

Legal Statement

The purpose of the information in this presentation is to guide ICA programs and provide members information to make independent business decisions.

Based on primary interviews conducted in the industry and publically available information. The Martec Group in cooperation with MetalsPlus are the sources of the forecasted data in this presentation.

Antitrust Guidelines

Antitrust Guidelines for Copper Industry Trade Association Meetings

The following guidelines with respect to compliance with antitrust laws of the United States, Japan and European Community¹ are intended to govern the conduct of participants in copper industry trade association meetings, both at the meeting itself and in informal discussions before or after the formal meeting.

Price: Competitors should not discuss future prices (including terms of sale) of their products. There is no blanket prohibition against the mention of or reference to current or past prices but limits must be observed. Such references or mentions should occur only when necessary in connection with the development of association programs. For example, reference to a particular price level in comparing the cost of a copper product to a competing product is permitted. Whenever possible, such references should be discussed in advance with legal counsel.

Competitive Information: Competitors should not discuss the market share of a particular copper producer or copper fabricator's products. Furthermore, nothing should be said at a meeting which could be interpreted as suggesting prearranged market shares for such products or producer production levels. The overall market share of copper products may be discussed with regard to competition with non-copper products and general market acceptance.

New Products: Competitors should not encourage or discourage the introduction of a new product by another competitor or reveal a particular copper company's plans to change the production rate of an existing product or to introduce a new product. No company should disclose to another company whether it is in a position to make or market a new product. New products may be discussed in a technical manner or from the standpoints of competition with non-copper products and general market acceptance. In addition, proposed methods for and results of field and laboratory testing can be considered.

The Role of Legal Counsel: Legal counsel attends association meetings to advise association staff and other meeting attendees regarding the antitrust laws and to see that none of the matters discussed or materials distributed raise even the appearance of antitrust improprieties. During the course of a meeting, if counsel believes that the discussion is turning to a sensitive or inappropriate subject, counsel will express that belief and request that the attendees return the discussion to a less sensitive area.

A paper entitled 'Copper Industry Trade Associations and Antitrust Laws' is available upon request.

10/92, 5/93, 10/10

1. Other foreign competition laws apply to International Copper Association, Ltd. (ICA)'s activities worldwide.

Competitive Analysis of the Appliances Market

Keith Miller

Business Director, The Martec Group

London, October 2018

Methodology/Interviews

Martec has completed 70 interviews with various key industry respondents:

- Leading global Appliance OEMs, Suppliers and other industry experts:
 - *Whirlpool, GE-Haier, BSH, LG, Samsung, Electrolux, Frigidaire, Panasonic, Keurig, Indesit, Zanussi, Vestel, Gorenje, Vestel, Candy, Elica, Insinkerator, Hoover, SharkNinja, Puppy Vacuums, Puti, Huadi, Rinnai, Gree, Prestige, Venus, Godrej, Rallison, Shanghai Highly, Nidec, A.O. Smith, Galanz Motor, Jinda Motor, Media Fans and various others*
- Across the following key appliances:
 - *Refrigerators, freezers, washers, dryers, ovens/hobs/cooking ranges, microwaves, dishwashers, range hoods, garbage disposals, mixers, hot water heaters, space heaters (non-home HVAC), air purifiers, coffee/tea machines, personal care appliances, etc.*
 - *Home HVAC including air conditioners were excluded*



Important Industry Topics

Design/Function

1.50

Changing functionality to meet customer's needs while keeping costs low is very important to manufacturers.

- *Providing a function that another brand or product does not have can differentiate an appliance enough for purchase*
- *Consumers are looking to save money without losing functionality*
 - Appliance OEMs trying to increase functionality while decreasing cost/price
 - Failures are a concern with usage of alternative materials
- *China and India scored Design/Functionality higher in importance than ROW*

Technology

2.10

Increasing integration of smart technologies will help separate great appliances from good appliances.

- *Companies will need to introduce new technologies to compete in the changing market*
- *Innovations may be expensive, but there are ways to make up for the losses*
- *Electrical efficiency is a major trend with regard to product technological improvements*
- *Technology scored much higher in importance in NA (1.44) and Europe (1.13) vs. China & India*

Product

2.16

Offering consistent products can help lead to product and brand loyalty.

- *Differentiating products through innovative designs can help gain the favor of consumers*
- *The product is the brand and needs to keep consistent quality*
- *Many product changes today are directly related to the image of the product*

Other

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Another important factor for manufacturers is keeping the products cost competitive

- *Increase functionality of appliances while keeping them efficient and low-cost*
- *Affordability of appliances is a big factor in fast paced middle-class countries such as China and India*
- *Energy Efficiency*

High Level Trends

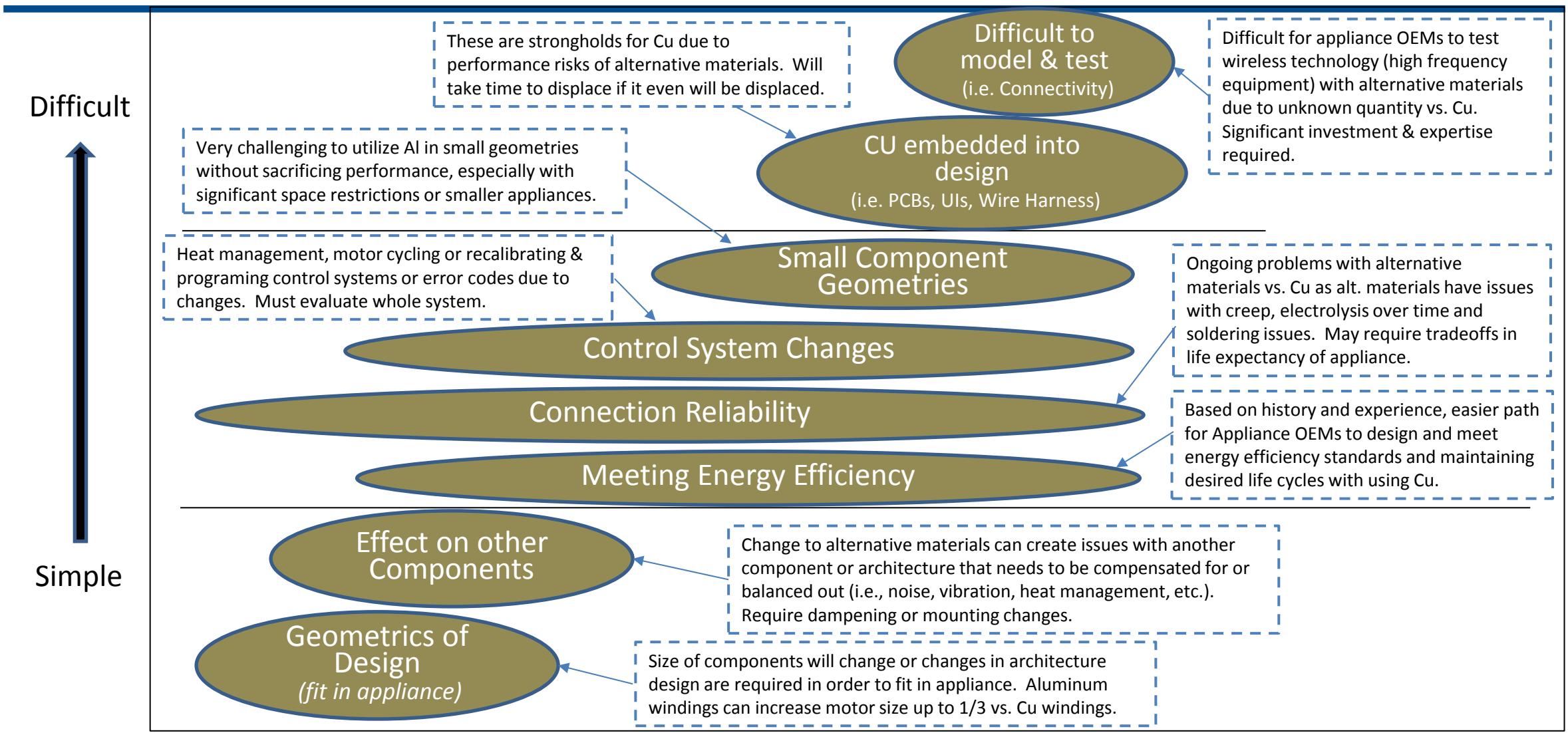
Leading Trends:

- Higher efficiency rated appliances
- Larger capacity appliances
- New product configurations with new/advanced controls
 - *Both large and small appliances*
- Cost effective touch UI w/ color graphics and multi-color LEDs
- Connectivity / Smart appliance technology
- Value engineering / Product diversification / Broader portfolios / Increased functionality
- Cost reduction targets / Increase affordability
- Unique features across brands and price points
 - *Materials, finishes, capabilities, extended warranties*

Challenges for Alternative Materials

- Conductivity differences and losses vs. using Copper
 - *Environmental effects in performance over time of alternative materials and issues with creep and electrolysis*
- Changes to control algorithms due to electronic properties
 - *Appliance process timing changes due to motor / pump / compressor performance such as torque or heating*
- Reduced product / component life span with alternative materials
 - *Impact on brand differentiation, may require or result in more maintenance, service & warranty*
- Solve cross-regional procurement issues and procurement complexities
 - *Need to provide reliable and low cost supply globally; 2 – 3 years to put into production and at least 2 – 3 to realize value*
- Heating / Material expansion (especially w/ aluminum)
 - *Effects contacts electrical properties & reliability*
- Diameters and ability of suppliers in forming effective diameters for windings w/ Al for smaller motors and components
 - *Aluminum and alternatives will increase motor size or will have to accept reduced performance and/or life span*
 - *Limited supply of reliable vendors capable to support material change*

Technical Matters that Defend Copper



Challenges over time to OEMs

Growth Opportunities

Leading Areas of Opportunity for Growth:

1. Appliance Connectivity

- Plans are to move more volume of appliances (even small appliances) to this space of functionality
- Controls and signals involved currently use copper and will be difficult to transition to AI or other alternatives without performance changes
 - *Engineers and designers accustomed to designing with Cu*
 - *Design initially with the best materials until there is a strong drive to make transition and create new materials & processes for lower cost*
- Area is more complex and more difficult to model & test (unless LG and Samsung, other appliance OEMs must invest heavily)

2. Expected appliance growth in China and India

- Growing economies & middle-class to purchase new appliance units

3. Finishes / Coatings / Coverings (small and large appliances)

- More copper colorant options are expected in the future

4. Alloy blends or Nano materials

- Largely an unexplored area in appliance sector
- Hybrid materials that are blended on the molecular level (i.e., conductive carbon fibers)
- Just being contemplated by Appliance OEMs (two areas where OEMs are focusing on):
 - *Wire harnesses / Displays / Connectivity components*
 - *Electric motors*

5. Any potential for stricter energy efficiency standards

Oven/Stove/Range/Hobs Overview – Large Appliance Example

Common Copper Components

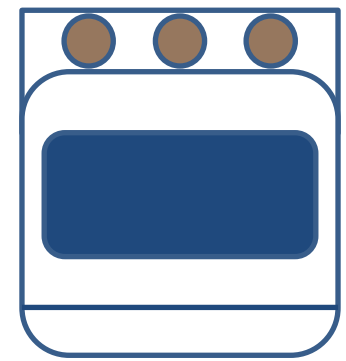
- Fan motor windings
- Induction Coils
- Contact Points & PCB for controls
- Power Cord/Wiring

Avg. Copper per Oven/Stove/Range

0.8kg

Copper as % of all materials in a Oven/Stove/Range

<2%



0.9 Ovens/Stoves/Ranges/Hobs per Household (total)



4.2 people per Oven/Stove/Range/Hobs (total)

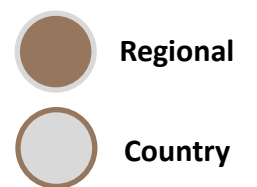


Fan motor windings

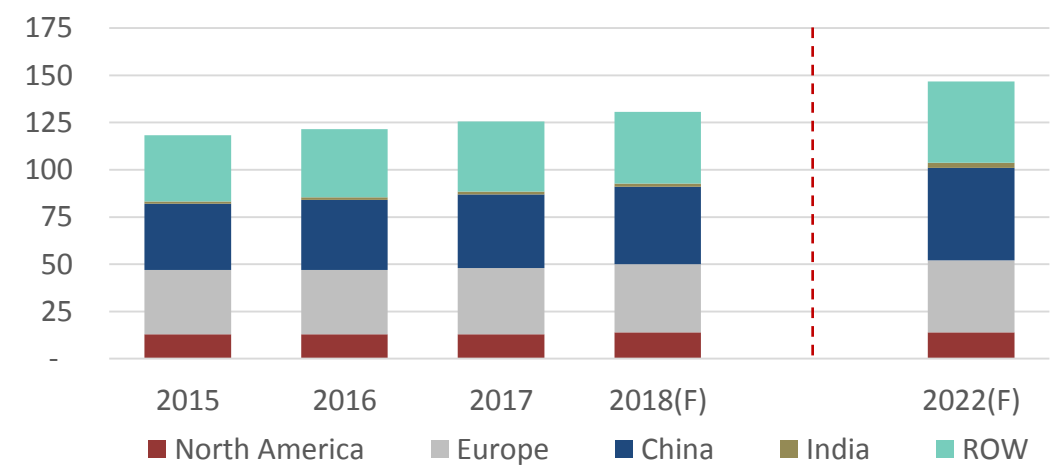
Induction coils (in process to copper-clad / aluminum)

Piping (typically aluminum, some copper)

Oven/Stove/Range/Hobs Sold per Household

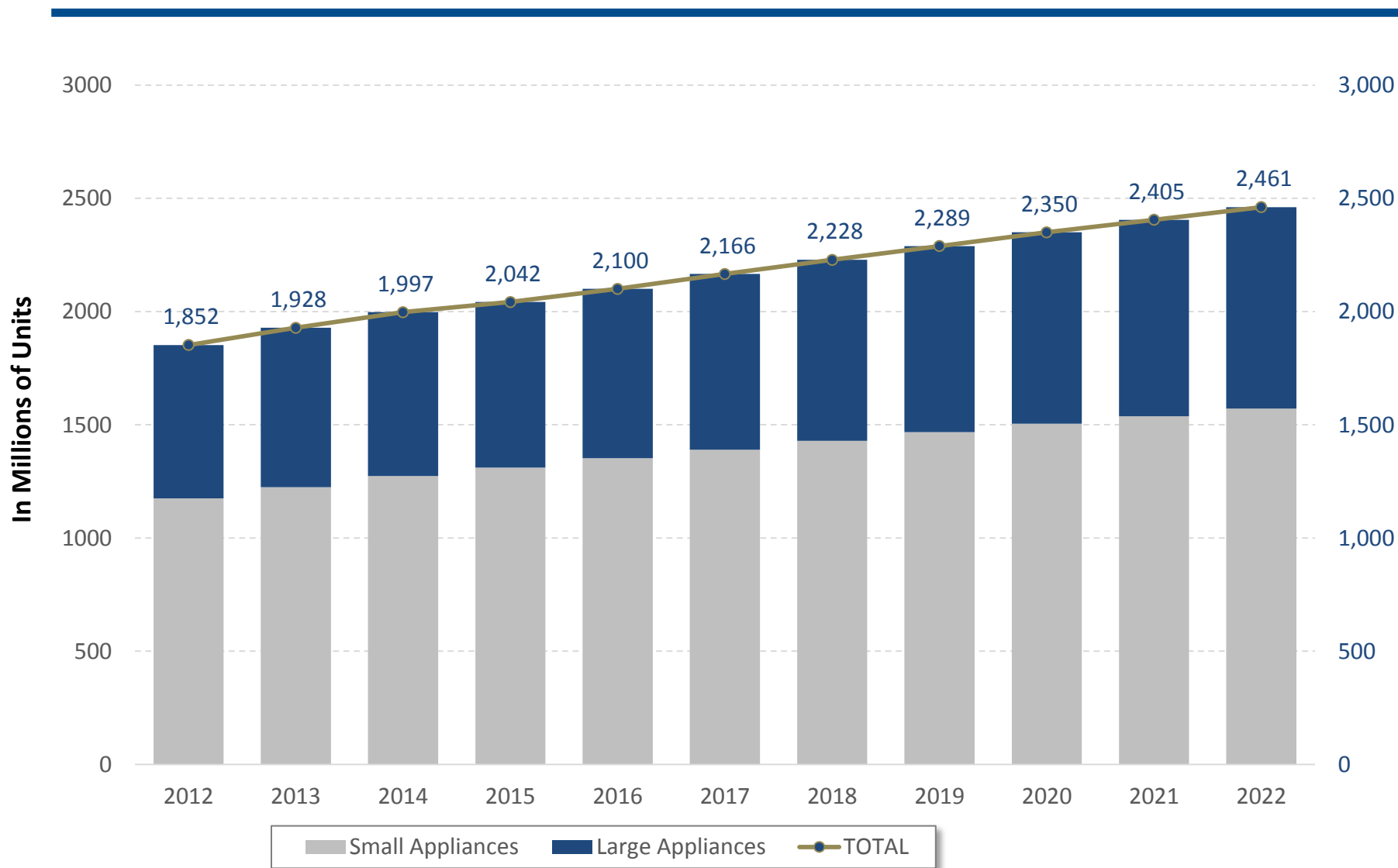


Global Units per Year (in millions)



Global Large and Small Appliance Sales: Year over Year 2012 – 2022(F)

Large & Small Appliances

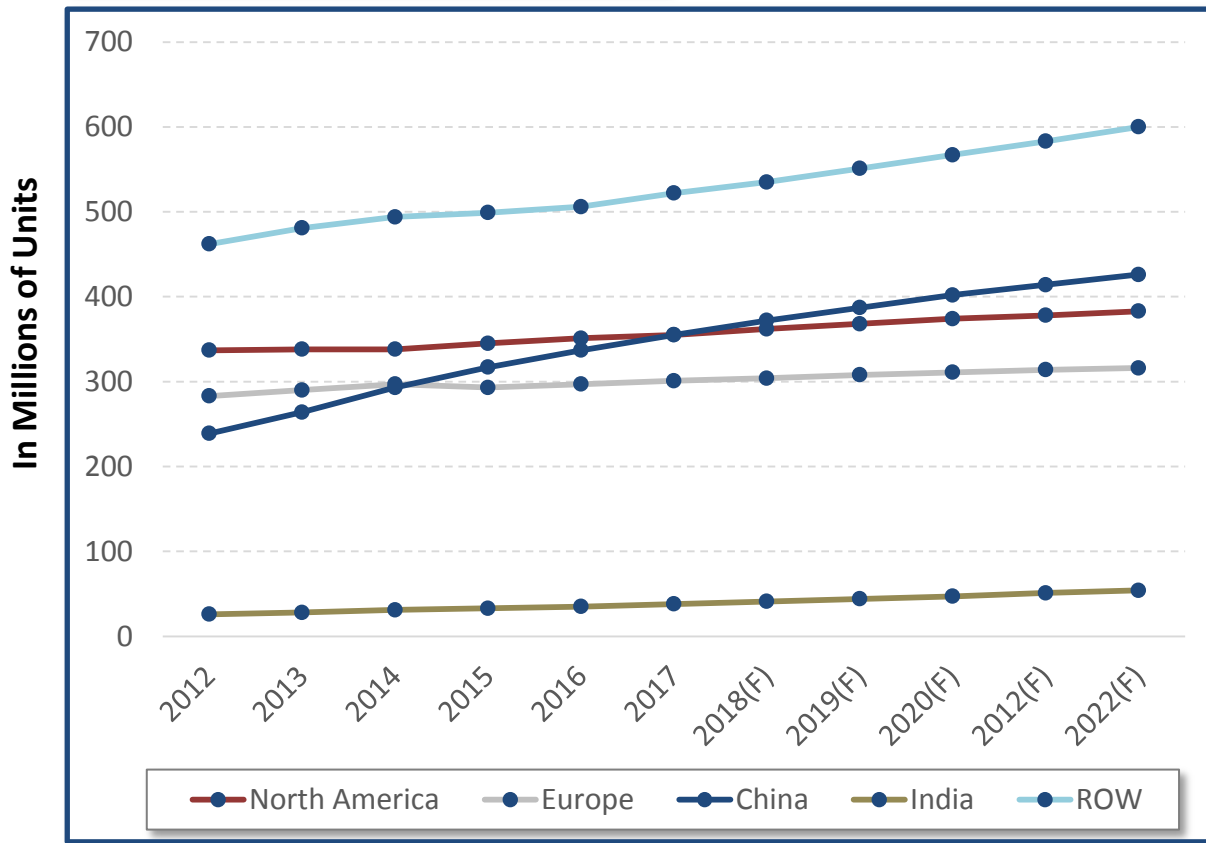


Total CAGR 2012-2017	3.2%
Total CAGR 2017-2022	2.6%
Total CAGR 2012-2022	2.9%
Large Appliances CAGR 2012-2017	2.7%
Large Appliances CAGR 2017-2022	2.8%
Large Appliances CAGR 2012-2022	2.8%
Small Appliances CAGR 2012-2017	3.4%
Small Appliances CAGR 2017-2022	2.5%
Small Appliances CAGR 2012-2022	3.0%

Small Appliances Sold by Region: 2012 – 2022(F)

Small Appliances

Small Appliances



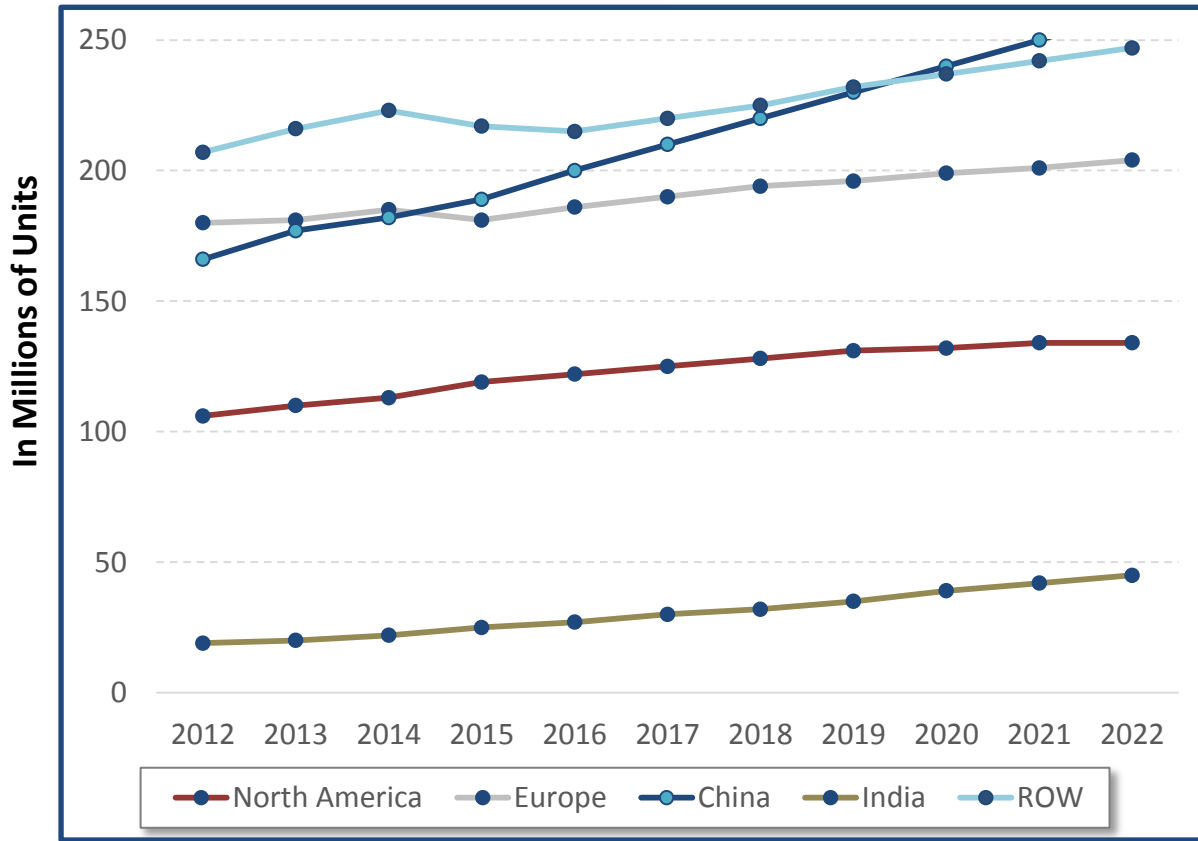
Total CAGR 2012-2017	3.4%
Total CAGR 2017-2022	2.5%
Total CAGR 2012-2022	3.0%
North America CAGR 2012-2017	1.1%
North America CAGR 2017-2022	1.5%
North America CAGR 2012-2022	1.3%
Europe CAGR 2012-2017	1.3%
Europe CAGR 2017-2022	1.0%
Europe CAGR 2012-2022	1.1%
China CAGR 2012-2017	8.2%
China CAGR 2017-2022	3.7%
China CAGR 2012-2022	6.0%
India CAGR 2012-2017	7.8%
India CAGR 2017-2022	7.4%
India CAGR 2012-2022	7.6%

Bulk of unit volume growth coming from China & India due to growing economies and middle class growth.

Large Appliances Sold by Region: 2012 – 2022(F)

Large Appliances

Large Appliances



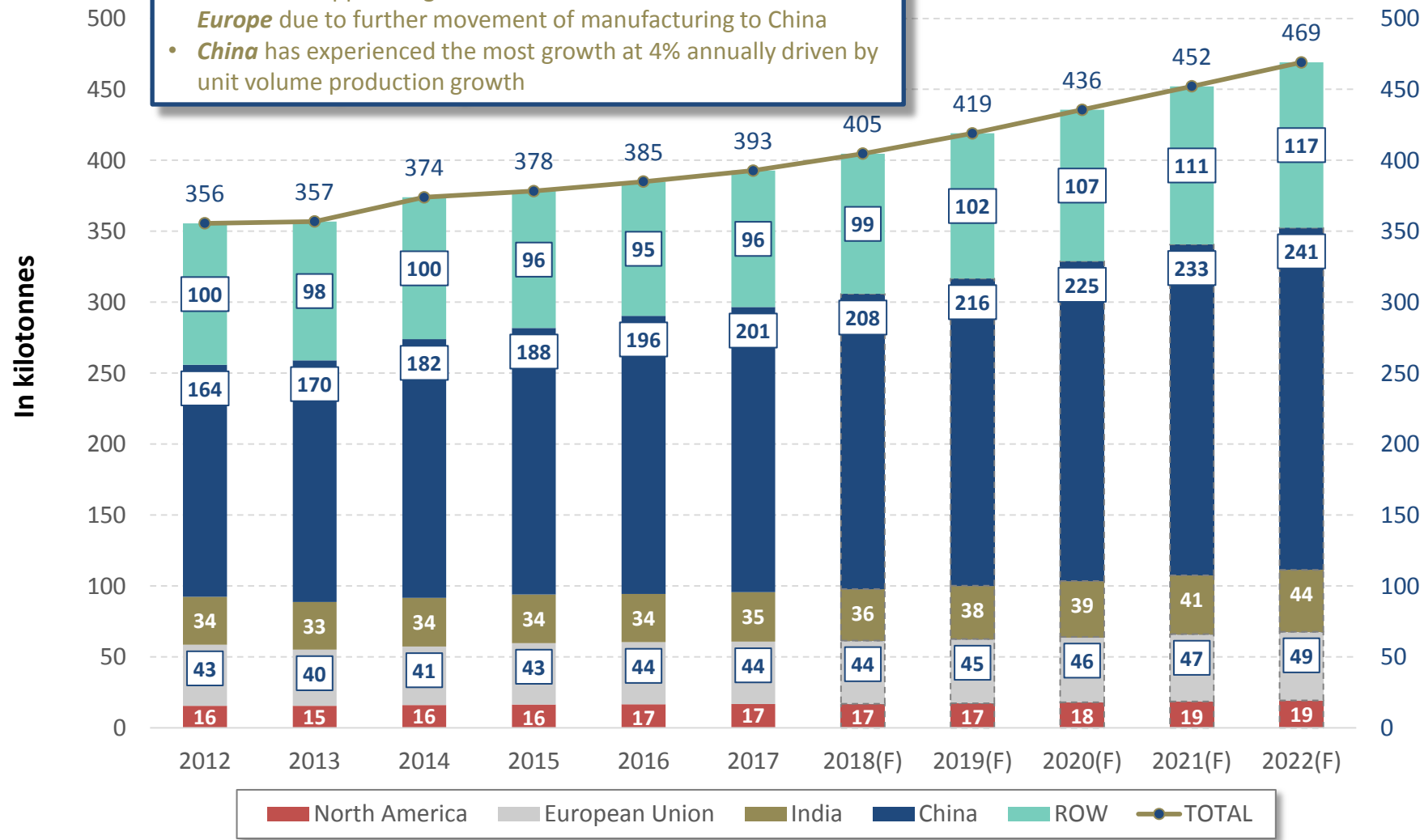
Total CAGR 2012-2017	2.5%
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North America CAGR 2012-2017	3.4%
North America CAGR 2017-2022	1.4%
North America CAGR 2012-2022	2.4%
Europe CAGR 2012-2017	1.3%
Europe CAGR 2017-2022	1.4%
Europe CAGR 2012-2022	1.1%
China CAGR 2012-2017	4.8%
China CAGR 2017-2022	4.4%
China CAGR 2012-2022	4.6%
India CAGR 2012-2017	9.4%
India CAGR 2017-2022	8.6%
India CAGR 2012-2022	9.0%

Bulk of unit volume growth coming from China & India due to growing economies and middle class growth.

Copper Use (kt Cu) – Motors

Electric Motors

- Motors represent approximately 25% of overall Cu usage
- Growth in copper usage has been slower for **North America & Europe** due to further movement of manufacturing to China
- **China** has experienced the most growth at 4% annually driven by unit volume production growth



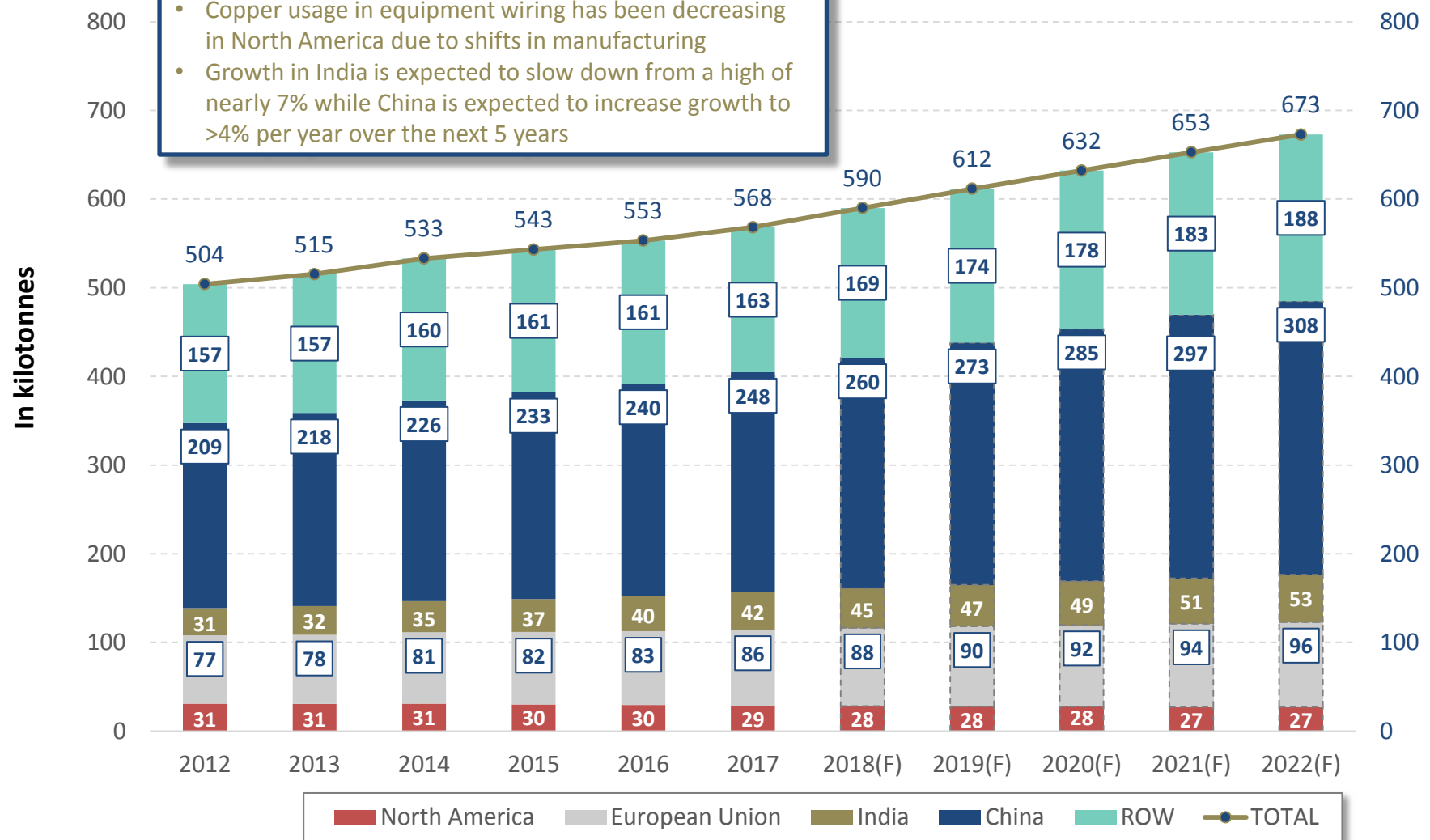
Global CAGR 2012-2017	2.0%
Global CAGR 2017-2022	3.6%
Global CAGR 2012-2022	2.8%
North America CAGR 2012-2017	1.5%
North America CAGR 2017-2022	2.8%
North America CAGR 2012-2022	2.1%
Europe CAGR 2012-2017	0.4%
Europe CAGR 2017-2022	2.0%
Europe CAGR 2012-2022	1.2%
China CAGR 2012-2017	4.2%
China CAGR 2017-2022	3.7%
China CAGR 2012-2022	4.0%
India CAGR 2012-2017	0.7%
India CAGR 2017-2022	4.5%
India CAGR 2012-2022	2.6%

*NOTE: Based on production.

Copper Use (kt Cu) – Equipment Wire

Equipment Wire

- Equipment wire represents ~35% of total Cu usage
- Copper usage in equipment wiring has been decreasing in North America due to shifts in manufacturing
- Growth in India is expected to slow down from a high of nearly 7% while China is expected to increase growth to >4% per year over the next 5 years

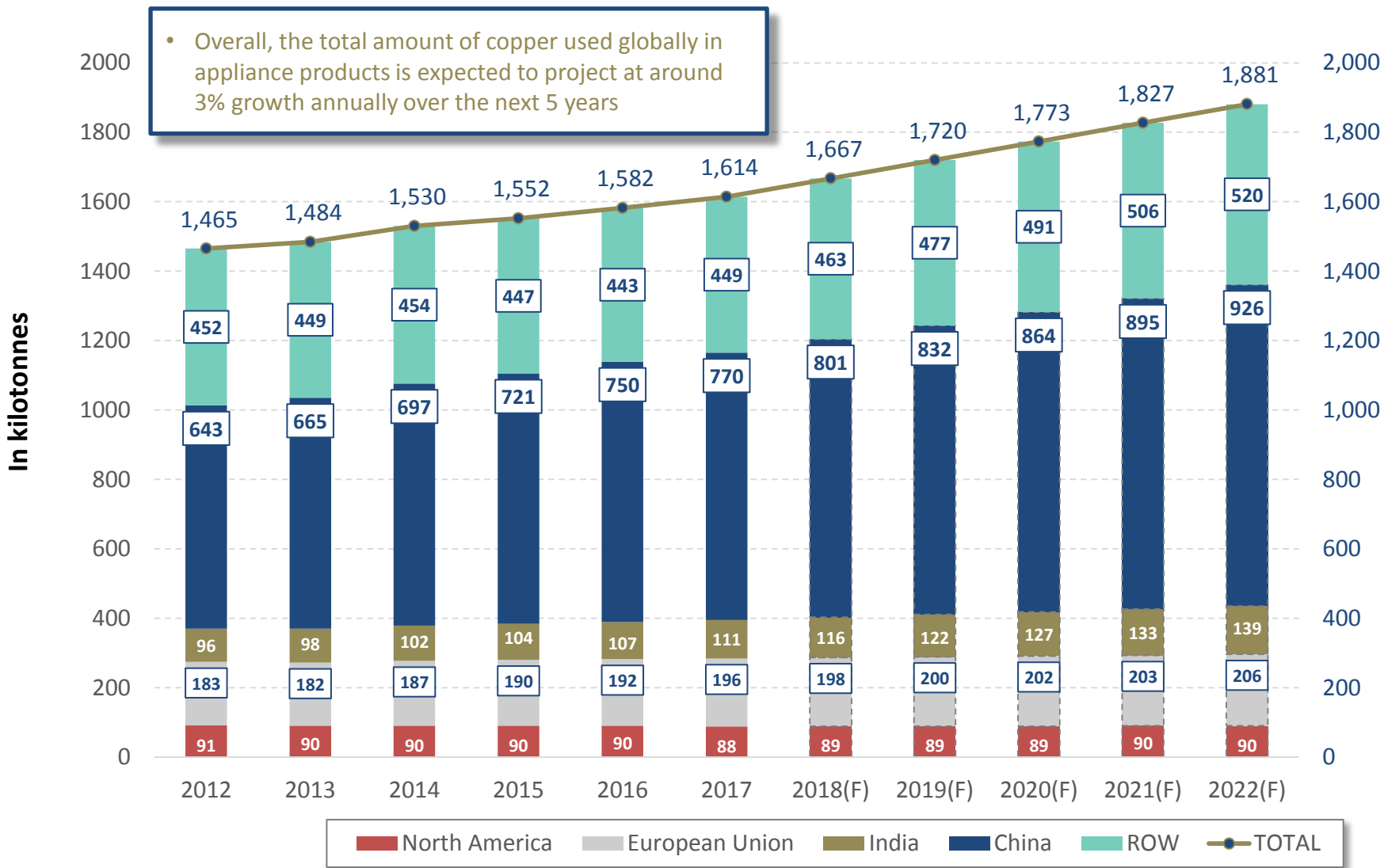


Global CAGR 2012-2017	2.4%
Global CAGR 2017-2022	3.4%
Global CAGR 2012-2022	2.9%
North America CAGR 2012-2017	-1.6%
North America CAGR 2017-2022	-0.9%
North America CAGR 2012-2022	-1.2%
Europe CAGR 2012-2017	2.2%
Europe CAGR 2017-2022	2.2%
Europe CAGR 2012-2022	2.2%
China CAGR 2012-2017	3.5%
China CAGR 2017-2022	4.4%
China CAGR 2012-2022	4.0%
India CAGR 2012-2017	6.7%
India CAGR 2017-2022	4.8%
India CAGR 2012-2022	5.7%

*NOTE: Based on production.

Total Copper Use (kt Cu)

Total Copper



Global CAGR 2012-2017	2.0%
Global CAGR 2017-2022	3.1%
Global CAGR 2012-2022	2.5%
North America CAGR 2012-2017	-0.7%
North America CAGR 2017-2022	0.5%
North America CAGR 2012-2022	-0.1%
Europe CAGR 2012-2017	1.4%
Europe CAGR 2017-2022	1.0%
Europe CAGR 2012-2022	1.2%
China CAGR 2012-2017	3.7%
China CAGR 2017-2022	3.8%
China CAGR 2012-2022	3.7%
India CAGR 2012-2017	3.0%
India CAGR 2017-2022	4.6%
India CAGR 2012-2022	3.8%

*NOTE: Based on production.