Cu Copper Alliance

Copper use in e-mobility

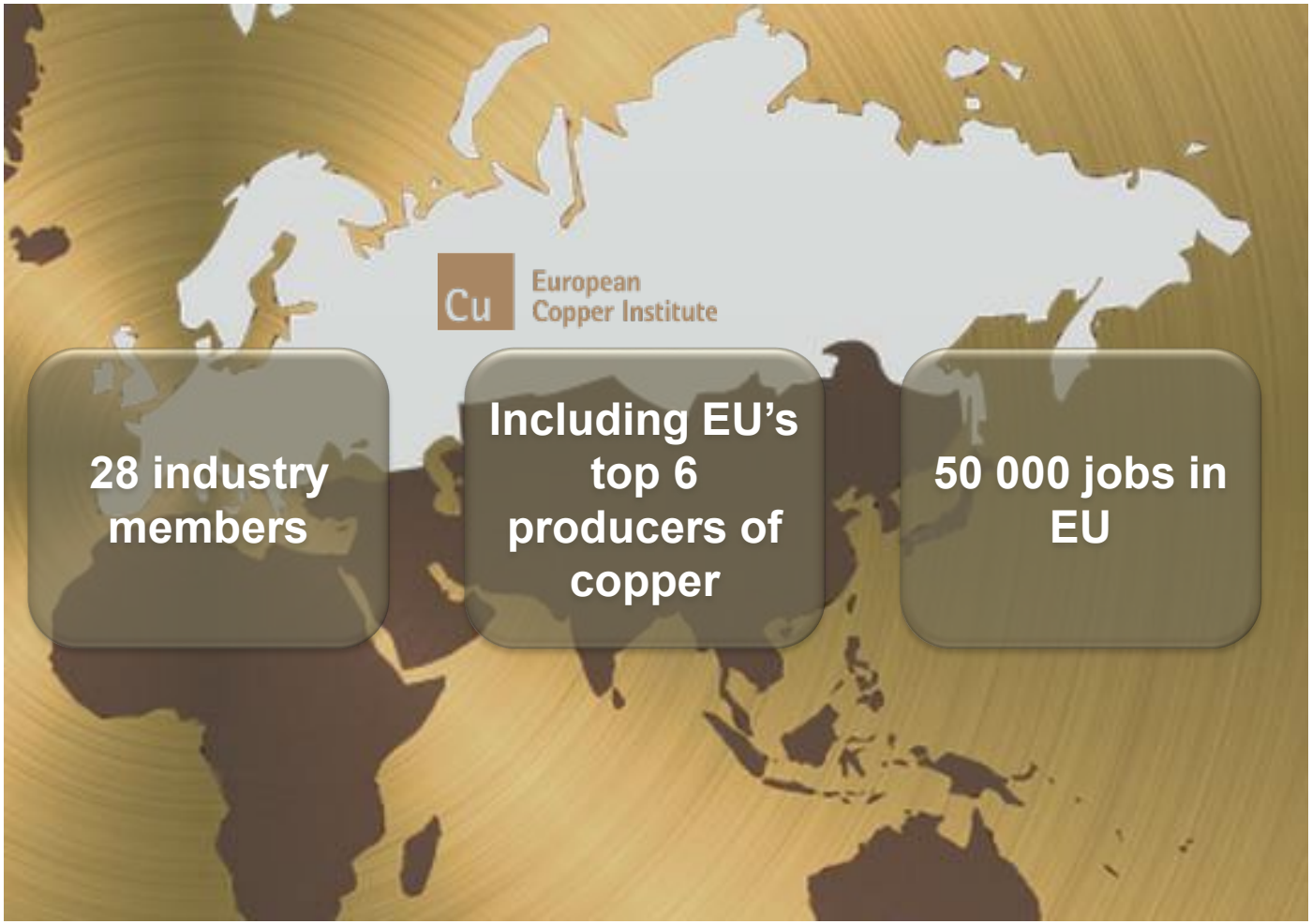
European Copper Institute

Fernando Nuño, Tomas Jezdinsky

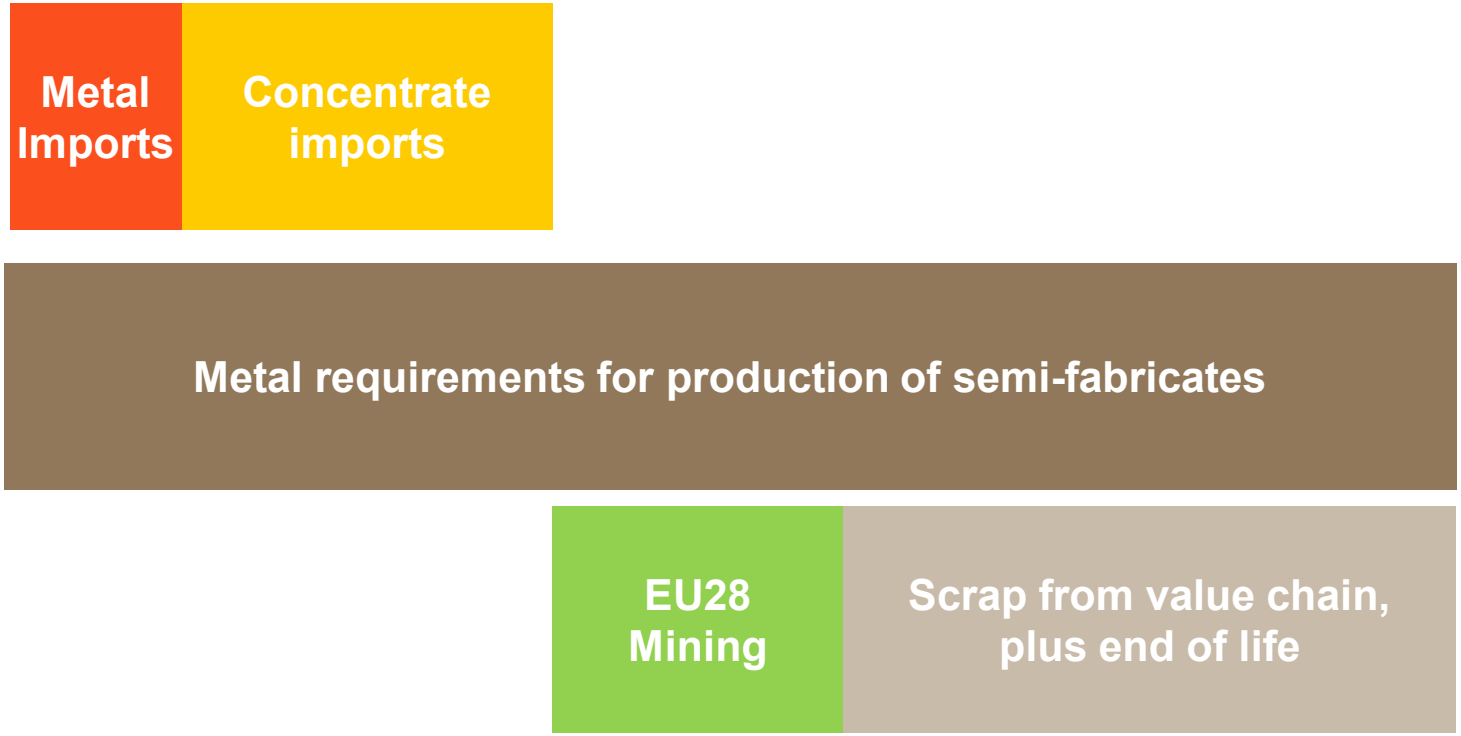
World Magnetic Conference - September 2018

International Copper Association

European Copper Institute

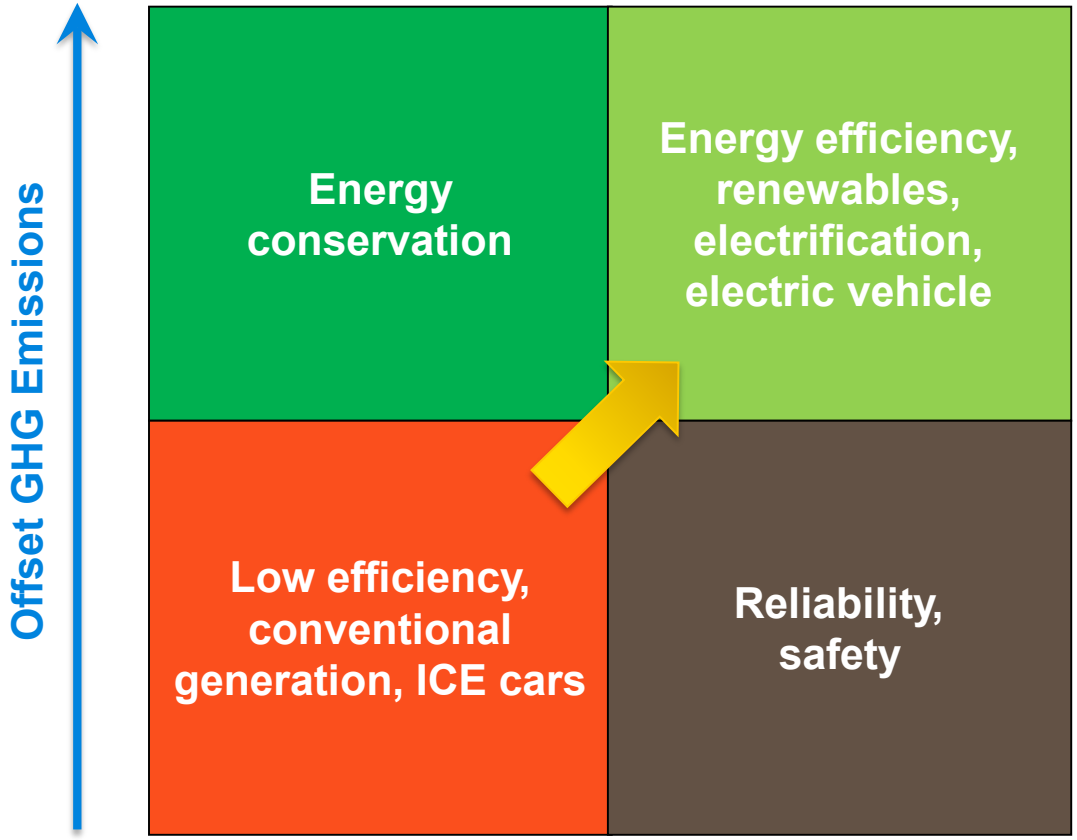


EU28 sources of copper supply
+/- 4.2 million tonnes of production



- EU 28 imports 37% of its copper needs
- 47% of demand sourced through recycling

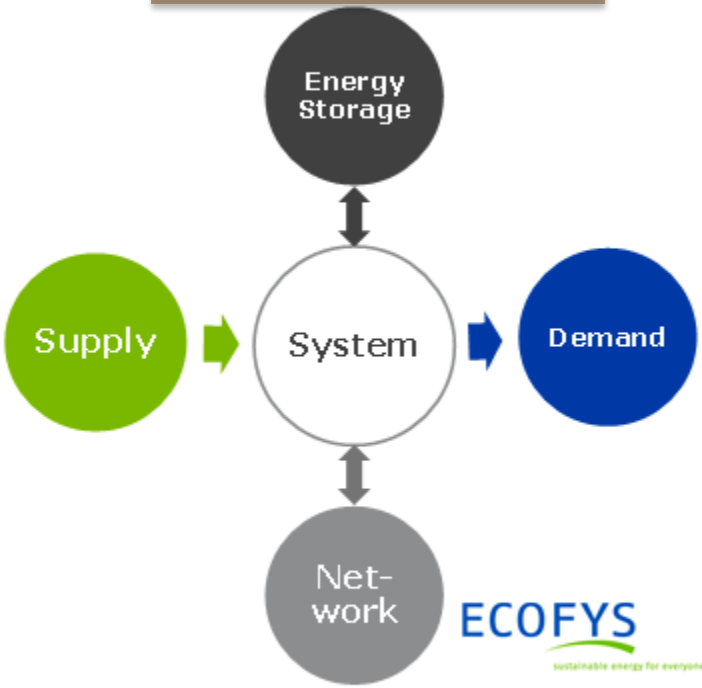
The strong link between copper use and energy sustainability



Copper in renewable electricity systems

Lithium batteries:
0,6 kg Cu / kWh

Wind & PV: up to 12 times more copper intensive



Building automation:
+10%
Home automation:
+43%
Electric vehicles:
+28 kg
Heat pumps:
+8 kg

Efficient grids; interconnectors; subsea grid; …
(370 – 450 ktons Cu over next decade)

Copper responds to e-mobility technological needs

BYD e6 - eTaxi: 110 kg Cu

Cu

Battery pack- 66.6 kg, Motor- 5.25 kg, Cables- 28.5 kg, others- 10 kg

http://copperalliance.org/wordpress/wp-content/uploads/2017/05/How_Important_are_EVs_Electromobility.pdf

BYD eBus: 224 kg Cu

Cu

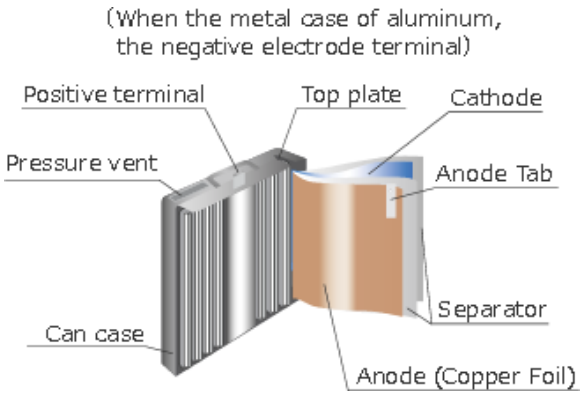
Battery packs- 128.6 kg, Motors- 12 kg, HV Cables- 48 kg, LV Cables- 30.3 kg, other controlling systems- 5 kg Cu

http://copperalliance.org/wordpress/wp-content/uploads/2017/05/How_Important_are_EVs_Electromobility.pdf

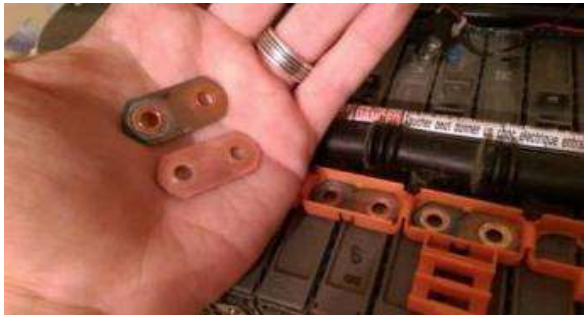
Copper responds to e-car technology requirements

Cu

Copper foils battery anode Current collectors



Copper busbars



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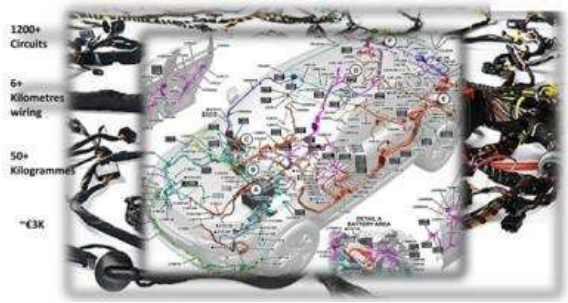
Copper responds to e-car technology requirements

Cu

Wiring



Windings in electric motors

Copper rotors for electric motors

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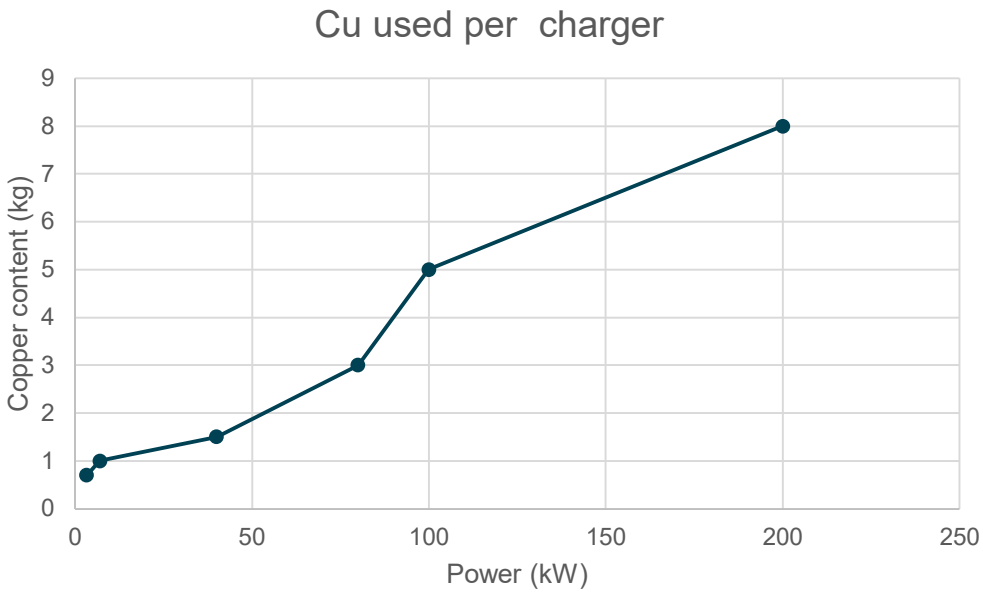
Charging infrastructure



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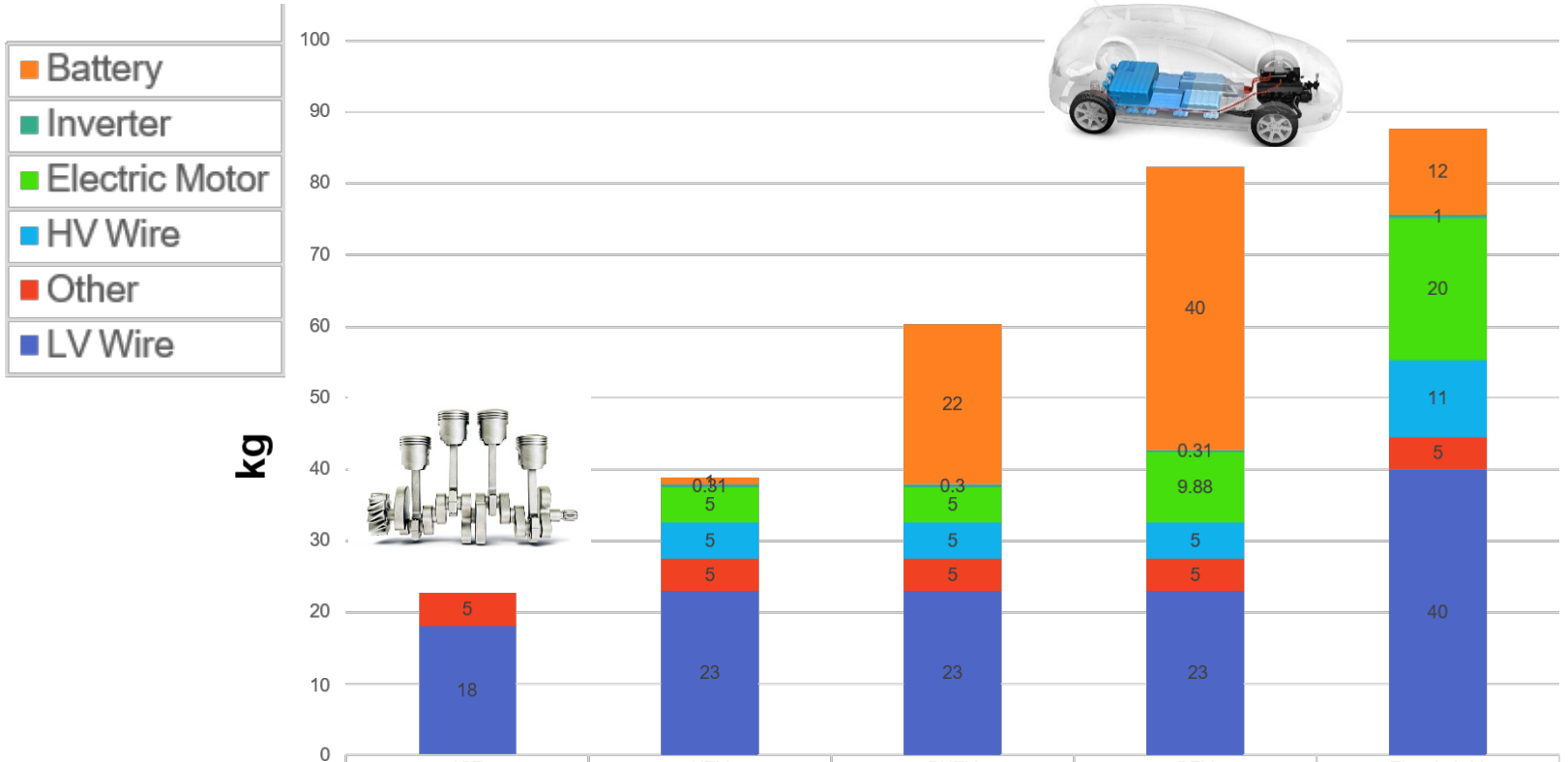
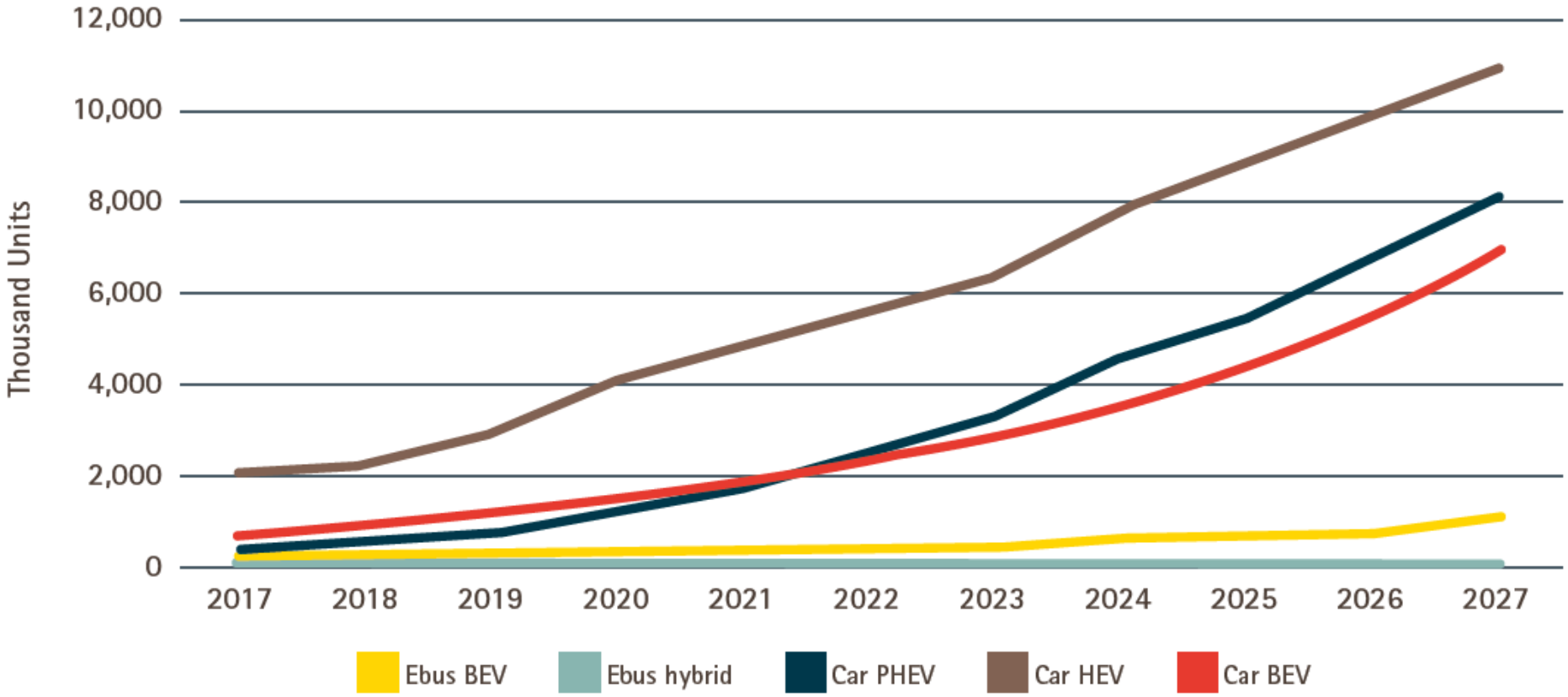
BEV (Battery Electric Vehicles) have significantly more copper than ICE



	ICE	HEV	PHEV	BEV	Ebus hybrid
Battery		1	22	40	12
Inverter		0.31	0.3	0.31	1
Electric Motor		5	5	9.88	20
HV Wire		5	5	5	11
Other	5	5	5	5	5
LV Wire	18	23	23	23	40

http://copperalliance.org/wordpress/wp-content/uploads/2017/05/How_Important_are_EVs_Electromobility.pdf

Market projections – Global forecast



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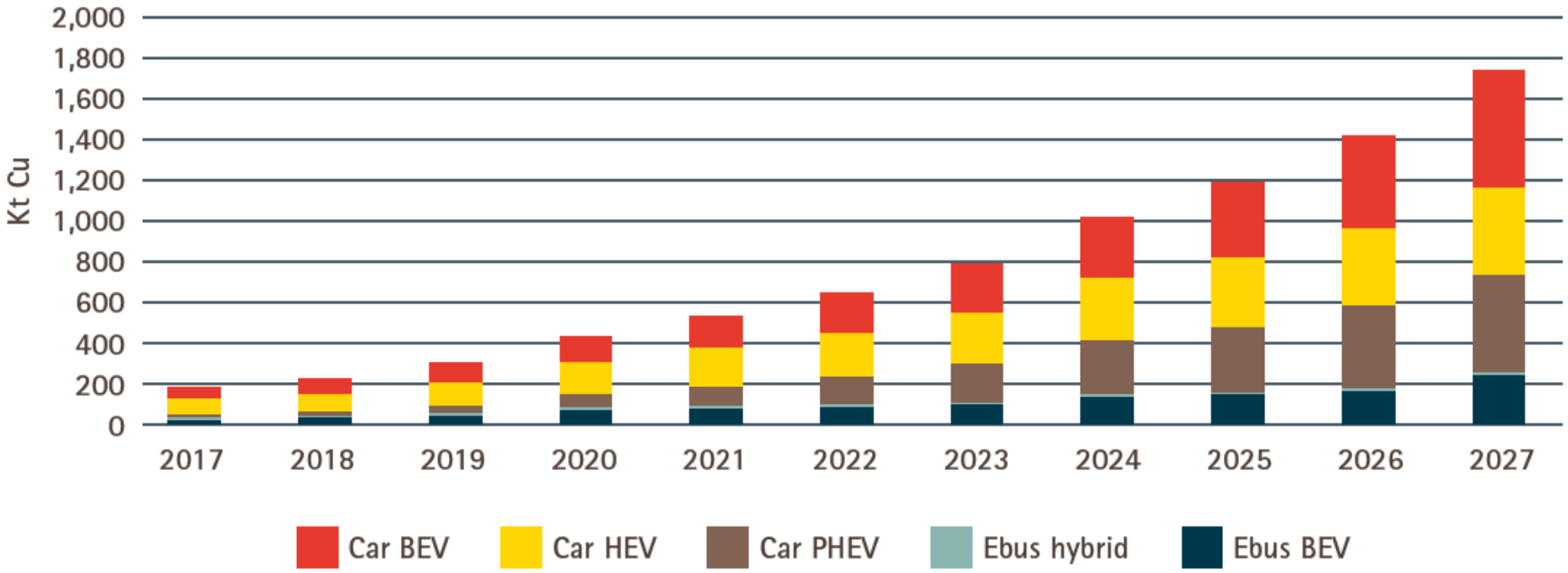
Global copper demand projections - Emobility



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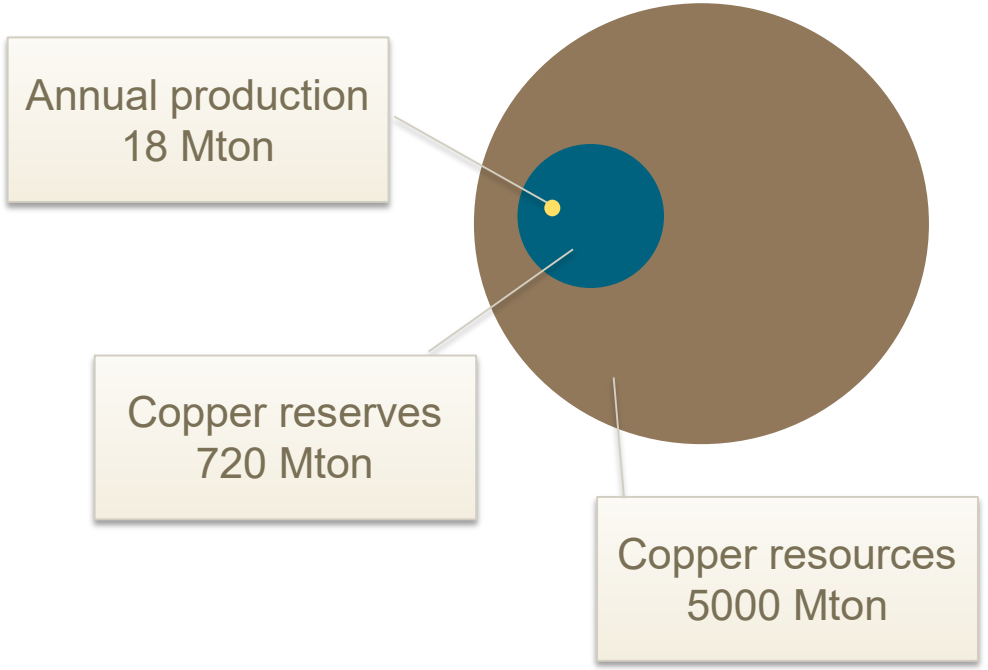
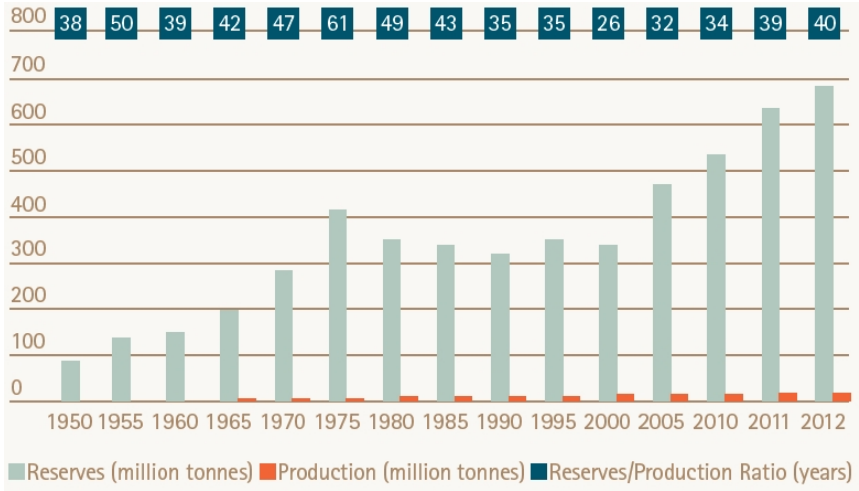
Copper’s long-term availability

40 years of copper reserves, 7 times higher resources

Cu



Deep sea deposits excluded



Since 1950, according to USGS data, there has always been, on average, nearly 40 years of copper reserves

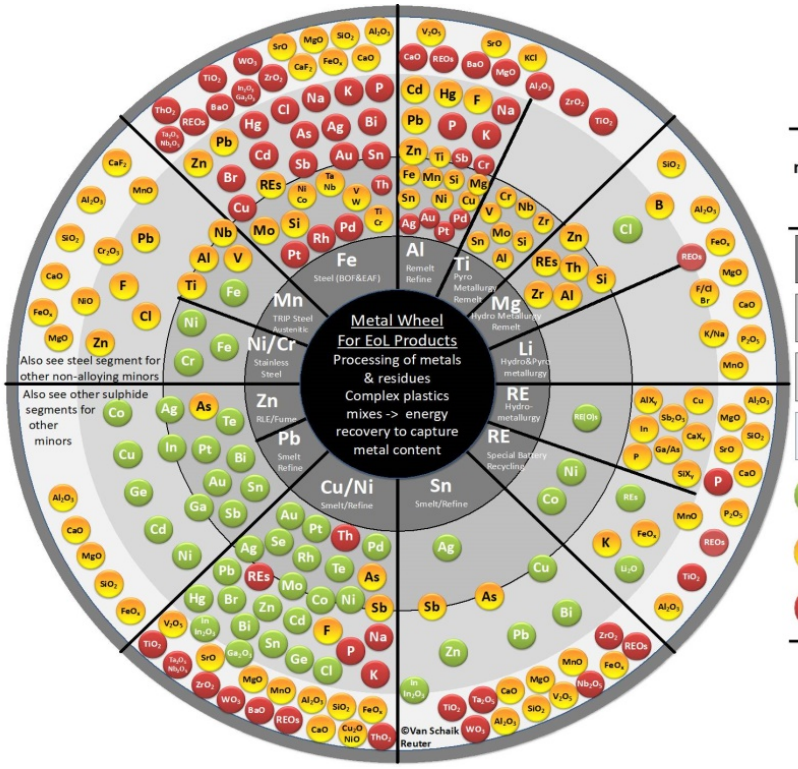
http://copperalliance.org/wordpress/wp-content/uploads/2018/02/ICA-long-term-availability-201802-A4-HR.pdf

Copper can be recycled without downgrading Most of its alloying elements can be recovered

Cu

The EU is a world leader in copper recycling.

In 2015, **61%** of European copper at end-of-life was recycled, while copper scrap made up **47%** of the source material for the production of new copper



Economically viable destinations of complex EoL designed functional material combinations, scrap, residues etc. to metallurgical processing infrastructure (each segment) to produce refined metal, compounds and alloys in best available technology

Circular Economy's carrier metals processing infrastructure
Extractive Metallurgy's Backbone, the enablers of a Circular Economy (CE) as it also recovers technology elements used e.g. in renewable energy infrastructure, IoT, eMobility etc.

Dissolves mainly in carrier metal if metallic (mainly pyrometallurgy)
Valuable elements recovered from these or (dissipative) lost (metallic, speiss, compounds, alloy in EoL also determines destination as also the metallurgical conditions in flowsheet).

Compounds mainly to dust, slime, speiss (mainly hydrometallurgy)
Collector of valuable minor elements as oxides/sulphates/chlorides etc. and mainly recovered in appropriate metallurgical infrastructure if economical.

Mainly to benign lower value building material products
Relatively lower value but inevitable part of society and materials processing. A sink for metals and loss from the CE system as oxides/ compounds. Dissipative losses.

A **Mainly recovered element**
Compatible with Carrier Metal as alloying Element or can be recovered in subsequent Processing.

B **Mainly element in alloy/compound, lost if in incorrect stream/scrap/module**
With possible functionality, not detrimental to Carrier Metal or product (if refractory metals in EoL product report to slag / slag also intermediate product for cement etc.).

C **Mainly element lost, not always compatible with carrier metal or product**
Detrimental to properties and cannot be economically recovered e.g. Au dissolved in steel or aluminium will be lost.

The Metal-Wheel, based on primary metallurgy. Combined with the thermodynamic limits of recycling, this provides an essential tool for a proper Design for Recycling. Developed by Maras B.V.

Benefits and challenges of e-mobility

Benefits of battery electric vehicles (BEV)

Road transport accounts for 20% of EU CO2 emissions.

BEV emits 1/3 CO2 compared to a petrol vehicle (Well-to-Wheel, EU energy mix average).

BEV is 2.5 times more energy efficient than its petrol counterpart (Well-to-Wheel, EU energy mix average).

Road transport consumes 24% of final energy in EU. EU imports 87% of oil; road transport consumes 47%.

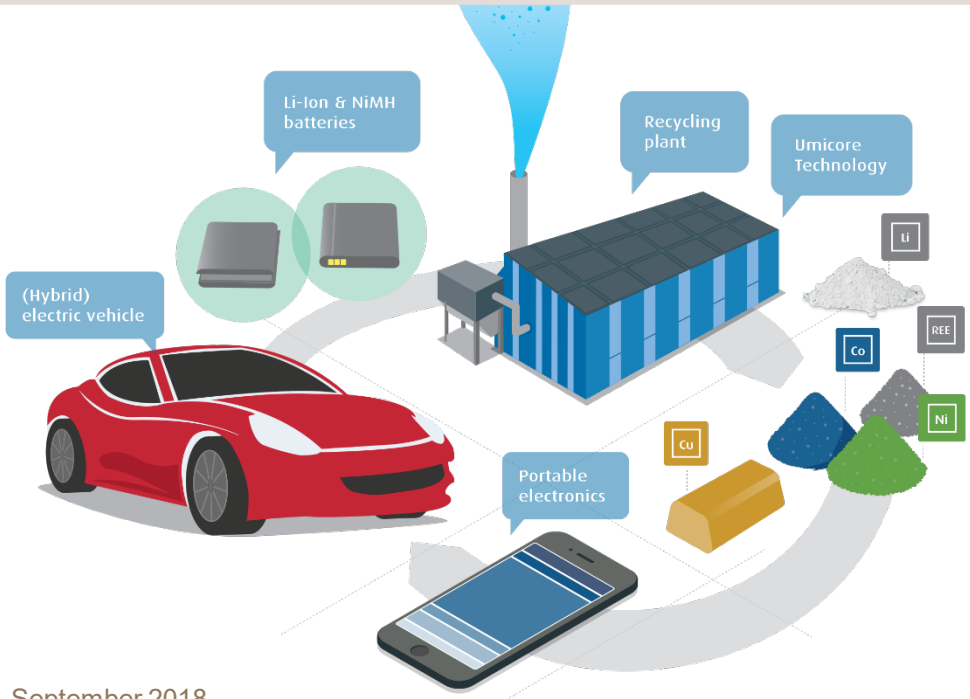
5.4% of deaths in Europe are due to air pollution.

Urban noise. Below 30 km/h BEV is significantly quieter than petrol vehicles.

BEV support renewables integration with much higher efficiency than power-to-X

Challenges of battery electric vehicles (BEV)

Setting up an efficient recycling chain for the complex electrical systems used in EV to recover the materials used (Li, Co, Ni, Cu, REE…)



http://csm.umicore.com/en/recycling/battery-recycling/our-recycling-process/

Copper Alliance supports a progressive uptake of e-mobility

ECI's vision on e-mobility

Targets for BEV

Examples: UK, France

CO2 standards for cars & vans

20% Zero Emission Vehicle (ZEV) mandate by 2025

150 kW chargers along key motorways

TEN-T Network

Useful to society, could be supported with public funds

Advertising and model availability

Car manufacturers to give more visibility to electric versions

Clean Vehicle Directive

Public services, mainly buses

CO2 standards for trucks

Short range trucks already more competitive than diesel

Re-thinking mobility

New business models, shared economy, blended mobility

Wrap-up

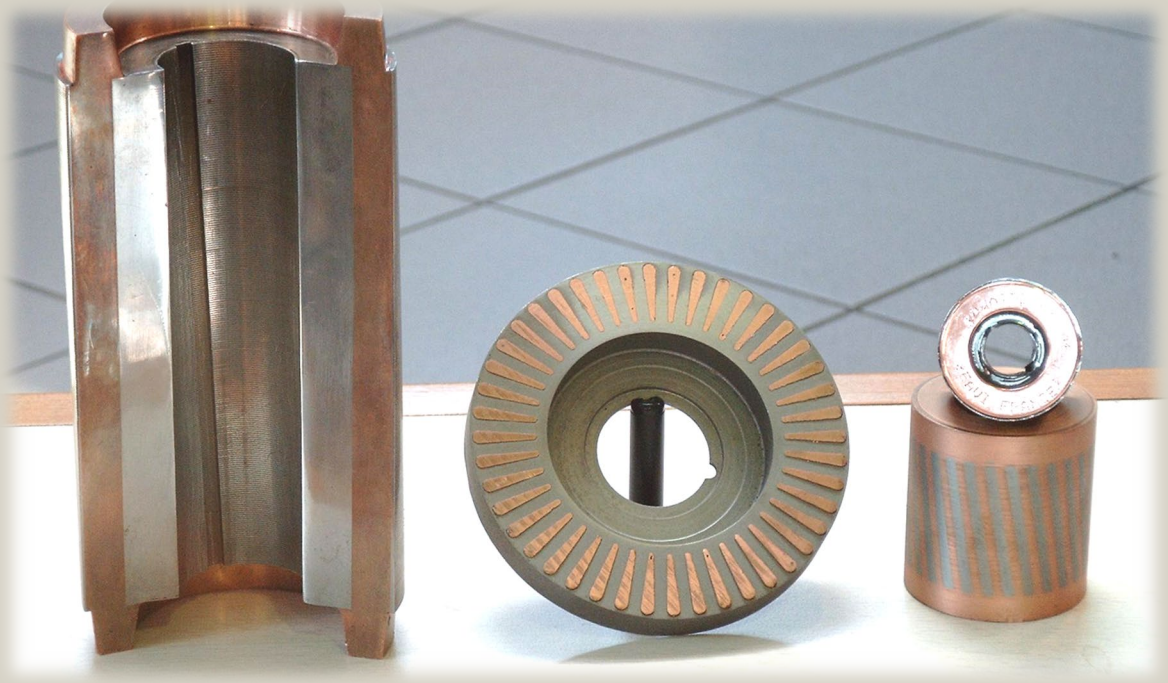
Copper is a key material that responds to the e-mobility technological needs

Long-term availability of copper

E-mobility offers multiple benefits that should be reaped sooner than later

Copper Alliance supports a progressive uptake of e-mobility

Many thanks!



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