



Junlu Liang, Metals Focus

Outlook for Silver Industrial Demand

IPMI Seminar

Budapest 13th November 2018



About Metals Focus

- Independent & Specialized; Focused only on precious metals
- Large & highly experienced team of analysts
- Extensive travel programme to gather data & information
- Comprehensive mines/projects database & costs analysis



Global Silver Industrial Demand



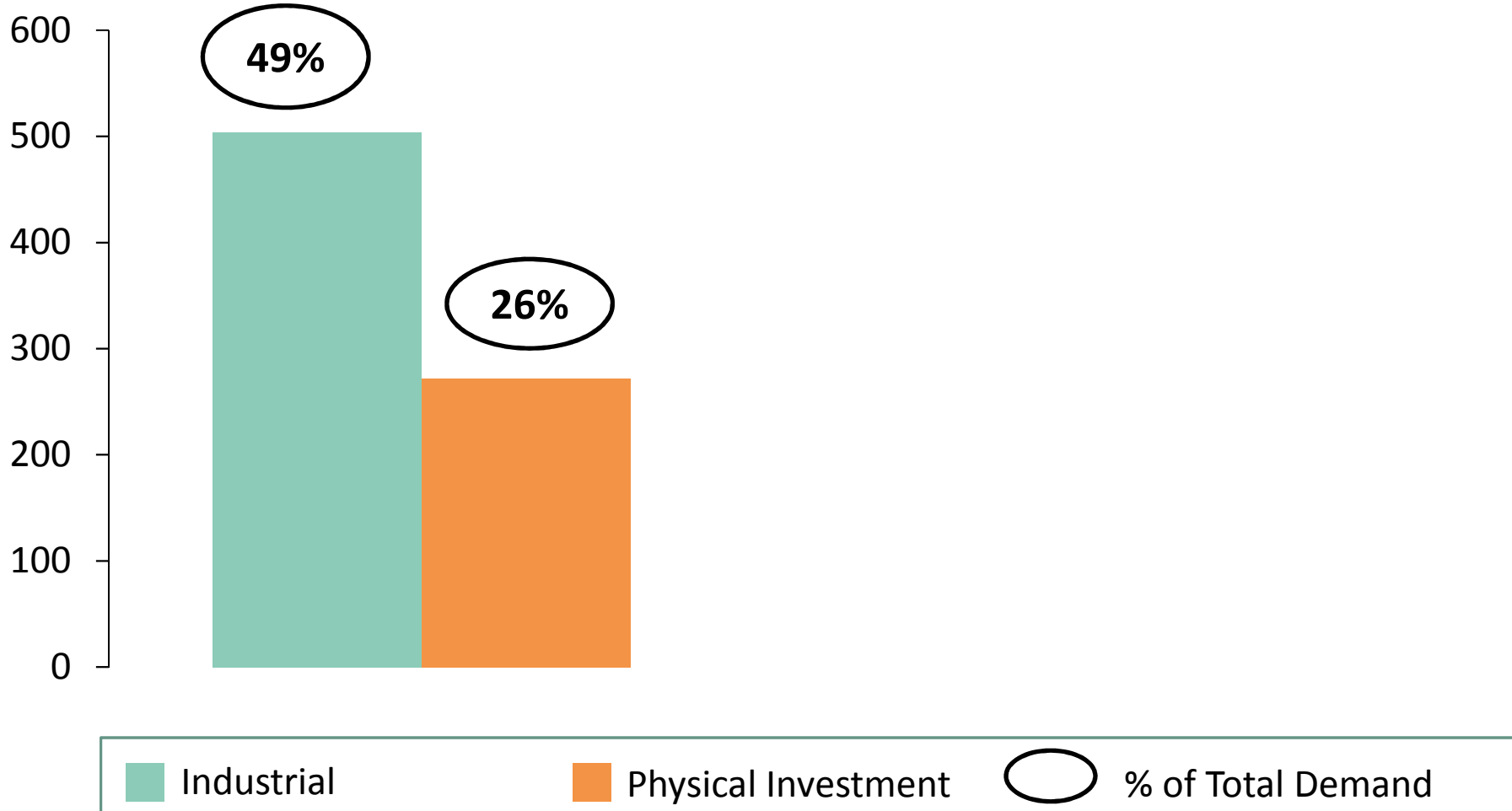
Source: Metals Focus



Importance of Silver Industrial Demand

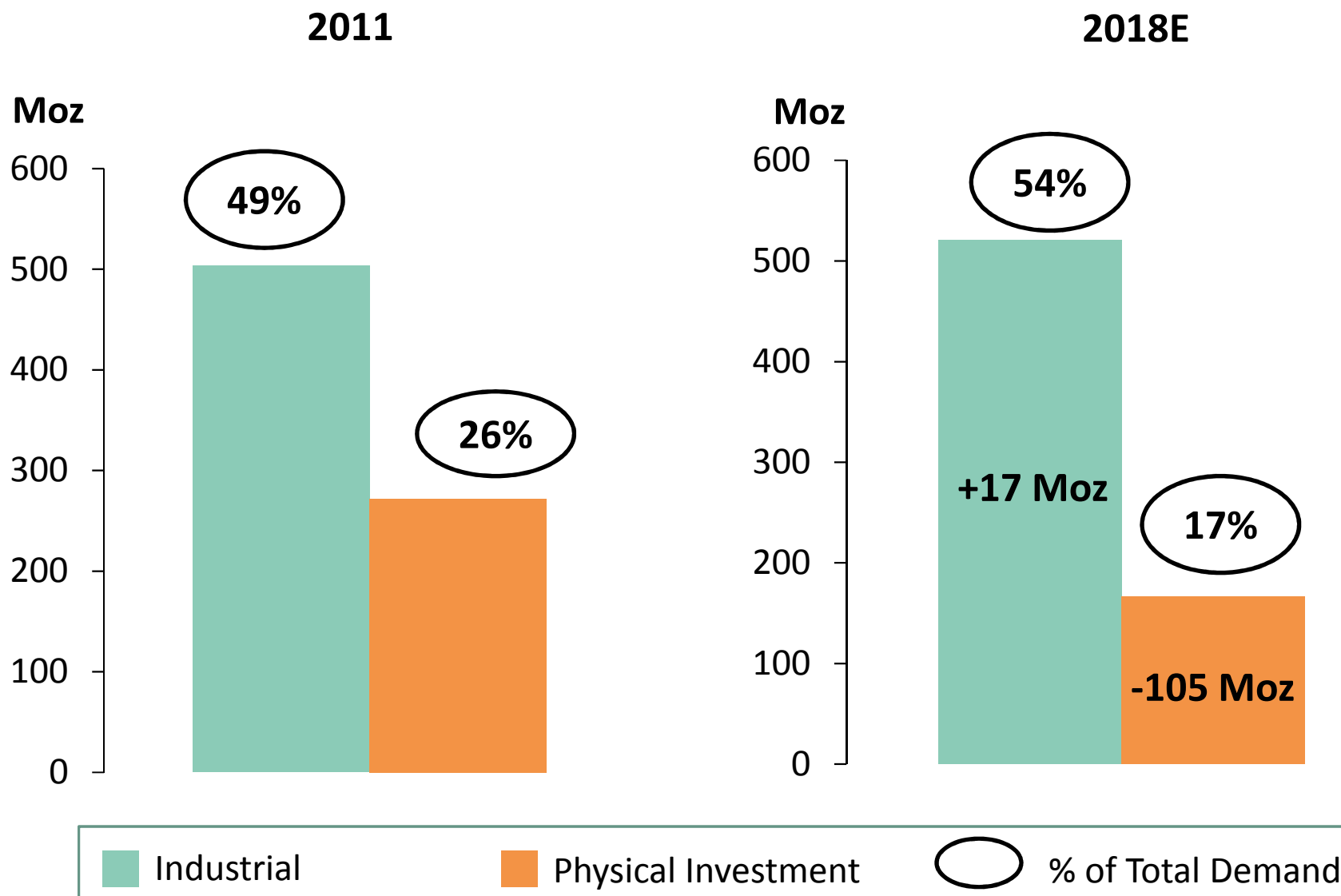
2011

Moz



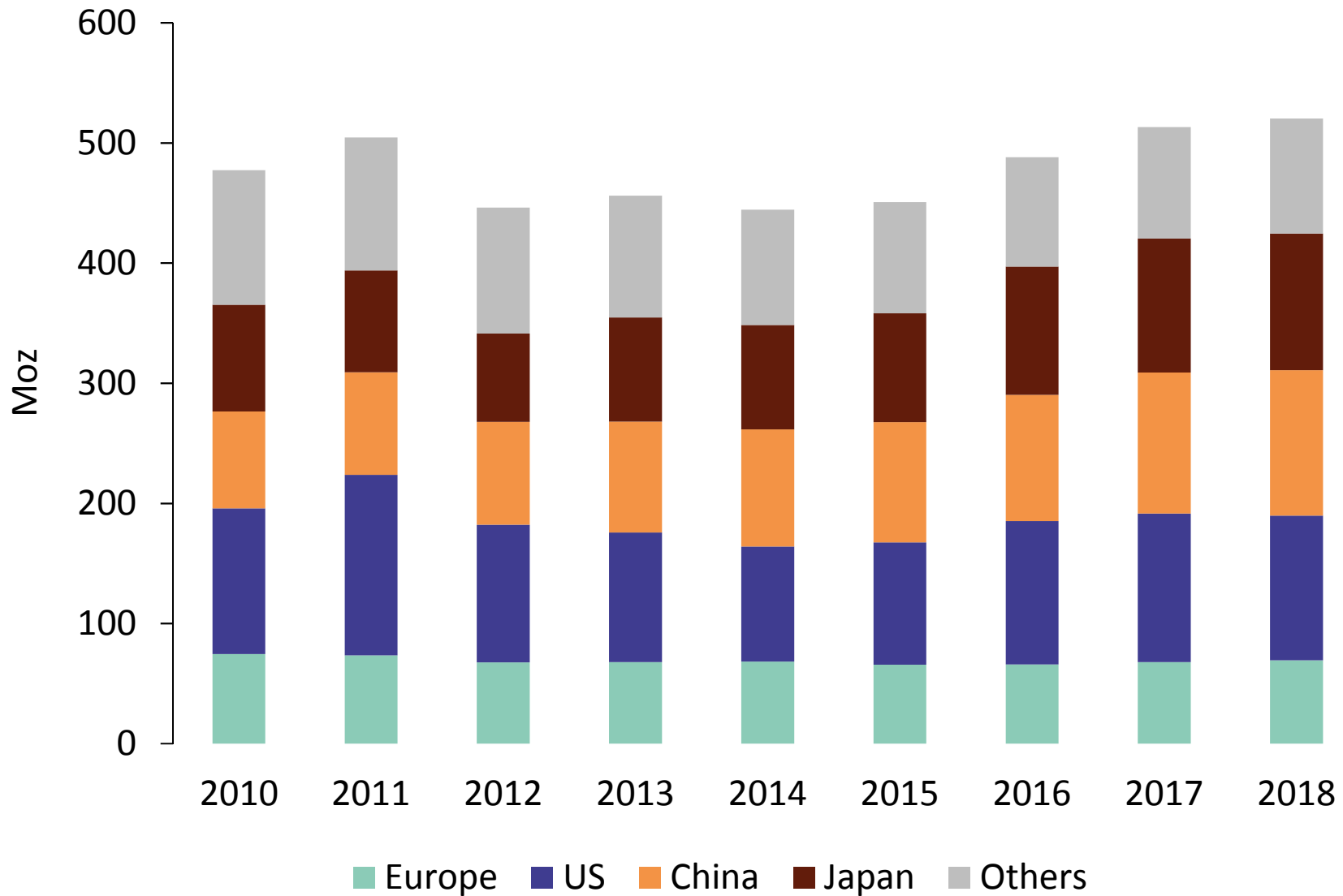
Source: Metals Focus

Importance of Silver Industrial Applications



Source: Metals Focus

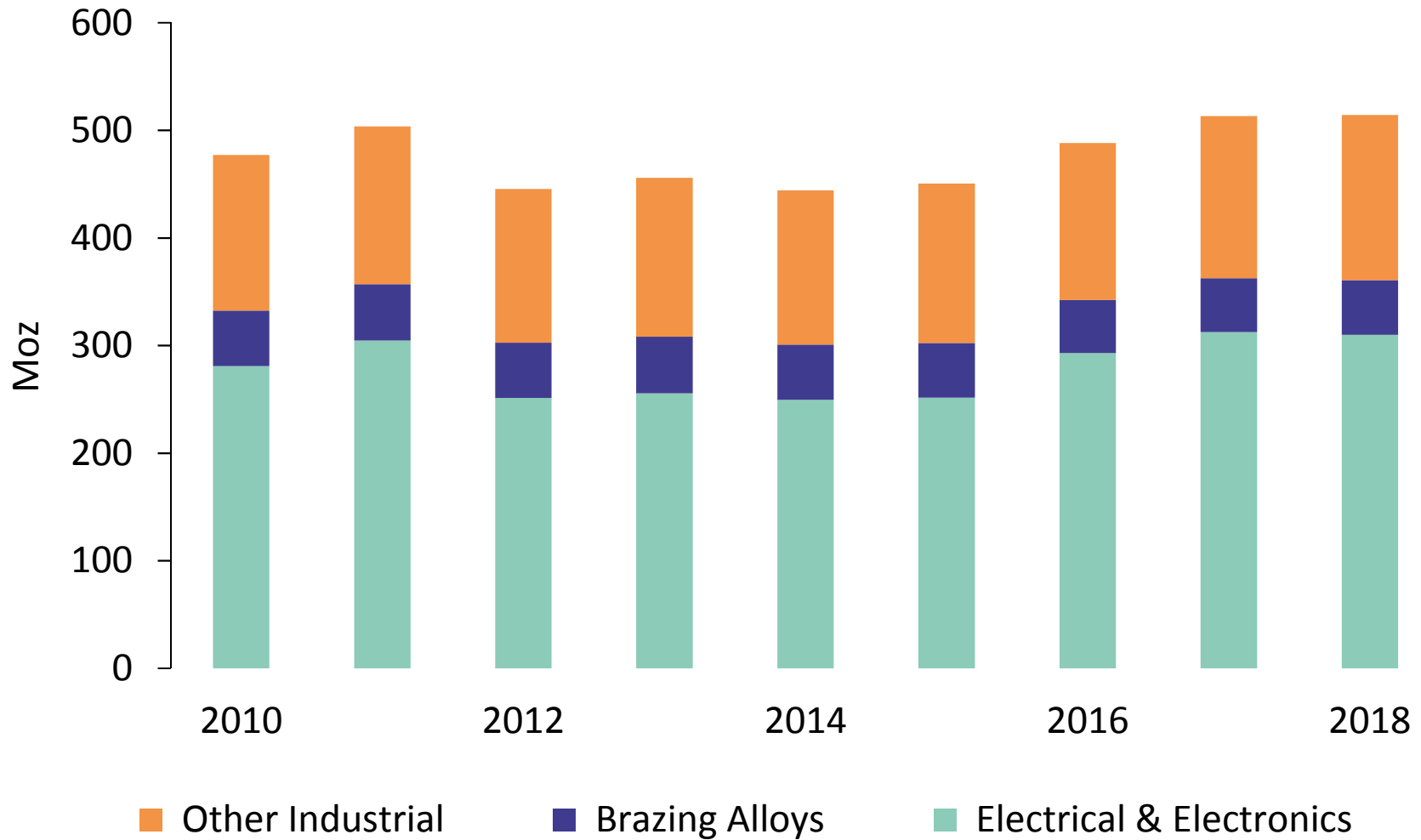
Key Industrial Fabricators



Source: Metals Focus



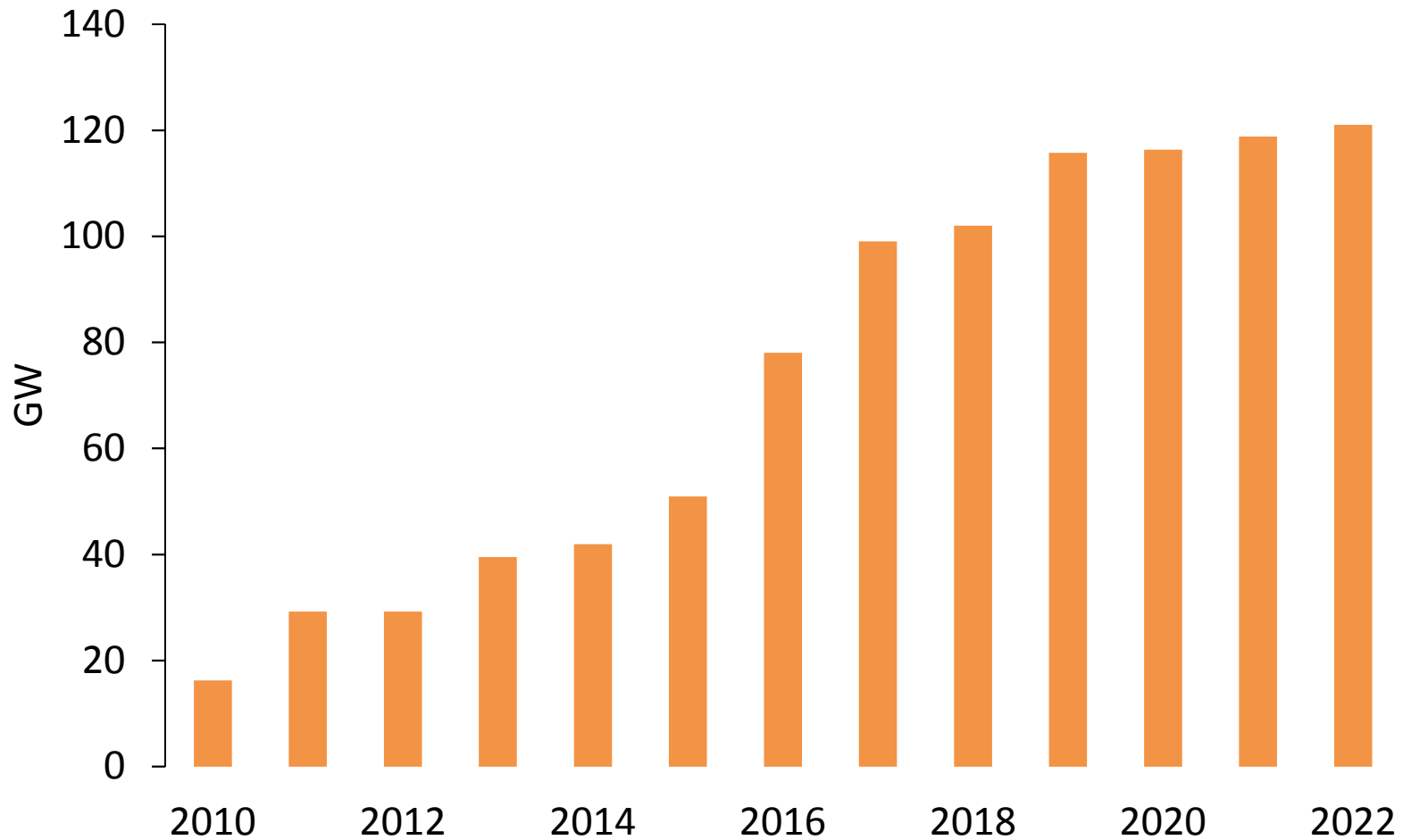
Setting the scene



Source: Metals Focus



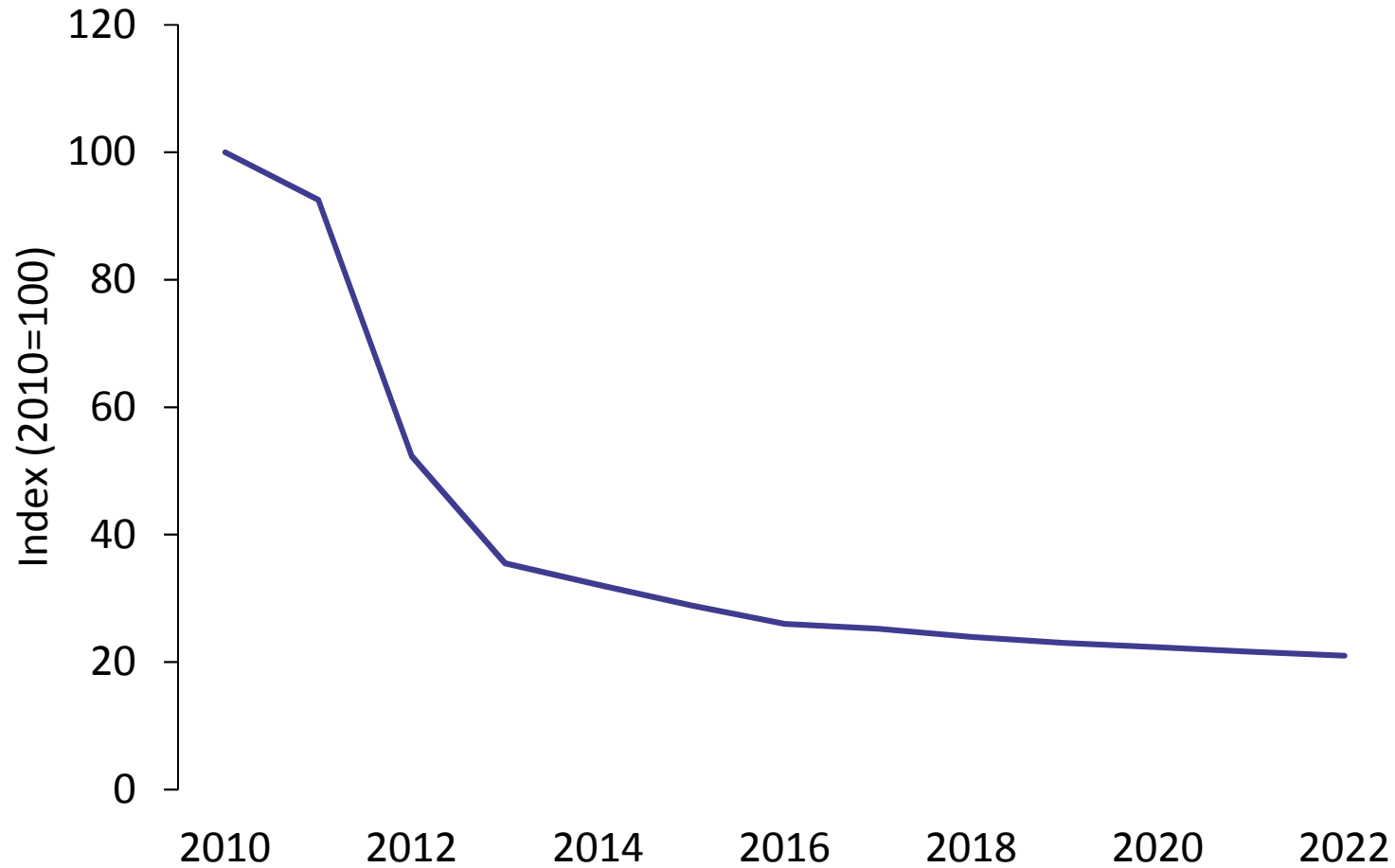
Photovoltaics Installations



Source: Metals Focus



Silver Loadings in Photovoltaics



Source: Metals Focus



Automotive: the interior

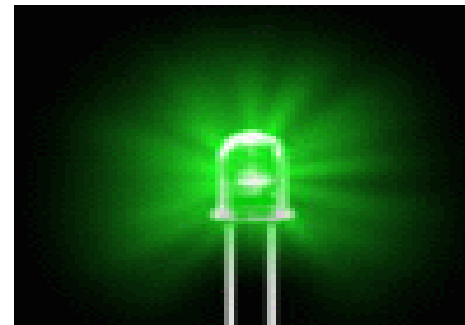
- Spark plugs: silver fine wire electrode for superior ignition ability and improved engine power.
- LED
 - Interior lighting : dashboard lighting, dome lamp, mirror lamp, indicator, ambient light, trunk lamp, head-up display, step lamp, projection lamp, driving recorder...etc.
- Actuators : an essential part of electronic control systems to convert the electrical signals from the control unit into an action. Most actuators are electric motors or electro-magnetic valves in the cars.
- Heated seats: connection wires, switches, contacts.
- Battery: Silver Zinc batteries have been used in some high-end cars for longer service life.

Automotive: the exterior

- Defogging lines:
 - Silver-ceramic lines on windscreens for melting ice and defogging.

- LED:
 - Exterior lighting
 - Headlamps, fog lamps, turn signal lamps, backup lamps, side marker lamps, brake lamps, tall lamps, license plate lamps.

LED*



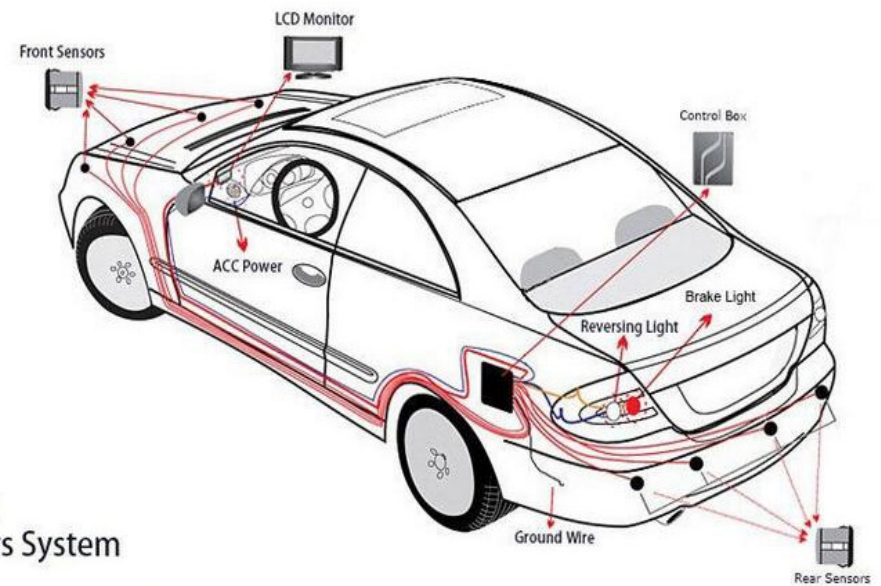
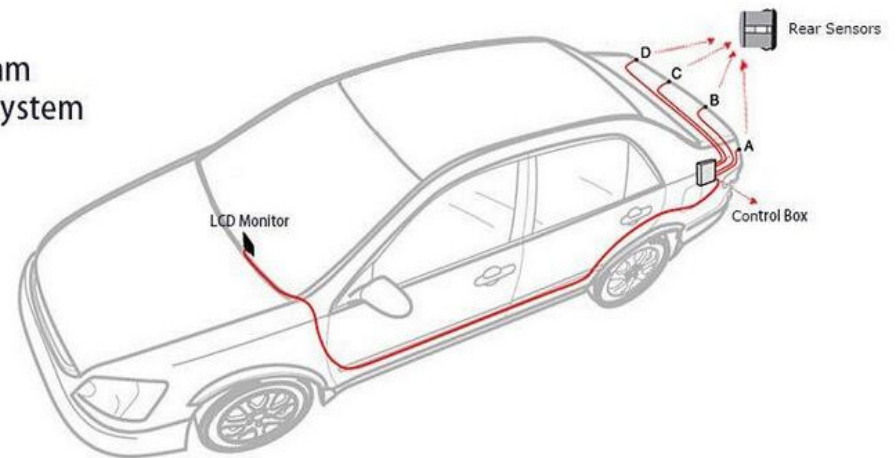
Au, Au alloy
Ag, Ag alloy

* Courtesy of Tanaka America Inc

Automotive: sensors

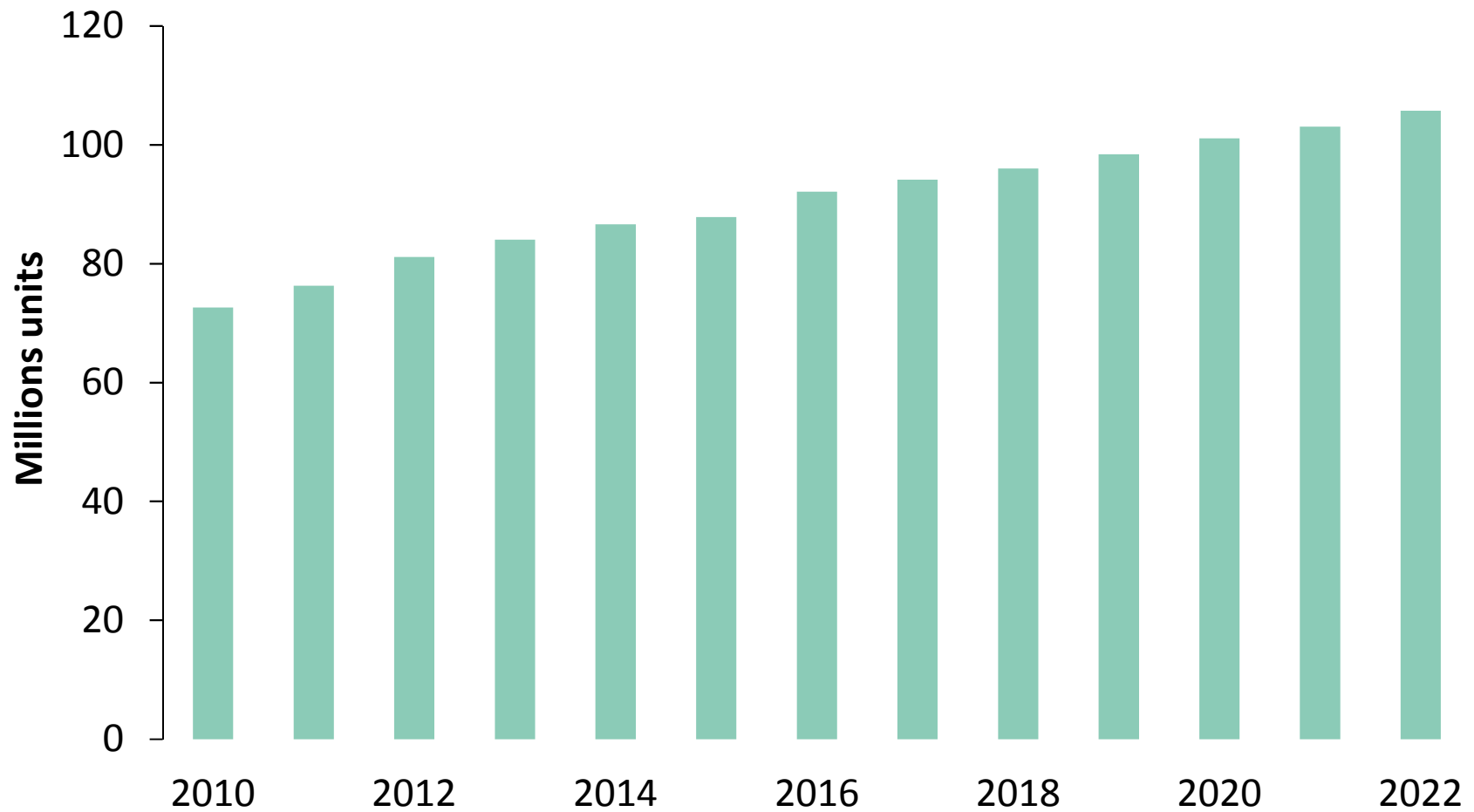
- Night vision
- Adaptive cruise control
- Gesture recognition
- Active warning systems
- Optical touch solution
- Intelligent sensing system
- collision avoidance system

Wiring Diagram
for 4 Sensor System



Wiring Diagram
for 6 or 8 Sensors System

Global Vehicle Production

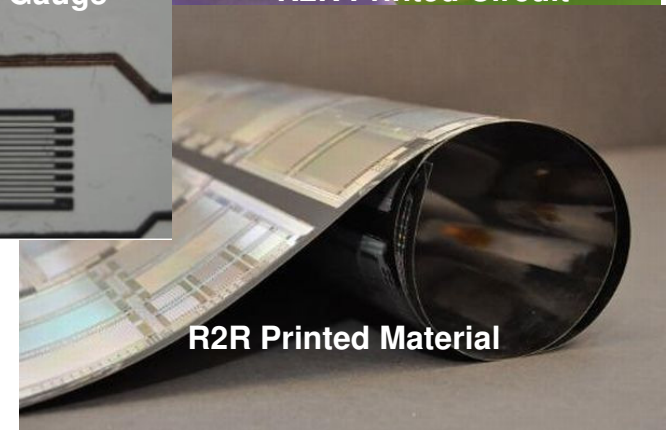
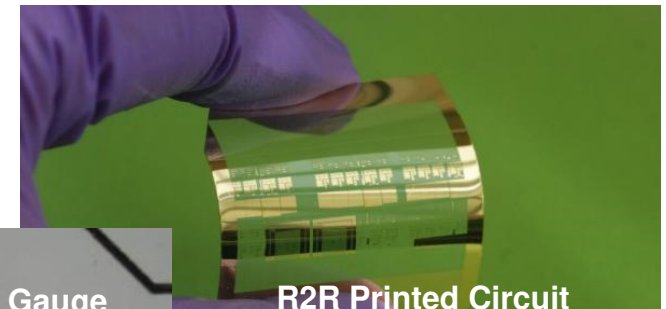


Source: LMC Automotive

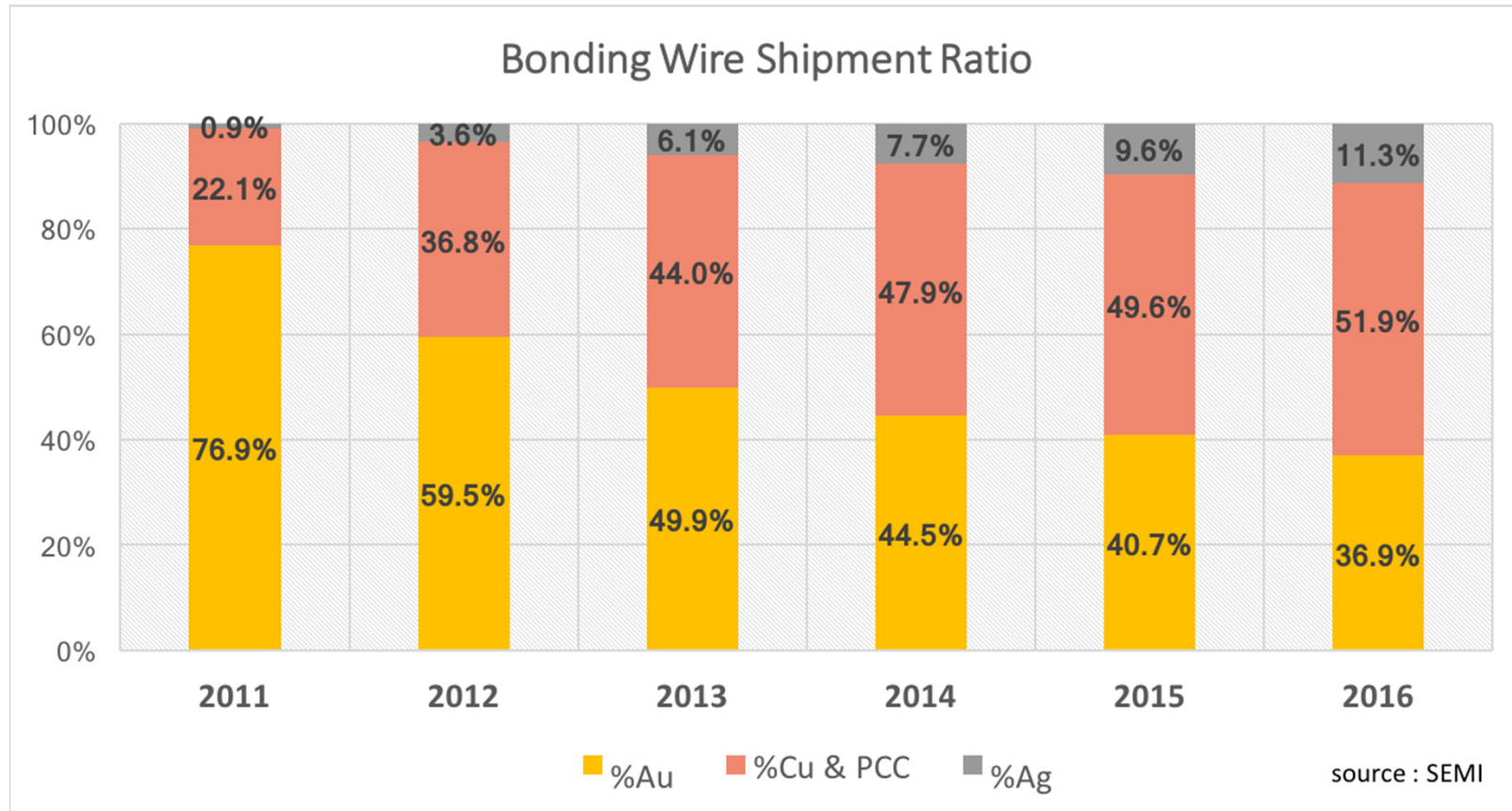


Emerging Markets: Flexible Electronics

- Key Technology Watch Item – full scale mass production of roll-to-roll sensor and circuit processing.
 - R2R will drive the IoT explosion
 - RF Tagging and smart sensors.
 - Sensor cost will dramatically reduce
 - Simplified packaging
 - Technology ramp underway.
-
- Low temperature curing requirements are advancing.
 - Both Panel processing and R2R will require lower temperature cures.



Trends in Semi-Conductor Packaging



Silver bonding wire :

- Lower cost solution for gold wire replacement.
- High reflectivity in low wavelength region.
- Softer than PCC for better bondability with lower risk of bond pad damage.

Conclusions

- Silver's unique properties and diverse applications base adds to the long-term stability and robustness of global industrial offtake.
- PV hugely important but the fortunes of industrial demand extend well beyond this segment.
- The prospects for automotive demand are considerable
- Flexible electronics / 3D printing appears to have a healthy future
- We have focussed on the above, but contacts and switches, with low unit costs, are also used in significant quantities in housing and infrastructure. These applications may not be sexy but they also consume large volumes of silver.





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