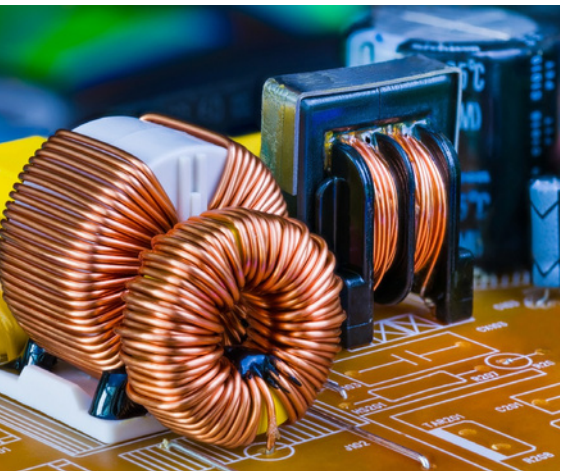
Leaded copper alloys are central to the EU circular economy



As the EU works towards a cleaner and more competitive Europe through the Circular Economy Act, the ability to recycle metals and other materials more efficiently is becoming increasingly important. The copper alloys market in Europe is expected to reach a revenue of USD 17.5 billion by 2030. This surge is driven by increasing demand across the electrical and electronics, automotive, industrial machinery and equipment, and aerospace industries, where copper alloys offer superior electrical conductivity, corrosion resistance, and mechanical strength. Thanks to the EU's energy transition and climate ambitions, the EU Grids Package, and activities such as the Digital Europe Programme, growth in electric vehicles, renewable energy, grid infrastructure, and data centres in Europe will drive increasing demand for copper and its alloys.

Lead plays a critical role in this equation. Numerous copper alloys include lead to improve engineering performance and machineability. Its use is especially critical in CEN standard leaded copper alloys – brasses and bronzes. Typically containing up to 4 % lead, in these alloys it acts as a lubricant and chip breaker, and increases corrosion resistance, enabling high-performance machining.

Beyond these practical benefits, the use of lead also makes it easier to reclaim and recycle the copper at end-of-life. Lead in scrap brass and bronze can easily be separated from copper in the smelter, ensuring that both copper and lead are recovered and can be reused, minimising waste and returning value to the product cycle for as long as possible.

Lead is a key enabler of many technical alloy properties. In most cases, it cannot be replaced without affecting performance, manufacturing efficiency, or product lifespan. Any alternative would need to provide technical and economic feasibility during the product's operational lifetime, and ensure there is no increased detrimental impact at end-of-life. Silicon and bismuth are sometimes considered viable alternatives, although they are unable to command the same technical performance levels. Silicon-containing brasses, for instance, are more energy-intensive and costly to produce, which limits their application to premium niche products.

From a practical standpoint, bismuth is less suited to complex machining as it can lead to stress corrosion cracking. The economic case is also difficult to make – a Critical Raw Material, it comes with high supply risk and price volatility – and is essentially a by-product of lead production. Moreover, the technical and commercial feasibility of recycling is challenging, due to the need to keep bismuth copper alloys separate from other materials during the reclamation process, something that is not required with leaded copper alloys. Using non-lead alternatives could adversely affect the economics of copper recycling by increasing processing costs for recyclers and penalties on the collectors.

There is a long-standing framework of legislation, developed to specifically address the occupational risk of working with lead, including the recently-updated EU binding limit values for lead. Covering production, use, and end-of-life recovery from waste, these strict risk management processes are observed across a breadth of touchpoints when working with lead. Encouragingly, the copper alloy value chain has reduced considerably the use of lead as far as technically feasible – in fact, today's leaded copper alloys have an average lead content that is approximately one-third lower than 15 years ago.

Lead is supporting sustainable copper recycling across the EU and is a key contributor to the EU's circular economy. It achieves this by maintaining the value of products, materials and resources for as long as possible, returning them into the product cycle at the end of their use, and minimising the generation of waste. With leaded copper alloys prevalent across so many industries, the overall impact of this is hugely significant.

Fact file

- Europe's copper alloys market generated a revenue of USD 12.1 billion in 2024. The market is expected to grow at a CAGR of 5.3 %, reaching USD 17.5 billion in 2030
- Leaded copper alloys typically contain up to 4 % lead for enhanced machineability
- Lead-containing copper alloys are 100 % recyclable and are widely recycled because of the high value of the recovered metals
- Today's leaded copper alloys have an average lead content that is approximately one-third lower than 15 years ago
- Bismuth is often considered as an alternative to lead in copper. However;
  - Bismuth can result in mechanical stress affecting production. Under EN 13602, pure copper used for certain wires and cables cannot contain more than 5 ppm bismuth
  - Bismuth and lead production are inextricably linked – for every tonne of bismuth, between **30 and 200 tonnes** of lead must be produced
  - Bismuth is designated an EU Critical Raw Material (CRM), with China responsible for more than 85 % of global production

Developed in conjunction with European Metals and the International Copper Association (ICA) Europe, this case study highlights just one of the many essential uses of lead that provide societal benefits and boost the EU's economy

For Europe's future, lead matters.

Lead Matters