Copper Substitution Survey 2022

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Executive Summary

Copper Use

Copper use has recovered in 2021 with green drivers increasingly dominating growth.

Many copper-intensive sectors like infrastructure, manufacturing or residential construction still benefit from the Covid19 recovery packages.

The combination of strong demand and supply disruptions lead to increasing copper material costs in 2021.

As end uses recovered and OEMs started to respond to increasing demand restocking in the supply chain intensified. Increasing copper material costs and shipping disruptions drove OEMs to restock more than their immediate semis requirements leading to supply shortages on the semi finished products level.

Large majority of the fast-growing copper applications are strongly impacted by green drivers such as electrification, e-mobility, energy efficiency and high-tech.

Substitution

Copper substitution increased in 2021 on the back of the rising copper material costs. Still net copper substitution remained at a low 1.32% of copper use in 2021.

The main driver of substitution was not the copper-aluminium cost ratio but the absolute difference between the copper and aluminium costs.

Applications which experienced limited substitution are power cables, industrial tubes, many non-electrical plates sheet strips and foils (PSSF), winding wires in transformers and some non-critical alloy applications.

Many large copper applications like electrical PSSF, building wires, equipment wires have very limited potential for substitution.

Furthermore, winding wires in electrical motors experienced gains due to higher energy efficiency requirements.
Examples Of Major Companies Included In the Interviews And Surveys

<table>
<thead>
<tr>
<th>Fabricators</th>
<th>Cable and wire producers</th>
</tr>
</thead>
<tbody>
<tr>
<td>cerro, Sundwig, Hailiang, Yunnan Copper Co. Ltd.</td>
<td>Southwire, Belden, Champlain, Siemens, ConduMEX, General Cable, Leviton</td>
</tr>
<tr>
<td>KME, Mitsubishi, wieland, HALCOR, Tecnofil</td>
<td>Prysmian, Sumitomo Electric</td>
</tr>
<tr>
<td>Cecil, Chabe Brass, Cambridge Street Metal, Quality Metal Wire, Inc.</td>
<td>Hexatronic, Apar Industries Ltd.</td>
</tr>
<tr>
<td>End users, Trade assoc., Distributors, Experts</td>
<td>Exans, Leon, Helukabel</td>
</tr>
<tr>
<td>Bowers, Suntech, BCA, ITRI, Edison International, R&amp;M, GWE, GWEC, BASEC</td>
<td>RXN, Schneider Electric</td>
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<tr>
<td>CECA, IRENA, ES, NETS, Brookfield, First Solar</td>
<td>ECD, DAIKIN</td>
</tr>
<tr>
<td>Blue Star, Elsewedy Electric</td>
<td>Bharat Bijlee</td>
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2021 was an unusual recovery year

**Manufacturing strong**
Manufacturing has recovered in 2021 after the disruptions of 2020. A gradual softening of manufacturing is expected from 2022 onwards as rising inflation and economic instability will bite.

**Automotive weak**
The shortage of semiconductors and chips is severe with negative impact on the automotive deliveries. The global chip shortage is now set to last into 2023 with an impact on automotive sales well into 2024.

**Construction strong**
Global construction market activity seemed positive in 2021 especially residential construction is predicted to drive short-term recovery. However, economies are recovering in different ways with China suffering due to the Evergrande scandal while USA and ASEAN showed strong recovery.

**Infrastructure developments strong**
Infrastructure developments drove medium term recovery as these were set up within the Covid 19 fiscal recovery plans. Grid expansion, transport, telecommunication network updates and building the EV charging infrastructure all require copper.

**China still strong and leading recovery**
China remarkably recovered after the Covid19 pandemic and is functioning at or close to pre-pandemic levels already. The world’s largest market for copper continues leading the recovery of copper use in the future.

**Supply chain issues & shipping**
Serious availability issues from supply chain disruption at mills together with skyrocketing shipping costs lead to limited availability of certain copper semifinished products.

Some OEMs have tripled their delivery time and at least 1-2 years are expected for stabilizing production and delivery times.
Applications impacted by **green drivers** are fast growing

Future Market Growth Rate CAGR 2021-26

Large majority of the fast-growing copper applications are "green"

Impact of green drivers on copper use

- 0
- +
- + +

Fast Growing Markets

Large Markets

Future Market Growth Rate CAGR 2021-26

Large majority of the fast-growing copper applications are "green"
Copper use will continue to increase as new green demand drivers will have an increasing impact.

Copper Use Forecast in kt

- Impact of new copper demand drivers
- Electrification
- E-mobility
- Energy Efficiency
- High-Tech

Natural demand growth mainly based on population increase and per capita income increase.
Copper Substitution increased in 2021...

Copper Substitution and Miniaturization - in kt and % of Copper Use in 2011-2020

- Loss to Miniaturisation
- Substitution Gain
- Substitution Loss
- Net substitution on copper use

2021: Net Substitution as 1.32% of Copper Use

2022-26: Net Substitution is expected to further increase in 2022 before stabilizing after 2023
... but still stands at just **1.32%** of copper use in 2021

2021: Net Substitution as **1.32 %** of Copper Use
Although small tonnages, the largest relative contributor to substitution are Alloys, Power Cables and Winding wires in Transformers.
Drivers and Inhibitors of Substitution

- Relative and absolute material costs
- Weight
- Theft

Drivers:
- Copper Conductivity / Space Performance
- Energy Efficiency Requirements
- Building and fire safety standards
- High corrosion, friction and fire resistance of copper alloys
Declining **Copper-Aluminium Price Ratio** does not match increase of net substitution

Price Ratios (Cu-Al, Cu-Steel Rebar) and Net Substitution - in kt

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Prices used: Monthly average LME Copper and Aluminium Cash-Settlement Price, Price of Steel Rebar according to Trading Economics
For OEMs the **absolute copper-aluminium price difference** matters and this widened in 2021.
Copper Products with the Largest Markets Experienced Low Net Substitution in 2021
Thank you very much for your attention.