https://insights.abnamro.nl/en/>

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