THE SILVERINSTITUTE

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Silver News

Improving Investor Sentiment Helped Drive the Price Higher in 2019: Interim Silver Market Review

Healthy gains were projected for physical silver investment in 2019, with sales of silver bars and coins projected to rise by 7% to a three-year high, according to the *Metals Focus / Silver Institute Interim Silver Market Review*.

The last few months have seen a major improvement in investor sentiment towards silver, according to Philip Newman, Director at Metals Focus, who recently presented the *Metals Focus / Silver Institute Interim Silver Market Review*. The silver price benefitted in 2019 from a host of factors, including global economic and political concerns, as some investors sought safe haven investments, such as silver.

Highlights of the *Interim Silver Market Review* include:

- Healthy gains were projected for physical silver investment in 2019, with sales of silver bars and coins projected to rise by 7% to a three-year high. In the US, investment was on track to record its first annual increase in four years, thanks to improving price expectations and rising price volatility, although levels remained historically low. In India, the partial recovery that started in 2017 continued in 2019, although the sharp rally in the rupee price saw sales ease recently, particularly in rural areas.
- Disruptions and strikes across South America impacted global mine production, which was expected to fall by 0.7% in 2019 to 849.3 million ounces.
- For the second year in a row, silver industrial fabrication was expected to hold at a record high. However, in the wake of the escalating US-China trade war, several areas of silver electrical and electronic end-uses have struggled. That said, any negative impact on silver demand had been mitigated by higher silver usage in other categories, especially in the automotive sector.
- Global silver jewelry and silverware demand was projected to grow by 3% and 4% respectively in 2019. For both, the year's increases were almost entirely led by India, where gains had been assisted by increasing awareness of sterling silver, and growth in organized retailing, along with the benefits from restrained silver prices in the first half of 2019.
- Overall, the silver market was expected to record a small surplus in 2019. However, this metal should have been easily absorbed by investors as rising macroeconomic uncertainties and fresh monetary easing by major central banks rejuvenated the appeal of safe haven assets from mid-2019 onwards which, looking ahead, should continue to benefit precious metal prices.

For more information about the report including a supply & demand chart, click here.

European Union Solar Power on a Tear

2019 was one of the best years for solar installations in the European Union (EU), according to the first *EU Market Outlook* published by SolarPower Europe, a group of over 200 organizations whose aim is to ensure that more energy is generated by solar than any other source by 2030.

Silver plays a key role in the photovoltaic (PV) industry. Metals Focus, the global precious metals research firm, forecast that 96 million ounces (Moz) of silver would be consumed globally in PV in 2019, a 2 Moz increase over 2018.

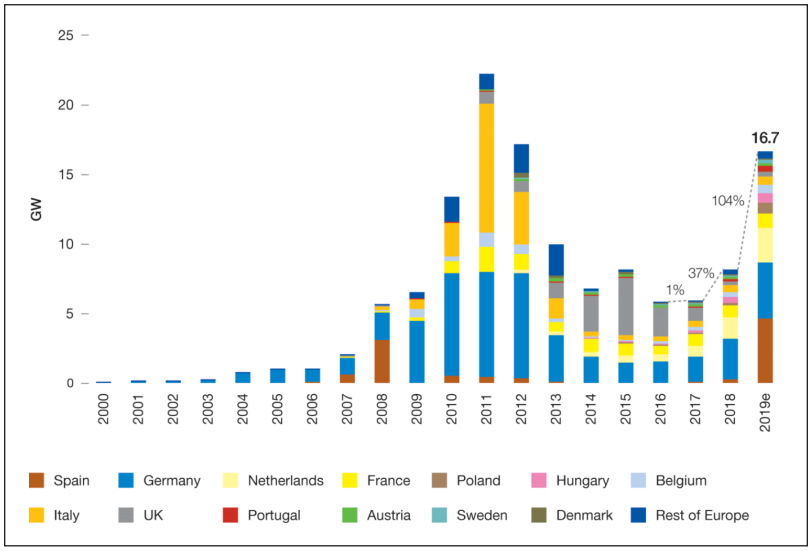
The region installed 16.7 gigawatts, a 104% increase over the 8.2 gigawatts added in 2018. In addition, 2019 also showed the strongest solar growth since 2010, when the EU photovoltaic market also increased by 104% during the first European solar boom, reaching 13.4 gigawatts, the report noted.

By adding about 4.7 gigawatts in 2019, Spain was both the EU's and Europe's largest solar market. "Completing the Top 5 EU solar markets list are Germany (4 gigawatts), the Netherlands (2.5 gigawatts), France (1.1 gigawatts), and, surprising to many, Poland, which nearly quadrupled its installed capacities in 2019 to 784 megawatts," the report stated. "The EU's Top 5 solar markets were responsible for over three quarters of the region's installed capacity in 2019."

There are several reasons for this growth spurt.

"First, solar power is often cheaper than any other power generation source today, and its attractiveness is only increasing as the cost reduction curve continues at a much faster pace than for any other technology," the report stated. "Another major factor for the growth of solar in the EU today is the close deadline for member states to meet their binding national 2020 renewable energy targets." In a prepared statement, Aurélie Beauvais, Policy Director of SolarPower Europe, said: "EU countries have also begun to prepare for their road to compliance with the Commission's Clean Energy Package, which sets a 32% renewables target by 2030, where many national governments are increasingly looking to low-cost solar to meet their targets."

Added Michael Schmela, Executive Advisor and Head of Market Intelligence at SolarPower Europe, "With solar being the most popular energy source among EU citizens, as well as the most versatile, and with price reductions continuing, we are only at the beginning of a long upward trend for solar in Europe. In terms of medium-term projections, we expect continued growth for the EU-bloc with a 26% increase in 2020 bringing demand to 21 gigawatts, and installations on track to reach 21.9 gigawatts in 2021. The record-breaking year is expected to be 2022, with an anticipated all-time high of 24.3 gigawatts of installations, and again in 2023 with 26.8 gigawatts of newly-installed solar capacity. The coming years are looking truly phenomenal for solar deployment in Europe."



EU-28 annual solar PV installed capacity 2000-2019

Silver Ions Help Make Organic Light Emitting Diodes Less Toxic, More Stable

Organic Light Emitting Diode (OLED) displays are brighter, have higher contrast and use less power than conventional plasma and LCDs (Liquid Crystal Displays), but they have drawbacks. OLEDs are more expensive, and the polymers used in their production are toxic, which adds another level of environmental challenges to manufacturing and disposal.

Chemists at The Peoples' Friendship University of Russia (RUDN) in Moscow may have an answer. They have made fluorescent compounds with special molecules, the nucleus of which are triangles of silver or copper atoms. These compounds have small organic fragments surrounding the central ion of the metal, and the unique geometry of the molecules allows the production of OLEDs without the toxicity found in polymers.

According to the research paper in the journal *Inorganic Chemistry*, the metal molecules were stabilized with nitrogen-based molecules that kept the OLEDs largely intact, and difficult to break apart. The researchers said that a single structure looks like a 'merry-go-round,' a configuration with nuclei of silver ions or copper that do not disintegrate under ambient temperatures.

OLEDs have additional advantages over LCDs. They do not require a backlight to see what's on the screen, they draw less power and, because there is no backlight needed, OLED screens can be made thinner than LCD panels.

Flexible Battery Made Possible by Silver Flakes

Silver is a crucial part of flexible electronics from printed-on antennas to body wearables to phones that fold, but one vital component has eluded engineers until now: batteries that bend, stretch and twist along with the gear they power.

Here again, silver's malleability and its high electrical conductivity are playing a role as researchers at ETH Zurich, Switzerland, have developed a flexible, thin-film battery that can be bent, stretched and even twisted without interrupting the supply of electricity.

Like conventional commercial batteries this prototype is built in layers, but with one major difference; its components are flexible. "To date, no one has employed exclusively flexible components as systematically as we have in creating a lithium-ion battery," said Markus Niederberger, Professor for Multifunctional Materials, in a prepared statement. The anode (plus terminal) and cathode (minus terminal) are made from bendable polymer composites that contain electrically-conductive carbon. These also serve as the battery's outer shell. Onto the interior, the research team applied a thin layer of microsized silver flakes that overlap like roof tiles. This configuration guarantees conductivity to the terminals even when stretched extensively, according to Niederberger. The researchers then sprayed anode and cathode powder onto precisely defined areas of the silver layer. Last, the team placed electrolyte gel between the terminals.

In the unlikely event that the silver flakes do lose contact for an instant, the current can still flow through the carbon composite, albeit weakly, until the flakes are once again touching each other.

The new battery is also safer than conventional lithium batteries, Niederberger said. "Liquid electrolyte in today's batteries are flammable and toxic." However, he said that the gel electrolyte used here contains water and high concentrations of lithium salts between cathode and anode that not only allows the flow of lithium ions between cathode and anode while the battery is charging or discharging, but also keeps the water from 'electrochemical decomposition,' a scientific way of saying 'leaking.' Even if the battery were to leak, the liquid would not cause any damage or toxic danger. Still, to commercialize the flexible battery the researchers must work on a better containment system, Niederberger acknowledged. "If we want to market the battery commercially, we'll have to find another process that will keep it sealed tight for a longer period of time," he said.

The battery's flexibility could offer some unprecedented applications, he notes. "For instance, you could sew our battery right into clothing."

ETH ZURICH / PETER RÜEGG

Silver flakes allow this battery to be flexible.

Nanosilver Produced from Blue-Green Algae Offers Promise of Colon Cancer Therapy

Scientists seeking new ways to produce silver nanoparticles from environmentally-friendly sources such as the kadam tree (see *Silver Helps Detect A Single Bacterium Before it Grows Into Deadly Infection*, February 2017, *Silver News*) and red seaweed (see *Silver and Seaweed Attack Biofilms*, December 2018, *Silver News*,) are now looking in a unique place: blue-green algae. Not only is the technique ecologically responsible, it is also less expensive than conventional chemical processes. In addition, the nanosilver produced is toxic to human colon cancer cells, according to researchers at Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia and Alexandria University, Alexandria, Egypt.

Blue-green algae's scientific name is *cyanobacteria* and it is a microscopic organism found in various types of water including brackish, sea and fresh. The organism can also be found in soil. The algae form into gelatinous masses and use sunlight to produce their own food. The strain of algae used in this research is known as *Nostoc sphaericum* and is not harmful to humans or pets as are some strains of blue-green algae often found in rivers, ponds and lakes.

For production of nanosilver, the algae were collected, washed, freeze-dried and ground by a mortar and pestle. The powder was mixed with a solution of silver nitrate, then filtered and dried on sterile plates.

The particles that resulted were between 8.5 and 26.44 nanometers, which classifies them as nanoparticles. When they were introduced to a type of colon cancer cells (known as Caco-2, developed for research studies by the Sloan-Kettering Institute for Cancer Research), the particles showed the ability to kill the tumor cells.

In their study, published in the *International Journal of Nanomedicine*, the authors stated: "Nanomaterials represent an alternative strategy for cancer treatment to overcome multidrug resistance and several drawbacks of traditional therapies. A green chemistry approach to nanoparticles synthesis offers a solution to safely produce nanoparticles. Silver nanoparticles had potent antitumor activity against Caco-2 cells, and cytotoxicity data showed that it would be possible to utilize silver nanoparticles as an antitumor agent against cancerous cells."

Turning Silver into Powder for 3D Printing Takes a Step Forward

Although many 3D printers use silver wire feedstock, powders offer a better source of raw material especially for intricate forms like jewelry, precision electronic components, aerospace applications such as satellites, and healthcare. Turning metal into powder, however, often requires atomizers that take up a lot of space and require high amounts of raw product because of losses during the atomization process.

3D Lab in Warsaw, Poland, may have found a solution. The company's *ATO Noble* atomizer uses a patented process known as 'ultrasonic plasma atomization' to melt non-reactive precious metals, like silver, gold and platinum, into powder form, company officials say. They note: "We are aware that each gram of the material is at a premium… we are able to process 100% of the powder to be atomized. In conjunction with a dedicated filtration system, we minimize the material loss of the most precious alloys, and we facilitate their later recovery for reuse." In addition, because the process starts with powder instead of wire, 3D printing can produce more complex and precise objects.

The atomizer itself measures 78.5 inches (1,995 mm) high, 32 inches (813 mm) wide and 44.8 inches (1,138 mm) deep and produces spherical particles ranging in size from 20 to 100 micrometers.

The new machine currently is being used by Birmingham, UK-based Cooksongold, a precious metals fabricator with over 100 years of experience in producing jewelry. "We are excited to announce this partnership with 3D Lab," said Martin Bach, managing director of Cooksongold, in a prepared statement. "We are confident that this revolutionary technology will have a major impact within the whole precious metal additive manufacturing market. Powder quality and costs are key drivers in this field and this technology will offer considerable advantages."

3D LAB

The *ATO Noble* atomizer could make 3D printing of silver much more cost efficient.

Silver Nanoparticles Aid in Tracking Human Cells

Health researchers often attach gold nanoparticles to biological molecules so the dense metal can be seen and tracked by special imaging devices. This tracking technique helps scientists learn how cells move, grow, interact and communicate with each other.

Gold presents a drawback, however. It only shows up as green, making it difficult to use when the cell or its surroundings may hide or blend in with that color.

Enter silver and gold-silver alloys, which show as different hues, making viewing clearer.

"Gold nanoparticles are very powerful tools used to precisely track the fast motion of biomolecules," said Ryota Iino, professor at the Institute for Molecular Science in the National Institutes of Natural Sciences, Okazaki, Japan. "However, the imaging was previously limited to monochromatic green. In this study, by using gold, silver and silver-gold nanoparticles, we have succeeded in extending the color palette -- between purple and green -- of high-speed and high-precision imaging of biomolecules."

Although scientists have tried using organic fluorescent dyes as tracking markers, these tended to display weaker colors that were not well defined or easy to discern. In addition, metallic nanoparticles are more stable than dyes, remaining visible longer. "Nanoparticles show much stronger signals, and they don't blink in the same way organic dyes can," Iino said.

The team is now working on extending the color palette even further with newly-engineered nanoparticles. This work appeared in a recent issue of *ACS Photonics*, a journal of the American Chemical Society.

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