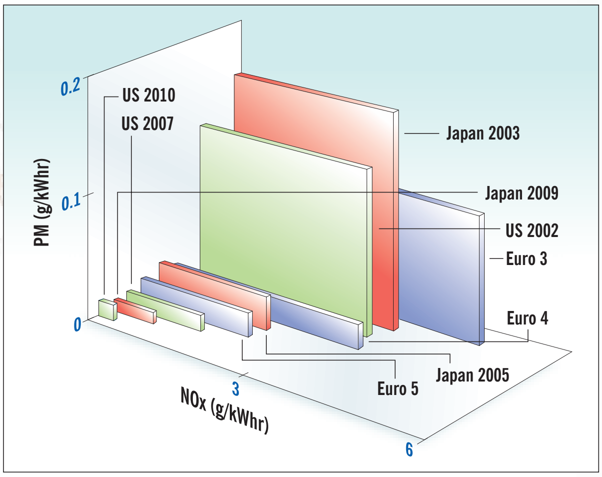
HEAVY DUTY DIESEL: A GROWING SOURCE OF PGM DEMAND

The market for trucks and buses is quickly becoming an important one for the platinum industry. Although there have been widespread examples of regulatory control of vehicle tailpipe emissions since the mid-1970s, these have mainly focused on cars and other light duty vehicles. Only in more recent years has the legislative process expanded to impose limits on what can be emitted from the exhaust of many other internal combustion engines, from mopeds to freight trucks.



New emissions legislation for heavy duty diesel vehicles is encouraging the fitment of aftertreatment systems around the world.

Amongst these new areas, the sector of greatest interest in terms of precious metals is the heavy duty diesel (HDD) market. The vast majority of large vehicles use the fuel-efficient diesel engine to power them and many of these are being fitted with aftertreatment for the first time.

Unsurprisingly, the limits of what can be emitted to the atmosphere are tightening over time, just as in the light duty market. What is slightly different though is the emphasis on which substances are regulated. The key emissions are particulate matter (PM) and the various oxides of nitrogen (NOx). Each of these forms in a different way in the engine: NOx comes from high-temperature combustion, when nitrogen from the intake air reacts with oxygen; particulate, however, is produced in cooler spots where burning of the fuel is incomplete and soot is formed.

As a result, many changes in engine technology will reduce the level of one pollutant but increase the output of the other. Nonetheless, over time, the engine manufacturers have improved the ways in which fuel is fed to the engine and combusted (including swirl, injection timing, injection pressure and so on) such as to reduce the emissions of both PM and NOx.

Until recently, these engine improvements have in fact been enough to meet the rules imposed by legislators. Additional relatively cheap and simple technologies, such as exhaust gas recirculation (EGR), have been used to reduce the amount of NOx formed. Where catalysts have been fitted, this has mostly been as so-called retrofit, where a vehicle already in use has a filter or catalyst fitted to it in order to gain tax breaks, to meet local urban pollution rules or simply out of concern for the environment.

Now though, aftertreatment, much of it using platinum and some of the other pgms, is being fitted to many new vehicles as standard. With diesel technology, as explained above, it is possible to balance emissions to produce a greater proportion of either nitrogen oxides or particulate. Engine makers have therefore had the choice of minimising the output of one pollutant at the cost of producing more of the other and then focusing on using a catalyst to deal with only one substance. And, this is exactly what has been seen in the market.

Two major aftertreatment technologies are presently in play, in the form of selective catalytic reduction (SCR) and diesel particulate filters (DPFs) dealing with NOx emissions and particulate or soot respectively.

In the former case, the engine is calibrated to make more oxides of nitrogen but to meet the regulations on particulate in its raw emissions. A catalyst is then placed in the vehicle's exhaust (most often a base metal catalyst is used) and urea, ammonia or a similar chemical compound is added into the exhaust downstream of the engine. If the correct amount is injected, it will react with any NOx present to produce nitrogen and water and, most importantly, reduce the levels of NOx to within the legal limits. This is how NOx is being treated

The CRT® approach is one possible approach to reducing tailpipe emissions of soot and other particulate matter.

on many HDD vehicles in Europe at present; one example of such a system is DaimlerChrysler's and Volkswagen's BlueTec® concept which has debuted in North America on smaller vehicles.

The way in which a diesel particulate filter works is much simpler. A semi-porous filter is placed in the exhaust stream and, as the hot exhaust gases pass through this, any particulate is filtered out, leaving the tailpipe emissions within the regulated limits. An added complexity, though, is that as this soot accumulates the back pressure on the engine increases, causing it to work harder and become less efficient. So, some systems use electrical heating to periodically raise the temperature of the filter so that any carbon burns off, producing only carbon dioxide.

Another method is Johnson Matthey's Continuously Regenerating Trap technology (CRT®): this uses a platinum-based catalyst to oxidise any NO to NO_2 which can then react with the soot to produce carbon dioxide and nitrogen. A number of other filter systems sold use platinum, and sometimes palladium as well, for similar purposes. Many filter systems are being fitted to vehicles for the first time, one of the main factors behind the increase in platinum use in the automotive market during 2006.

These single technologies are able to meet today's regulations but can they meet tomorrow's? Improvements in engine design and control will help but most current thinking is that something new will have to be added.

Here again, the industry has a few options. We should still see the use of DPFs and the SCR system but cleaner fuels may allow a few more technologies to come into play. Although not the only two contenders, from the perspective of pgm uptake, the most relevant are NOx traps and combined DPF and SCR technologies.

NOx traps have already been used in lean burn gasoline cars for some years where they use a fairly inactive support material and a high-loaded platinum-rhodium catalyst. Any nitrogen oxides adsorb onto the catalyst's surface and the catalyst converts them into the more reactive NO_2. When the on-board systems calculate that the catalyst cannot store any more gases, a burst of hydrocarbons is sent through the catalyst in the form of a small amount of unburnt fuel. The NO_2 is released from the surface of the catalyst and reacts with this fuel, to produce nitrogen, water and carbon dioxide, with very low levels of other pollutants. At the moment, few companies are using this technology on diesel vehicles but the concept does work and as fuel quality continues to improve, it may become more attractive.

Alternatively, a diesel particulate filter can be used upstream of an SCR system so that any NOx passing through the first part is destroyed in the second. In this way, extremely strict emissions regulations can be met, albeit at the price of greater complexity on the vehicle and extra capital cost. In the very long-term, it is possible that a range of combined aftertreatment technologies will be used on every vehicle.

So, although forecasting which technology will dominate in the future is almost impossible, two trends are clear. The emissions from the heaviest of the road vehicles will continue to decrease and the platinum group metals will play a vital part in this process.

Fitting catalytic aftertreatment may allow vehicles such as this to enter urban Low Emission Zones.