

VM Group research for Fortis Bank Nederland

# Silver Book

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**Fortis Bank** Nederland

**VM GROUP**

The **Silver Book** is produced as part of a joint venture between Fortis Bank Nederland and VM Group

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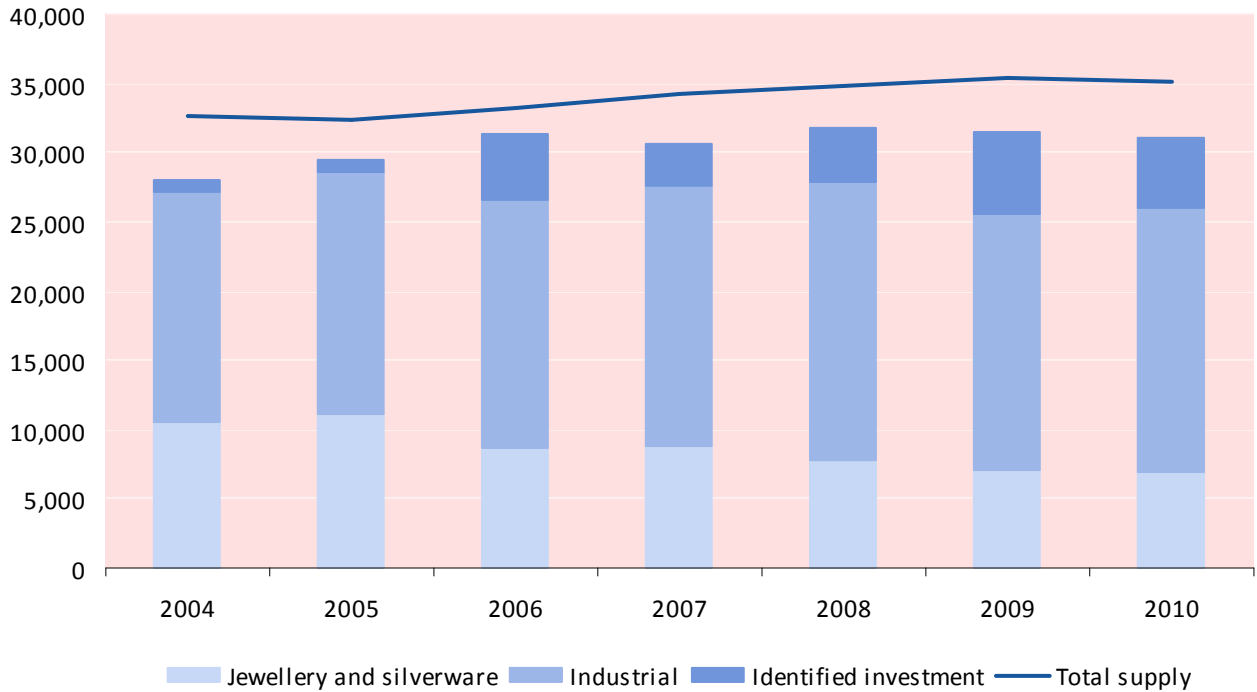
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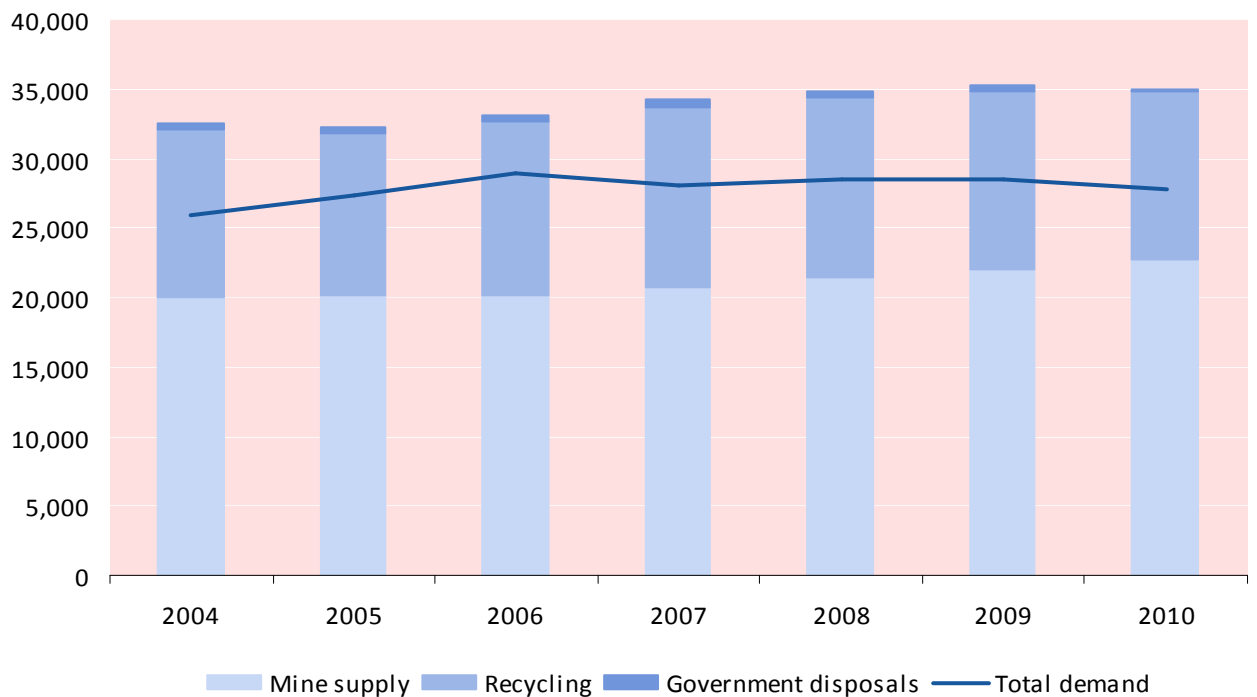
# The Chartbook

Silver demand by category (tonnes) v. total supply



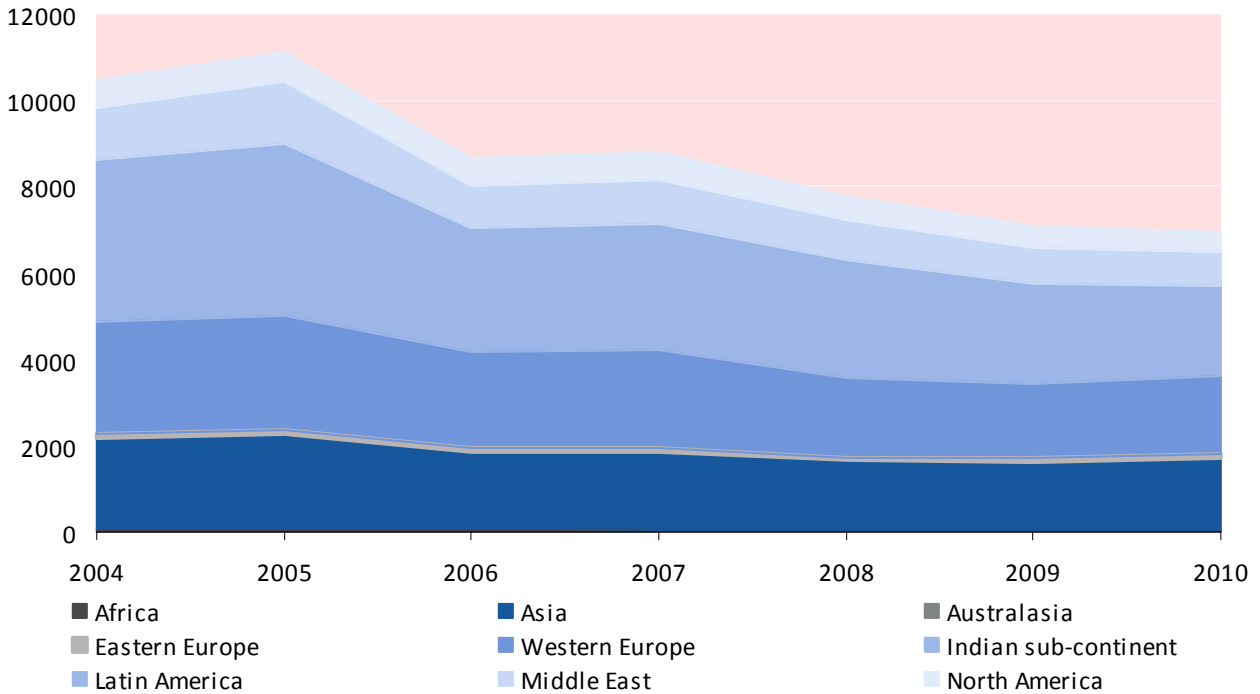
Source: VM Group

Silver supply by category (tonnes) v. total demand



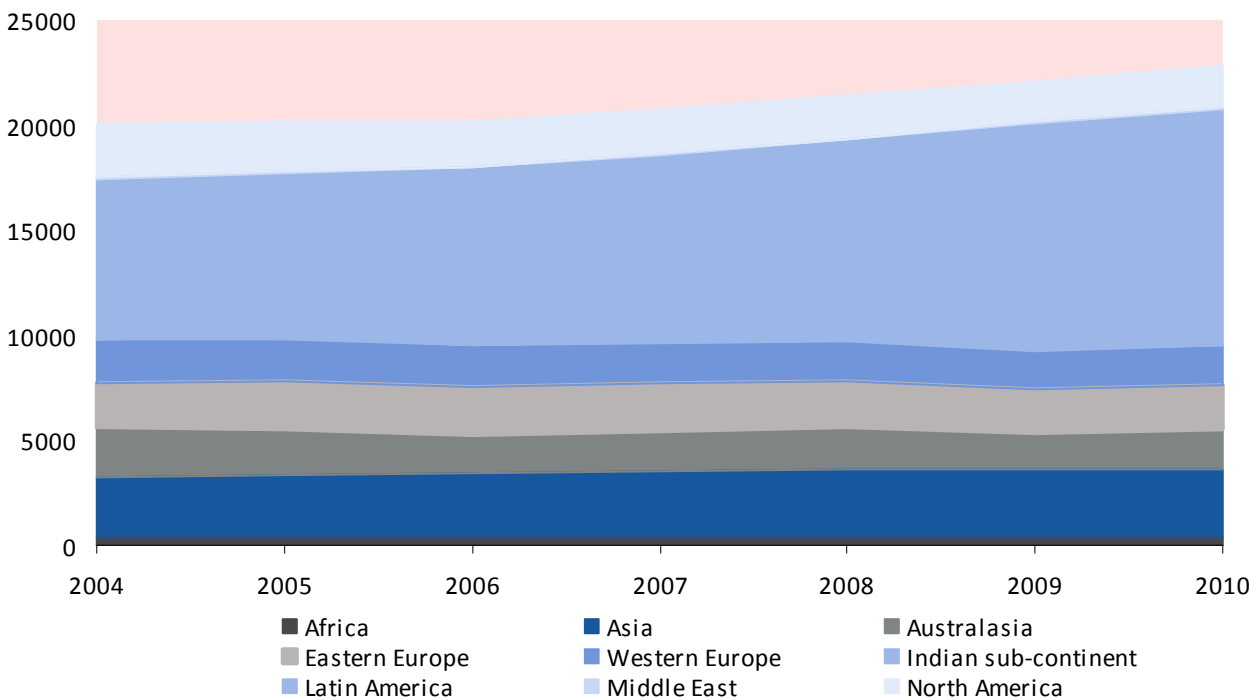
Source: VM Group

**Jewellery demand by region (tonnes)**



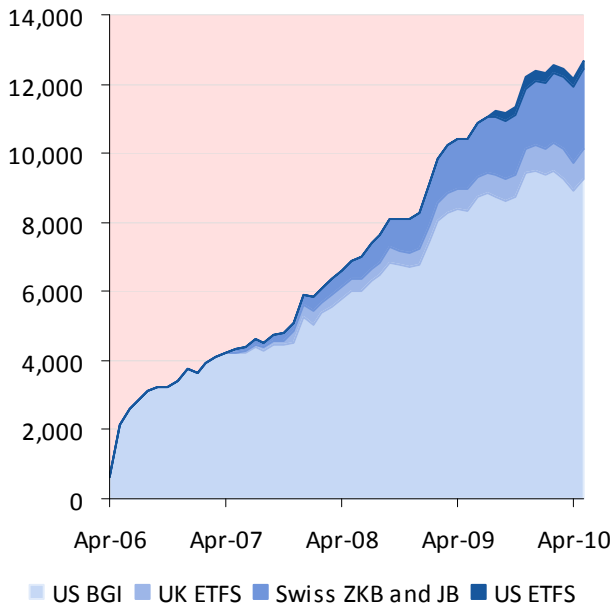
Source: VM Group

**Mine production by region (tonnes)**

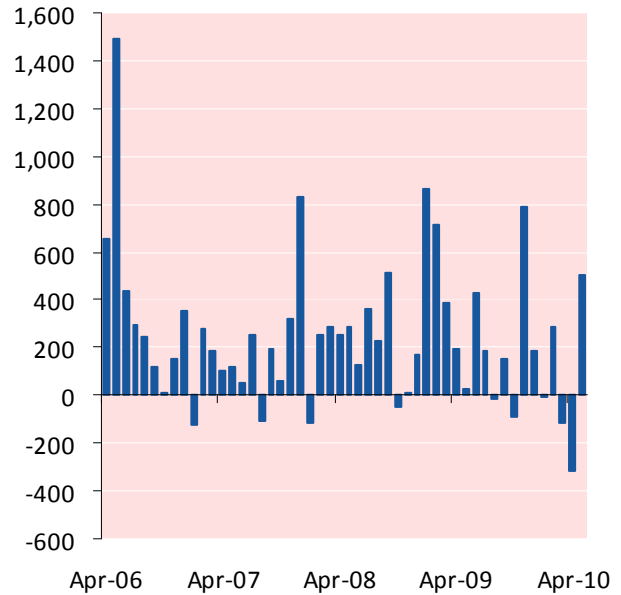


Source: VM Group

**ETF holdings (tonnes)**



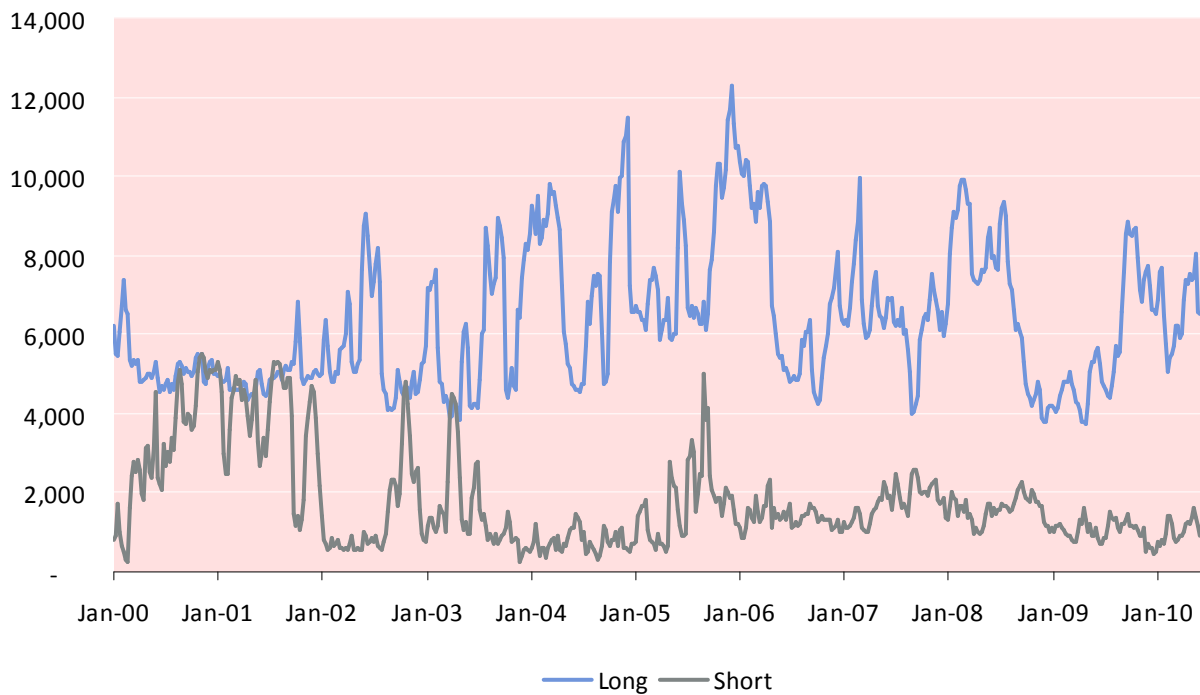
**ETF monthly offtake (tonnes)**



Source: VM Group from company data

Source: VM Group from company data

**COMEX large speculators long and short positions (tonnes)**



Source: VM Group from CFTC data

# Feature

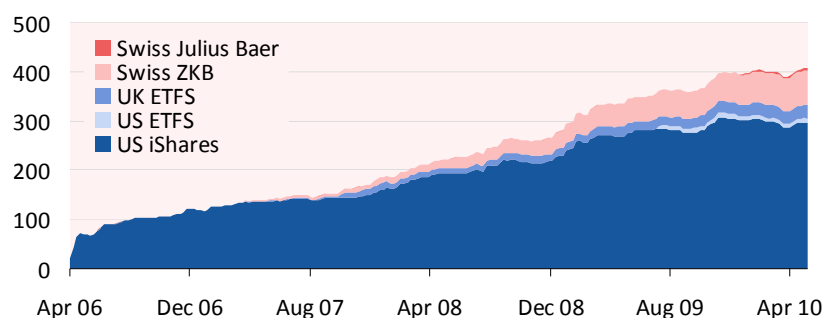
## Silver set for structural change

*For years the silver market has been characterised by falling demand in the photographic industry and tepid jewellery offtake, while supply has seen rapid growth. The resulting market surplus has thus risen from 1,800t in 2000 to an estimated 7,200t in 2010. Under normal circumstances such growth in supply relative to demand would see prices under extreme downward pressure, but investment demand has soared since the launch of the first silver-backed ETF in 2006, and now accounts for more than 400 Moz (12,440t) of silver held in bullion bank vaults. Physical investment in the form of coins and bars has also helped support prices in the face of this explosive growth in supply. Price support has increasingly come to depend on investment demand more than industrial demand.*

*However, new and emerging end uses for silver could well pick up the baton from photography as far as silver industrial demand is concerned. We estimate these new end uses, comprising solar, medical, textile, radio frequency identification, water purification, and food hygiene, among others, will more than offset the decline in photographic consumption and lead to the silver market surplus eroding significantly by 2020. The degree to which the current surplus falls depends on a number of factors, including the growth in these new areas of demand, the response by the investment community and growth in mine supply.*

Silver mine supply is relatively price inelastic and largely detached from the fundamental supply-demand aspects of the silver market. This mine supply is set to grow steadily throughout the next decade, largely due to the broader growth in gold and base metals' mine output, because silver is largely mined as a primary as well as a co- and by-product. About 30% of total annual silver output is from primary production, with 15%-20% as a co-product and the balance a by-product. Primary supply is set to fall to a low of 23% by 2020, as co- and bi-product silver mine supply becomes more dominant.

### Silver ETF demand, 2006-end-May 2010, Moz



Source: VM Group from various sources

However, will this extra mine supply be sufficient to meet projected demand growth, considering these new end uses? Notwithstanding declining photographic offtake – since there will inevitably be a like-for-like fall in photographic recycling, albeit somewhat lagged – we estimate that these new end uses will grow at a combined compound annual growth (CAGR) rate of more than 12% in the next 10 years. ETF demand may grow in response, as these new end uses come to the fore and the shrinking of the global silver surplus becomes more evident. The silver price is therefore almost certain to rise in our view – but to what extent must be uncertain, simply because a substantial

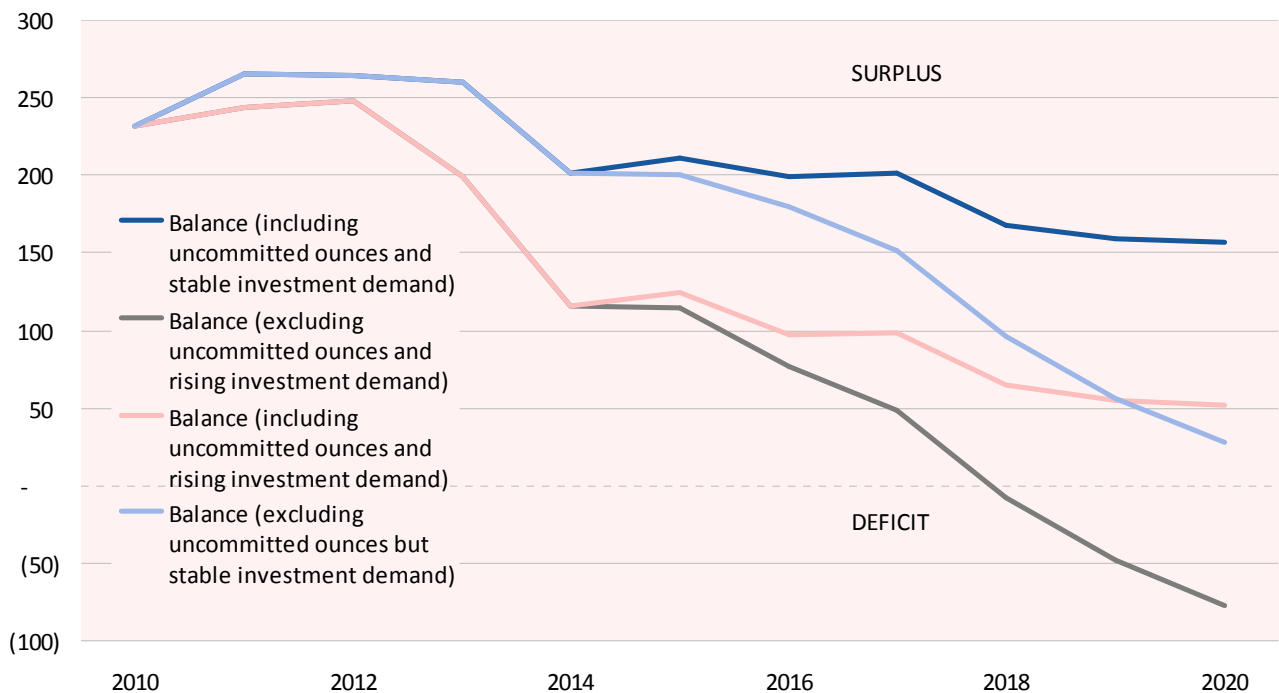
price rise would inevitably threaten some of the new end uses that are developing. The higher the silver price rise, the more some of these new silver-consuming technologies would seek to substitute the metal with cheaper products. But tighter silver market fundamentals are very likely to fuel investment demand growth.

Strong silver mine supply growth will therefore be critical to avoid any potential market deficit ahead, but at an estimated CAGR of 2.4% in the next decade, from more than 22,000t in 2009 to more than 28,500t in 2020, keeping supply running well ahead of potential demand could be a very tall order.

Our supply-side estimate includes advanced projects as well as existing mines and mine expansions. It also includes identified uncommitted projects that might come online in the next 10 years, and it is these latter projects that will determine the market balance by 2020. Should none of the uncommitted ounces be brought online, but ETF demand dip slightly, to say 1,500-2,500t/year, then we estimate a market surplus of just 800t in 2020 (light blue line in chart below). If ETF demand grows to more than 2009 levels (more than 4,000t) in the period 2014-2020, then we estimate a market deficit of as much as 2,400t in 2020 (grey line). But if mine supply, including uncommitted output, all comes online without delay, and ETF demand declines to as low as 1,500t/year, then our market balance will show a surplus of about 4,900t (dark blue line). The pink line market balance scenario considers that all the uncommitted ounces of mine supply come online while investment demand rises.

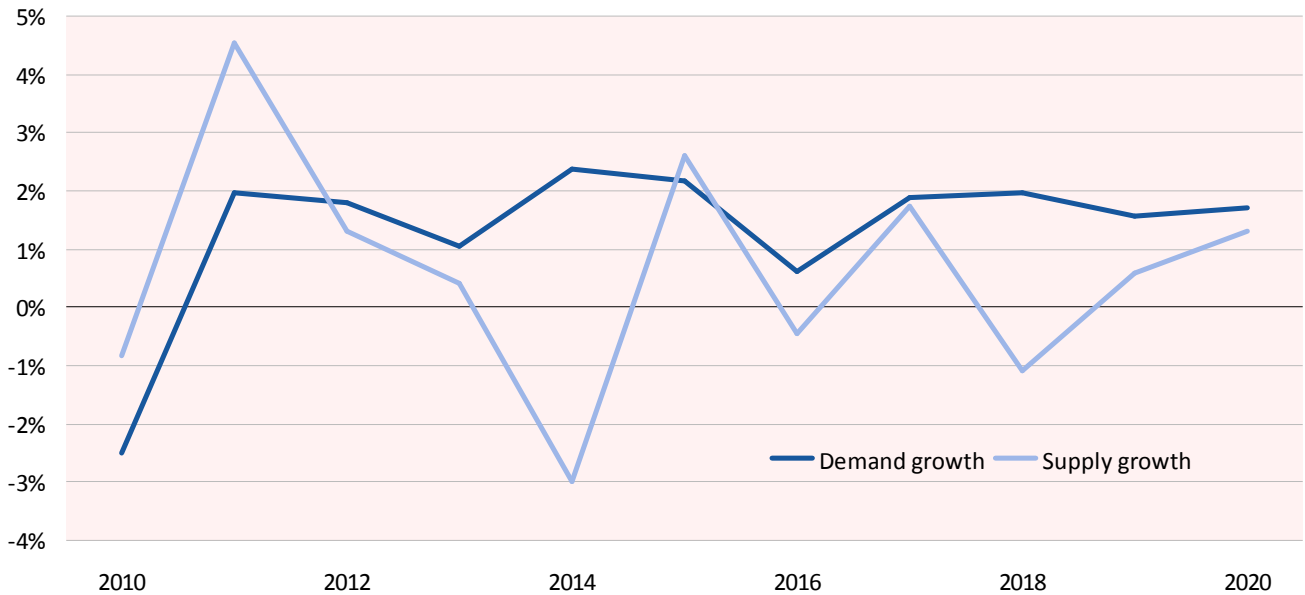
It is therefore evident that, from current levels, the silver market balance is trending down from a large surplus to either something more manageable or even into a deficit. Demand growth in the new end use sectors, as well as investment demand (coins, bar hoardings or ETFs), therefore will have an increasingly critical influence over the silver market balance in the medium to longer term – and prices.

Silver market balance under different scenarios, 2010-2020, Moz



Source: VM Group

**Projected year-on-year supply and demand growth, 2010-2020, %**

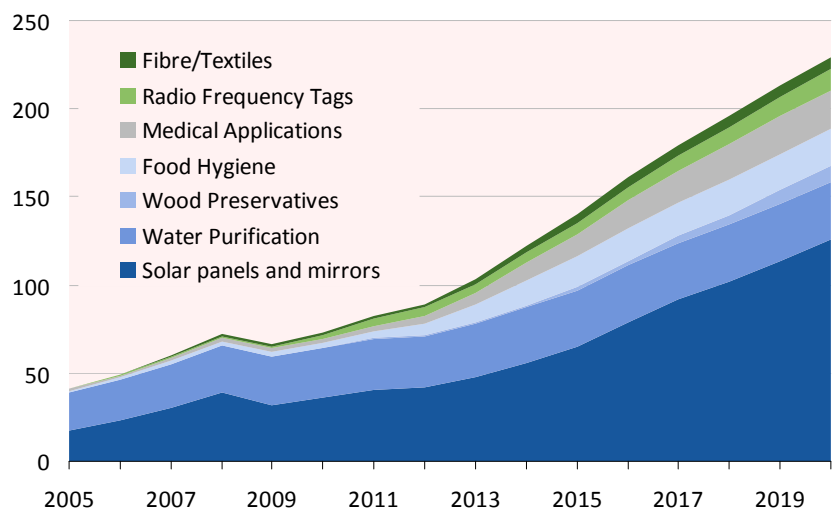


Source: VM Group

**New demand**

The identified new end use sectors that will come to determine the silver balance ahead are reliant on silver’s unique properties, which have been understood and utilised for millennia. Among these unique properties are the fact that silver is the best conductor of all metals, and that its antimicrobial properties offer perhaps excellent protection against infection and diseases. These properties may see silver gain recognition as the greenest and cleanest of all metals, leaving it best placed to tackle certain important problems that face the world this century, such as improvements in security measures, climate change, health issues, and the ageing Western population.

**New end use silver offtake, 2005-2020, Moz**



Source: VM Group

The chart above shows our estimates as to how these new uses will evolve in the next 10 years and how much additional silver they could potentially consume. It

should be noted that these projections are very conservative; it is quite possible that demand may exceed our base case scenario.

### Solar energy

The most important new end use for silver offtake belongs to the solar energy sector. Silver is used not just in crystalline silicon solar cells as the conducting medium to channel the electron flow created by the electric field, but is also used in highly reflective mirrors that are and will be used extensively in solar concentrator plants. Both these solar power generating sectors have seen almost exponential growth recently, and while capital costs and generating costs are still high relative to fossil fuel power generation, costs per Watt are falling, drawing closer to wholesale electricity prices.

With each crystalline silicon solar cell containing as much as 0.12 grams per Watt of silver, the solar sector is already a major silver consumer, with an estimated 18 Moz consumed in 2009 while reflective mirrors consumed 15 Moz in 2009. However this includes other non-solar mirror usages and the actual figure is a much reduced 2 Moz in 2009. Although the photovoltaic sector, like all industries, took a hit during the recession, announcements by the US, India and China in 2009 to raise their respective solar power capacity have lifted the market. India plans to increase its solar output to 20 Gigawatts by 2020 from virtually zero now, while the Chinese plan to raise their capacity from 5.5 GW to 30 GW by 2020. The US is extremely keen to press ahead with numerous projects that could see it become the world leader in installed solar capacity in the close future.

Globally, projections for solar generating capacity by 2020 are currently 20 to 40 times that of today's 20 GW of installed capacity. Some projections see solar power accounting for as much as 20% of global power generation capacity by 2050.

The International Energy Agency (IEA) currently estimates that as much as 3,000 GW of solar generating capacity will be in place by 2050, accounting for 11% of total world power generating capacity. The IEA based their forecast on a 50:50 split between photovoltaic generation and concentrator technology. This equates to about 85 Moz/year of silver offtake between 2010-2050 for photovoltaics alone, taking into account the increasing market share of non-silver containing thin film photovoltaic technology and improved silver loading efficiencies.

We have adopted a much more conservative approach in our estimates than the IEA or others as far as solar energy is concerned. Nevertheless, we forecast an average compound annual growth rate of about 17.5% over the next decade, which means that total installed capacity will rise by at least 500%.

After taking into account the increasing market share of non-silver containing thin film solar panels, and the gradual improvement of silver loading efficiencies, this will require about 70 Moz of silver per year by 2020. And this factors in only photovoltaic units, and not reflective mirrors used currently in solar power concentrator power plants being built or in the pipeline. This will mean at least a 25% increase in silver offtake for reflective mirrors over the next decade, to 60 Moz per year – including offtake from non-solar mirror demand. The global push towards greener energy generation will have a significant impact on silver offtake.

### Water purification

Another rapidly growing major end use for silver is in water purification. Our figures project just a small rise in growth in this sector in the next decade, but, as with our estimates for silver usage in solar energy, our forecast is very conservative.

Silver has long been used in to purify drinking water and cleanse swimming pool water. These are big industries – there are millions of portable and semi-

portable water purifiers sold annually in the US alone. These remove bacteria, chlorine, lead and particulates from water to render it potable. Potable water in the right place at the right time is going to be of growing global importance.

### Food hygiene

Silver's strength as a biocide could potentially become much more significant in food hygiene. The slow-release of antibacterial silver ions applied to exposed surfaces can help control the spread of bacteria. Silver is already in use in this respect, being applied not only to kitchen surfaces but in vending machines, mass market food processing and packaging units. The amount of silver going into each unit of industrial product is minute, measured in microns over a surface area. But the potential surface area is huge. The mass roll out of this sort of equipment and these types of products imply that a good deal of silver every year is destined for this sector.

### Medical and textiles

The medical and textiles sectors will also play an important role in determining the longer-term silver balance. Medical offtake will soar by around nine times from current levels by 2020, to 22 Moz/year. This could once again be too conservative an estimate.

Silver is used to inhibit bacterial growth in wound care dressings, catheters, pacemakers, feeding tubes and even surgical clothing. It is available extensively in the developed world. Sticking plasters with minute loadings of silver can now be bought over the counter in most pharmacies. Our forecast for future demand growth for silver in this sector does not take into account the uptake of silver impregnated medical products in the developing world; it does however reflect the issues that will increasingly face many Western economies, including the rising proportion of the elderly relative and also rising obesity levels, which bring with it many health and skin issues.

Although the quantities of silver used in this category are measured in the nano-scale, because of the vast volumes being used in the health-related industries we envisage silver demand for this sector becoming increasingly important. Add to this the use of silver in textiles, also to inhibit the development and spread of odorous bacteria, or its use in providing superior thermal protection, and the potential offtake volumes become even bigger.

Silver impregnated textiles were originally introduced into the sportswear sector, since it was found that the silver content cut levels of bacteria that create body odour generated by sweat and heat. They have since been introduced to the wider leisure-wear sector. There are now available non-odour generating socks, shoes, insoles, boots, gloves, back-packs and sleeping bags. More recently, the textile industry has developed advanced silver-impregnated fibres for use as thermal insulators; this again opens up a whole new potential market in commercial and domestic protective clothing in cooler climates.

### RFIDs

Radio frequency identification (RFID) tags or devices are rapidly taking over from barcodes, owing to their improved performance. The advantages of RFID tags over barcodes include the ability to be read through radio contact – they can be 'scanned' through a cardboard box or out of line-of-sight. They can also store much more information, and this information can be easily revised or updated. A barcode scanner has to make close-range optical contact to read effectively, and it cannot readily change or update information. The potential efficiency saving of RFIDs is vast – not least by cutting point of sales staff.

We view the uptake of these tags as perhaps one of the biggest technological changes after the Internet, and one that will almost certainly permeate down throughout the supply-chain. In China, the government has committed \$6bn to a massive programme which uses these tags not only in ID cards for all Chinese citizens but also for annually issuing billions of transport tickets. Any new European passport now includes an RFID. This technology can be applied in all

sorts of tracking functions, such as in pharmaceuticals, to track and properly label drugs, chemicals or indeed patients. Perhaps its biggest potential market is in retail supply-chain management, where the tags can track goods from source to retail store and to your door.

Silver's use in RFIDs is crucial, due to its superior conductivity relative to other metals or substances. Although loadings may be minute, the volumes of RFIDs already produced (and likely to be produced in the longer-term) will make it a major silver consumer. We estimate – again conservatively – that RFID manufacture will exceed 36bn units by 2020, from almost 6.5bn now. At loadings of as much as 10 milligrams of silver per tag, that would mean about 12 Moz of silver ounces would be consumed, from 2.1 Moz now. Looking to 2030 and beyond, the use of RFIDs is likely to have even more global offtake which could eventually run into the hundreds of billions of units used. Furthermore, the recycling of RFIDs will be practically zero, meaning the silver consumed will be forever lost to the market.

One caveat is whether RFIDs become so small in size that silver's effectiveness is diminished. Under these circumstances we expect to see the increased uptake of gold in nano-scale RFIDs. There also remains the tricky topic of privacy, which was summed up neatly in 2003 by California state senator Debra Bowen: "How would you like it if, for instance, one day you realise your underwear was reporting your whereabouts." Maybe RFIDs will not see huge growth in 'people tracking'; but the potential in tracking goods is huge and likely to grow rapidly.

### Wood preservatives

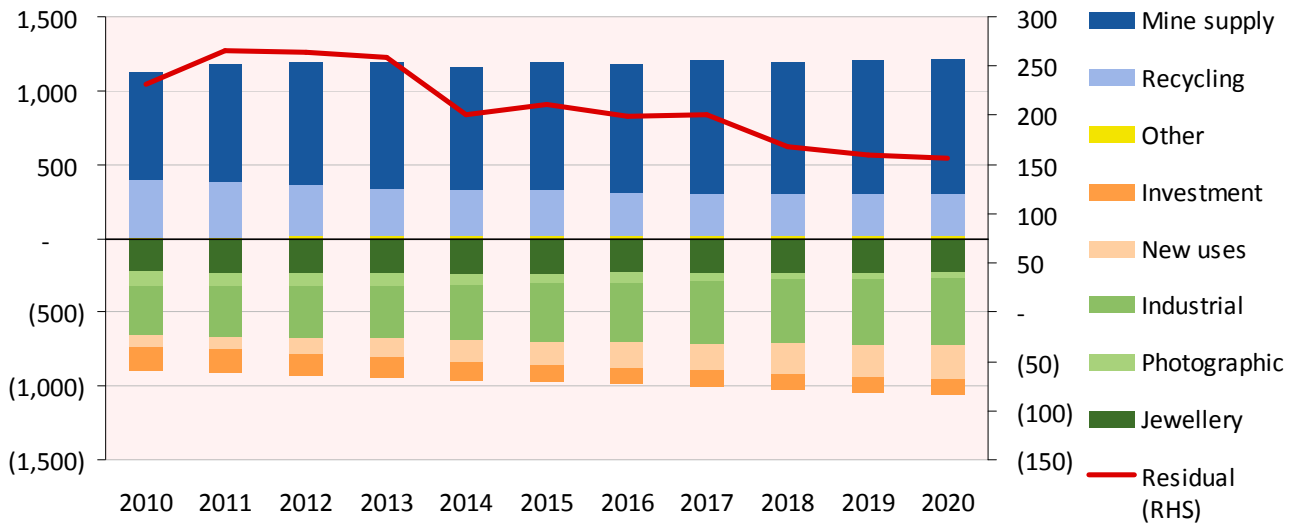
Finally, there is a potential role for silver usage in the manufacture of wood preservatives, although to date the US American Wood Protection Association has yet to receive any efficacy-proving data for these products. Silver wood preservatives are but one product that has the potential to fill the void left by the phasing out in residential applications of the dominant chromate copper arsenate wood preservative product in 2004, due to concerns over health hazards. Currently copper azole, copper quats and certain borates are being used as a replacement, but silver based wood preservatives have the potential to compete in this market, especially since the amount of silver used in these chemical solutions has been dramatically reduced in the past decade to as little as 0.1% silver. We expect to see an introduction of silver-based wood preservatives in the next five years, with the key US market consuming as much as 11 Moz by 2020.

### Tipping the balance

Aggregating the identified new end uses, we estimate that demand from these new sectors will quadruple in the next ten years to at least 230 Moz, – or about 25% of world silver demand, from about 8% today. Mine supply growth, investment demand and future industrial offtake growth will all be critical in determining the market balance. Supply growth will be largely independent from the fundamentals affecting the silver market and, despite projected growth in by-product and co-product output, we doubt that it will meet the growth in demand. Silver's mid and long-term prospects are therefore more convincingly bullish than they have been for some time.

As the current surplus begins to erode over the next few years we expect a reaction among the investment community, with ETF demand likely to hit new records, possibly bringing about a deficit. However under these circumstances, and rising prices, miners will be incentivised to bring on greater supply. The resultant market balance by 2020, we forecast, will see a surplus of about half of today's, more than 7,000t.

Forecast silver market supply and demand (including residual), Moz



Source: VM Group

# Data

## The methodology

In an industry characterised by large and permanent above-ground stocks, a silver supply/demand balance only attempts to record the additions made to those stocks in a calendar year, the destination of that new supply and the mobilisation of the existing stocks largely through recycling.

Furthermore, there are considerable swathes of the silver market that are largely immeasurable and unverifiable. The supply/demand balances indicated in this report are therefore designed to give overall general flows of metal between regions and sectors.

## The data sources

Our historical data sources include:

- Simba and Krishnan: *The Saga of Silver*, The Institute of Financial Management and Research, Madras, 1980.
- Tim Green, *The Silver Millennium*, electronic copyright, Virtual Metals Research & Consulting.
- The Samuel Montagu & Co Annual Bullion Reviews, 1968-1989.
- Bullion imports into India compiled by Janet Long, covering 1925 to 1949.
- Raw Materials Group, Stockholm.
- The MMRS Silver Market Fundamentals Report compiled in August 1994.
- Stephen Fry, *The Great Silver Bubble*, Hodder and Stoughton, London, 1982.
- Eduard Kann, *The Currencies of China*, Kelly & Walsh, Shanghai, 1926.
- Benjamin White, *Silver, Its History and Romance*, Waterlow & Sons, London, 1920.
- Roy Jastram, *Silver, the Restless Metal*, John Wiley and Sons, 1981.
- US Geological Annual Surveys, various years, archived.
- Silver Trade Data back to the early 1990s.
- **Mine supply:** data collated from Raw Materials Group, company reports, ABARE, USBM, China Gold Association and newswires, VM Group in house research.
- **Scrap recycling:** data from refineries and industry participants. VM Group has modelled the recycling of photographic and electronic waste and has made estimates of jewellery recycling based on silver price movements and market information.
- **Photographic:** base data from the MMRS Silver Report 1994, with permission, extrapolated using market information and the analysis of annual reports of major manufacturers of film and photographic products.
- **Jewellery consumption:** base data from the MMRS Silver Report 1994, with permission. Individual country data series further estimated by the VM Group from our understanding of the individual markets, discussions with the bullion banks active in various physical markets, jewellery wholesalers, hallmarking charts where available, and trade data, which is subject to interpretation but gives direction of physical flows. Data is further derived from the comparison of gold and silver jewellery data and an analysis of country-by-country and regional gold/silver volumes in this sector.

- **Electrical/Electronics:** data series derived by the VM Group, based on work relating to the electronics industry when studying the pgm industry and the recycling of electronic scrap.
- **Exchange traded funds:** data series from published data.
- **Brazing Alloys and Bearings:** base data from the MMRS Silver Report 1994, with permission and modelled by the VM Group.
- **Batteries:** VM Group primary research commissioned by The Silver Institute.
- **New Industrial End Uses:** VM Group primary research commissioned by The Silver Institute.

## The residual

The overall supply/demand balance does not balance. The difference between supply and demand (negative is demand exceeding supply), we term the residual. The residual is an acknowledgement that a) omniscience about this market is impossible, and to pretend otherwise is misleading b) there are silver flows of considerable magnitude associated with the unofficial market, such as smuggled or stolen metal which cannot be verified and c) there are sectors which cannot be measured and therefore we do not pretend otherwise; these include “investment” or “bar hoarding”, which is the purchase of silver in bar form.

The residual also does not reflect the net long or short positions held by the hedge funds or the speculators over year-end. While CFTC data gives an indication of outstanding positions on Comex, it is not possible to put a number on the net longs or shorts in the OTC market.

**World supply & demand balance, tonnes**

	2008	2009	2010	2011
<b>Supply</b>				
Mine supply	21,398	22,058	22,793	23,967
Recycling - Jewellery	3,268	3,350	3,431	3,510
Recycling - Photographic	3,121	2,794	2,412	2,198
Recycling - Coin Melt	141	187	195	169
Recycling - Other Industrial	6,421	6,422	5,940	5,495
Government Disposals	500	500	250	350
<b>Total Supply</b>	<b>34,849</b>	<b>35,310</b>	<b>35,021</b>	<b>35,689</b>
<b>Demand</b>				
Jewellery and Silverware	7,784	7,068	6,971	7,218
Photographic	4,327	3,553	3,259	3,019
Electrical/Electronics	6,600	6,260	6,385	6,612
Brazing Alloys	1,293	1,270	1,437	1,459
Catalysts	1,516	1,357	1,391	1,453
Others:	3,198	3,017	3,295	3,655
- Solar Panels	603	501	568	628
- Water Purification	846	855	898	942
- Wood Preservatives	0	0	0	0
- Batteries	589	560	657	756
- Mirrors/Reflective Glass	515	487	584	701
- Plasma Screens	413	372	288	209
- Food Hygiene	61	73	88	132
- Medical Applications	61	64	76	90
- Radio Frequency Tags	36	36	65	118
- Bearings	16	14	15	16
- Detox, chemicals	8	9	10	10
- Fibre/textiles	50	48	47	52
ETF	2,325	4,088	2,500	2,500
Coins	1,470	1,902	2,568	2,440
<b>Total Demand</b>	<b>28,512</b>	<b>28,517</b>	<b>27,805</b>	<b>28,356</b>
<b>Residual (Supply less demand)</b>	<b>6,337</b>	<b>6,794</b>	<b>7,216</b>	<b>7,333</b>

Source: VM Group

Note: because of rounding of individual items the total might not equal the sum of the subtotals

**Mine Production, tonnes**

	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Morocco	190.0	190.0	194.0	204.2
South Africa	77.0	75.5	68.3	65.2
Congo (Dem Rep)	78.9	52.0	57.2	68.1
Namibia	25.0	19.2	17.5	18.5
Zambia	10.3	8.2	9.1	10.9
Ghana	3.1	3.0	3.5	3.9
Tunisia	4.1	4.0	4.1	3.9
Algeria	1.0	1.2	1.1	1.0
Zimbabwe	0.5	0.5	0.6	0.5
<b>Total Africa</b>	<b>389.9</b>	<b>353.6</b>	<b>355.4</b>	<b>376.2</b>
China	2,800.0	2,800.0	2,821.0	2,892.0
Indonesia	320.0	300.0	305.0	308.2
Japan	10.0	9.9	9.8	9.7
North Korea	41.0	41.0	40.0	39.0
Mongolia	25.6	26.0	26.3	29.5
Thailand	7.7	8.0	7.8	8.5
Philippines	27.5	26.1	29.2	35.4
Myanmar	4.5	5.0	4.9	5.0
<b>Total Asia</b>	<b>3,236.3</b>	<b>3,216.0</b>	<b>3,244.0</b>	<b>3,327.3</b>
Australia	1,878.5	1,705.0	1,756.0	1,901.0
Papua New Guinea	44.0	41.0	82.1	162.1
New Zealand	30.8	22.0	29.5	30.5
Fiji	1.2	1.3	1.2	1.2
<b>Total Australasia</b>	<b>1,954.4</b>	<b>1,769.3</b>	<b>1,868.8</b>	<b>2,094.8</b>
Russia	1,300.0	1,250.0	1,255.0	1,305.5
Kazakhstan	700.0	655.0	675.0	715.0
Bulgaria	71.8	71.4	72.1	71.4
Uzbekistan	85.0	70.0	90.0	100.0
Romania	19.0	15.0	18.0	21.5
Macedonia	10.3	10.2	10.1	10.0
Serbia	2.0	1.5	2.0	2.0
<b>Total Eastern Europe</b>	<b>2,188.0</b>	<b>2,073.1</b>	<b>2,122.2</b>	<b>2,225.4</b>
Poland	1,216.0	1,154.0	1,187.0	1,225.2
Sweden	328.0	295.0	305.0	326.1
Turkey	223.0	225.0	228.3	232.5
Former Yugoslavia	61.5	45.0	48.0	62.5
Portugal	27.7	12.0	14.0	15.0
Finland	60.0	41.0	50.0	71.0
Greece	37.4	24.5	32.1	35.4
Ireland	4.1	0.0	0.0	0.0
Spain	4.9	4.8	4.1	4.2
France	0.7	0.7	0.7	0.7
<b>Total Western Europe</b>	<b>1,963.3</b>	<b>1,802.0</b>	<b>1,869.2</b>	<b>1,972.6</b>
India	61.5	62.0	63.5	64.5
<b>Total Indian sub-continent</b>	<b>61.5</b>	<b>62.0</b>	<b>63.5</b>	<b>64.5</b>
Mexico	2,722.9	2,989.0	3,352.0	3,856.2
Peru	3,685.9	3,985.0	3,989.2	4,000.5
Chile	1,780.0	1,782.0	1,775.0	1,775.0
Bolivia	762.0	1,360.0	1,425.0	1,448.4
Argentina	309.3	458.2	468.2	462.3
Honduras	60.0	60.0	59.2	62.1
Colombia	8.2	8.1	8.2	8.6
Brazil	39.0	39.3	40.1	44.1
Nicaragua	3.1	2.9	3.1	3.2
Guatemala	99.0	82.0	91.2	110.5
<b>Total Latin America</b>	<b>9,469.3</b>	<b>10,766.5</b>	<b>11,211.2</b>	<b>11,770.9</b>

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Iran	61.5	62.3	68.5	74.3
Saudi Arabia	14.0	13.2	14.1	16.2
<b>Total Middle East</b>	<b>75.5</b>	<b>75.5</b>	<b>82.6</b>	<b>90.5</b>
USA	1,230.0	1,240.0	1,224.8	1,226.0
Canada	830.0	700.0	751.0	818.5
<b>Total North America</b>	<b>2,060.0</b>	<b>1,940.0</b>	<b>1,975.8</b>	<b>2,044.5</b>
<b>World total</b>	<b>21,398.2</b>	<b>22,058.1</b>	<b>22,792.7</b>	<b>23,966.6</b>

Source: VM Group

Note: because of rounding of individual items the total might not equal the sum of the subtotals

### Photographic recycling, tonnes

	2008	2009	2010	2011
Imaging	1,211.4	1,041.3	917.6	837.0
Medical	922.7	859.1	832.3	818.7
Graphic	553.8	496.2	450.9	426.2
Industrial	150.3	137.7	132.0	126.2
Other	155.8	149.8	144.6	143.5
Movies	127.1	109.7	100.7	95.0
<b>Total</b>	<b>3,121.0</b>	<b>2,793.8</b>	<b>2,578.1</b>	<b>2,446.7</b>

Source: VM Group

**Jewellery recycling, tonnes**

	2008	2009	2010	2011	
Algeria		19.2	19.3	18.5	15.8
Tunisia		8.2	8.2	8.6	8.9
<b>Total Africa</b>		<b>27.4</b>	<b>27.6</b>	<b>27.1</b>	<b>24.7</b>
Thailand		396.0	400.4	404.8	409.2
Indonesia		115.4	116.8	118.3	119.7
Japan		109.4	110.6	111.8	113.0
China		76.0	82.4	88.7	95.0
South Korea		58.5	59.3	60.1	60.8
Malaysia		34.7	35.2	35.6	36.1
Singapore		29.3	29.6	29.9	30.2
Philippines		16.9	17.1	17.1	17.1
Hong Kong		5.2	6.4	7.7	8.9
<b>Total Asia</b>		<b>841.3</b>	<b>857.7</b>	<b>873.9</b>	<b>890.0</b>
Australia		8.8	8.9	9.0	9.2
<b>Total Australasia</b>		<b>8.8</b>	<b>8.9</b>	<b>9.0</b>	<b>9.2</b>
Russia		55.9	56.6	57.4	58.1
<b>Total Eastern Europe</b>		<b>55.9</b>	<b>56.6</b>	<b>57.4</b>	<b>58.1</b>
Italy		279.1	287.2	295.3	303.4
Turkey		245.0	249.5	253.9	258.4
Germany		52.6	57.6	62.6	67.6
Spain		40.1	41.4	42.7	44.0
France		9.7	10.5	11.4	12.2
Sweden		7.6	7.8	8.0	8.1
Switzerland		5.3	5.9	6.5	7.2
UK & Ireland		4.2	4.8	5.3	5.9
Austria		3.6	3.7	3.8	3.9
Belgium		3.4	3.5	3.6	3.7
Greece		3.0	3.3	3.6	3.9
Denmark		2.7	2.8	2.8	2.9
Portugal		2.1	2.7	3.3	3.8
Cyprus		1.5	1.6	1.6	1.7
Norway		1.5	1.5	1.6	1.7
Former Yugoslavia		1.2	1.2	1.2	1.2
Netherlands		0.5	0.6	0.7	0.8
<b>Total Western Europe</b>		<b>663.1</b>	<b>685.5</b>	<b>707.9</b>	<b>730.3</b>
India		703.2	723.2	743.3	763.4
Pakistan		116.7	120.1	123.4	126.7
Bangladesh		19.9	21.0	22.0	23.1
Sri Lanka		4.5	4.6	4.7	4.7
<b>Total Indian sub-continent</b>		<b>844.3</b>	<b>868.8</b>	<b>893.4</b>	<b>918.0</b>
Brazil		47.6	48.3	49.0	49.6
Mexico		36.1	37.7	39.3	40.8
Chile		26.4	26.7	27.0	27.3
Peru		25.2	25.5	25.8	26.0
Colombia		13.5	13.7	13.9	14.0
Argentina		8.5	8.6	8.7	8.9
Venezuela		7.6	7.7	7.9	8.0
<b>Total Latin America</b>		<b>165.0</b>	<b>168.2</b>	<b>171.4</b>	<b>174.6</b>
Saudi Arabia		214.5	217.4	220.2	223.1
Iraq		104.5	105.6	106.7	107.8
Egypt		61.7	63.0	64.4	65.8
Iran		47.4	48.3	49.3	50.2
Kuwait		45.6	46.1	46.6	47.0

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Arab Emirates	29.1	29.8	30.6	31.3
Lebanon	15.0	15.6	16.2	16.8
Israel	3.0	3.0	3.1	3.1
<b>Total Middle East</b>	<b>520.7</b>	<b>528.8</b>	<b>537.0</b>	<b>545.1</b>
USA	114.8	120.4	126.0	131.5
Canada	26.3	27.1	28.0	28.8
<b>Total North America</b>	<b>141.1</b>	<b>147.5</b>	<b>153.9</b>	<b>160.3</b>
<b>World Total</b>	<b>3,267.6</b>	<b>3,349.8</b>	<b>3,431.0</b>	<b>3,510.4</b>

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Source: VM Group

**Jewellery Consumption, tonnes**

	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Morocco	20.9	19.9	20.3	19.9
South Africa	12.6	11.6	11.8	11.6
Libya	8.2	8.0	8.6	8.4
Algeria	8.1	7.9	8.1	7.9
Tunisia	5.4	5.2	5.4	5.3
<b>Total Africa</b>	<b>55.1</b>	<b>52.6</b>	<b>54.1</b>	<b>53.0</b>
China	577.4	609.1	667.0	730.4
Thailand	388.7	371.2	386.8	403.1
Indonesia	132.1	125.5	127.5	129.5
Japan	103.7	95.9	97.5	92.6
South Korea	70.8	69.4	73.2	71.7
Afghanistan	64.2	57.8	59.0	57.8
Vietnam	55.0	53.1	54.1	55.2
Malaysia	40.0	39.6	40.4	40.0
Singapore	28.2	26.3	26.9	26.3
Taiwan	19.0	18.6	18.9	18.5
Myanmar	18.0	17.5	17.8	17.4
Philippines	16.7	15.9	16.9	16.1
Cambodia	13.9	12.9	13.1	13.2
Hong Kong	5.9	5.6	5.7	5.6
Nepal	5.1	5.0	5.1	5.0
<b>Total Asia</b>	<b>1,591.2</b>	<b>1,570.7</b>	<b>1,657.7</b>	<b>1,729.3</b>
Australia	11.4	11.0	11.7	11.4
<b>Total Australasia</b>	<b>11.4</b>	<b>11.0</b>	<b>11.7</b>	<b>11.4</b>
Russia	68.2	63.7	66.0	68.3
Uzbekistan	1.2	1.1	1.2	1.1
Croatia	1.2	1.1	1.2	1.1
Bulgaria	0.6	0.6	0.6	0.6
Estonia	0.5	0.5	0.5	0.5
<b>Total Eastern Europe</b>	<b>71.7</b>	<b>67.0</b>	<b>69.3</b>	<b>71.6</b>
Italy	675.4	634.8	670.4	707.9
Germany	400.5	370.5	397.8	427.0
Turkey	339.8	312.6	342.3	385.1
Spain	108.1	100.6	107.5	114.9
France	69.6	64.0	65.0	62.4
Switzerland	51.5	47.9	48.9	47.9
Portugal	48.4	44.3	45.2	43.4
UK & Ireland	47.9	43.6	44.7	42.9
Greece	25.3	23.2	20.9	20.1
Sweden	13.3	12.2	11.5	11.0
Austria	7.7	7.0	7.0	6.8
Belgium	7.2	6.8	6.9	6.6
Finland	6.4	6.0	5.7	5.4
Netherlands	6.1	5.8	5.9	5.7
Poland	5.6	5.1	5.2	4.9
Denmark	4.8	4.5	4.3	4.1
Norway	4.8	4.4	4.2	4.0
Cyprus	4.2	3.8	3.6	3.4
Former Yugoslavia	2.4	2.2	2.1	2.0
Hungary	2.0	1.9	1.8	1.7
Malta	2.1	1.9	1.8	1.7
Czech Republic	1.7	1.6	1.6	1.5
Romania	0.8	0.7	0.7	0.7
<b>Total Western Europe</b>	<b>1,835.4</b>	<b>1,705.2</b>	<b>1,804.8</b>	<b>1,910.9</b>
India	1,963.7	1,620.0	1,433.7	1,469.6
Pakistan	316.0	278.1	243.3	249.4
Bangladesh	102.3	92.1	82.9	84.9
Others	16.4	14.3	13.3	12.6

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Sri Lanka	6.8	6.1	5.5	5.7
<b>Total Indian sub-continent</b>	<b>2,405.1</b>	<b>2,010.6</b>	<b>1,778.6</b>	<b>1,822.2</b>
Mexico	144.2	139.9	146.9	153.5
Brazil	63.6	61.7	62.3	63.9
Chile	27.3	26.5	26.7	27.0
Peru	25.5	24.7	24.9	25.2
Dominican Republic	21.8	21.2	21.4	21.6
Bolivia	16.4	15.9	16.0	16.2
Colombia	16.4	15.9	16.0	16.2
Venezuela	11.5	11.2	11.3	11.4
Ecuador	10.3	10.0	10.1	10.2
Argentina	9.7	9.4	9.5	9.6
<b>Total Latin America</b>	<b>346.6</b>	<b>336.2</b>	<b>345.2</b>	<b>354.7</b>
Saudi Arabia	276.0	242.9	230.7	236.5
Egypt	135.8	119.5	113.6	116.4
Iraq	106.2	93.5	88.8	91.0
Iran	100.0	88.0	83.6	85.7
United Arab Emirates	58.9	51.8	49.2	50.5
Lebanon	59.1	52.0	49.4	50.7
Syria	51.3	45.1	42.9	43.9
Yemen	55.1	48.5	46.1	47.2
Kuwait	42.8	37.7	35.8	36.7
Jordan	45.1	39.7	37.7	38.7
Israel	3.6	3.2	3.0	3.1
<b>Total Middle East</b>	<b>933.9</b>	<b>821.8</b>	<b>780.7</b>	<b>800.2</b>
USA	457.6	423.2	402.1	398.1
Canada	75.7	70.0	66.5	66.4
<b>Total North America</b>	<b>533.2</b>	<b>493.2</b>	<b>468.6</b>	<b>464.4</b>
<b>World total</b>	<b>7,783.7</b>	<b>7,068.4</b>	<b>6,970.8</b>	<b>7,217.8</b>

Source: VM Group

### Photographic Demand, tonnes

	2008	2009	2010	2011
Japan	1,032.4	851.7	702.7	579.7
China	92.9	83.6	98.2	115.4
<b>Total Asia</b>	<b>1,125.3</b>	<b>935.3</b>	<b>800.9</b>	<b>695.1</b>
Belgium	457.6	377.5	345.4	336.8
Germany	321.5	271.7	243.1	217.6
UK & Ireland	280.4	234.7	205.4	179.7
France	246.9	213.6	191.2	171.1
Italy	53.4	43.7	40.2	37.0
Spain	52.7	42.1	39.0	36.1
<b>Total Western Europe</b>	<b>1,412.5</b>	<b>1,183.4</b>	<b>1,064.4</b>	<b>978.3</b>
<b>Total Latin America</b>	<b>216.8</b>	<b>189.7</b>	<b>192.6</b>	<b>195.5</b>
USA	1,369.4	1,088.7	1,050.6	1,013.8
Canada	203.2	156.3	150.8	136.5
<b>Total North America</b>	<b>1,572.6</b>	<b>1,245.0</b>	<b>1,201.4</b>	<b>1,150.3</b>
<b>World Total</b>	<b>4,327.2</b>	<b>3,553.4</b>	<b>3,259.2</b>	<b>3,019.2</b>

Source: VM Group

**Electrical/Electronic demand, tonnes**

	2008	2009	2010	2011
Japan	1,597.8	1,477.9	1,544.5	1,575.3
Taiwan	463.8	454.5	477.3	501.1
China	431.6	429.5	515.4	670.0
South Korea	231.9	215.7	223.2	231.0
Others	116.0	110.2	112.9	115.7
<b>Total Asia</b>	<b>2,841.1</b>	<b>2,687.8</b>	<b>2,873.2</b>	<b>3,093.2</b>
Germany	717.6	683.1	676.3	672.9
France	381.2	366.0	329.4	326.1
Others	254.8	239.5	232.3	230.0
Italy	252.8	240.6	228.6	226.3
UK & Ireland	252.8	237.6	216.2	214.1
<b>Total Western Europe</b>	<b>1,859.2</b>	<b>1,766.9</b>	<b>1,682.9</b>	<b>1,669.4</b>
India	438.2	429.5	442.4	455.6
<b>Total Indian sub-continent</b>	<b>438.2</b>	<b>429.5</b>	<b>442.4</b>	<b>455.6</b>
USA	1,402.5	1,318.4	1,328.9	1,335.6
Canada	59.1	57.9	57.4	58.2
<b>Total North America</b>	<b>1,461.7</b>	<b>1,376.3</b>	<b>1,386.3</b>	<b>1,393.8</b>
<b>World Total</b>	<b>6,600.2</b>	<b>6,260.5</b>	<b>6,384.7</b>	<b>6,612.0</b>

Source: VM Group

**Brazing Alloys demand, tonnes**

	2008	2009	2010	2011
China	205.6	209.8	229.7	241.2
Japan	161.7	145.6	153.6	160.5
South Korea	54.4	50.0	52.4	54.9
Taiwan	35.2	33.4	34.2	35.1
Others	14.6	13.7	14.1	14.5
<b>Total Asia</b>	<b>471.4</b>	<b>452.4</b>	<b>484.0</b>	<b>506.1</b>
Germany	190.3	189.3	274.5	273.1
UK & Ireland	88.3	87.9	101.1	100.6
Switzerland	85.6	85.2	98.0	97.5
Italy	80.2	79.8	91.8	91.3
<b>Total Western Europe</b>	<b>444.4</b>	<b>442.2</b>	<b>565.3</b>	<b>562.5</b>
India	101.9	101.4	107.9	108.1
Others	42.1	41.9	44.6	44.4
<b>Total Indian sub-continent</b>	<b>144.1</b>	<b>143.3</b>	<b>152.5</b>	<b>152.5</b>
USA	209.6	208.5	211.1	213.8
Canada	23.7	23.6	23.9	23.8
<b>Total North America</b>	<b>233.2</b>	<b>232.1</b>	<b>235.0</b>	<b>237.5</b>
<b>World Total</b>	<b>1,293.2</b>	<b>1,270.0</b>	<b>1,436.8</b>	<b>1,458.6</b>

Source: VM Group

**Inflation-adjusted silver price, end of period (in 2008 dollars)**

	Nominal silver price (\$/oz)	US CPI (2008=100)	Real silver price (2008 dollars)
1980	15.20	41.05	37.03
1981	8.13	44.71	18.17
1982	10.93	46.43	23.54
1983	8.91	48.19	18.49
1984	6.39	50.09	12.75
1985	5.80	51.99	11.16
1986	5.28	52.56	10.05
1987	6.70	54.89	12.21
1988	6.05	57.32	10.56
1989	5.22	59.98	8.70
1990	4.19	63.65	6.59
1991	3.86	65.60	5.88
1992	3.67	67.50	5.44
1993	5.12	69.35	7.38
1994	4.85	71.21	6.81
1995	5.14	73.02	7.04
1996	4.80	75.44	6.36
1997	6.00	76.73	7.81
1998	5.01	77.96	6.42
1999	5.33	80.06	6.66
2000	4.58	82.77	5.53
2001	4.52	84.05	5.38
2002	4.67	86.05	5.42
2003	5.97	87.67	6.80
2004	6.82	90.52	7.53
2005	8.83	93.61	9.43
2006	12.90	95.99	13.44
2007	14.76	99.91	14.77
2008	10.79	100.00	10.79
2009	16.99	102.72	16.54

Source: Reuters, VM Group

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**Silver prices in various currencies, average**

	\$/oz	Euro/oz	Yen/oz
1997	4.90	4.34	19.08
1998	5.54	4.95	23.30
1999	5.22	4.90	19.07
2000	4.95	5.37	17.16
2001	4.37	4.88	17.05
2002	4.60	4.87	18.49
2003	4.88	4.31	18.14
2004	6.66	5.35	23.12
2005	7.31	5.90	25.97
2006	11.55	9.17	43.16
2007	13.38	9.77	50.63
2008	14.99	10.09	50.15
2009	14.67	10.48	44.01
Nov-08	9.87	7.75	30.71
Dec-08	10.29	7.62	30.11
Jan-09	11.29	8.53	32.78
Feb-09	13.41	10.48	40.06
Mar-09	13.12	10.04	41.20
Apr-09	12.51	9.49	39.74
May-09	14.03	10.26	43.50
Jun-09	14.65	10.46	45.55
Jul-09	13.36	9.49	40.57
Aug-09	14.35	10.06	43.81
Sep-09	16.39	11.25	48.14
Oct-09	17.24	11.63	50.04
Nov-09	17.82	11.94	51.04
Dec-09	17.67	12.11	51.04
Jan-10	17.79	12.46	52.11
Feb-10	15.87	11.60	46.00
Mar-10	17.11	12.60	49.88
Apr-10	18.10	13.49	54.33
May-10	18.42	14.73	54.34

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Source: Reuters

**Lease Rates (%)**

	<b>1-month</b>	<b>3-month</b>	<b>6-month</b>	<b>12-month</b>
1997	3.07	4.03	4.92	5.69
1998	0.97	1.60	2.42	3.58
1999	1.19	1.24	1.28	1.53
2000	1.72	0.91	1.31	1.55
2001	0.30	0.43	0.59	0.85
2002	0.17	0.37	0.64	1.13
2003	0.48	0.75	1.22	2.05
2004	1.14	1.85	2.49	3.42
2005	0	0.15	0.43	0.74
2006	0.24	0.47	0.64	0.73
2007	0.04	0.37	0.75	1.14
2008	3.07	4.03	4.92	5.69
2009	0.97	1.60	2.42	3.58
Nov-08	1.73	2.01	2.20	2.31
Dec-08	0.44	1.41	1.58	1.73
Jan-09	0.78	1.49	1.85	2.13
Feb-09	0.77	1.40	1.79	2.01
Mar-09	0.48	1.17	1.72	1.87
Apr-09	0.38	0.98	1.45	1.69
May-09	0.04	0.36	0.92	1.24
Jun-09	0	0.08	0.57	0.99
Jul-09	0	0	0.37	0.88
Aug-09	0	0	0.23	0.72
Sep-09	0	0	0	0.58
Oct-09	0	0	0.01	0.60
Nov-09	0	0	0	0.43
Dec-09	0	0	0	0.35
Jan-10	0	0	0	0.25
Feb-10	0	0	0	0.26
Mar-10	0	0	0	0.31
Apr-10	0	0	0	0.43
May-10	0	0	0.03	0.45

Source: Reuters

**Silver ETFs offtake, tonnes**

	US ETFs		UK & Swiss ETFs	
	ETF offtake	Change	ETF offtake	Change
2006	3,768	0%	0	0
2007	5,246	139%	683	0%
2008	6,793	129%	1,460	214%
2009	9,779	144%	2,574	176%
Nov-08	6,687	(1%)	1,394	6%
Dec-08	6,793	2%	1,460	5%
Jan-09	7,453	10%	1,660	14%
Feb-09	8,058	8%	1,771	7%
Mar-09	8,297	3%	1,918	8%
Apr-09	8,413	1%	1,994	4%
May-09	8,348	(1%)	2,086	5%
Jun-09	8,725	5%	2,135	2%
Jul-09	8,837	1%	2,212	4%
Aug-09	8,957	1%	2,290	4%
Sep-09	8,834	(1%)	2,350	3%
Oct-09	9,014	2%	2,350	0%
Nov-09	9,706	8%	2,477	5%
Dec-09	9,779	1%	2,574	4%
Jan-10	9,633	(1%)	2,672	4%
Feb-10	9,679	0%	2,871	7%
Mar-10	9,502	(2%)	2,954	3%
Apr-10	9,143	(4%)	3,005	2%
May-10	9,510	4%	3,160	5%

Source: Various data

**COMEX silver, tonnes**

	Open interest	Futures net long		Options net long		Total	Change
		Large specs	Small specs I	Large specs	Small specs		
2001	9,929	2,794	1,507	-68	377	4,611	3,693
2002	11,964	4,499	3,289	3	512	8,303	4,038
2003	15,954	7,616	3,794	629	304	12,342	(2,261)
2004	15,438	5,864	3,661	231	325	10,081	2,539
2005	25,911	9,517	3,482	-580	202	12,620	(4,934)
2006	19,834	5,366	2,601	-607	326	7,686	681
2007	29,224	4,897	3,255	-89	305	8,367	(3,368)
2008	17,232	3,148	1,624	-30	258	4,999	4,154
2009	23,631	6,171	2,719	-4	267	9,153	3,693
Oct-08	22,055	2,343	1,313	-797	291	3,150	(1,423)
Nov-08	17,279	2,202	1,481	-57	227	3,853	703
Dec-08	17,232	3,148	1,624	-30	258	4,999	1,146
Jan-09	18,633	3,259	1,748	84	310	5,401	402
Feb-09	20,053	3,920	2,025	88	212	6,246	845
Mar-09	18,863	3,535	1,690	187	271	5,684	(562)
Apr-09	19,394	2,177	1,738	53	229	4,197	(1,487)
May-09	19,749	4,360	2,293	237	213	7,103	2,907
Jun-09	21,754	4,075	2,455	385	155	7,071	(33)
Jul-09	19,980	3,317	2,264	288	192	6,061	(1,010)
Aug-09	20,963	4,530	2,113	499	175	7,318	1,257
Sep-09	26,604	7,346	2,663	755	150	10,914	3,596
Oct-09	26,740	6,865	3,145	691	113	10,814	(100)
Nov-09	26,199	7,099	2,923	84	175	10,281	(533)
Dec-09	23,631	6,171	2,719	-4	267	9,153	(1,128)
Jan-10	23,805	5,765	2,744	-27	281	8,763	(390)
Feb-10	21,681	4,326	1,859	-143	196	6,238	(2,525)
Mar-10	21,367	5,023	2,083	83	123	7,313	1,075
Apr-10	23,121	6,309	2,466	174	224	9,173	1,860

Source: VM Group and  
CFTC

# Weights and measures

## Chemical properties

Atomic weight	107.87
Atomic number	47
Chemical symbol	Ag
Melting point deg C	961.78
Hardness (moha)	2.5
Boiling point deg C	2,162
Specific gravity gr/cubic cm	10.49
Hardness	24.5
Tensile strength psi	21,000

Source: VM Group

## Measures

1 troy ounce	= 31.103 grammes = 408.6 grains =1.097 oz avoirdupois = 20 pennyweights
1 metric tonne	=32.151 troy ounces = 1.102 short tons
1 short ton	= 0.893 long tonnes =2,000 pounds
1 pound	= 14.58 troy ounces
1 grain	= 0.0648 grammes = 0.002083 troy ounces
1 gramme	= 14.43 grains
1 pennyweight	= 24 grains
1 kilogramme	= 32.1507 troy ounces
1 oz avoirdupois	=0.9115 troy ounces

Source: VM Group

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VM Group is a commodities research consultancy that covers not just conventional energy, but also renewable energy, carbon, base and precious metals, and agricommodities. The VM Group comprises a uniquely skilled team that is highly experienced in the analysis of the fundamentals of commodities and their geopolitical impact and contexts.

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