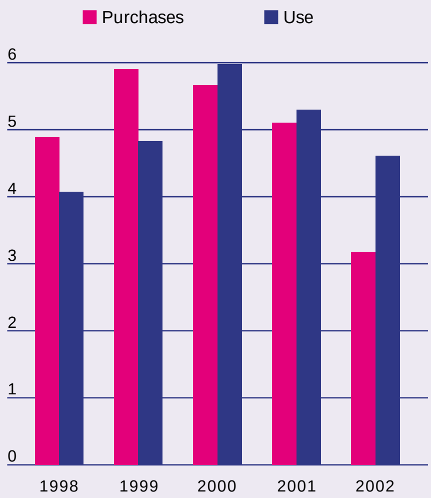
Palladium

Autocatalyst

Demand for palladium from the autocatalyst market is forecast to slump to 3.16 million oz in 2002, a drop of 38 per cent compared to 2001. The fall will be largely due to a massive run down in metal stocks by US auto companies, a reversal of the inventory accumulation that took place in the late 1990s. Demand will also be hit by efforts to thrift palladium loadings and by the move towards greater use of platinum-based autocatalysts on gasoline cars. These are consequences of the very high and volatile palladium prices of 2000 and early 2001.

Palladium Autocatalyst Demand 1998-2002
Million oz



Palladium Demand: Autocatalyst
'000 oz

	2001	2002
Europe	1,730	1,410
Japan	505	490
North America	2,375	760
Rest of the World	480	500
Total	**5,090**	**3,160**
Autocatalyst recovery	**(280)**	**(370)**

Europe

European autocatalyst demand for palladium is expected to drop by 18 per cent in 2002 to 1.41 million oz, the lowest level since 1998. Consumption will be affected by a decline in sales of gasoline cars, moves by some auto makers to reduce the use of catalyst systems based on palladium, and a reduction in average metal loadings on palladium-based catalysts.

The growth of the diesel car sector in Europe in 2002 will again reduce palladium autocatalyst demand as gasoline vehicles lose market share. Diesel cars, which for technical reasons do not utilise catalysts containing palladium, will account for almost 40 per cent of new car sales this year. Consequently, sales of gasoline passenger vehicles are forecast to fall from 9.49 million in 2001 to 8.67 million in 2002.

The trend by auto companies to engineer greater use of platinum-based catalysts at the expense of palladium-based formulations has been less pronounced in Europe than in the USA. Nevertheless, it will still have a measurable impact on palladium consumption in 2002 as technical programmes initiated in 2000 and 2001 take effect.

The majority of catalyst systems used on European gasoline vehicles are still palladium-based. But auto manufacturers have been able to reduce average palladium loadings through thrifting programmes and these efforts will also account for an element of the total decline in European autocatalyst demand in 2002.

Japan

Consumption of palladium by the Japanese auto industry is forecast to rise moderately in 2002 but demand will edge down by 15,000 oz to 490,000 oz as manufacturers supplement purchases with the use of inventories. Some Japanese car companies accumulated significant stocks of palladium in the late 1990s and have been utilising these to satisfy a proportion of their metal requirements this year.

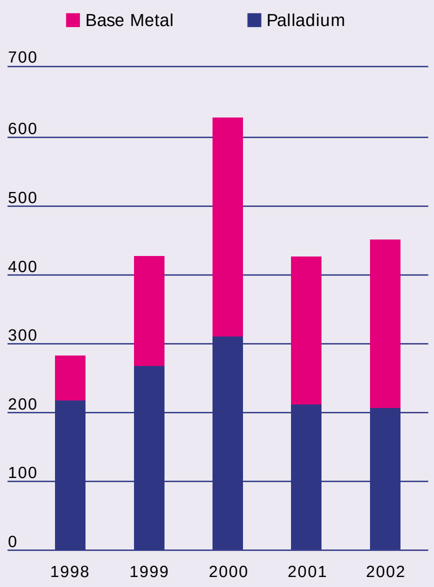
The growth in underlying palladium use reflects both an expected small rise in Japanese light vehicle production plus an increase in average pgm loadings. Although domestic light vehicle sales will drop this year (sales were down almost 4 per cent year-on-year at the end of July), deliveries to North America and Europe have increased substantially. These factors are expected to equate to a small rise in light vehicle production in 2002.

It appears likely that Japanese vehicle emission standards will be tightened considerably by the end of 2005. In April 2002, the Central Environment Council (which advises the Ministry of Environment) announced its targets for reducing emissions. These are similar to earlier proposals published by the JEA that would cut current NOx and HC limits by half. Japanese auto manufacturers, in an effort to attract consumers, are already producing models that would meet the suggested new standards and average pgm loadings have increased accordingly.

North America

Consumption of palladium in autocatalysts will be considerably higher than purchases of metal in North America this year,

MLCC Production by Electrode Type 1998-2002
Billions



remaining well in excess of 2 million oz. Nevertheless, thrifting of palladium and greater use of platinum-based autocatalysts are expected to reduce actual use of palladium by an estimated 16 per cent.

North American demand for palladium in autocatalysts in 2002 will be heavily distorted by the large scale use of stocks by some US auto manufacturers. As a result, purchases of palladium by US car companies this year are expected to plummet and some palladium has also been sold back to the market. Total North American demand is forecast to sink to only 760,000 oz – the majority of which will be accounted for by plants owned by foreign manufacturers.

The major US car companies have minimised their purchases of palladium as far as possible during the year to date, and have satisfied a very substantial proportion of their requirements from inventories. In addition to the financial pressures on the US auto industry to cut costs, there are several reasons for the heavy stock run down. Inventories at the start of 2002 were considerable, following the accumulation of large volumes of metal in previous years, and auto companies have reduced their minimum inventory requirements as technical improvements have enabled reductions in catalyst pgm loadings. Uncertainty about the stability of supply has also eased somewhat, with growing palladium production in South Africa and North America.

The forecast 16 per cent fall in palladium consumption is partly a consequence of successful auto company initiatives to thrift palladium autocatalyst loadings. Reductions in average loadings have been achieved through advances in catalyst technology and engine management systems.

The drop in palladium use is also due to the move away from gasoline vehicle catalyst systems that primarily employ palladium to alternatives that utilise a much greater proportion of platinum. The effects of development programmes that were instigated in 2000 and 2001 as the palladium price soared are now being manifested in lower palladium consumption.

Rest of the World

Palladium autocatalyst demand in the Rest of the World is expected to expand by 4 per cent (20,000 oz) to reach 500,000 oz in 2002. Higher light-duty vehicle production in Asia, particularly in China, will be the main driver of purchases. Demand for palladium, however, is not forecast to grow as rapidly as that for platinum due to thrifting and substitution programmes initiated by leading auto companies over the last two years.

Autocatalyst Recovery

The volume of palladium recovered from scrapped autocatalysts is forecast to increase by almost one-third to reach 370,000 oz in 2002. Recovery rates in the USA have remained relatively high after rising pgm prices in 2000 and 2001 stimulated increased autocatalyst collection in scrap yards. Recovery rates are also growing strongly in Europe, but from a low base.

Auto manufacturers started using significant loadings of palladium in autocatalysts from the mid-1990s. As greater numbers of these vehicles are now being scrapped, the amount of palladium available for recovery is rising noticeably.

Dental

Demand for palladium in dental alloys is forecast to increase slightly to 730,000 oz in 2002. The fall in the palladium price from its early 2001 peak has had a stabilising effect on demand but there is little evidence to date that palladium will be able to regain a significant proportion of the markets lost to alternative materials in recent years.

Japanese dental demand for palladium is largely independent of price and should grow marginally to 480,000 oz in 2002. The government-backed subsidy of dental treatment using a 20 per cent palladium alloy has underpinned consumption, although spending on dental treatment as a whole remains affected by the weakness of the economy.

Europe has seen a strong move away from the use of palladium alloys to alternative dental materials over the past three years. Rising and volatile prices have slashed demand from a consistent level of around 250,000 oz per year in the mid-1990s to an estimated 45,000 oz in 2002. The substitution of palladium by high-gold alloys and ceramic alternatives has required considerable investment in

Palladium Demand: Dental
'000 oz

	2001	2002
Europe	50	45
Japan	470	480
North America	190	195
Rest of the World	10	10
Total	**720**	**730**

equipment and training. Consequently, the European dental industry has shown little inclination to move back to palladium-based products.

In North America, however, the recent fall in the palladium price is expected to spur a small increase in the use of the metal in dental alloys to 195,000 oz. Although the substitution of palladium has not been as widespread in the USA as in Europe, consumption this year will still be less than half the level of demand five years ago.

Electronics

Use of palladium in electronics is forecast to decline further in 2002 due to the continuing weakness in equipment sales, further substitution by nickel in capacitors, and thrifting of metal in plating applications. However, as the use of inventories by component manufacturers will be lower than in 2001, purchases of metal are expected to stage a muted recovery to 750,000 oz.

Shipments of multi-layer ceramic capacitors (MLCC), by far the largest electronic use for palladium, slumped in 2001 when a sharp downturn in demand for electronic goods left manufacturers with exceptionally large inventories of components and raw material stocks. The excess component inventories had, to a certain extent, been run down by the end of the first quarter of 2002. In spite of this, MLCC fabricators still held significant stocks of palladium pastes and metal at that time and have continued to use these to supplement palladium purchases.

Palladium Demand: Electronics
'000 oz

	2001	2002
Europe	130	110
Japan	275	170
North America	70	155
Rest of the World	235	315
Total	**710**	**750**

Total output of MLCC is forecast to improve by 5 per cent to just over 450 billion this year. However, although MLCC manufacturers reported an upturn in orders during the second quarter of the year, by July the tentative recovery in sales had already weakened again. In addition, the substitution of palladium by nickel will increase again in 2002. This will have reduced the overall market share of palladium electrode MLCC to an estimated 45 per cent by the end of 2002. The exception is China, where penetration of nickel electrode MLCC remains low and demand for all electronic components continues to grow rapidly.

Palladium demand for use in plating applications is expected to fall further in 2002 after dropping by 50 per cent in 2001. Substitution of palladium by gold continued during the first half of the year, and manufacturers have been successful in thrifting the amount of precious metals used to plate lead frames. Demand for palladium conductive pastes used in hybrid integrated circuits (HIC) and surge resistors is forecast to be flat.

Other

Palladium demand from other applications is forecast to increase by 60,000 oz to 610,000 oz in 2002. Greater demand will be seen from the Japanese jewellery sector as less old stock is returned for remelting. Increased production of white gold, which is typically alloyed with a proportion of palladium, will also have an influence. The lower palladium price has halted the substitution of some palladium-based petroleum cracking catalysts with base metal formulations in the USA.

Demand for palladium in jewellery alloys is expected to increase by 15 per cent this year to 265,000 oz, primarily due to increased purchases by the Japanese jewellery trade. Demand will rise despite weakening sales of platinum jewellery because fabricators are not depleting their stocks as heavily as in 2001. In addition, production of white gold, in which palladium is often used as a whitening agent, has grown. It has increased its penetration of the Japanese jewellery market and has taken market share from yellow gold.

Palladium Demand: Other
'000 oz

	2001	2002
Europe	125	120
Japan	170	200
North America	90	120
Rest of the World	165	170
Total	**550**	**610**

In China, jewellery trade demand for palladium as an alloying agent will increase in concert with growing platinum jewellery production and white gold output.

The use of palladium in the chemical industry will be stable at 255,000 oz this year as weak market conditions have persisted in Europe, Japan and North America. In China, construction of new production capacity for purified terephthalic acid is expected to provide a small fillip to palladium catalyst demand. The lower palladium price has improved the cost effectiveness of palladium catchment gauzes in the nitric acid industry, but acid producers have been suffering from poor sales and prices of nitrogen fertilisers – the primary end use for nitric acid.

The fall in the palladium price has also reduced the incentive with petroleum companies to substitute palladium-based hydrocracking catalysts with base metal products. After net sales of palladium back to the market from this source in 2001, demand this year across the industry is expected to be positive.