

Session 4: The Auto-Catalyst Market – The Next Decade

Dr David Jollie

Manager, Precious Metals Marketing, Johnson Matthey

For anyone who was in Kyoto last year, Neil Collins also from Johnson Matthey gave, I think, quite a well-balanced, coherent view of the automotive market going forward. In order to be a bit different this year, I've decided to be rambling and incoherent and have a little bit of variety for you.

We are looking at the same sort of issues. Trying to talk about what the current catalyst trends are in the automotive market. What the road ahead looks like, the road we can predict, which I am saying here 'with no corners'. What the market would look like then. Looking at guiding forces for change and why that isn't a realistic scenario, things like CO₂, regulations, fuel economy, environmental drivers and customer preferences. Then what the road ahead really looks like, or an approximation of what it looks like, what it means in terms of diesel, hybrid, electric vehicles and fuel cells. What that means in terms of platinum group metals, PGM demand going forward on a 10-year timescale.

Just to give you an idea of where we're at, we have something like a 9 or 10 million gross demand before taking recycling into account per year, this was the 2008 figure.

I won't touch much on what's happening this year because I think this is just a dislocation in the market, and I think a lot of the trends from before continue although there are some trends that change – maybe downsizing is one of those. I think this year, and you can almost say 2010 too, is a dislocation; it doesn't represent what's happening in the market.

If we talk about current catalysts – what you see in the market at the moment – you have a three-way catalyst; using a gasoline vehicle, typically, they will use

palladium/rhodium formulations. You can use platinum as well if you want, but you would be a bit stupid if you could avoid it because platinum is a lot more expensive than palladium. At the moment, you see almost always only palladium/rhodium on three-way catalysts. On every gasoline vehicle sold in the world pretty much, you'll see a three-way catalyst. That's all you get.

The diesel market is a little bit different; we're talking light duty here particularly, so smaller vehicles like passenger vehicles. We see oxidation catalysts, similar but usually platinum-based, sometimes platinum/palladium. We see diesel particular filters, which are for collecting particular matter – soot essentially. Those are platinum-based, with the platinum being

replaced slowly by a platinum/palladium mixture really to give a heat tolerance, durability to these catalysts. The palladium is not necessarily added for catalytic reasons although it may do something.

That's where we are today. If you look at what that means in terms of the market at the moment, if you look at the rest of the world market, it is essentially a gasoline market; so 80% of the vehicles are gasoline, the 'other' out of interest is probably Brazil with the ethanol and some hybrid vehicles as well, which will be mainly gasoline; a little bit of diesel for India, commercial vehicles in China as well. What we're talking about is really a gasoline market, so predominantly a palladium/rhodium market and some platinum where fuel quality is bad for instance. North America is pretty similar, the 'other' here is largely flex-fuelled vehicles. So, in theory, they are not gasoline vehicles but, in practice, they almost exclusively run on gasoline or E85, so they have the same catalysts – largely palladium/rhodium in the light duty market.

The reason we talk about diesel is we look at the European market and again the 'other' is LPGs etc., but you see roughly a 50-50 split between diesel and gasoline. I think last year would have been 53% sales in Europe were diesel, of light duty; this year, it will be lower than that for a variety of reasons. What that says is that Europe is much more where you're talking about platinum demand, so Europe is where you'll see most of the platinum used, but a fair amount of palladium used in the gasoline vehicles.

To this current status in historical terms, what you've got is a fairly strong growth, and this shows 20 years. I was surprised by the strength of growth over 20 years and the amount of metal used in the automotive market, and the auto-catalyst market. You go from 1988, where people had essentially oxidation catalysts, three-way catalysts on gasoline vehicles and platinum is what you used. After that going to around 1999, you are seeing people basically putting a lot of

effort into using palladium in gasoline catalysts if they could do it to save money. This worked well, so much so that, by 1999, you get a huge amount of palladium used, the price goes through the roof and everyone goes back to platinum in around 2000-2001. Post-2001 is more of a diesel growth story and tightening legislation elsewhere.

Does the history map onto where we're going in the future and I think it does map pretty closely. For gasoline cars, you're going to have three-way catalysts, we know that. They are largely going to be palladium/rhodium. You'll get tightening Euro 6 legislation, which is likely to come in in 2015-2016, and tightening US legislation, as well as Chinese, Indian, South American legislation. Tightening legislation almost always means more precious metals going on.

We're going to vehicle growth, more vehicles sold than this year or last year in the fullness of time. I don't think that's next year necessarily. You might see some recovery, but the real recovery is further out than that. What we have at the moment is dislocation, but I don't think that changes the position 10 years out at all.

Then we have this balance between thrifting and new legislation, meaning that you add more metal in, and all the time you're fighting against that with your chemists and engineers trying to improve how the catalyst works and how the engine works. So hopefully you can balance things, but my take on this generally means that there will be more palladium usage in the fullness of time.

If you are looking at the diesel market, we'll have more oxidation catalysts, we'll have more filters, you see them now on a lot of vehicles in Europe, and you'll see them increasingly. However, against that more platinum and palladium use, Euro 6 legislation looks at Nox emissions, oxides of nitrogen, brown fumes essentially from your exhaust, and that's going to change the

legislation. I think that adds a bit of complexity to the treatment you have to use and probably adds to the cost, but probably adds to the PGM use as well.

Vehicle numbers I think is a big question because, again, we talk about consumer preference; you can see some potential for growth in some markets. Some potential for growth in gasoline market share in Europe, and that's one of the questions we don't know the answer to – what the diesel market share is.

Heavy trucks will have, after treatment, more metal. Again, we say that for diesel, it is probably positive. What we know is going to happen is probably positive for PGMs, and the balance between platinum and palladium is a bit more difficult to read.

So what changes things? Well, it is possible that the economic crisis changes things; I would rather think it won't do a great deal. It will probably mean that for a few years, people will buy slightly smaller cars; it might mean a change in the way the auto companies work, but it's not going to be a sea change. Fundamentally, if you play ice hockey, you need a car that is long enough to hold an ice hockey stick – there's no choice about it. So you will buy a large car. If you've got six kids, you'll buy a car to fit six kids.

The changes are things like CO₂ and fuel economy regulations. It depends where you go but essentially it means the same thing. Basically, can you travel further for less money with lower CO₂ emissions? If you can do that, great. And if you can't do that, you'll be legislated to do it anyway. There are varieties of ways you can do that. In the gasoline market, downsizing of vehicles is one way: light weight vehicles, e.g. the Audi A2 a few years ago was made of aluminium to make it lighter, turbo-charging so you can add power with a smaller engine; and then things like other engine technology, which I don't know much about. Also HCCI, GDIFSI, basically a more efficient form of

gasoline engine, and that doesn't really change a great deal. Generally, these are the sorts of trends you get for gasoline.

What I think fuel economy does do is give you more diesels, because diesel is better fuel economy than gasoline generally, certainly for larger vehicles. It also means hybrids. Hybrids refer to a whole range of things – at the very least, it means stop/start hybrids where when you are at a traffic light, your engine stops and you don't emit as much. That is a little bit more fuel-efficient. You might get a little bit more hybridisation, like the Prius.

Then the environmental concerns, the legislators want zero emissions or as close as they can get. So they are looking for that. We can already plot – China is following the European emissions rules, going forward for the next five years. It'll follow it for the next 10 years I would think. China will have tighter emissions legislation. I think India will as well, the US has also got a fairly clear future map for the next few years at least and so too will Europe. My personal guess is that Euro 7 legislation will come, and, who knows, Euro 15 in some year or other.

Focus on 'new' pollutants: When we started out, they focused on the big pollutants, things you could see, e.g. soot. Now they're beginning to focus on things you can't see, so maybe particulate from gasoline engines, and that's interesting because it maybe means you'll put a filter on a gasoline car, meaning more PGMs if you do that. What it all means is that as you get tighter emissions legislation, it gets more complex to do this after treatment. Previously, you just bolted a catalyst on and it was fairly passive, you didn't have to worry about it. Now you have to control the engine, to get it to the right temperature, maybe to regenerate the catalyst, maybe have a catalyst up front to do one pollutant and then a catalyst behind to do another pollutant. That kind of gets you away from one size fits all, probably in both the gasoline and the diesel markets, and

I think it essentially gives you an opportunity to put a bit more platinum in the gasoline market and it probably means that you can't have 100% anything in the diesel market. You'll have a bit of a mixture and much more complicated chemistry going on.

In the fullness of time, whenever that may be, electric vehicles – someone will probably ask the question and I will give you a very negative answer about it – and fuel cells, which I'll be a bit more positive about, but this is the 10-year forecast.

What does it all mean? This is, I think, what the real future looks like. This is just foreseeable analysis. Red is bad for PGM use, the green is good and the orange is neutral or I think you can see from this, thrifting or downsizing always happens and they are going to happen in platinum. Palladium substitution is going to happen in platinum. You will see a growing vehicle market; you will see more heavy-duty vehicles as well with more emission controls on them. Tighter emission legislation, and my guess is you'll see some growth in the US diesel market. All of those are positives. So I think the base point you expect to see is platinum use increasing over the next 10 years. There are question marks, but there are more positives than negatives for platinum demand, I would say.

Looking at palladium, exactly the same. The downsize is a little bit different. CO₂ legislation I think is probably a negative for palladium, because it probably helps to drive diesel, and a few other things as well – some other engines, which might use different catalyst technologies. So I think that that is a change between the two metals, but thrifting and downsizing are essentially exactly the same issue, smaller engines mean smaller catalysts, which usually means less metal on them.

The positives are pretty much the same again, the difference being the use in the diesel market – I think palladium is going to benefit from that. It has over the past two or

three years, and it will continue to do so. On the far right as well, China and India. Clearly, most of the growth in China is gasoline cars, a lot of the growth, although less of it in India is gasoline. You can say the same about Russia – a lot of PGM use, a lot of palladium use at current prices.

What does hybridisation mean? My view, and it might be a bit controversial, but it doesn't mean anything at all for PGMs really – it has virtually no impact. Again, you look at that and you're saying basically more palladium being used as well, probably in the next 10 years.

So what does the future look like? We can give you the immediate future, and given that we are presenting our numbers in two weeks, I didn't put this year's in. Clearly, if you look at all the PGM demand, demand this year is going to be lower, and demand next is not going to be markedly better. I do think looking forward that although measuring the balance between the metals is quite challenging, to know which is going to succeed more, I think if you're looking into the future, there will be more precious metal demand from the auto-catalyst market.

Thank you.