OLIVER PETSCHENYK, AUTOMOTIVE POWERTRAIN ANALYST
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Will BEVs really drive demand for more copper?

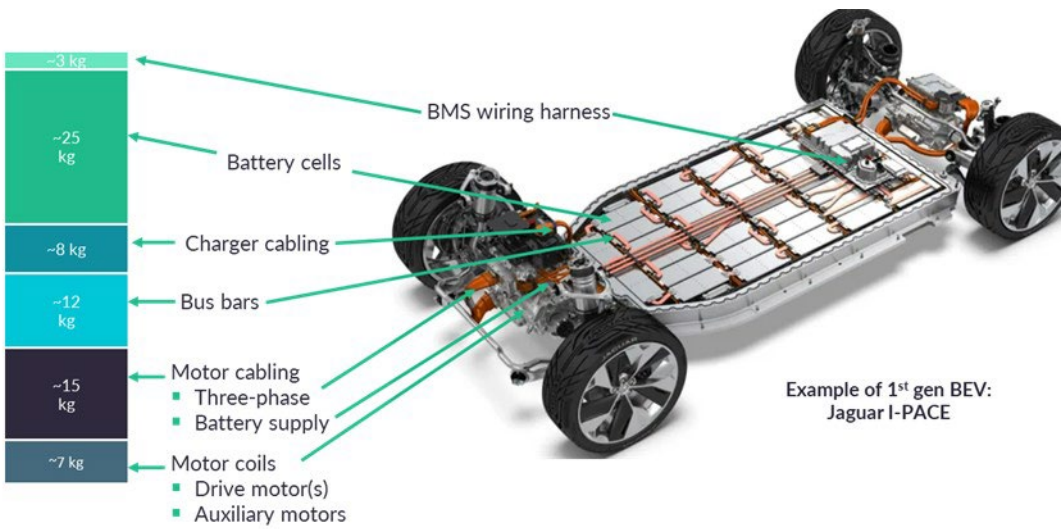
There has been a general expectation that copper demand will increase massively because of its use in BEVs, but how true is this?

All modern vehicles require a nominal amount of copper as an electrical conductor in wiring, ancillaries, and other electrical equipment.

Why copper? The best electrical conductor is silver, but the cost makes it uneconomical. Copper also offers a durable yet malleable solution for flexibility requirements.

Material	Silver	Copper	Aluminum
Price USD/kg	700	8.44	2.46
Conductivity σ (S/m)	6.3×10^7	5.96×10^7	3.77×10^7
Density kg/m³	10500	8960	2710

Battery electric vehicles (BEVs) use considerably more copper than internal combustion engine (ICE) vehicles or even hybrid electric vehicles (HEVs). The largest consumers of copper in BEVs are the battery, electric motor, and power electronics.



The majority of copper is within the battery. Most lithium-ion battery cells use copper foil as a current collector in the anode. Modernisation of cell manufacturing techniques has allowed copper foils to become thinner, in many cases halving the thickness over the last two years.

Busbars are solid copper strips that are used to connect battery cells and modules. Automakers vary drastically in how they deal with connecting cells, but new cell packaging methods can drastically reduce the need for busbars.

The Battery Management System (BMS) is used for voltage levelling, diagnostics, and cell monitoring, and needs wiring to connect to battery modules. A few companies are researching a wireless BMS but not many automakers have committed to that setup.

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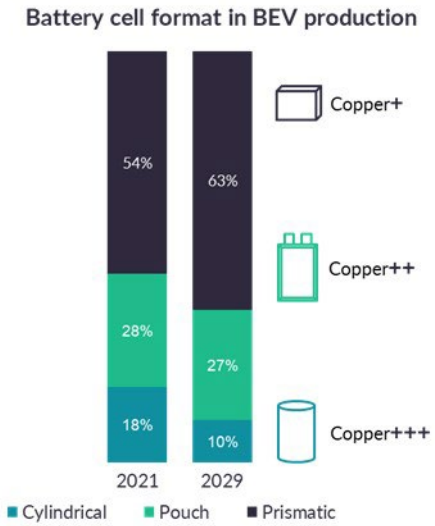
The battery capacity, system voltage, cell integration method, and cell format are some of the variables that impact the quantity of copper used in batteries.

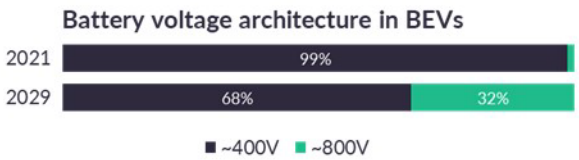
We expect average battery pack sizes to at least plateau, as mentioned in an earlier blog.

Prismatic cells generally use less copper on the busbars than cylindrical and pouch cells and even less with long-format 'Blade' cells in conjunction with module-less Cell-to-Pack technology. This reduces the number of cells and the inter-pack busbars. Several automakers have committed to this concept, and we calculate at least half of BEVs will use this by the end of the decade.



Outside of the battery, there is a lot of thick, high-current copper cabling. Charger cabling takes current from the external charger port to the onboard charger and the battery. The battery supply connects the battery to the inverter. Motor cabling connects the inverter to the electric motor.

Doubling the operating voltage can significantly reduce the copper used in bus bars, charger cabling, and motor cabling. Several automakers have committed to an 800V architecture.



Copper can be further reduced by positioning the electrical interfaces close to the required source cabling.

The trend is now towards building the inverter and the electric motor into one unit, needing only a short busbar to connect the two, rather than cabling.

Elsewhere, motor coils or windings are used in all forms of electric motors. Copper usage generally depends on the size and power of the motor, and like battery sizes, we expect average motor powers to plateau.

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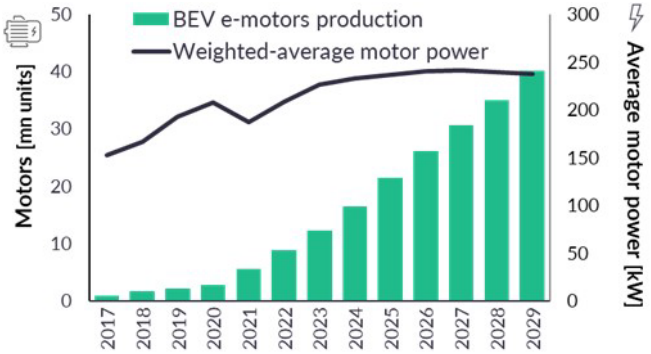
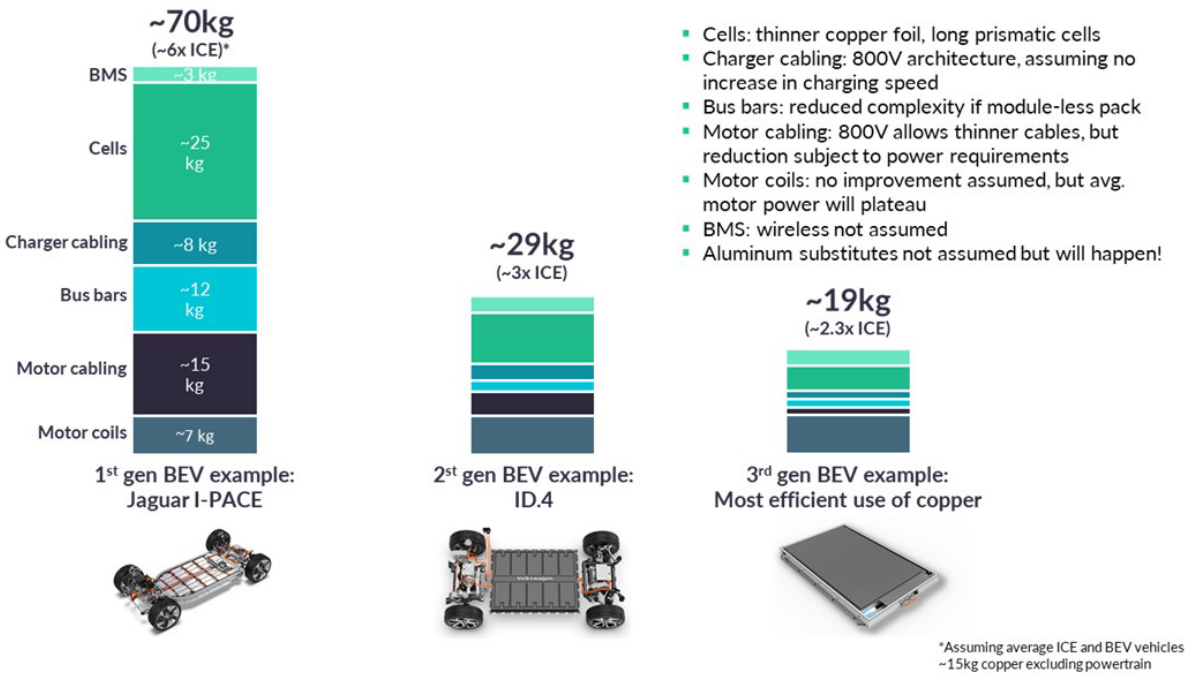


Furthermore, this does not take into account manufacturers using aluminium instead of copper, depending on its suitability for specific components. It offers half the conductivity of silver, but a substantial weight and cost saving over copper.

When adding up these pathways to reducing copper, we can see that although the first-generation BEVs did indeed use a massive amount of copper, more efficient use of copper is being made over time.



If you have any questions, please contact us at media@lmc-auto.com