



REUTERS

THE OUTLOOK FOR SILVER INDUSTRIAL DEMAND

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GFMS



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TABLE OF CONTENTS

| | |
|---|----|
| 1. Introduction & Executive Summary | 3 |
| • Introduction 3 • Economic Outlook 4 • Industrial Demand Outlook 4 | |
| 2. Future Prospects for Silver Industrial Fabrication | 6 |
| • Introduction 6 • Forecast Summary 6 • Forecast by Sector 7 | |
| • Forecast by Region 8 | |
| 3. The Role of Silver in Consumer and Industrial Products | 10 |
| • Introduction 10 • Automobiles 10 • Cell Phones 11 | |
| • Desktop and Laptop Computers 11 • Tablet Computers 12 | |
| • Televisions 12 • Photovoltaics 13 | |

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1. INTRODUCTION & EXECUTIVE SUMMARY

INTRODUCTION

Over the past decade, silver industrial demand has enjoyed a robust performance. At the turn of the millennium world industrial demand stood at 383.3 Moz. This reflected rising demand from a growing range of consumer products, but was also due to strong infrastructure spending. The bursting of the “dot-com” bubble in 2001 led to a pronounced drop, although a recovery phase quickly emerged the following year, marking the start of a period of seven consecutive years in which global industrial offtake grew, to a then record total of 492.7 Moz in 2008. The extent of the recession-induced decline in 2009 eclipsed that of 2001, but as severe as this outcome was, 2010 not only saw industrial demand register its largest one year gain, but also a new high of 499.6 Moz. The strong performance from the industrial sector has also been crucial in terms of offsetting structural declines elsewhere in the silver market, namely in photography and silverware. Together in 2000, at around 315 Moz, these two segments accounted for over one-third of global silver fabrication, but by 2011 their contribution had fallen to just 13%, or 112 Moz.

Returning to last year, it would be misleading to suggest from this performance that the industrial sector is entirely immune to the global economic backdrop, but in the context of the sluggish economic recovery, it was perhaps surprising that last year produced a fall of just a little under 4%. The losses were largely concentrated in the dominant electrical & electronics sector, in part because of a decline in photovoltaics.

The 4% drop for the global industrial segment in 2011 also hides some quite varied intra-year developments, namely a strong first half followed by a sharp fall towards end-year. The uncertainty carried over into 2012 and it was against this backdrop that the Silver Institute commissioned Thomson Reuters GFMS to not only gauge the underlying health of the market, but also to determine if we would see a repeat of 2009’s marked downturn, or if in fact a sufficient recovery would emerge during the latter part of 2012 to counter the initial decline.

Related to this analysis, we have also produced an assessment of the silver content of a number of key consumer and industrial products. This helps to quantify another key element of the industrial forecast, namely the impact of thrifting and substitution. These twin themes have gained some importance in recent years as industrial fabricators have contended with rising and,

INDUSTRIAL FABRICATION

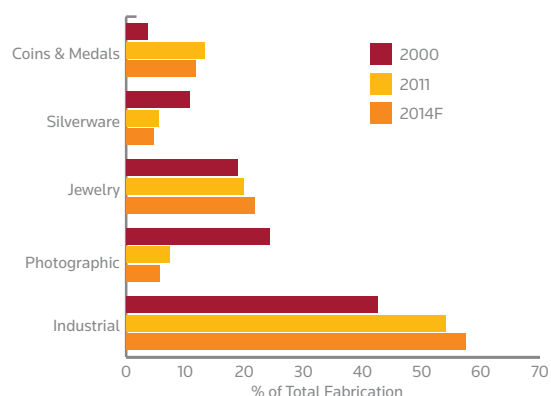
| (million ounces) | 1992-01 Average | 2002-11 Average | 2012-14F Average |
|------------------------|--------------------|--------------------|---------------------|
| Industrial Fabrication | 313.4 | 436.9 | 483.3 |

Source: Thomson Reuters GFMS

at times, volatile silver prices. That said, the shift away from silver in the brazing industry is arguably part of a longer term trend, pre-dating recent price action. A similar argument applies to consumer electronics in part because of the trend towards products with a shorter shelf-life. However, as the report sets out thrifting is also gaining momentum in some key market segments, such as photovoltaics. That said, an important limiting factor is silver’s unique technical properties and, as we discuss in the report, the growing range of silver-bearing devices can provide an important offset to the thrifting discussed above. In addition, we also highlight some areas where silver consumption is running “counter trend”, in other words those industries whose silver content (i.e. per unit of demand) is tending to rise.

Finally, the report considers the outlook for the major fabricating and consuming silver industrial markets. Traditionally dominated by the United States (accounting for 24% of the global total in 2011), we assess the prospects of some of its nearest rivals, including China, whose contribution over the past decade has risen from a 11% share in 2002 to 18% last year. This of course reflects the growing manufacture of silver components in the domestic market, but on a consumption basis, China enjoys a far greater standing, given its substantial imports of semi-manufactured industrial silver.

SHARES OF GLOBAL SILVER OFFTAKE



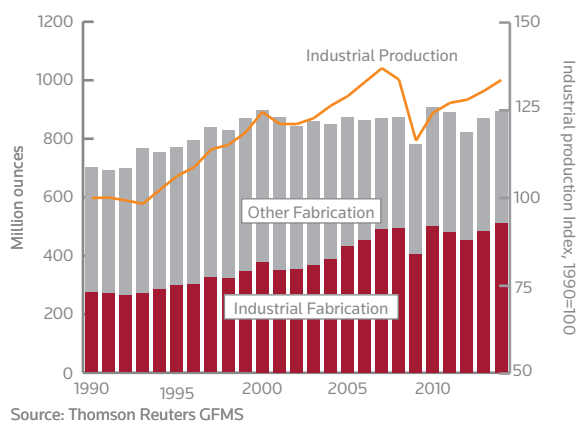
Source: Thomson Reuters GFMS

ECONOMIC OUTLOOK

Before constructing a forecast of industrial demand it is important to assess the macro economic backdrop and this section briefly sets out our view. This year has so far seen further indications of a slowdown in the global economy amid the continuing risks posed by the financial and sovereign debt crises in Europe. Eurozone economies continue to struggle amid elevated levels of unemployment, government austerity measures and the long-running debt crisis. Looking across the Atlantic, the US economy has so far achieved only a mild recovery, with little if any sign of gaining sufficient momentum to make inroads into the country's stubbornly high unemployment rate. Elsewhere, although economic performance in the major developing countries has remained relatively solid, the growth path has flattened as a result of a tightening of monetary and fiscal policies last year and a weak recovery in demand from advanced economies.

Overall, therefore, we expect global GDP growth to rise this year by 2.1%, impacted by recessionary conditions in Europe, together with only a faltering recovery in the United States and sluggish economic growth in key emerging markets. Looking ahead to next year, as the table opposite shows, expected monetary easing, notably in the United States (where it is already underway), Europe and, to a lesser extent in China, will see global GDP growth reach 2.4%. However, there are some substantive risks to this view, not least in terms of the impending fiscal cliff. We assume some form of resolution before end-2012, but the implications for US economic growth in 2013 (as well as for other countries) therefore remains uncertain. Nevertheless, by 2014 a somewhat more sustained recovery is envisaged, although for many key economies this will continue to fall short of levels achieved over the past decade.

INDUSTRIAL'S SHARE OF TOTAL SILVER FABRICATION



FORECAST ECONOMIC INDICATORS

| (%) | 2011 | 2012 | 2013 | 2014 |
|---------------|------|------|------|------|
| World | 3.8 | 2.1 | 2.4 | 2.8 |
| United States | 1.8 | 1.8 | 1.7 | 2.2 |
| EU-27 | 1.6 | -0.3 | 0.2 | 1.5 |
| Japan | -0.8 | 1.8 | 1.2 | 1.0 |
| China | 9.2 | 7.7 | 7.8 | 7.3 |
| India | 6.8 | 5.0 | 6.0 | 6.5 |

Source: Thomson Reuters GFMS, IMF

INDUSTRIAL DEMAND OUTLOOK

In the context of this economic assessment, it should be of little surprise that the use of silver in industrial applications has slowed in 2012. Indeed, the start of the year saw industrial offtake remain extremely weak in a number of key markets, following the steep drop of late 2011. That said, the fact that we are forecasting a decline approaching 6% for the full year total indicates the extent of the recovery we expect to see in approach to year-end. This is partly thanks to the fact that some market segments will outperform others, helping to limit the expected losses for 2012. One such example concerns the use of silver in ethylene oxide (EO) plants, which appears to be enjoying a strong performance in 2012. (Silver oxide is employed as a catalyst to produce EO. This in turn is used to produce ethylene glycol, a key ingredient in, for example, polyester products.) This showcases an interesting feature of the silver industrial landscape, namely the myriad of applications that together make up the global total, some of which often display different growth cycles. As a result, a robust performance for one industrial segment can help to offset weaker demand trends elsewhere.

Strong EO demand in 2012 has also been reflective of another development, namely growth in the silver content per EO plant. This in itself has been quite noteworthy, because it effectively runs counter-trend to the thrifting which has characterized the use of silver in other industrial applications. The photovoltaic (PV) industry is illustrative of this point, where research and development has been increasingly channeled into reducing the silver required for both the back and front sides of PV cells. An important reason for this shift has been the rise in silver prices, together with the greater price volatility which accompanied much of this upward move. As a result, there is now clear momentum in the PV industry to reduce silver content still further and so, should silver prices weaken at some point, in our view this will have little impact on this trend. This outcome is not unique to the PV industry, but it is important in that, in a wider context, it can help to constrain growth in silver industrial demand. In other

SILVER CONSUMPTION BY END-USE, 2012E

| | Silver Consumption per unit of Demand | Product Demand ¹ | Total Silver Consumption ¹ |
|----------------------------|---------------------------------------|-----------------------------|---------------------------------------|
| Automobiles | 10-30g | 80m | 22-77Moz |
| Thick film solar cells | 70-80kg/MW | 16MW | 40Moz |
| Cell phones ³ | 0.05-0.25g | 1.6bn | 2.6-13Moz |
| PC & Laptops (LCD) | 0.3-0.5g | 361m | 3.5-5.8Moz |
| Televisions (majority LCD) | 0.05-0.4g | 228m | 0.8-1Moz |
| iPhone 3GS | 0.058g ² | 140m | 0.33Moz |
| Tablet computers | 0.02-0.05g | 120m | 0.08-0.19Moz |
| iPad (first generation) | 0.047g ² | 45m | 0.07Moz |

¹ Estimated ; ² Assayed by Alex Stewart International

³ Includes smartphones and standard handsets;

Source: Thomson Reuters GFMS, Umicore

words, as the economic recovery gradually strengthens, the resultant boost to consumer demand, for example, could well see a less than proportionate increase in silver offtake in some of these markets.

Returning to the forecast out to 2014, following the downturn this year, a modest rebound is forecast for 2013 which should recoup the losses sustained in 2012. This will owe much to a new peak in China, while a jump in the Indian market will see the country post its second highest total on record. In terms of some of the key silver consuming market segments, auto demand will help underpin this performance (see chart opposite). In Chapter 3, we have identified a wide range of components which are likely to consume silver in the auto market, in particular the growing use of safety-based services that are likely to require silver contacts. While the analysis also highlights the inherent difficulty in realizing precise estimates for silver consumption per automobile, it is clear that there is a trend for applications typically present in high-end vehicles to eventually filter through to the mass market. That said, the ability to economize on the use of the white metal will continue to impact silver demand in the auto industry, but in our view the growth in electronic gadgetry will help to offset this trend.

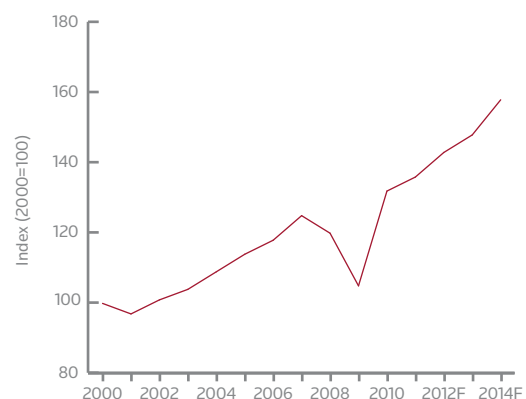
Finally, we expect that in 2014 the global total will rise by nearly 6% to a new record high of 511.6 Moz. This reflects several developments, not least a firmer lift in auto production, which is expected to rise by some 7% that year. As alluded to above, we believe that silver consumption in the auto sector will outpace the expected growth in unit production. The improving economic backdrop will also drive demand in the housing and construction industry, benefitting electrical as well as brazing alloy demand. Overall, therefore, industrial offtake in 2014 will account for

some 57% of total silver fabrication, its highest contribution in our 25-year data series, against a still noteworthy 54% share in 2011 (as highlighted in the charts on page 3 and 4).

Another issue affecting the forecast series is the somewhat limited contribution from a number of newer consumer products; indeed, our analysis of the iPhone and iPad is quite revealing. Although each has shown significant sales growth from their respective initial launches, the silver consumption, both on a per unit basis and in totality, is modest (as shown in the table opposite). This is perhaps illustrative of the limited shelf life which characterizes many of today’s consumer products.

It is worth noting, however, that some products did not exist until just a few years ago, so although their individual silver content is modest, they nonetheless represent silver demand that simply did not exist before. Furthermore, there are many uses of silver which may be considered niche or novel now, such as in biocides, printed inks and superconductors (as illustrated in greater depth in an earlier report produced for the Silver Institute). Should such markets, however, achieve a greater commercial role, they may come to cumulatively account for an increasingly important share of industrial fabrication. Overall, therefore, the development of ‘novel’ silver uses will, albeit modestly, add to the growth we expect to see in many established applications, resulting in healthy gains for silver industrial demand going forward.

GLOBAL LIGHT DUTY AUTO PRODUCTION



Source: Thomson Reuters GFMS

2. FUTURE PROSPECTS FOR SILVER INDUSTRIAL FABRICATION

INTRODUCTION

For most of the last decade, industrial demand for silver enjoyed an upwards trajectory. From the low in 2001, when offtake dropped by 9% to 349.7 Moz due to the ‘dot-com bust’, fabrication enjoyed an uninterrupted rise to a then-record high of 492.7 Moz in 2008. The sharp increase in the electrical & electronics sector accounted for the bulk of these gains, benefiting in part from strong photovoltaic and end-consumer demand.

A key driver of this overall performance has been gains in industrial production growth. In contrast, rising silver prices only had a relatively limited impact, chiefly owing to technical difficulties in both thrifting and substituting the white metal in favor of other materials. That said, the threat from a longer-term standpoint remains, as companies continue in their efforts to reduce costs, leading to either a shift towards less silver offtake per unit, or a switch in favor of alternative materials. In the solder industry, for example, there are already commercial products that offer reduced silver content (now approaching 1% compared with a 3% silver content in the past); in silver pastes, there has been considerable success in reducing the amount of silver used for products in a variety of electrical & electronic applications; and in brazing alloys, silver has on occasion been successfully replaced with plastics.

From 2008, the trajectory of industrial demand has been decidedly more mixed. Although offtake that year reached a record high, this was only marginally higher than the level posted in 2007. This was, of course, due to the recessionary environment that emerged in the latter part of 2008 in the wake of the collapse of Lehman Brothers,

INDUSTRIAL FABRICATION

| (million ounces) | 2011 | 2012E | 2013F | 2014F |
|------------------|-------|-------|-------|-------|
| Total | 481.9 | 454.4 | 484.0 | 511.6 |

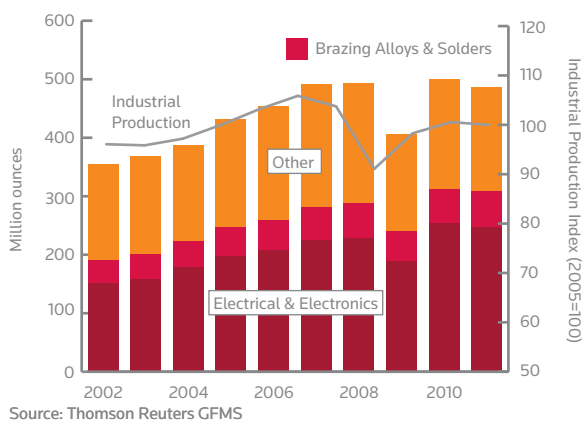
Source: Thomson Reuters GFMS

which led to a sharp contraction in industrial offtake at that time. This weakness spilled over into 2009, with fabrication demand for the white metal falling sharply to a five-year low of 406.5 Moz (a 17% fall year-on-year). In broad measure, this reflected a combination of far weaker consumer demand and widespread destocking.

In 2010, however, global silver industrial demand recovered much of the lost ground from the previous year to reach a new record high of 499.6 Moz. The improvement was due to both the replenishment of a heavily depleted supply chain, along with robust growth in a number of areas, as demand responded favorably to improved global economic conditions.

Last year, fabrication fell to 481.9 Moz. This result was something of a surprise, given that demand over the first three quarters seemed on track to deliver a year-on-year increase. However, the decline was concentrated in the final quarter of the year, as strong levels of stocking earlier in the year and notably weak demand from Europe led to fabricators (primarily in the United States and Japan) heavily cutting back on production in this period. Meanwhile, the natural disasters that affected both Japan and Thailand had a relatively limited impact in terms of silver demand, as local shortfalls were compensated by other markets.

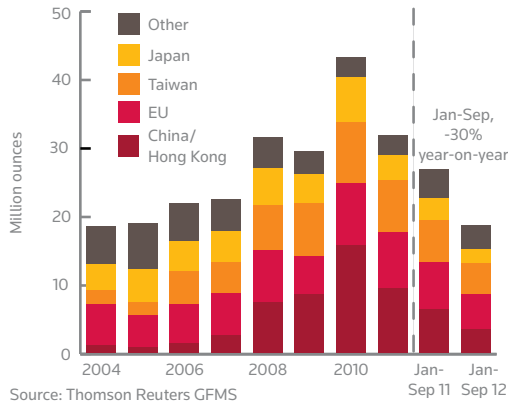
MAIN COMPONENTS OF INDUSTRIAL FABRICATION



FORECAST SUMMARY

Looking ahead, we expect silver industrial demand to weaken this year, by around 6%, to reach 454.4 Moz. This result is, of course, due to the sluggish global economy, with many of the difficulties focused on Europe. This performance also reflects an extremely challenging start to 2012, which in particular impacted the United States and China. The former, for example, saw its silver powder exports fall over the January to September period by around 30%, to their lowest level since 2009 (at the height of the Lehman crisis; see chart on page 7). Perhaps surprisingly, semi-conductor shipments (as a proxy for the

US SILVER POWDER EXPORTS

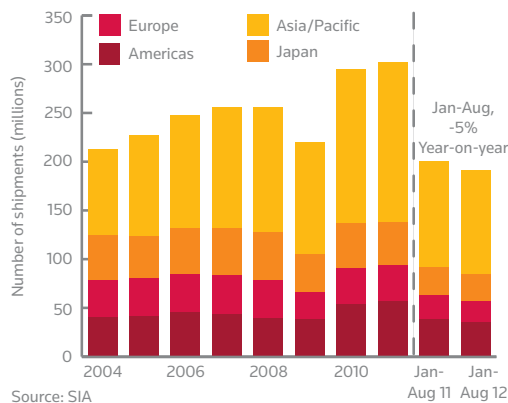


general health of the electronics manufacturing sector; see chart below) were “only” 5% weaker over the same timeframe, although it is perhaps not surprising to see a sharper 14% drop in European shipments.

Turning to next year, industrial fabrication is forecast to rise (reaching 484.0 Moz) as economic growth starts to return, in spite of the lingering effects of the Euro crisis, which could continue to impact the PV industry, as government subsidies remain under pressure (although, in overall terms, we are still expecting European silver industrial offtake to rise in 2013, albeit still falling short of pre-recession levels). However, we expect to see a further lift in the EO sector next year (in terms of new capacity being added), which explains the double-digit percentage gain for the United States at that time.

A broadly similar performance, in terms of the global total, is predicted for 2014, with a 6% lift as the macroeconomic backdrop continues to improve. Demand will in part benefit from a stronger automotive sector, while firmer growth from the developing world should provide the catalyst for gains in brazing alloys & solder fabrication. As a result, global industrial silver demand is expected to

GLOBAL SEMI-CONDUCTOR BILLINGS



INDUSTRIAL FABRICATION

| (million ounces) | 1992-01 Average | 2002-11 Average | 2012-14 Average |
|------------------------|-----------------|-----------------|-----------------|
| Industrial Fabrication | 313.4 | 436.9 | 483.3 |

Source: Thomson Reuters GFMS

achieve a new record high of 511.6 Moz by 2014, some 2% above the previous peak set in 2010.

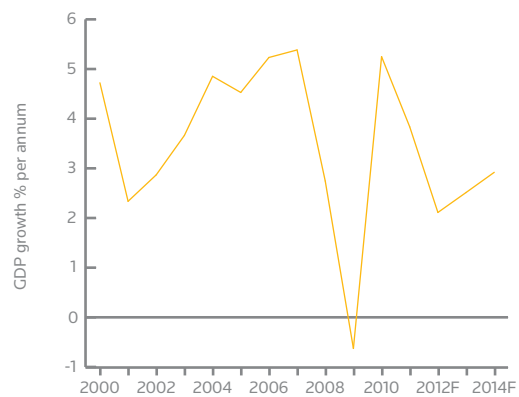
FORECAST BY SECTOR

The largest end-use of silver is in the wide-ranging sector of electrical & electronics. This includes products such as computers, televisions and cell phones, as well as PV (addressed in more detail below). The most rapid growth in these sectors is set to come from emerging markets, such as India and China, where rapid advances in living standards mean such products have become increasingly affordable as well as desirable. Many industrialized markets, in contrast, are already in replenishment phases, so the rate of gain is forecast to be somewhat slower.

Demand from the auto sector is forecast to increase robustly, given both the growing number of electronic components that are required per vehicle and the projected increase in global vehicle production. In terms of the former, features that are currently viewed as ‘luxury’ options, such as in-car DVD players or electric wing mirrors, may become increasingly ‘standard’, thus raising the number of electronic components required per vehicle, predominantly in the form of switches and contacts.

Offtake for brazing alloys & solders, meanwhile, will benefit from the gradual return of a healthy construction industry, as investment in infrastructure, housing and commercial developments should benefit from improving, albeit still sluggish, economic growth (as highlighted in the chart below). Gains will be particularly strong in emerging

FORECAST GDP GROWTH

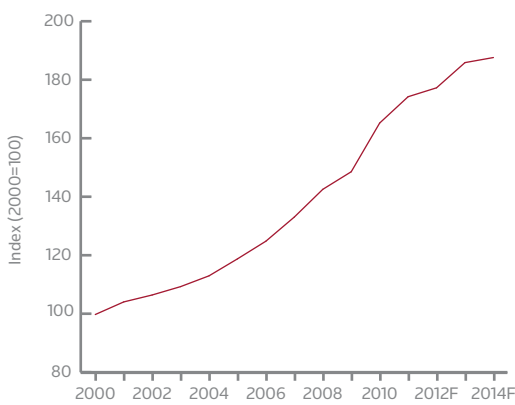


markets, given their faster economic growth rates compared to those in industrialized countries. In addition, silver-based solders may win some market share from lead solders should the latter be gradually phased out, due to more stringent environmental legislation. Demand for brazing alloys in household appliances, such as fridge freezers and air-conditioning units, is also set to grow strongly, underpinned by gains from emerging markets.

With regard to the PV sector, demand for silver in this area has experienced dramatic growth in recent years, benefiting in large part from the well documented Feed-in-Tariffs (FITs). Looking ahead, we expect PV offtake to broadly stabilize in 2013 (following a marked downturn in 2012), in part due to somewhat healthier demand in North America and China. 2014 is then predicted to see a slight drop, benefiting from a lift in new capacity installations that year, which will largely offset a further drop in the average silver content (per PV cell). However, we would caution that, looking ahead, the use of silver in PV may not regain the heights seen in 2011. In our view though, 2011's performance should be taken as an outlier, instead of representing a new benchmark for the industry. Adopting this more realistic perspective suggests that 2014 will still see a robust total for the use of silver in the PV industry.

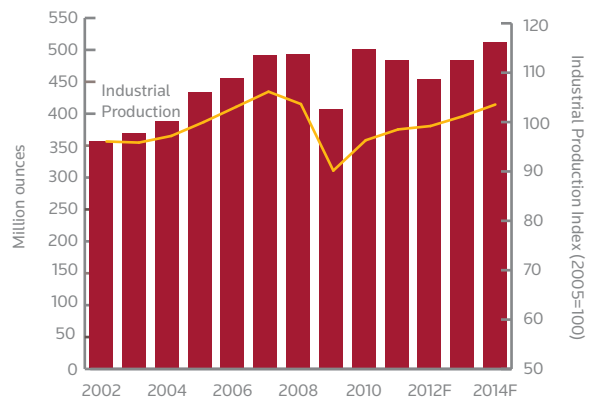
The EO industry represents a key growth area, driven by strong demand, for example, from PET (polyethylene terephthalate) bottle manufacturers, which in total could translate into silver demand of around 20-25 Moz per annum. This highlights one area of silver industrial demand where there is a trend towards rising silver consumption in terms of increasingly large EO plants, but also with regards to a higher silver content per plant. The additional capacity will largely originate in China and the Middle East, although it is worth remembering that the manufacture of silver oxide will still largely take place in North America.

GLOBAL ETHYLENE OXIDE INSTALLED CAPACITY



Source: Thomson Reuters GFMS

INDUSTRIAL FABRICATION FORECAST



Source: Thomson Reuters GFMS

FORECAST BY REGION

Finally, it is worth considering how silver industrial fabrication may shift in terms of its key geographic locations. Over the past 10 years, the most notable change has occurred in terms of the rise in emerging market demand, principally in China. The most significant casualty of this has been the losses suffered in Europe. In sharp contrast, and perhaps surprisingly, the United States has seen little change in its performance in relative terms.

Looking first at China in more detail, the country has enjoyed a dramatic improvement in its fortunes. In 2000, China accounted for just 8% of global silver industrial offtake, against a contribution last year of 18%. This reflects two key developments. First, we have seen a growing trend towards off-shore relocation (from across east Asia as well as western markets) in favor of the Chinese market. Second, the tremendous growth in the local economy has boosted demand for silver-bearing products, which have been increasingly met by domestic fabricators. It is also worth noting that Chinese industrial silver consumption has also grown strongly (partially reflected in the growth in its silver powder imports, highlighted to some extent in the US silver powder export chart on page 7). This illustrates that China's importance to the global silver industrial total extends beyond its 18% headline share of fabrication.

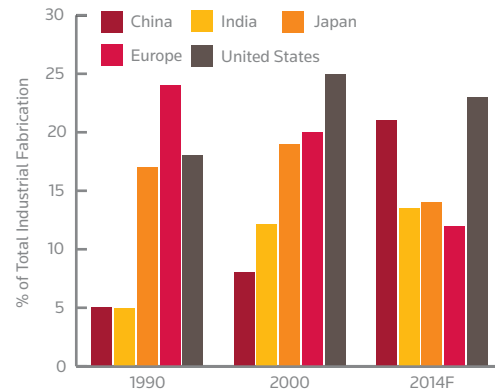
Over the next three years, China's contribution to the global total is expected to edge gradually higher, reflecting a slower pace of relocations (which have taken advantage of lower cost manufacturing on the Mainland), which instead will be broadly offset by overseas companies moving to China to gain direct access to its market. Nevertheless, in absolute terms, China is expected to achieve successive record highs in terms of its silver industrial offtake over the forecast.

Looking at the Indian market, given that much of the country's industrial demand is relatively price sensitive it is not surprising that its contribution to world industrial fabrication has varied markedly over the years. From a share as low as 9% in 2004, this jumped to 16% in 2009, before then settling at around the 13% level. In contrast to China, there is little indication of the local market benefiting from inward investment by overseas manufacturers; domestic consumption is therefore key in dictating its performance. Although we expect to see a record total in 2014, the sluggish economic performance, combined with elevated rupee silver prices, explain why the 2014 forecast total is only modestly higher compared with the previous peak achieved during the late 2000s.

In contrast, developed markets are likely to post comparatively slower gains. Japanese fabrication, for example, highlights the impact of offshore relocations, the pace of which has quickened in recent years. Manufacturers there have been forced to look abroad, hampered by prolonged yen strength, while the earthquake and tsunami of last year have also highlighted the country's vulnerability to natural disasters. Indeed, in relative terms Japan has seen its contribution to global industrial offtake fall back from a high point of 20% in the mid-2000s to 15% last year. Looking ahead, a slightly lower market share for Japan is projected out to 2014. In absolute terms, although a modest recovery is predicted for Japanese silver industrial demand, the absolute level will fall comfortably short of the record totals seen before the onset of the global recession.

A similar outcome applies to Europe, which has arguably been the most significant casualty of the shift in manufacturing facilities to lower cost locations. In part, this has involved a transfer from western to eastern Europe (which would therefore still be captured in the European series), but a more important slice has involved relocating to east Asia. While China has been the chief beneficiary of this development, rising costs there have encouraged western companies more recently to shift their focus elsewhere. In this regard, over the life of this forecast we would expect countries such as Vietnam and Indonesia to increasingly benefit from this development. In terms of the European industrial market itself, a combination of overseas relocations and the region's debt crises have seen Europe's share of world industrial demand fall to just 13% in 2011. Looking further ahead, the fact that we believe Europe will see its contribution (to the global total) remain broadly unchanged is indicative of the only modest rise in industrial offtake expected for Europe out to 2014.

LEADING MANUFACTURERS' SHARE OF INDUSTRIAL FABRICATION



Source: Thomson Reuters GFMS

Finally, we expect the United States to run counter trend to other industrialized countries, in terms of the performance of its silver industrial demand. As noted above, the US has seen its share of the global total remain remarkably stable over the past decade, at around 24%, in spite of the tremendous growth seen in the Chinese market. This is not to say that the United States has not suffered from companies shifting manufacturing facilities to lower cost locations. However, in the context of the silver market, the United States has retained and in fact enhanced its position as a leading manufacturer of high-end silver materials. In large part, these consist of semi-manufactured products, such as silver powder and paste.

The dominant position the United States enjoys, in terms of the fabrication of these intermediaries, has been reflected in the jump, for example, in US silver powder exports (see chart on page 7). Of course, this trend also reflects a shift from delivering powder (almost entirely) to US-based companies to those (increasingly) located overseas. However, in our view, the growth in this trade reflects the significant market share US suppliers have achieved in a number of growth industries, the PV market perhaps being one of the most noticeable examples in recent years. Looking ahead, however, the United States will see its share of global industrial demand edge lower through to 2014. Although US industrial fabrication is expected to rise over the next two years, China, for example, will achieve a faster rate of growth over the same timeframe, hence the slight drop in the United States' market share during this period.

3. THE ROLE OF SILVER IN CONSUMER AND INDUSTRIAL PRODUCTS

INTRODUCTION

In this chapter, given the intrinsic role silver plays in a wide range of industries, we address both the role of silver in specific consumer and industrial product lines, as well as the silver content in each of these applications. All of the areas discussed below make use of silver's well-established role in electronics. In each instance, we also reflect on what are effectively conflicting strategies; on one side industry is encouraged to use silver because of its unique technical properties, but from another perspective, there is an ongoing drive to reduce costs. Finally, we consider the prospects for silver demand in each category and their contribution therefore to global silver industrial fabrication.

AUTOMOBILES

In the automobile industry, silver can be found in a range of electronic applications, the result of its high conductivity, resistance to corrosion and ability to endure extreme temperatures. It is used in devices such as contacts and switches, which operate features including power assisted steering and braking, as well as within printed circuit boards (PCBs), which are responsible for controlling the dashboard, and applications using liquid crystal display (LCD) devices, such as satellite navigation. Silver is also frequently present in the form of silver ceramic lines in rear windows, which generate heat to clear the glass of frost and ice. Furthermore, silver is increasingly found in windshields as a result of its reflective properties.

Over the past five years, auto-related silver demand has grown rapidly, due to the increased implementation of electronic accessories in vehicles. A fully-equipped car is estimated to contain over 40 silver-tipped switches which, among other functions, start the engine, control windows, mirrors and locks. Features such as air conditioning and satellite navigation, which had originally been confined to luxury vehicles, have become far more widespread in the automobile market. As a result, automotive silver demand has outpaced car production over the last few years, a trend which we expect will continue for the foreseeable future. Demand for contacts has also risen because of the rise in vehicle production itself, which has improved by close to 10% during the 2007-2011 timeframe (see chart opposite).

In our view, the future of automotive electronics will increasingly focus on safety as well as passenger and

driver comfort. Applications such as lane and speed assist systems and blind spot detection, as well as internet access and advanced heating systems, are already available in certain high-end vehicles. Looking ahead, many of these (now) exclusive or anticipated accessories are expected to become increasingly standardized features.

However, the growth in silver demand across the auto industry is likely to be partially mitigated by market share gains by other materials. Indeed, there have already been instances where silver has been replaced by the predominantly copper material "CuAg 0.10" in slip rings and contacts, used in applications such as ignition systems. A growing emphasis on the use of software, as opposed to the earlier reliance on hardware, in the automotive electronics industry is also likely to have a bearing. Nonetheless, several new technologies, particularly those focused in safety devices (such as night vision systems and parking distance image assistance), will require components such as cameras, sensors and infrared, all of which are likely to use silver switches and contacts. In addition, silver is not always the primary focus for thrifting; other materials may account for a greater share of the overall value, while the trade-off between performance and cost may also benefit the use of silver in a given device.

Overall, therefore, silver demand is forecast to continue rising in the automobile industry (at least within the confines of this forecast). Electronic accessories that are currently deemed high-end are expected in time to become standard features at the mass market level (although many of these features may only appear in the mass market after 2014, the period under review in this report). Furthermore,

GLOBAL LIGHT VEHICLE PRODUCTION



Source: Thomson Reuters GFMS

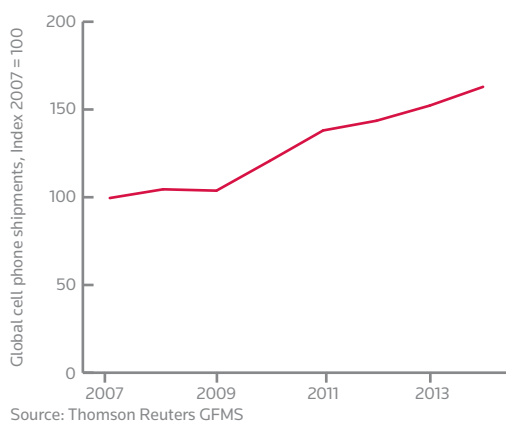
auto production is set to maintain its upwards trajectory, climbing by over 16% from 2011 to 2014. That said, we would be the first to acknowledge that our data for silver consumption per vehicle represents broad estimates, and should only be taken as a tentative indication as to the true level of silver offtake in each vehicle. In part, this is due to the wide variation found between different models, although it is also a function of the difficulties in obtaining transparent data. With these caveats in mind, we have settled on a wide range of silver demand, of 10-30g per vehicle (although there are likely to be models that fall either side of this range), which covers a significant number of silver-bearing uses, many of which are outlined here. In total, therefore, this gives us a span of between 22-77 Moz of silver offtake, on the basis of light vehicle production reaching 80m units this year, with closer to 50 Moz arguably a fair reflection of the industry's silver consumption in 2012.

CELL PHONES

Silver benefits from a number of roles within cell phones, but is typically present in membrane switches and printed circuit boards (PCBs). The silver content of a cell phone (excluding smartphones) is estimated at up to 0.25g, although there are clearly significant variations between models. A smartphone, in contrast, contains far less silver; specifically, the iPhone 3GS contains just 0.058g (source: Alex Stewart International, see table on page 5 in Chapter 1), the majority of which is found on the PCB.

Despite the fact that smartphones (with their far smaller silver content per unit) are gaining market share, we have not seen this translate into a decline in silver use in the total cell phone market. This has been thanks to the strong growth in terms of the combined production of both smartphones and "ordinary" cell phones. Global shipments of handsets have grown by almost 60% over the last five years, while sales of iPhones, launched in

GLOBAL CELL PHONE SHIPMENTS



2007, are estimated to have reached a cumulative total in excess of 244 million to-date, which alone could well have accounted for up to 0.5 Moz of silver demand.

In terms of the silver content of each handset, looking ahead this may not suffer the same rate of attrition seen in recent years. This partly reflects the fact that silver is often irreplaceable, due to its superior conductivity compared to alternative materials. Perhaps just as important, the extent to which the average silver content has already been lowered suggests that there is less room to achieve similar cuts in future. Finally, the European Restriction of Hazardous Substances Directive (RoHS), which bans the use of lead, may lift silver demand as tin-lead solders in cell phones will be increasingly replaced by alternative metals, such as tin-silver bismuth or tin-copper-silver alloys.

However, the pressure to instead use lower cost materials will remain a feature of the cell phone market. This in part stems from the increasingly short shelf life of many cell phones (the US Environmental Protection Agency estimates cell phones are used for an average of 18 months before being replaced) which means that longevity in the production process is often not a primary concern. Copper, for example, is already heavily used in cell phones in wiring as an alternative to silver (and gold), due to its lower cost. Despite the fact that its electrical conductivity is inferior to that of silver, it is often more than adequate for the relatively short period it is expected to last.

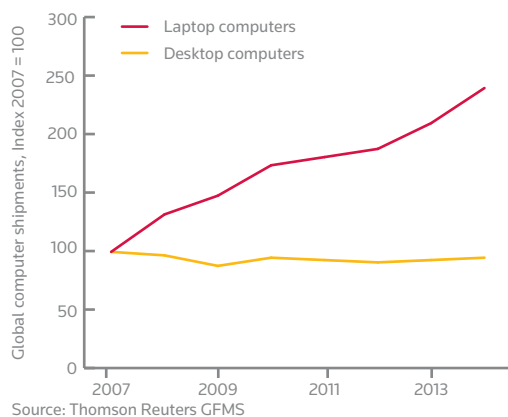
Looking ahead, however, we expect total silver demand in cell phones to rise by around 3% in 2012 to near the 13 Moz level (based on the 0.25g/handset metric). This view is underpinned by forecast gains in the number of handset sales (see chart opposite), which should comfortably outweigh the fall in the average silver content per phone (not least due to market share gains by smartphones).

DESKTOP AND LAPTOP COMPUTERS

Silver enjoys a number of uses within laptops and computers. In particular, it is present in PCBs, where it connects components, as well as in random-access memory (RAM), albeit to a lesser degree. Silver can also be found in computer screens (as is also the case in televisions). These include the edge of liquid crystal displays (LCDs) and in plasma display panels (PDPs). It is also found in external accessories, including keyboards and mice, in the form of silver membrane switches.

In a typical desktop computer with an LCD screen, we estimate that there is an average of around 0.5g of silver

GLOBAL COMPUTER SHIPMENTS



(excluding the keyboard and mouse), while in laptops the content is lower at around 0.4g. In a laptop computer, silver can also be found in small quantities on aluminium-based hard disk platters.

Over the past few years, the silver content per device has declined noticeably, principally because of the miniaturization of components. Furthermore, growing competition from tablet computers and smartphones (which use less silver than computers and laptops) have further eroded total silver demand in this area. Furthermore, the use in laptops of semiconductor flash memory (solid state disk storage; SSD), which does not contain silver, is likely to increasingly encroach on more traditional hard disk drive sales.

With regards to silver use in computer accessories, this too has been paired back. Furthermore, we are likely to see demand for keyboards and mice diminish in absolute terms, given the increasing popularity of touchscreen technology (already common for smartphones and tablet computers), which in turn is likely to impact silver demand in membrane switches. That said, losses may be partially mitigated by the growing use of silver in the form of buss bars in touchscreens, that is, silver ink circuits which are situated along the edges of the screen. In addition, silver may appear more frequently in more novel forms, such as a nano-silver coating on keyboards and mice, although the absolute quantity of silver used in this way is unlikely to mitigate losses realized elsewhere.

Overall, however, we expect total silver demand in the computer industry to continue its upwards trajectory, with expectations that it will exceed 5 Moz this year. Although silver demand on a per unit basis may face further attrition, there is also a point at which the potential cost saving from reducing the silver content becomes uneconomic.

TABLET COMPUTERS

In keeping with many other devices, the main use of silver within tablet computers is in the PCB, although the metal can also be found in the form of buss bars in the edge of the screen. A first generation iPad was found to contain some 0.047g of silver (our thanks again to Alex Stewart International). Other iPads models and tablet computers are believed to feature a similar amount of silver, although as expected the precise quantity will vary between make.

While the amount of silver contained per unit is arguably modest, tablet computers are nonetheless expected to account for a growing area of silver demand in future by sheer virtue of anticipated sales. Cumulatively, over 84m iPads alone, for example, have been sold (to-date) since their launch in late 2010, equivalent to around 0.13 Moz of silver demand.

We are also of the opinion that the silver content per tablet is unlikely to weaken significantly going forward, given that it is already limited and therefore forms a relatively small proportion of the overall cost of the product. Furthermore, the high performance required from such devices suggests that silver may well continue to be preferred over less costly alternatives (such as copper), due to its superior technical capabilities and reliability, as performance considerations balance cost concerns.

Looking ahead, we expect demand for silver in tablet computers to continue to grow. For 2012, global tablet sales are forecast to reach 120m units (source: Gartner), which translates to around 0.2 Moz of silver fabrication. This may appear modest, but it is important to remember that just two years ago this sector was almost non-existent.

TELEVISIONS

There are three main types of televisions: cathode ray tube (CRT), plasma display panels (PDP) and thin film transistor liquid crystal displays (TFT LCD). One of silver's key roles in CRT televisions is as an activator, used to produce color. PDPs, meanwhile, contain a grid of thousands of lines of silver in between the glass panels that make up the television screen, while in LCDs, most of the silver can be found in the PCB (as a solder) and contacts. Silver is also present in each technology in the form of switches and electrodes. While all three types use silver, the largest quantity per television is found in PDPs, which contain on average around 10g of the white metal (at its peak in 2010, PDPs are likely to have accounted for around 5 Moz of silver demand).

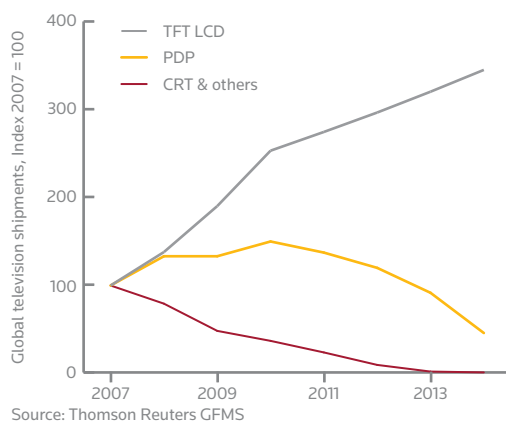
Recent years have seen LCDs gain tremendous market share and by last year they accounted for over 80% of the global television market. We expect this trend to continue and, as such, 2014 is likely to see this technology almost entirely dominate global television production. In essence, the old fashioned CRT technology has become rapidly more niche, while PDPs have struggled to compete with LCDs on cost and, increasingly, quality across all screen sizes (PDPs had previously offered a clearer advantage for larger formats).

In some regards, the outlook for the LCD market and therefore silver offtake in this area is not entirely clear cut. In the first instance, it is possible that less expensive materials, such as copper, may start to replace silver in devices such as PCBs. In addition, we could also see demand for television sets themselves slow, due to growing competition from computers, which increasingly offer television content online. In addition, there will be far less opportunity for LCDs to benefit from substantial market share gains, as they have done so in recent years, with overall LCD sales in future becoming notably more cyclical.

However, there are also a number of ways in which we may see silver content per television improve. First, although demand for televisions may lose out to growing computer-related content, it could also be the case that television sales benefit from becoming increasingly interactive, while new applications such as motion sensors and webcams will require silver contacts, for which so far there has been little requirement.

Second, silver may also enjoy substitution gains elsewhere, such as in the replacement of indium-tin-oxide electrodes in LCD screens with silver nano-wire electrodes. Although the gain in silver content per television is likely to be marginal, in aggregate such uses may have the potential to boost total silver offtake in this area.

GLOBAL TELEVISION SHIPMENTS



Unsurprisingly though, it is the strong growth forecast for LCD televisions (see chart below) that will prove to be the single most important driver of the increased use of silver in televisions going forward. For 2012, LCD shipments are expected to rise by around 8% to 228m units, which will therefore account for around 1 Moz of silver demand.

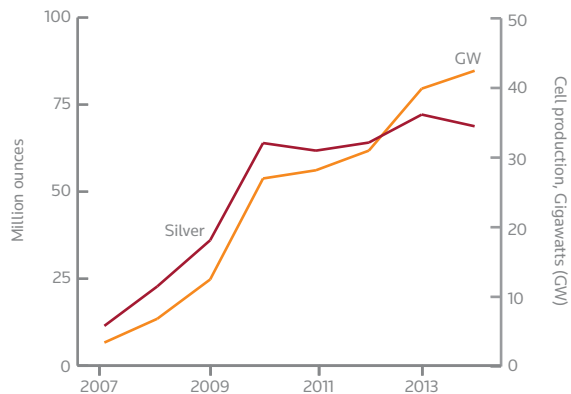
PHOTOVOLTAICS

There are two main types of photovoltaic cells: thick film and thin film. Thick film cells are mono-crystalline based, while thin film cells come in various forms, including copper indium gallium selenide (CIGS), cadmium telluride (CdTe) or amorphous silicon (a-Si). It is thick film cells that require significant volumes of silver, in the form of silver paste, which is used to conduct solar energy to power lines. In contrast, the only type of thin film cells understood to use any quantity of silver is a-Si (although even this is in trivial amounts). At present, thick film technology comprises over 80% of the PV market as, despite the higher initial cost of the cell, its overall costs are lower due to higher cell efficiency.

The growth of the solar industry has been almost entirely due to the success of Feed-in-Tariffs (FiTs; discussed in more detail elsewhere in this report). The eventual goal for solar energy is to reach grid parity. This is the point at which the cost of solar power is equal to or less than fossil fuel energy, hence regions where both fossil fuel costs and insolation levels (which records the level of solar radiation) are high will achieve this more rapidly (indeed, it has already been reached in certain areas such as Hawaii and California). When grid parity is reached, solar energy is able to compete with fossil fuel power without the need for government subsidies (although FiTs still offer the important function of guaranteeing solar energy providers access to the power grid).

Last year, silver demand for use in PV applications reached some 60 Moz. Looking ahead, we forecast that the rate of growth in silver demand will slow considerably from the average of 57% seen between 2005 and 2010. There are three main reasons for the anticipated slowdown. First, the rapid growth of the last few years has been due largely the fact that the industry benefited from an aggressive growth phase in PV installations. As the industry is now approaching maturity, we are unlikely to see a repeat of such rapid growth. Furthermore, the ongoing macroeconomic uncertainty has seen numerous FiTs undergo downward revisions, an outcome which has discouraged investment in the sector.

SILVER DEMAND VS CELL PRODUCTION



Source: Thomson Reuters GFMS

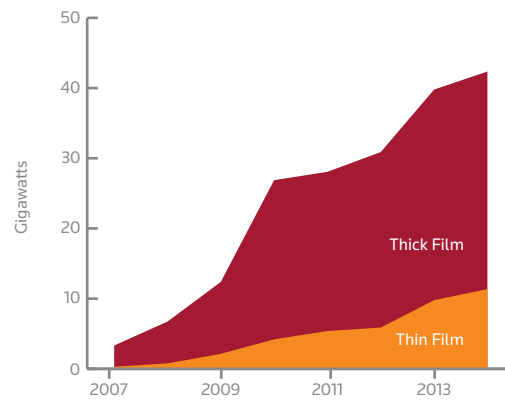
Second, the industry continues to focus on reducing silver content, in order to contain costs. We currently estimate that around 80kg of silver is required to generate 1 MW of energy, compared to a loading of around 120kg per MW four to five years ago. Much of the decline has been due to the substitution of silver-based pastes on the back side of the cell with aluminum-based pastes. The silver loading on the front-side has also seen considerable attrition, with significant advances made in the efficiency of pastes. Research into further replacing or reducing silver continues, including the possible use of nano-silver plated copper or nickel particles, which could have a significant bearing on PV-related silver demand.

Third, thin film technologies may gain market share from thick film at a far more rapid pace than previously anticipated. At present, we would suggest that thin film enjoys a near 20% market share (in terms of new capacity), compared with around the 10% mark during the mid-2000s. Despite its lower costs thin film suffers from a far lower efficiency. However, should this metric improve sufficiently we would expect this technology to make further gains, thus becoming competitive with thick film on a cost per watt basis.

There are, however, several reasons as to why silver use in solar is unlikely to face a sharp decline. One is that silver is not the only cost concern. Indeed, there are a myriad of other components that could also fall under the spotlight, including silicon, batteries, inverters and glass. Furthermore, the industry is at present relatively conservative, in terms of the technology it employs, given the high capital costs required to start production lines. Manufacturers therefore often favor products that can be easily accommodated into existing modes of production, avoiding the need for costly new equipment.

Given that silver is used because of its technical abilities and proven performance, it may therefore be a false

GLOBAL SOLAR CELL PRODUCTION: THICK AND THIN FILM



Source: Thomson Reuters GFMS

economy to reduce silver use if this were to compromise the PV product (which is expected to last for at least twenty years).

It is also worth noting that political will to support solar remains relatively high. Although some government-backed programs have been reduced or withdrawn, this has usually been due to oversubscription, combined with an overriding need to reduce expenditure (notably in the Eurozone). In addition, as grid parity becomes more widespread, solar will become an increasingly attractive source of power.

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